

Tentative English version

**Japan's Voluntary Emissions Trading
Scheme (JVETS)**

**Monitoring and Reporting
Guidelines**

Ver.1.0 Published February 16, 2007

Ministry of the Environment

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Part I Basic Framework for Calculating and Reporting the Emissions of Greenhouse Gases

Chapter 1. Preface

1.1 Objectives

These guidelines were prepared by emissions-reducing operators to appropriately calculate and report their greenhouse gas emissions pursuant to Japan's Voluntary Emissions Trading Scheme (JVETS) established by Ministry of the Environment.

One of the objectives of JVETS is to ensure that the operators who voluntarily and actively strive to reduce greenhouse gas emissions can optimally and cost-effectively reduce those emissions. In order to effectively reduce greenhouse gas emissions, it is essential for operators to be able to (1) accurately calculate the greenhouse gas emissions resulting from their own business activities; (2) plan and implement their emissions reduction projects based upon those accurate calculations; and (3) monitor and assess the results.

Additionally, the results obtained by calculating greenhouse gas emissions must always be proven to maintain a high quality level, because JVETS values the maximum allowable emissions as commercial products that can be sold and bought by operators.

Therefore, operators are required to calculate their own greenhouse gas emissions in accordance with five principles as listed in the table below:

Principles	Description
Reasonability	A site's reasonable boundary of calculation shall be established.
Completeness	All the emissions sources within each site's boundary shall be identified, and the greenhouse gas emissions from all sources shall be calculated.
Consistency	All emissions shall be calculated by using the same method and data such that the emissions in any fiscal year that emission reduction measures were implemented for can be compared with those in the base year.
Transparency	All monitored data shall be recorded, managed, and documented such that the calculated emissions of greenhouse gases can be reproduced.
Accuracy	Greenhouse gas emissions shall be accurately calculated as required.

One characteristic of JVETS is the calculation of greenhouse gas emissions by factory or business facility unit. In this regard, this system is different from the EU Emissions Trading System (EUETS) in which greenhouse gas emissions are calculated by equipment unit. The calculation of emissions by factory or business facility unit can ensure a high and stable quality level for emissions calculation by using the existing legal system.

For example, it is possible to clearly identify any site's boundary by using the appropriate method as well as the formal notification of site or building boundary that was submitted to the competent administrative agency under the Factory Location Law or the Building Standards Law. It is also possible to easily identify all the emissions sources present within a site's identified boundary, provided that those emissions sources are fuels and other combustible materials within the facilities handling such materials, the operation of which was licensed by the competent administrative agency pursuant to pertinent laws such as the Fire Service Law and the High Pressure Gas Safety Law.

Therefore, these guidelines aim to reduce operators' burdens and ensure the quality of emission calculations by using the existing legal system.

1.2 Structure of Guidelines

These guidelines use the following structure to describe the procedures for calculating greenhouse gas emissions:

Part I Basic Framework for Calculating and Reporting the Emissions of Greenhouse Gases

Chapter 1. Preface

This chapter describes the objectives and structure of these guidelines.

Chapter 2. Calculation Method for Greenhouse Gas Emissions

This chapter describes the mandatory procedures for operators to calculate their own greenhouse gas emissions. For detailed information about those procedures, refer to subsequent chapters.

Chapter 3. Identification of Emission Sources and Establishment of Boundaries

This chapter describes the method for identifying site boundaries, defines emission sources and the method for identifying them, explains the calculation boundaries, and clarifies the activities within the boundaries.

Chapter 4. Data Monitoring

This chapter describes those monitoring methods and procedures to be used by operators to calculate their greenhouse gas emissions. Operators must first submit their monitoring plans to the competent administrative agency for approval before calculating their emissions, and then implement their approved monitoring plans in principle. **(It is not necessary for operators to obtain approval for their monitoring plans before calculating their emissions in the base year.)**

Chapter 5. Calculation and Report of Greenhouse Gas Emissions

Operators shall report their calculated greenhouse gas emissions in the designated format. The Report of Calculations shall contain not only the calculation results, but shall also provide summaries of the operator, the boundary, the monitoring method, and the quality control and assurance methods.

Chapter 6. Verification

The Report of Calculations prepared by an operator shall be verified by a third party verifier. The verification refers to the process of evaluating whether or not the calculated greenhouse gas emissions were accurately calculated using an appropriate process.

The results of calculations verified by the verifier shall be established **after they have been approved by the Competent Authority (CA) that has been established within Ministry of the Environment to manage compliance with this system's rules.**

Part II Calculation Manual

Chapter 1. Calculation of Emissions Resulting from the Use of Fuels, Electricity, and Heat

This chapter describes the calculation method for greenhouse gas emissions if purchased fuels such as heavy oil A and municipal gas are burned and used at the sources of emissions, or if electric power and heat purchased from electric power companies are used. **It is generally estimated that this chapter applies to all operators using fuel, electric power, and heat.** (The use of heat involves only the operators who receive the supply of heat.)

In addition, this chapter describes the cogene-credit and the method of deduction for those operators who supply electric power and heat to parties beyond their site boundary. Those operators concerned should refer to this chapter.

Chapter 2. Incineration of Wastes and Use of Waste Fuels

This chapter describes the method for calculating greenhouse gas emissions if operators incinerate wastes or use waste fuels within their site boundaries. **Those operators who contract their waste disposal to outside parties are excluded, but those operators who incinerate wastes or use waste fuels received from other parties are included.**

Chapter 3. Emissions from Industrial Processes

This chapter describes the method for calculating industrial process emissions that release greenhouse gases, such as the production of cement and unslaked lime. **This chapter applies only to those operators who have industrial processes included in their emissions calculation.**

Chapter 2. Calculation Method for Greenhouse Gas Emissions

In principle, a greenhouse gas emission is calculated by using any of the following equations:

$$\begin{aligned} <\text{Fuel burning}> \quad \text{Greenhouse gas emission} \\ &= \text{Amount of activity} \times \text{unit calorific power} \times \text{emissions coefficient} \\ <\text{Others}> \quad \text{Greenhouse gas emission} = \text{Amount of activity} \times \text{emissions coefficient} \end{aligned}$$

The amount of activity refers to the activity magnitude by activity type, including the following:

- The use of energy (such as fuel, electricity, or heat)
- The incineration or disposal of wastes
- The use of raw materials (such as limestone or dolomite)
- The production of finished or intermediate products (such as clinker or silicon carbide)

To calculate greenhouse gas emissions, it is necessary to determine (or monitor) each of the terms (the amount of activity, unit calorific power, and emissions coefficient) in the above-mentioned equations by using the appropriate method.

To accurately calculate all the greenhouse gas emissions from an identified plant or business facility, it is necessary for that operator to calculate the emissions in line with the flow charts as shown in Fig. 1 and Fig. 2. The activity amount is primarily monitored, because it is permissible in many cases to use predetermined (default) values for the unit calorific power and the emissions coefficient.

To calculate emissions within the fiscal year in which emission reduction measures were implemented, operators should submit their monitoring plans to the Competent Authority (CA)¹ for approval prior to the calculation, and then implement their approved monitoring plans. To calculate emissions for the base year, it is not necessary for operators to submit their monitoring plans for approval, because the monitored data are used for the calculation.

¹ The Competent Authority (CA) is an organization established within Ministry of the Environment to manage the rules of this system.

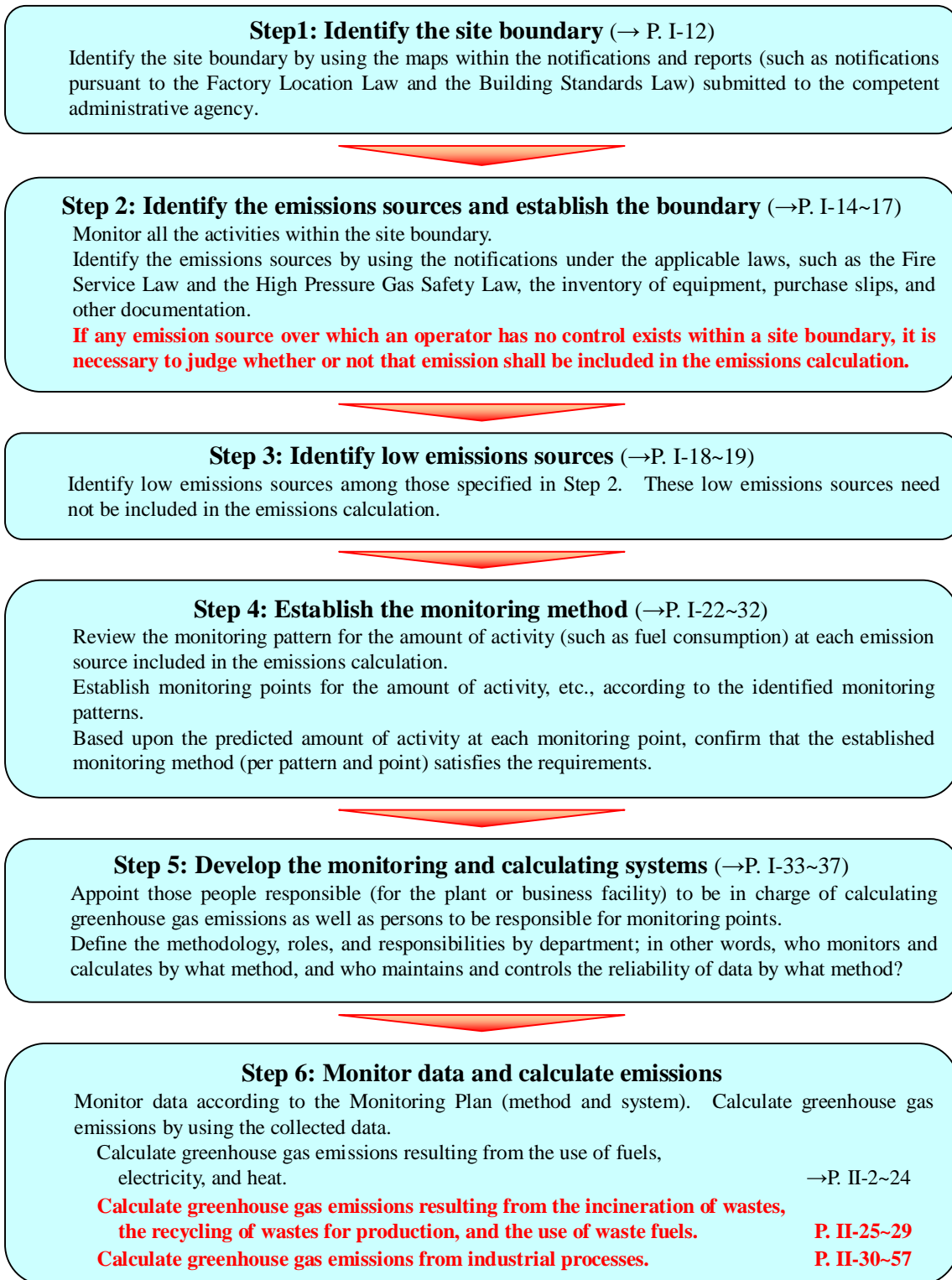


Fig. 1: Flow Chart of Greenhouse Gases Calculation (Outline)

Note: The red lines indicate those items that should be implemented by the operators involved.

Reference ~Emissions Sources, Monitoring Patterns, and Monitoring Points~
(For details, refer to Chapter 4.)

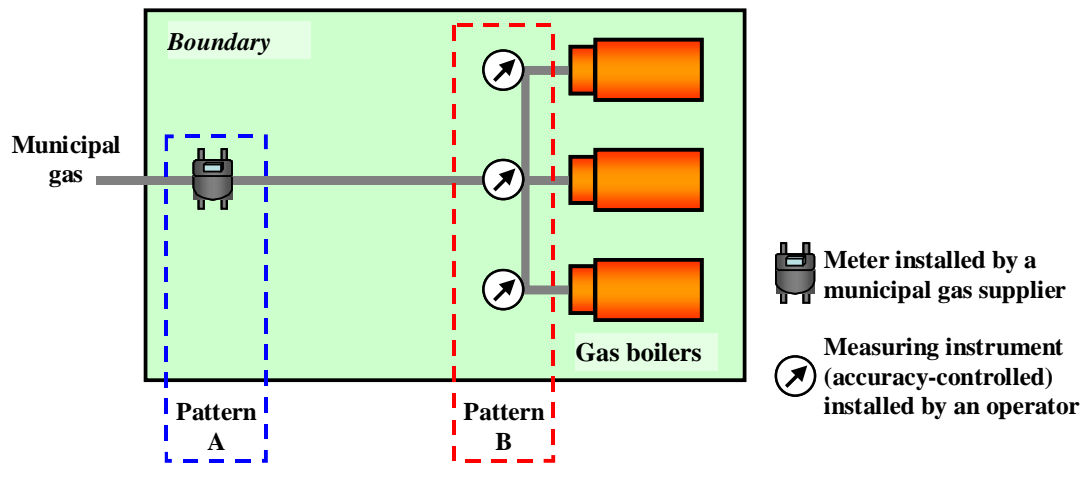
The optimal monitoring pattern should be selected from among the three patterns below:

- Pattern A: Purchase-based method (data used: receipts)
- Pattern B: Method using determinations made by accuracy-controlled measuring instruments (data used: measured values)
- Pattern C: Approximation method (optional only if Pattern A or B is difficult to use)

The figure below illustrates a scenario where an operator purchases municipal gas from a municipal gas supplier and uses it within three gas boilers. In this case, the boilers are the emissions sources.

- If Pattern A is selected, the monitoring points are the gas meters (= delivery slip) installed by the supplier.
- If Pattern B is selected, the monitoring point is each of the measuring instruments installed by the operator. These measuring instruments should be within an effective period of certification or have been regularly inspected, as specified by the Measurement Law.
- If the measuring instruments are not accuracy-controlled, Pattern C should be selected. If the measuring instruments are not accuracy-controlled without any suitable reason, however, the Competent Authority may not approve the use of the meters.

The number of sources may not always be the same as the number of monitoring points. It is possible to control multiple sources at one monitoring point as shown by Pattern A in the figure below. Conversely, multiple monitoring points may be required to monitor a single emission source.



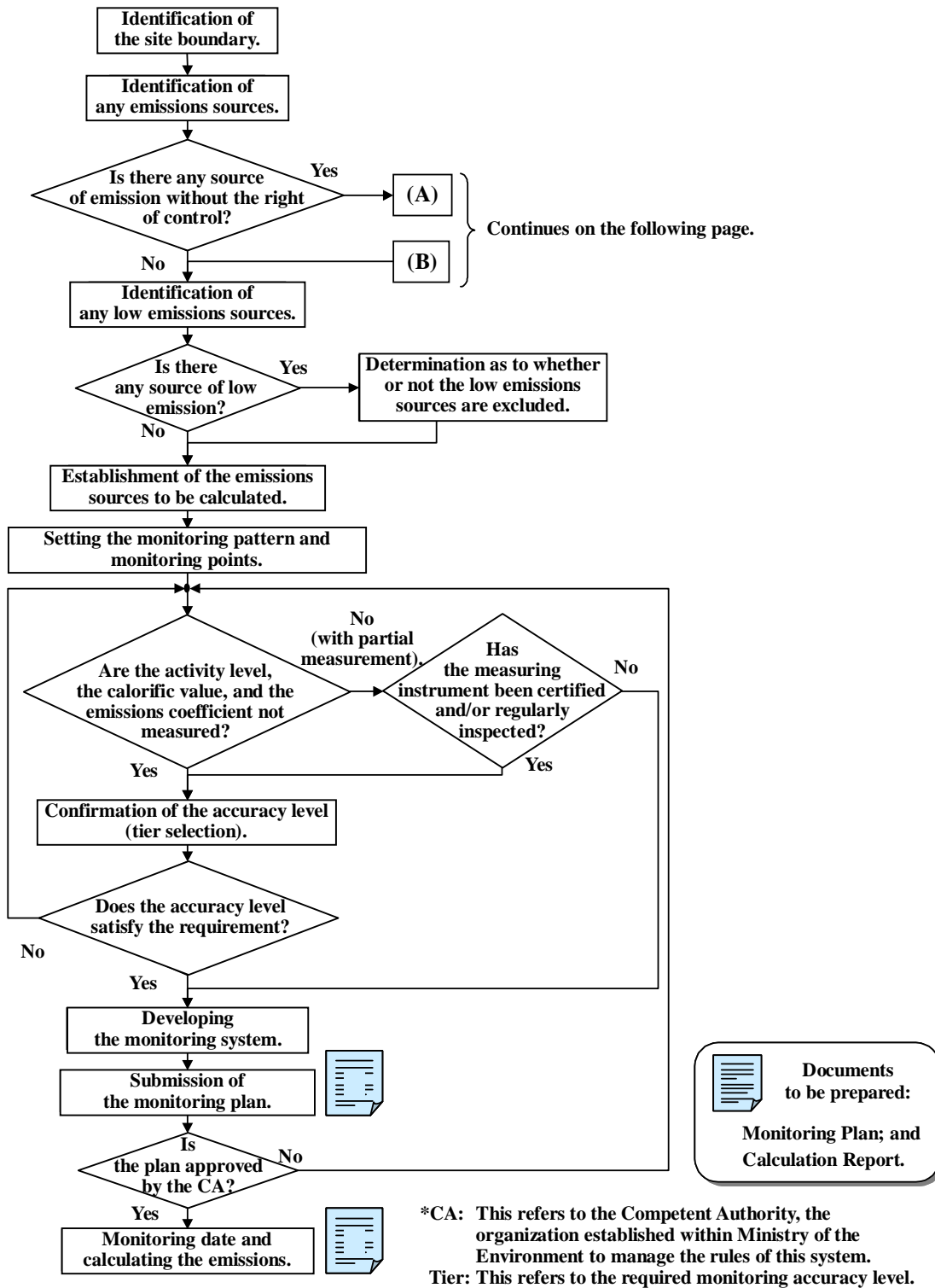
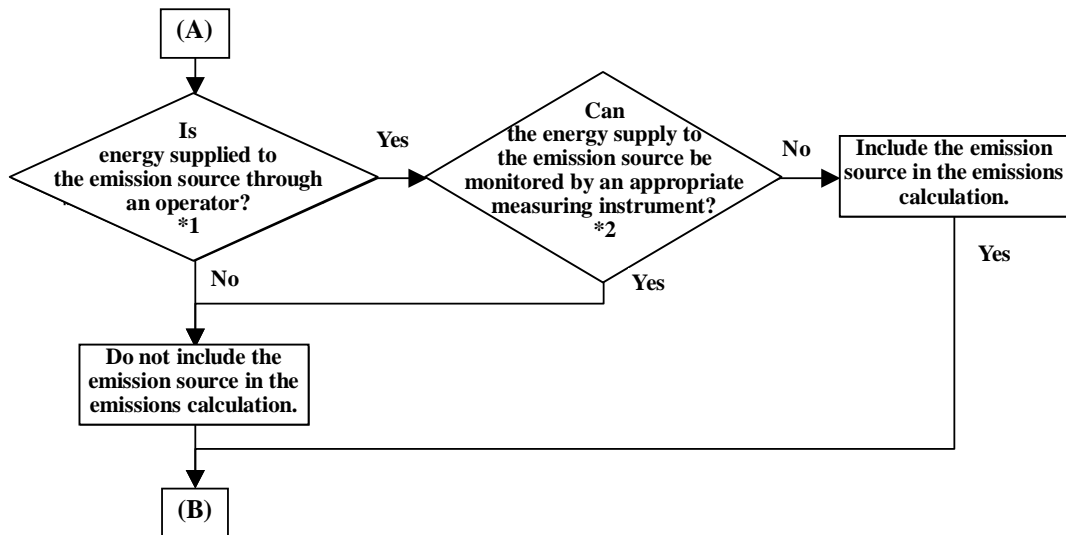


Fig. 2: Detailed Flow Chart for Calculating Greenhouse Gases



Positive scenarios at *1	<ul style="list-style-type: none"> · Scenario in which a building owner, one who is an emissions-reducing operator, purchases electric power from a company, and supplies some part of it to tenants. · Scenario in which an operator, one who is an emissions-reducing operator, purchases fuels, produces electric power (heat) by using its own equipment, and supplies some part of it to other operators.
Negative scenarios at *1	<ul style="list-style-type: none"> · Scenario in which a building owner is an emissions-reducing operator and whose tenants have contracted with a municipal gas provider to receive their gas supply.
Judgment examples at *2	<ul style="list-style-type: none"> · If a building owner who is an emissions-reducing operator purchases electric power from a company and then supplies some part of it to tenants, those supplies to the tenants may be excluded from the emissions calculation, but only if they are measured with certified/inspected meters (or within the effective period of certification) under the Measurement Law. · The electric power supplies that are measured by other meters must be included in the emissions calculation.

Fig. 2: Detailed Flow Chart for Calculating Greenhouse Gases (continued)

Chapter 3. Identification of Emission Sources and Establishment of Boundaries

This chapter describes the basic rules for calculating greenhouse gas emissions. The emissions-reducing operators are required to monitor greenhouse gas emissions resulting from all the activities within their factories and business facilities.

[Keywords]: Site boundaries, activities involved, emission sources, and boundaries

3.1 Flow of Procedure

The boundaries for the calculation and verification of greenhouse gas emissions are defined and established within the following procedure:

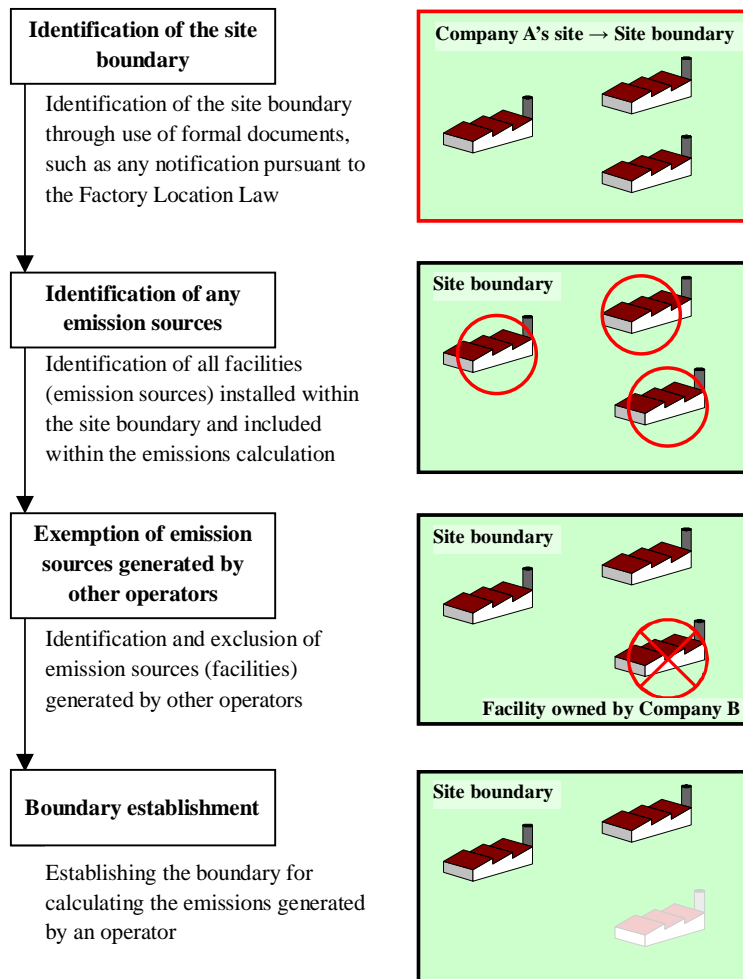


Fig. 3: Flow of Boundary Establishment Procedure

3.2 Site Boundary

3.2.1 Site Boundary Identification

The boundary of any factory/business facility site² is confirmed by pertinent documents such as the notifications and reports submitted to the competent administrative agencies. The factory site can also be identified by using documents such as notifications pursuant to the Factory Location Law and the Fire Service Law, while the business facility (building) site can be identified by using the maps in the notifications under the Fire Service Law and the Building Standards Law.

All new factories in Japan that are constructed on site areas exceeding 9000m², or with building additions that bring the total building area in excess of 3000m², are required to make notifications under the Factory Location Law. The site areas that operators should manage can be accurately ascertained from notifications pursuant to the Fire Service Law that clearly define the boundaries of the involved factories and business facilities. However, all controlled factory boundaries cannot be identified by notifications pursuant to the Building Standards Law. Therefore, notifications pursuant to the Building Standards Law cannot be used to identify the factory site boundaries when notifications should be made under the Factory Location Law.

Scenario in which lots are separated from each other by a road or a river

Generally, site boundaries as specified by the Factory Location Law should be used. If a factory site installed by the same operator comprises two lots separated from each other by a road or a river, and if the total energy usage in the lots is controlled by the factory such that the energy usage cannot accurately be divided into two portions for the lots, then the factory's total energy usage should be used as the total fuel consumption. (For fuel consumption accuracy, refer to Part I, 4.3 "Required Accuracy")

Scenario in which another operator's lot or facility is contained within a site boundary

Refer to Part I, 3.5 "Establishment of Boundaries."

² The definition and unit of "factory" or "business facility" are basically, set down in the "Energy Conservation and Recycling Assistance Law" (hereinafter referred to as the "Energy Conservation Law"). In accordance with this law, a "factory" is defined as an industrial facility continuously used for the production or processing (including repair) of goods, and a "business facility" is defined as a facility continuously used for activities other than the production and processing (including repair) of goods.

3.2.2 Responses to any site boundary change

This system shall not make any change to the site boundaries established for calculating emissions in the base year. If any site boundary changes as a result of corporate merger, breakup, or for any other reason due to the acquisition or sale of any factory, business facility or equipment during the period of calculation and verification, the established site boundaries shall not be changed, but shall be used to calculate the emissions both in the base year and in the fiscal year when emission-reducing measures were taken.

The method of responding to any change is illustrated below:

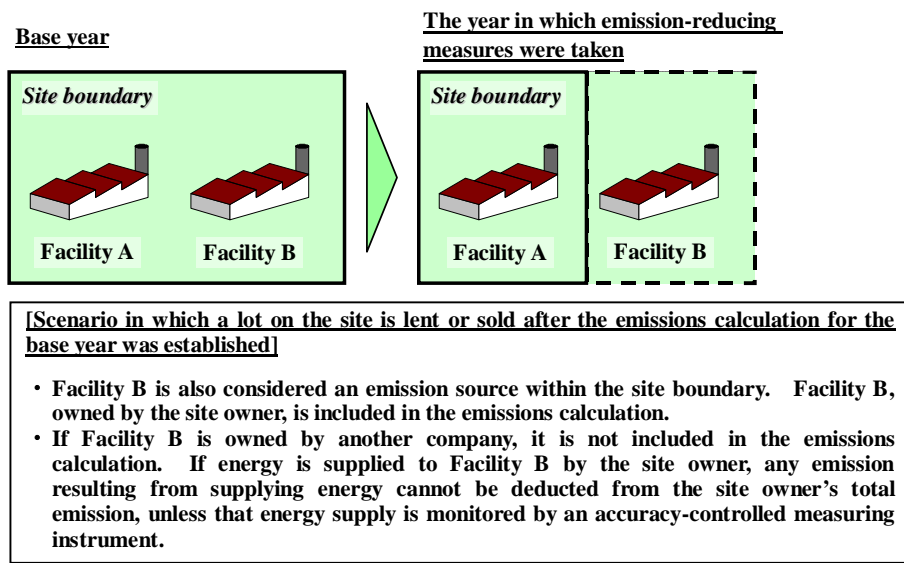


Fig. 4: Method of calculating emissions if a lot within the involved site is lent or sold after the emissions in the base year had already been established for that site

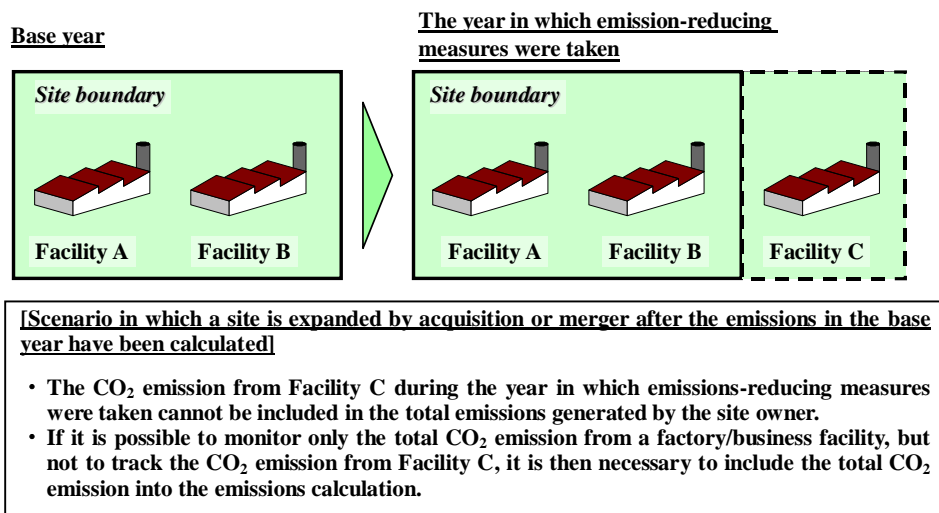


Fig. 5: Method of calculating emissions if the involved site is expanded by acquisition or merger after the emissions for the base year had already been established for the site

3.3 Activities Involved

Activities involved refers to those activities contributing to the greenhouse gas emissions that are included in greenhouse gas emission calculations. The emissions caused by these activities are divided into those that directly emit greenhouse gases (direct emissions) and those that emit Greenhouse gases indirectly through the use of electric power and heat supplied from beyond the site boundaries (indirect emissions).

3.3.1 Activities involved

This system accounts only for CO₂ emissions. The activities involved include the combustion of fossil fuels, the use of electric power and heat, the incineration and recycling of wastes, and industrial processes, all of which emit CO₂. The activities involved are listed in the table below:

Table 1: Activities Involved

Type	Activities involved
CO ₂ emissions resulting from fuel usage	The use of fossil fuels (including vehicular emissions)
CO ₂ emissions resulting from the use of electricity and heat	The use of electric power and heat supplied from beyond the site boundaries
CO ₂ emissions resulting from the incineration and use of wastes	The calculated CO ₂ emissions caused by the incineration of wastes, use of wastes for production, and the use of waste fuels
CO ₂ emissions resulting from industrial processes	The production of cement and unslaked lime, the use of limestone and dolomite, the production of ammonia and other chemical products, and the use of acetylene, dry ice, and sprays

Activities other than those listed in the table above but that may emit CO₂ are not included in the emissions calculation. However, voluntarily reporting the greenhouse gases (including five other gases) emitted by such activities is encouraged.

If the number of emission sources is increased by any reason (such as the addition of equipment), the emissions from those sources are included in the emissions calculation in principle. Those emissions resulting from the starting and stoppage of facility operations and in any emergency also are included in the calculation.

~ Greenhouse gas emissions resulting from electricity and heat usage ~

The use of electric power and heat supplied from outside a factory or business facility does not directly emit any greenhouse gases, but those power plants and heat supply facilities that produce electric power and heat do emit greenhouse gases. Therefore, those indirect emissions resulting from electric power and heat usage are calculated by the users (on the demand side).

3.3.2 Activities excluded

Any emissions resulting from the following activities carried out by any operator can be excluded from the calculation of greenhouse gas emissions, because they are emitted by others beyond the site boundaries.

Emissions by trustees³

If any portion of activities is outsourced, the CO₂ emissions caused by trustees or by the incineration of wastes entrusted to waste disposers are excluded from the calculation. Similarly, the emissions by the transportation carriers used by employees for commuting and traveling as well as the emissions by cargo carriers used to transport products and materials are excluded.

Emissions resulting from supplied products and materials

When consumers use or discard the products that emissions-reducing operators manufacture or sell, those CO₂ emissions caused by the consumers are excluded. Specifically, these excluded emissions include those occurring when the manufactured and sold household equipment, office equipment, automobiles, and other products use electric power and heat.

Utilization of CO₂ not released into the atmospheric air

If CO₂ released by the activities as listed in Table 1 is supplied as raw materials to outside parties, the supply of CO₂ is excluded from the calculation of greenhouse gas emissions.

Examples: CO₂ used to carbonate drinks

CO₂ in delivered products

CO₂ sold as raw materials to outside parties

CO₂ emissions from vehicles used outside factories and business facilities

CO₂ emissions from vehicles (such as business cars) used outside factories and business facilities (mobile sources of emissions) are not included in the emissions calculation.

On the other hand, calculations shall include the CO₂ emissions from vehicles used within factories and business facilities, including forklifts refueled by service stations (including mobile ones) and used within factories and business facilities, and the service station shall be considered an emissions source. However, those forklifts used in factories and business facilities but refueled at service stations outside their site boundaries are excluded from the calculation. All the CO₂ emissions from business cars used outside factories and business facilities and refueled at service stations inside their site boundaries are included in the emissions calculation, unless the fuel consumption inside factories and business facilities can be distinguished from that beyond them.

In operators' factories and business facilities, the CO₂ emissions from the forklifts owned and used by other operators are excluded in principle. However, all CO₂ emissions from those forklifts refueled at service stations within the factories and business facilities are included in the emissions calculation, unless the fuel consumption by the factory/facility operators can be distinguished from that of the other operators.

³ Indirect emissions are those in which the greenhouse effect gas emissions caused by a supplier can be reduced (or increased) by reducing (or increasing) the amount of activities by a demander, if the business activities carried out by an operator have caused such demand for business activities.

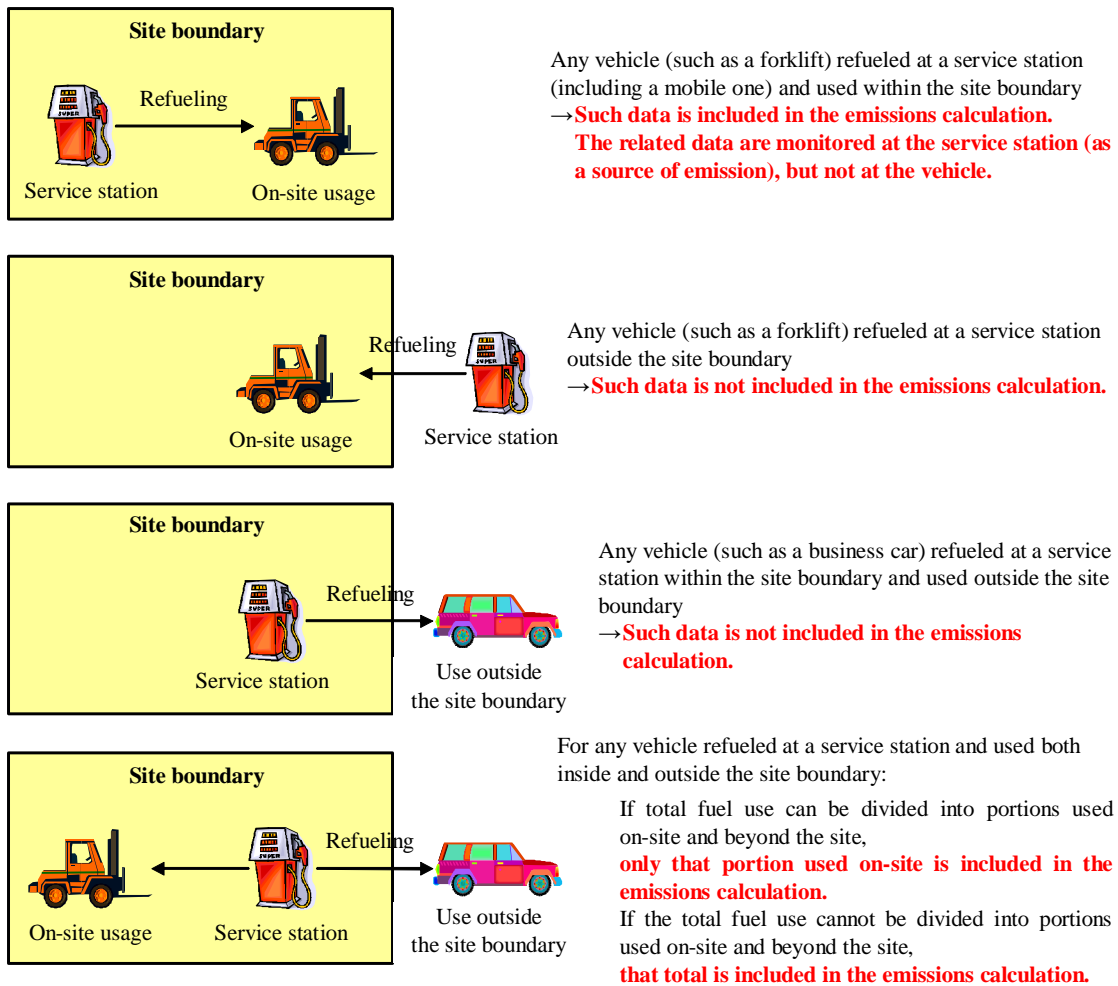


Fig. 6: Treatment of On-Site Vehicles

Emissions during the execution of work

Any CO₂ emissions caused by any contractor within a site boundary are not included in the emissions calculation, unless that contractor is an emissions-reducing operator, because such emissions are temporary and therefore cannot be controlled. However, if fuel tanks within a factory/business facility are shared by contractors such that the fuel amount used by each contractor is unknown, then those emissions are included in the emissions calculation.

3.4 Emissions sources

3.4.1 Definition of an emission source

An emission source refers to the equipment or facility that is used to carry out any of the activities listed in Table 1 within a site boundary. It is necessary to identify the emission source by equipment unit. For instance, if CO₂ emissions are caused by the use of electric power or heat supplied from outside the site boundary, then each of the meters used is considered an emission source. Similarly, if an independent wattmeter (contract) is used for each plant and office, or if each of multiple companies controls its power consumption by using its own accuracy-controlled integrating wattmeter or other instrument within a site boundary, then each wattmeter is considered as an independent emission source.

Examples of Emission Sources

Power-receiving equipment, incinerators, boilers, gas turbine generators, on-site service stations for forklifts, LPG cylinders, waste incinerators, glass manufacturing furnaces (using soda ash), fire extinguishers, and freezers (using dry ice)

3.4.2 Method of identifying the emission source

To identify any emission source, it is optimal to refer to multiple relevant documents or materials. For liquid fuels such as heavy oil, kerosene, light oil, or gasoline, the storage and handling facilities for dangerous materials that have sizes equal to and exceeding the fixed limits are identified in accordance with Article 10 of the Fire Service Law. For those facilities using LPG, high-pressure gas manufacturing, storage and handling facilities are identified within Article 2, the High Pressure Gas Safety Law. Therefore, those facilities using heavy oil, kerosene, light oil, gasoline and LPG can be identified by the two laws.

Industrial processes and purchased LPG cylinders, or other sources of relatively low emissions may not be recognized as emissions sources solely under these two laws. Therefore, it is necessary to confirm these emissions sources by using equipment arrangement plans and purchased goods lists, or by field inspection.

If emissions sources are identified from an environmental aspect extraction table by using the “ISO 14001:2004 Environmental Management System,” the important emissions sources that are not included within the environmental aspect extraction table for a factory/business facility may be overlooked. It is not desirable to identify the emissions sources solely by using the regular report pursuant to the Energy Conservation Law, because such reports do not contain all emissions sources to be identified.

It is necessary to clarify the processes for identifying emissions sources (such as referring to documents), because such processes are verified by the verifier. (For detailed information, refer to Chapter 6.)

3.4.3 Treatment of low-emission sources

This system may exclude the following emissions sources within site boundaries from the calculation of greenhouse gas emissions:

Sources having less than 10 tons of CO₂ emissions per year
 Sources accounting for less than 0.1% of the total emissions from a factory/business facility

To prove that their emissions sources fall into one of those low emissions categories, emissions-reducing operators must calculate or approximate the emissions from their sources, enter those emissions in the proper columns of their calculation reports, and present their rationales for those emissions at the time of verification.

For the cut-off sources of low emissions in the base year, it is not necessary to calculate the emissions in the year when measures were taken to reduce emissions but, rather, to quantitatively/qualitatively prove that the emissions in that year are not significantly higher than in the base year. For emissions sources not qualifying for low emissions status in the base year, it is necessary to calculate all emissions, whether low or high, in the year when measures were taken to reduce emissions.

The examples of low emissions sources are given in Table 2. It is supposed that some factories do not have any sources of low emission. Therefore, emissions-reducing operators should determine whether or not their sources fall into any of these of low emission categories.

Table 2: Examples of Low Emissions Sources

Sources of emissions	Scenarios
LPG cylinders	LPG is a fuel used in offices, control buildings, and testing facilities. It is also used for ignition or firework fuel in co-generation facilities and incinerators.
Space heating equipment	Fuels are used for heating offices.
Hot-water supply equipment	Fuels are used to supply hot-water in offices.
Lawn mowers	They are used to maintain the green spaces in factories/business facilities.
Emergency generators	They are used as power sources during any power service interruption. They use fuels during each annual inspection.
On-site vehicles	Vehicles (such as forklifts) used on site use fuels.
Waste incinerators	Small waste incinerators use firework fuels. Care should be given to the CO ₂ produced by the burning of wastes.
Acetylene cylinders	They are used for repair work within factories.
Fire pumps	Water shooting pumps used to extinguish fire. Such pumps are typically used annually for fire fighting training.

Emissions sources	Scenarios
CO ₂ fire extinguishers	Special high-voltage receiving and transformer facilities are always equipped with CO ₂ fire extinguishers. These fire extinguishers are typically used annually for fire fighting training.
VOC combustion equipment	Fuels are used to burn volatile organic chemicals. This equipment is used in painting and printing plants.
CO ₂ cylinders	CO ₂ is used or sprayed for welding. Food packages are filled with CO ₂ to preserve foods inside them.
Dry ice	This is used to cool and preserve foods. If it is used in the form of liquefied carbonate gas, care should be taken when the usage is high.

Table 3 (below) gives the standard amount of activity equivalent to the source of low emission for each type of activity.

Table 3: Standard Activity Amount Equivalent to an Annual Emission of 10 tons⁴

Type of activity	Consumption
Heavy oil A	Less than 4 kl
Heavy oil C	Less than 4 kl
Kerosene	Less than 5 kl
Light oil	Less than 4 kl
Gasoline	Less than 5 kl
LPG	Less than 4 t or 2,000 m ³ _N
Municipal gas	Less than 5,000 m ³ _N
Acetylene	Less than 3 t
Dry ice	Less than 10 t
CO ₂ cylinder	Less than 10 t

⁴ This table provides reference values determined by using the default values of the unit calorific value and emissions coefficient, except when they are calculated using manufacturer-provided components tables and measured values.

3.5 Establishment of Boundaries

The boundary refers to the limits of a source used to calculate and verify an emission. Within an operator's site boundary, any source of emission (except the equipment that is owned by any other operator) is called a boundary.

If the site boundary contains the lot or facility owned by any other operator, those emissions sources in the lot or facility can be excluded from the boundary without identifying them. (However, it is necessary for the operator to confirm whether there is any emission source owned by the operator in the lot or facility.)

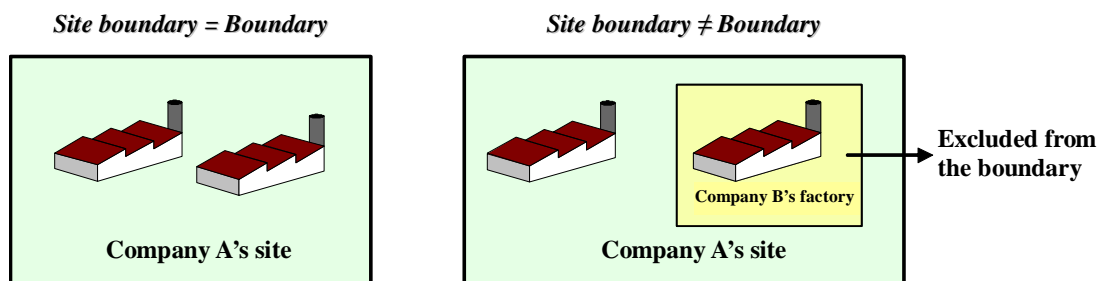


Fig. 7: Relationship between the Site Boundary and the Boundary

To establish any boundary, care should be taken in the following instances:

Scenario in which a subsidiary or affiliated company operates within a site boundary

Within an operator's site boundary, any source of emission owned by any other operator (a subsidiary or affiliated company) is not contained within the boundary.

Scenario in which a facility or facilities is installed within a factory site

If facilities such as offices, canteens, or employee housing are installed within an operator's factory site, the emissions sources in these facilities are contained within the boundary. However, the emissions sources operated and managed by any other operator are excluded from the boundary.

Scenario in which multiple companies are doing business at the same site (such as a complex)

If multiple companies are doing business at the same site (such as a complex) and together control the total energy use such that the energy consumption by each of the companies cannot be determined, the emissions sources for which all the companies collectively control the total energy use are contained in the boundary.

Boundary of a tenant-occupied building

In a tenant-occupied building, the emissions sources for which the owner and tenants of the building have the energy use control rights are considered to be contained within the boundary.

Scenario in which the building owner participates as an emissions-reducing operator in this system:

In principle, the boundary includes the emissions sources for which the owner has a right to control the energy use, including the lighting and air conditioning systems in the public spaces, such as elevators, entrances and corridors, but does not contain the equipment (emission source) owned by the tenants. If the owner receives the energy supply from an energy supplier and distributes it to the tenants (or purchases electric power from an electric power company and supplies some part of it to the tenants), and if the energy supplies to the tenants can not be accurately determined, that owner should include the CO₂ emission resulting from the supplied energy in the total calculation of that owner's own emissions. (For the monitoring method, refer to Chapter 4.)

However, if the tenants purchase energy directly from energy suppliers (or contract directly with municipal gas suppliers to receive a supply of municipal gas), it is not necessary for the owner to include those CO₂ emissions resulting from the supplied energy into the total calculation of that owner's emissions.

Scenario in which tenants participate as emissions-reducing operators in this system:

The emissions sources for which tenants have a right to control the energy use are considered to be contained within the boundaries. If tenants receive the supply of energy through the owner, it is necessary that their energy uses be accurately monitored as required by specified measuring instruments. (For the required monitoring accuracy, refer to Chapter 4).

Chapter 4. Data Monitoring

This chapter describes the method of collecting the basic data necessary to calculate greenhouse gas emissions. Emissions-reducing operators are required to select a monitoring method to accurately determine the greenhouse gas emissions resulting from all the activities carried out in their factories and business facilities.

[Keywords]: Monitoring patterns, monitoring points, and tier.

Operators must monitor the necessary basic data in accordance with Part II of the “Calculation Manual” and the five principles as listed in “1.1 Objectives” by using the most appropriate and rational method to correctly calculate the CO₂ emissions in their factories and business facilities.

In principle, a factory/business facility’s emissions are calculated by using one of the following equations (as described earlier):

<Burning of fuel> CO₂ emission = Amount of activity × unit calorific value × emissions coefficient

<Others> CO₂ emission = Amount of activity × emissions coefficient

To calculate CO₂ emissions, it is necessary to monitor each of the terms (the amount of activity, unit calorific value, and emissions coefficient) in each of the equations above by using an appropriate method. This chapter describes the methods of monitoring data and ensuring the required accuracy.

4.1 Selection of the Monitoring Pattern

The monitoring patterns are the methods of monitoring the amount of activity, and are roughly divided into three patterns.

- Pattern A: Purchase-based method (data used: purchase slips)
 - Pattern A-1: Monitoring of purchases only (of electric power, municipal gas, etc.)
 - Pattern A-2: Monitoring of purchases plus inventory changes (of heavy oil, LPG, etc.)
- Pattern B: Method of monitoring using an accuracy-controlled measuring instrument (data used: measured values)
- Pattern C: Approximation method (optional only if Pattern A or B is difficult to use)

Fig. 8 shows a scenario in which municipal gas is purchased from a municipal gas supplier and used in three gas boilers. In this case, these boilers are the emissions sources.

- If Pattern A is selected, the monitoring point is the meter (as recorded on the delivery slip) installed by the municipal gas supplier.
- If Pattern B is selected, the monitoring points are each of the measuring instruments installed by an operator. These measuring instruments should be within their effective periods of certification or have been regularly inspected pursuant to the Measurement Law. (It is not sufficient even if they are regularly calibrated.)
- If the measuring instruments are not accuracy-controlled, Pattern C should be selected. However, if the measuring instruments are not accuracy-controlled without any suitable reason, the Competent Authority may not approve the use of those instruments.

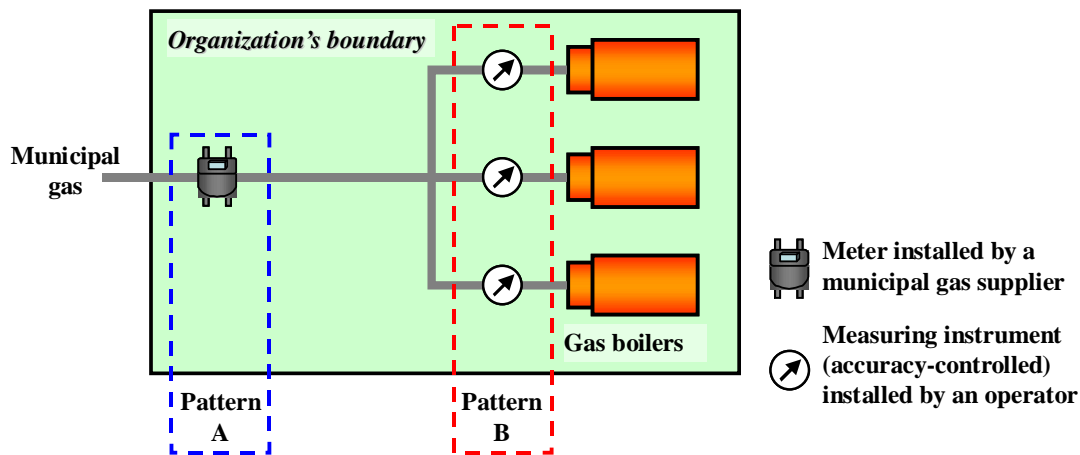


Fig. 8: Examples of Monitoring Patterns

Purchases are determined by the measuring instruments as specified by the Measurement Law, which automatically provides for high accuracy and reliability. In this case, therefore, Pattern A is the most strongly recommended.

4.2 Setting of Monitoring Points

The monitoring point refers to the place where the amount of activity is monitored, and generally corresponds to the location of a measuring instrument. The set of monitoring pattern and monitoring point is generally selected.

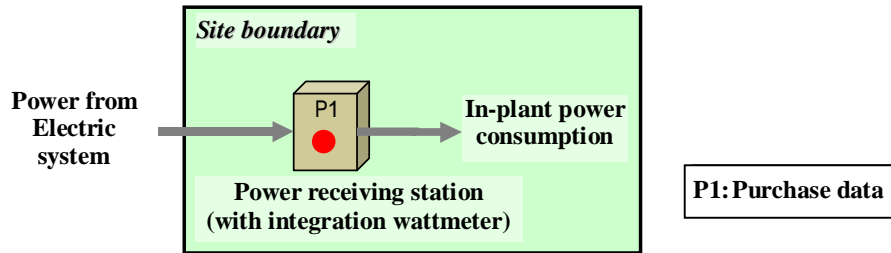
The number of emission sources may not be always same as that of the monitoring points. It is possible to control multiple sources at one monitoring point. Conversely, plural monitoring points may be required to monitor the amount of activity at a single emissions source.

For monitoring, each emissions-reducing operator should select the methods of monitoring the amount of activity, unit calorific value, and emissions coefficient at each monitoring point.

Examples of selecting a monitoring pattern and monitoring points

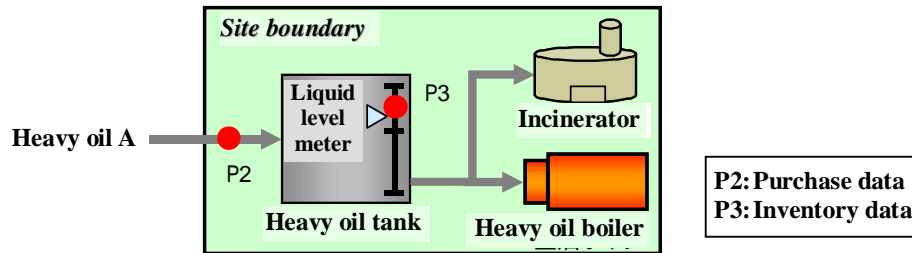
[Pattern A-1]

- The power consumption within a boundary is monitored by the purchase terms.
- The monitoring point is the integrating wattmeter installed in a power receiving station, and the data used is the valuation on the delivery slip as issued by an electric power company.
- * If the electric power for a plant and that for an office are purchased under different contracts, monitoring patterns and points should be set for each purchase.



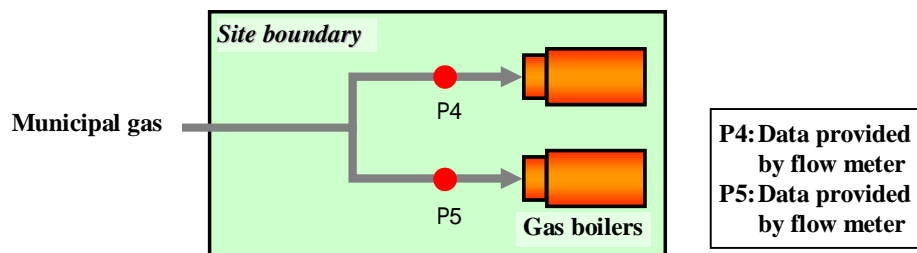
[Pattern A-2]

- The consumption of heavy oil A for a boiler and a waste incinerator is monitored by the purchase terms plus inventory changes.
- The monitoring points are the inlet port of a heavy oil tank and a level meter, and the data used are the valuations on the delivery slip as issued by an oil company and the level meter reading.



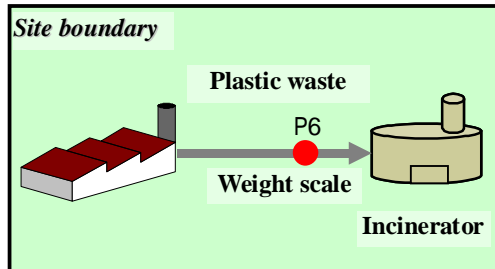
[Pattern B]

- The consumption of municipal gas by gas boilers are monitored by flow meters.
- The monitoring points are the flow meters, and the data used are the flow meter readings.



[Pattern C]

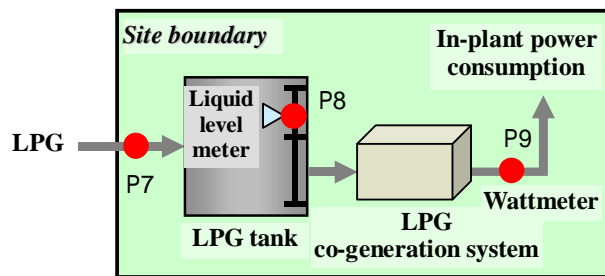
- The amount of plastic waste to be disposed of by an incinerator is monitored by a weight scale for in-plant control (beyond the effective period of certification).
- The monitoring point is the measuring instrument, and the data used is the weight scale reading.



P6: Data provided by weight scale

[Special case : Co-generation]

- For a co-generation system, it is necessary to monitor the in-plant consumption of electric power (except that used for auxiliary machines), because a cogene-credit is issued.
- The monitoring pattern and the monitoring point are selected for each in-plant fuel and electric power consumption uses.

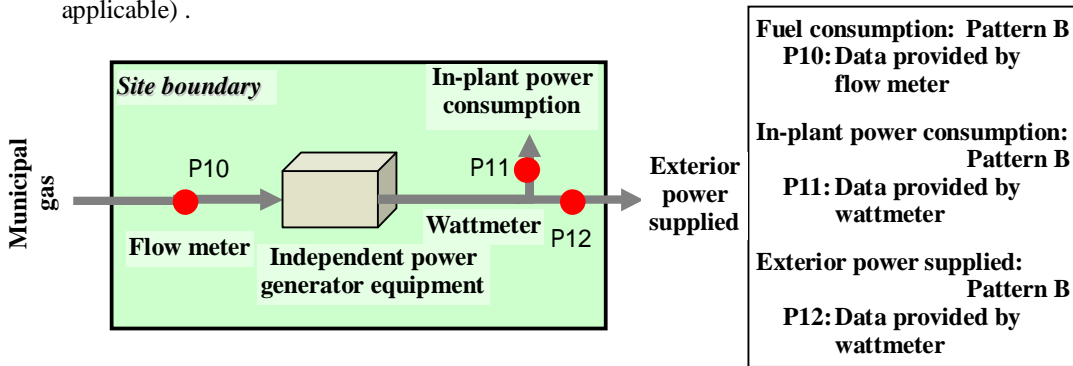


**Fuel consumption: Pattern A-2
P7: Purchase data
P8: Inventory data**

**In-plant power consumption:
Pattern B
P9: Data (value) measured by wattmeter**

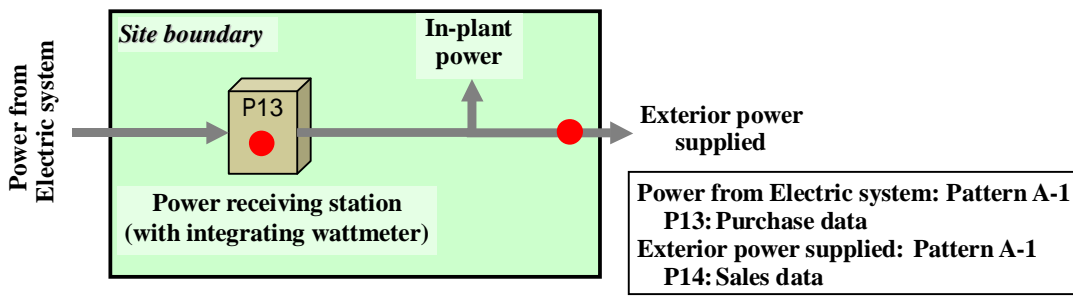
[Special case : Exterior supply (scenario in which electric power or heat produced by using a fuel in a factory/business facility is supplied to the exterior)]

- If a factory/business facility uses fuel to produce electric power or heat and then supplies such power or heat to another, the CO₂ emissions from the fuel is divided into two portions proportional to the consumption of fuel by the factory/business facility and for the other party respectively, and only the CO₂ emission equivalent to the fuel consumption by the factory/business facility is included in the emissions calculation for the factory/business facility.
- Therefore, it is necessary to monitor the total consumption of fuel as well as the electric power consumption (or calorific values) for the factory/business facility and for the other party (if applicable).



[Special case : Exterior supply (scenario in which electric power or heat is received from an electric power company or a heat supplier respectively and then supplied to an exterior party)]

- If the whole or some part of the fuel, electric power, or heat received by an operator from an outside party is supplied beyond the boundary and if that supply to the exterior is determined using a measuring instrument within its effective period of certification or that has been regularly inspected, the emission equivalent to the supply may be deducted from the total emission by the operator.
- The monitored items are the amount of fuel and the electric power or heat received from the outside party, as well as that of what is supplied to the exterior. (From a cross-checking perspective, it is desirable to monitor the in-plant consumption of electric power, even though that consumption is not used to calculate the direct emission.)



4.3 Required Accuracy

Any emissions-reducing operator must measure data with high accuracy at each monitoring point. A conceptual “tier” is used to easily attain the required accuracy.

The tier is the hierarchy of accuracy levels for the monitoring method used at each monitoring point. The accuracy level of a monitoring method is represented in tier X, where X is 1, 2 or 3, etc., as in tier 1, tier 2, or tier 3, etc. Tier 1 is the lowest accuracy level and tier 4 is the highest. The tier for the selected monitoring method depends upon the monitoring pattern and the accuracy of the measuring instrument (Table 4). The tiers are pre-set for the amount of activity, the calorific value, and the emissions coefficient respectively.

The minimum required tier is established for the use/supply of fuel or material (amount of activity) (Table 5). In principle, any monitoring plan cannot be approved if the tier for the amount of activity, the calorific value, or the emissions coefficient is lower than the corresponding minimum required tier.

If the emission in the base year is calculated, it is unnecessary to evaluate the level of accuracy in terms of a tier level. However, the tier for the calculation in the year when emission reduction measures were taken should be established in accordance with these guidelines. Therefore, confirmation of the monitoring method used in the base year for a factory/business facility is recommended.

Table 4: Tier Criteria

Type of activity	Type of fuel or material	Tier	Amount of activity		Unit calorific value and emissions coefficient
			Pattern A	Pattern B	
Use of solid fuel	General coal, coke, etc.	4	Truck scale	Maximum tolerance $\pm 1.0\%$	-
		3	Non-truck scale	Maximum tolerance $\pm 2.0\%$	Values measured by operator
		2	-	Maximum tolerance $\pm 3.5\%$	Others
		1	-	Maximum tolerance $\pm 5.0\%$	Default values
Use of liquid fuel	Heavy oils A, B, and C, kerosene, light oil, gasoline, etc.	4	Non-fuel oil flow micrometer	Maximum tolerance $\pm 1.0\%$	-
		3	Fuel oil flow micrometer	Maximum tolerance $\pm 2.0\%$	Values measured by operator
		2	-	Maximum tolerance $\pm 3.5\%$	Others
		1	-	Maximum tolerance $\pm 5.0\%$	Default values
Use of fuel gas	Municipal gas	4	-	Maximum tolerance $\pm 1.0\%$	-
		3	-	Maximum tolerance $\pm 2.0\%$	Values measured by operator
		2	Non-temperature conversion meter	Maximum tolerance $\pm 3.5\%$	Others
		1	Temperature conversion meter	Maximum tolerance $\pm 5.0\%$	Default values
	LPG	4	Truck scale (liquid)	Maximum tolerance $\pm 1.0\%$	-
		3	LPG meter (gas) Non-truck scale (liquid)	Maximum tolerance $\pm 2.0\%$	Values measured by operator
		2	-	Maximum tolerance $\pm 3.5\%$	Others
		1	-	Maximum tolerance $\pm 5.0\%$	Default values
	LNG	4	Truck scale	Maximum tolerance $\pm 1.0\%$	-
		3	Non-truck scale	Maximum tolerance $\pm 2.0\%$	Values measured by operator
		2	-	Maximum tolerance $\pm 3.5\%$	Others
		1	-	Maximum tolerance $\pm 5.0\%$	Default values

Note: The evaluation of the tier depends upon the fuel type, but not upon the method of using the fuel, even though the different uses of liquid fuel are provided for both fixed and mobile emissions sources in Part II of the “Calculation Manual.”

Table 4: Tier Criteria (continued)

Type of activity	Type of fuel or material	Tier	Amount of activity		Unit calorific value and Emission factor
			Pattern A	Pattern B	
Use of electric power	Electric power from the system Independent power generation	4	Special precision wattmeter	Maximum tolerance $\pm 1.0\%$	-
		3	Precision wattmeter	Maximum tolerance $\pm 2.0\%$	Values measured by operator
		2	Ordinary wattmeter	Maximum tolerance $\pm 3.5\%$	Others
		1	-	Maximum tolerance $\pm 5.0\%$	Default values
Use of heat	Industrial steam, warm water, cold water and steam	4	-	Maximum tolerance $\pm 1.0\%$	-
		3	-	Maximum tolerance $\pm 2.0\%$	Values measured by operator
		2	-	Maximum tolerance $\pm 3.5\%$	Others
		1	Integrating calorimeter	Maximum tolerance $\pm 5.0\%$	Default values
Incineration of wastes, etc.		4	Truck scale	Maximum tolerance $\pm 1.0\%$	-
		3	Non-truck scale	Maximum tolerance $\pm 2.0\%$	Values measured by operator
		2	-	Maximum tolerance $\pm 3.5\%$	Others
		1	-	Maximum tolerance $\pm 5.0\%$	Default values
Industrial processes		4	Truck scale	Maximum tolerance $\pm 1.0\%$	-
		3	Non-truck scale	Maximum tolerance $\pm 2.0\%$	Values measured by operator
		2	-	Maximum tolerance $\pm 3.5\%$	Others
		1	-	Maximum tolerance $\pm 5.0\%$	Default values

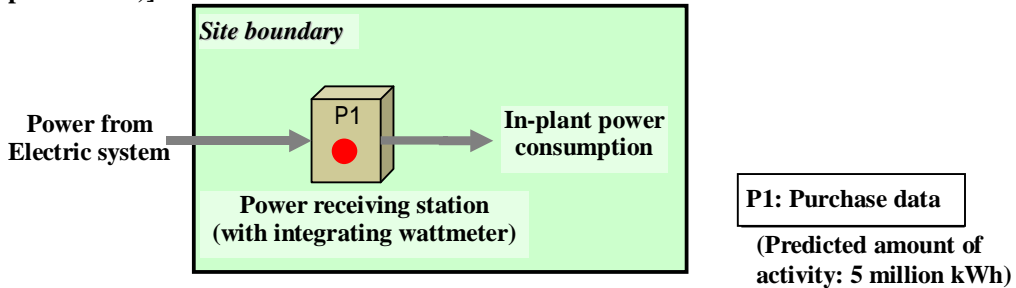
Table 5: List of tiers required for each type of activity and each amount of activity

Type of activity	Type of fuel or material	Amount of activity	Tier by amount of activity	Tier for unit calorific value	Tier for emissions coefficient
Use of solid fuel	General coal, cokes, etc.	5,000t or more	Tier 3	Tier 2	Tier 2
		500t to 5,000t	Tier 2		
		Less than 500t	Tier 1	Tier 1	Tier 1
Use of liquid fuel	Heavy oils A, B, and C Kerosene, light oil, gasoline, etc.	5,000kl or more	Tier 3	Tier 1	Tier 1
		500kl to 5,000kl	Tier 2		
		Less than 500kl	Tier 1		
Use of fuel gas	Municipal gas	Indefinite	Tier 1	Tier 2	Tier 1
	LPG	5,000t or more	Tier 3	Tier 1	Tier 1
		500t to 5,000t	Tier 2		
		Less than 500t	Tier 1		
	LNG	5,000t or more	Tier 3	Tier 1	Tier 1
		500t to 5,000t	Tier 2		
Less than 500t		Tier 1			
Use of electric power	Electric power from the system Independent power generation	90 millions kWh or more	Tier 4	-	Tier 1
		4.5 millions kWh to 90 millions kWh	Tier 3	-	
		Less than 4.5 millions kWh	Tier 2	-	
Use of heat	Industrial steam, warm water, cold water and steam	Indefinite	Tier 1	-	Tier 1
Incineration of wastes, etc.		Indefinite	Tier 1	-	Tier 1
Industrial processes		Indefinite	Tier 1	-	Tier 1

Note: The required tier depends upon the type of fuel, but not upon the method of using the fuel, even though the different liquid fuel uses are provided for both fixed and mobile emissions sources in Part II of the “Calculation Manual.”

Example of Evaluation by Tier

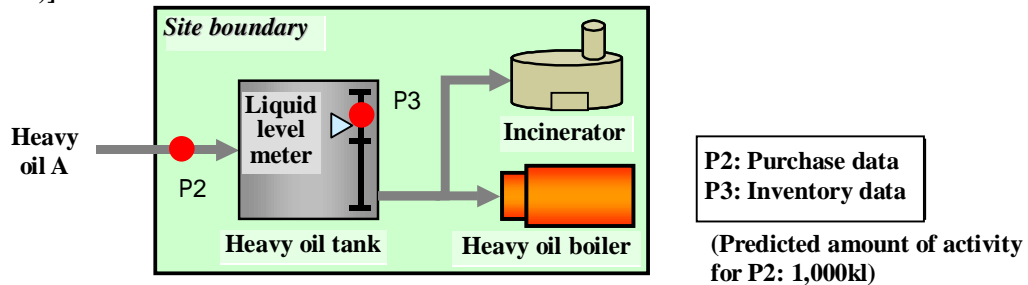
[The use of electric power from a system using purchase-based monitoring (Monitoring pattern A-1)]



	Required Tier (See Table 5)	Actual Tier (See Table 4)
Amount of activity	Tier 3	Monitored by a precision wattmeter →Tier 3
Emission factor	Tier 1	Default value used →Tier 1

⇒ The actual tiers for the amount of activity and the emissions coefficient satisfy the respective tier requirements.

[The use of heavy oil A monitored by purchase plus inventory change (Monitoring pattern A-2)]

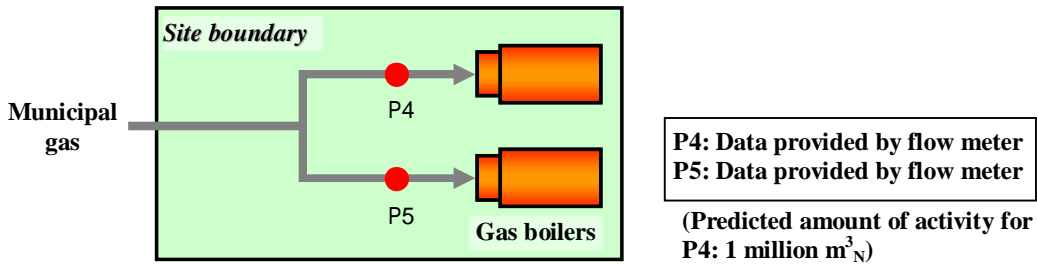


	Required Tier (See Table 5)	Actual Tier (See Table 4)
Amount of activity	Tier 2	Monitored by an instrument other than a fuel oil flow micrometer →Tier 4
Calorific value	Tier 1	Default value used →Tier 1
Emission factor	Tier 1	Default value used →Tier 1

⇒ The actual tiers for the amount of activity, calorific value, and the emissions coefficient satisfy the respective tier requirements.

The level meter (P3) is not a measuring instrument such that it is impossible (unnecessary) to evaluate the tier.

[The use of municipal gas as monitored by a measuring instrument (Monitoring pattern B)]

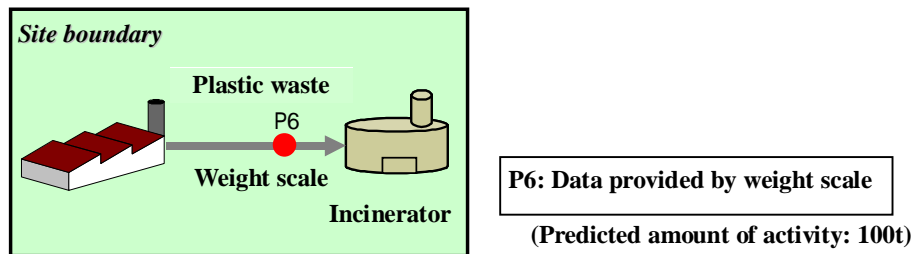


	Required Tier (See Table 5)	Actual Tier (See Table 4)
Amount of activity	Tier 1	Monitored by a flow meter with maximum tolerance $\pm 6\%$ →Tier 1 not satisfied
Calorific value	Tier 2	Default value used →Tier 1
Emission factor	Tier 1	value provided by a gas supplier used →Tier 2

- ⇒ One of the following actions must be taken because the actual tier for the amount of activity does not satisfy the tier requirement.
 - The flow meter used is replaced with a higher accuracy product; or
 - The selected monitoring pattern becomes changed to Pattern A-1.
- ⇒ The following action must be taken because the actual tier for the calorific value does not satisfy the tier requirement.
 - The measured or other value (provided by a municipal gas supplier) is used.
- ⇒ The actual tier for the emissions coefficient satisfies the tier requirement.

The same evaluation is made for P5. (The tier is evaluated for each monitoring point.)

[The amount of incinerated wastes are monitored by a measuring instrument for in-plant control beyond the effective period of certification (Monitoring pattern C)]



	Required Tier (See Table 5)	Actual Tier (See Table 4)
Amount of activity	Tier 1	Monitored by using Pattern C →Tier not set
Emission factor	Tier 1	Default value used →Tier 1

- ⇒ It is impossible to evaluate the tier if the amount of activity is monitored by using Pattern C. In this case, the Competent Authority (CA) makes a judgment for each parameter.

4.4 Monitoring System Development

4.4.1 Developing the necessary systems for emissions monitoring, calculation, and reporting

Any operator is required to establish the appropriate monitoring and calculation systems for accurately determining emissions. In order to avoid any omission or insufficient data checking, it is effective to establish the appropriate data collecting and monitoring methods and systems.

Specifically, the following steps should be taken:

- Appoint the responsible persons and the persons in charge. A person in charge of each necessary task should be appointed.
- Establish a checking system. Such a system should be established that can be counted upon to check the collected data.
- Establish the procedure. It is necessary to decide what should be done, who should do it, when it should be done, and present them in an easily understandable way.

The chief officer responsible for a factory/business facility must be appointed as the person responsible for calculation, take responsibility for the following tasks, and ensure that the parties interested in the factory/business facility take corrective actions if any of the tasks is not performed:

- Preparation and submission of the Calculation Report to Ministry of the Environment (CA);
- Calculation, submission and maintenance of emission data; and
- Quality control of emission data.

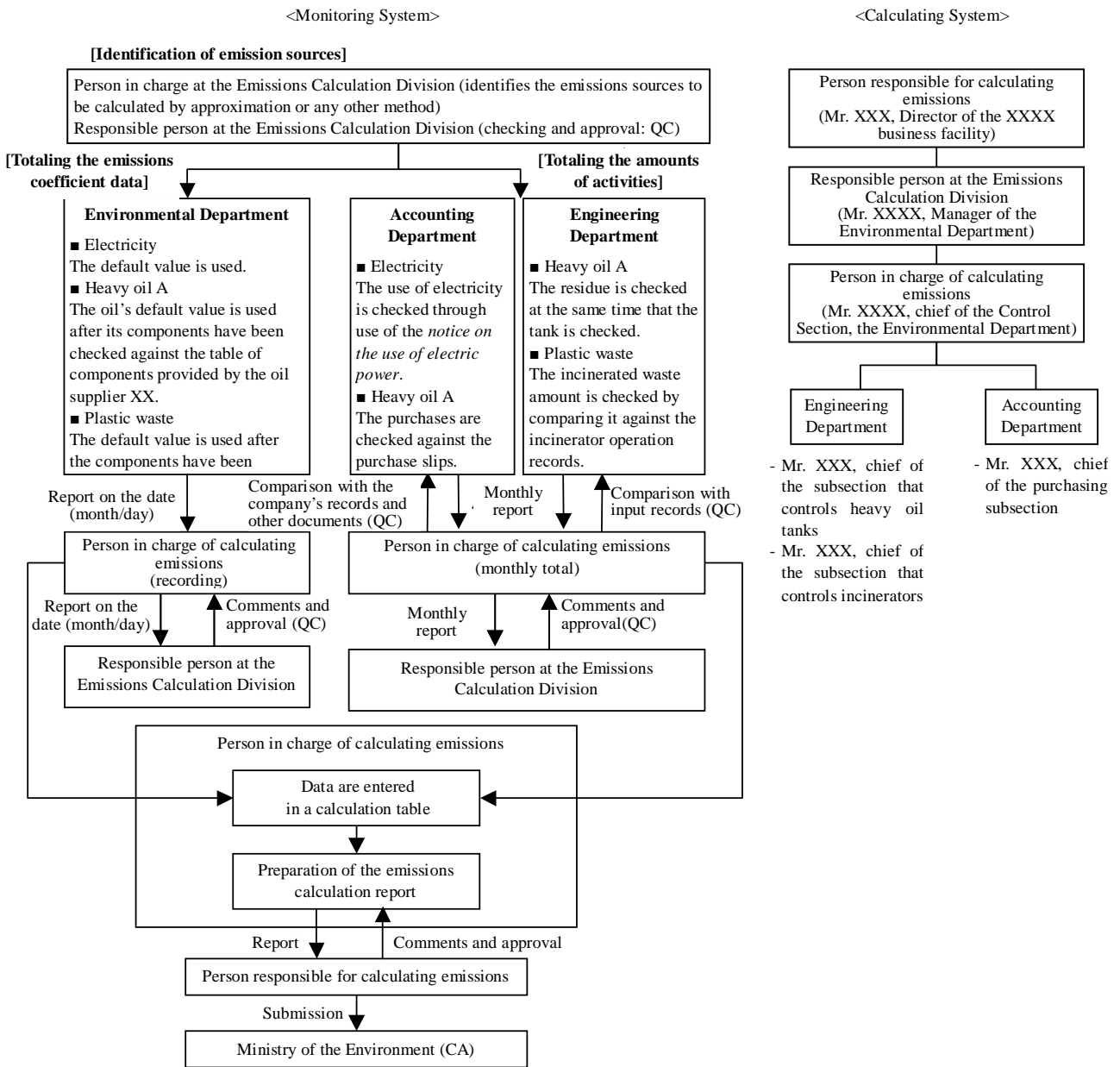
The person in charge of calculation must:

- Identify the sources of emissions;
- Calculate emission data; and
- Prepare the Calculation Report.

The persons responsible for and in charge of controlling monitoring points must be appointed to monitor data and maintain and control measuring instruments (certification/regular inspections).

A chart showing the monitoring system, considering the above-described requirements, and determining what should be done, who should do it, and when it should be done must be prepared. For those operators who established their management system based upon the “ISO 14064-1:2005 Calculation and Report and Verification of Greenhouse Gas Emissions – Calculation Report of Emissions by an Organization,” or who implement the “ISO 14001:2004 Environmental Management System,” it is probably effective to establish a management system that also allows for monitoring of data and calculating of CO₂ emissions.

Fig. 9 shows examples of monitoring and calculation systems. Other scenarios can also be considered. If a factory/business facility has many facilities, for example, it will be necessary to appoint many persons in charge of monitoring and calculation. Medium- and small-sized enterprises may have to develop their calculation systems with a small number of persons. In any case, it is imperative to establish monitoring and calculation systems that can clarify the method of collecting data, the procedure of calculating emissions, and the responsibilities of the persons in charge of monitoring and calculating, as well as regularly check the data collected by monitoring.



Person responsible for calculating emissions
(Mr. XXX, Director of the XXXX business facility)

Responsible person at the Emissions Calculation Division
(Mr. XXXX, Manager of the Environmental Department)

Person in charge of calculating emissions
(Mr. XXXX, chief of the Control Section, the Environmental Department)

Engineering Department

Accounting Department

- Mr. XXX, chief of the subsection that controls heavy oil tanks

- Mr. XXX, chief of the subsection that controls incinerators

Fig. 9: Examples of Monitoring and Calculation Systems

4.4.2 Quality assurance (QA) and quality control (QC)

In order to calculate CO₂ emissions, it is important to monitor and collect accurate data. To do so, it is necessary to develop a system for assuring data quality. Generally, it is expected that the quality of data will be improved by these two approaches: checking individual collected data and establishing the necessary systems. The former and latter are typically called quality assurance (QA) and quality control (QC), respectively.

Example of quality assurance (QA)

- Any person appointed as an internal inspector makes internal inspections regularly (about once or twice a year) and plays the following roles in addition to his or her other responsibilities:
 - Confirming that the data randomly selected from all records are recorded, entered, and checked in the specified ways;
 - Confirming that the data randomly selected from all records and described in the Calculation Report are appropriately prepared in accordance with these guidelines as the standards of calculation and include within the report all the important points; and
 - If it is necessary to correct the data as described in item , the person recommends corrective actions such as reviewing the method of confirmation as described in item , and then reports those corrective actions to the person responsible for calculation to review the management after having confirmed the effectiveness of the actions.

Example of quality control (QC)

- When entering bill data, double-checking for any errors.
- After having entered bill data, double-checking for any error or abnormal value by comparing each date's data with the other data for the same date of the preceding year.

Examples of various actions that can be taken for appropriate QA and QC are described below:

(1) Education and training

To maintain monitoring reliability, it is important to continuously disseminate knowledge and information about the calculation and report of emissions through education and training about the monitoring procedure and calculation standards. Concrete examples of this education and training include explaining the:

- In-house monitoring system;
- Approval system for the results of calculations;
- Calculation standards;
- Monitoring procedure;
- Totaling sheets (totaling system) for in-house management;
- Way to maintain documents and records;

- Control and maintenance of measuring instruments; and
- Way to make entries in the Calculation Report.

For operators who implement the “ISO 14001:2004 Environmental Management System,” it is effective to use a management system in order to monitor basic data and calculate CO₂ emissions. For designated plants controlling energy pursuant to the Energy Conservation Law, it is probably efficient to appoint the regular report preparing persons as the persons responsible for and in charge of calculating emissions under this system. However, this system uses a calculating method that is almost the same as the Energy Conversion Law, although different from that law in some details, such as how to think about the boundary, low emission sources, and the method for processing values. Under this system, therefore, it is necessary to educate and train the persons responsible for and in charge of calculating emissions, in consideration of the differences in calculating standards and methodology between this system and the Energy Conversion Law.

(2) Information maintenance

Under this system, operators must document and maintain all the data used to calculate the emissions from their factories/business facilities. It is necessary for the operators to collect, record, totalize, analyze, and document these data in such a way that the verifier and the Competent Authority (CA) can recalculate the calculated emissions.

For the information required for verification, refer to *****.

(3) Checking of data

To improve data reliability, it is necessary to check the data themselves. Various methods of checking data can be considered. For example, these methods include:

- Checking the unit of data collected;
- Checking data in comparison with data contained in the statements of deliveries and monthly reports;
- Checking the component analysis data;
- Checking data to see if they reflect the relationship predicted by the real situation as follows:
 - Comparison with the other related data (such as fuel consumption per hour, production per fuel consumption unit);
 - Yearly data variations; and
 - Comparison between factories/business facilities.
- Identifying arbitrary data and deviated values.

In the process of data checking, data may be checked not only when a person in charge enters data on a system’s delivery statements, but also when a person in charge of calculation totals the data for a factory/business facility. Thus, it is possible to decrease the uncertainty due to errors in data entry by setting multiple checking times.

(4) Internal inspection

The internal inspection refers to the in-house review to check whether the activities carried out by an organization satisfy these guidelines and the rules for implementing JVETS and other in-house systems, and whether they are implemented with high efficiency. The key objective is to maintain and improve the reliability of the reporting processes, such as the monitoring, collection, calculation and reporting of data. These processes must be performed regularly. If any problems or issues are detected in the reporting processes of monitoring, collecting, calculating, reporting, and checking data, then both corrective and preventive actions must be taken to solve them.

For those operators who implement the “ISO 14001:2004 Environmental Management System,” it is probably effective to review their data monitoring systems within their in-house management systems.

4.5 Control and Maintenance of Measuring Instruments

4.5.1 Measuring instruments applicable to monitoring

To accurately monitor CO₂ emissions, it is mandatory to use measuring instruments that have the required accuracy and a high reliability.

In principle, purchase data are accurately measured in accordance with the Measurement Law.⁵ Therefore, the measuring instruments used for the purchase data automatically have a high accuracy insofar as they are used for the data (Monitoring pattern A: Purchase-based method).

When Pattern B is implemented to monitor data by use of accuracy-controlled measuring instruments, however, operators are allowed to use only the measuring instruments that are within their effective period of certification or have been regularly inspected pursuant to the Measurement Law. (Self-calibrated measuring instruments are not allowed.) In order to use measuring instruments that are not accuracy-controlled pursuant to the Measurement Law, that is, to implement Pattern C (Approximation method), it is necessary to obtain the Competent Authority’s approval.

⁵ The Measurement Law defines the measuring standards for the purpose of making accurate measurements. Originally, this law was established to define the Japanese measuring standards and ensure that trades are made under uniform standards (the Law of Weights and Measures). The existing Measurement Law was established primarily to employ the International System of Units (SI) and the international measuring standards and maintain the traceability and accuracy of various measuring instruments.

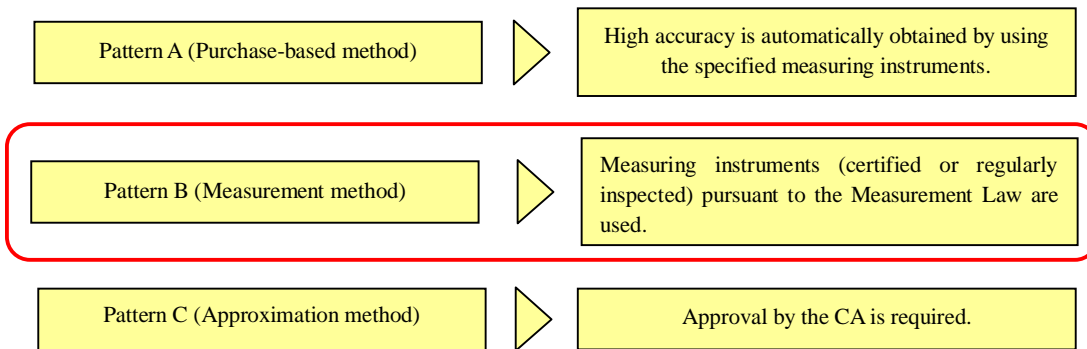


Fig. 10: Type of Measuring Instrument Depending upon Monitoring Pattern

< Glossary >

“The specified measuring instrument” ... This term refers to the measuring instrument that is used for trade and certification as well as for consumers and for which the standards of construction and instrumental errors is required to be established pursuant to the Measurement Law in order to ensure that accurate measurements are made.

“Certification” ... This term refers to the inspection that the certifying organization appointed by the Government makes to determine whether the constructions and accuracy of the specified measuring instrument manufactured or repaired meet the standards established pursuant to the applicable law.

“Regular Inspection” ... This term refers to the appropriate inspection to be made regularly of the performance and instrumental errors of the specified measuring instrument from the viewpoints such as its construction, conditions of operation, and situation of operation. Any person must receive the regular inspection of any measuring instrument as specified by the applicable ordinance, before he or she uses it to make measurements in legal measuring units for trade or certification. The regular inspection shall be made on each of the specified measuring instruments once during the period of at least one year as specified by the applicable ordinance in each area.

“Calibration” ... This term refers to the measurement that makes the difference between the parameter value of a subject indicated by a measuring instrument for a part and the standard parameter value indicated by the measuring instrument as specified by the provisions of the Measurement Law, or otherwise the standard parameter value indicated by the measuring instrument on the specified reference material manufactured by the tool, machine, or apparatus as specified by the provisions of the said law for the other part.

4.5.2 Instrumental errors of measuring instruments

The instrumental error refers to any error that the specified measuring instrument has resulting from its construction, that is, the difference between the value indicated by the measuring instrument and the value (true value) by the standard measuring instrument, or the ratio of the former to the latter.

Instrumental error =
the measured value – the value (true value) as indicated by the standard measuring instrument.

The instrumental error indicates the accuracy of a measuring instrument, and the instrumental error of the measuring instrument used has a great influence on the monitoring accuracy. Therefore, any operator should check not only the maximum tolerance value of each measuring instrument used by referring to documents such as the “Inspection Results for Measuring Instrument,” but also the tier evaluations for using that measuring instrument.

If a measuring instrument having a high value of maximum tolerance is used, it may not satisfy the required level of monitoring accuracy (tier). In such a case, then, it may be necessary to install a measuring instrument having a higher accuracy.

< Method of monitoring the instrumental error of a measuring instrument >

- The regular inspection is the system under which an inspection is regularly made for the primary purpose of checking the instrumental error of a measuring instrument in order to keep the instrument accurate and fair. A regular inspection is applicable to the specified measuring instruments that are required to be certified and that have performances and instrumental errors that are considered especially dependent upon their conditions and situations of operation, respectively.
- The Measurement Law requires that any measuring instruments (mass meters) used for trading and certification shall be biannually inspected to confirm that they meet the standard values of accuracy.
- To evaluate the tier, the maximum tolerance in the normal use range is calculated from the results of regular inspection and used.

Example: If a measuring instrument generally uses a range of 5 to 20t as shown in the figure below, it has the maximum tolerance as follows:

$$\text{Maximum tolerance} = \pm 20\text{kg}/5\text{t} = \pm 0.4\%$$

Criteria		
0 to 5t	=	± 10kg
5t to 20t	=	± 20kg
20t to 30t	=	± 30kg

計量器検査成績書 第 420-1 号
(定期検査) 平成 17 年 5 月 6 日

計量器の名称	電気抵抗線式秤	検査年月日	平成 17 年 5 月 4 日
使用範囲	200kg ~ 50t	精度等級	M 級
目量	10kg	積載台寸法	3m × 15m
器物番号	150428	検査場所	

1. 器差検査				2. 感度検査 (24kg)			
表示量	公差	往器差	復器差	200kg	2目量の変位	良	
0t	±10kg	±0 kg	±0 kg	25t	2目量の変位	良	
2	#	±0	±0	30t	2目量の変位	良	
5	#	±0	±0	判定基準: 目量に相当する変位			
8	±20kg	±0	±0	3. 繰返検査 (検査荷重 12.5t)			
12	#	±0	±0	1回目	±0 kg	良	
16	#	±0	±0	2回目	±0 kg	良	
20	#	±0	±0	3回目	±0 kg	良	
24	±30kg	±0	±0	判定基準: 其々の計量値が±20kg以内			
28	#	±0	±0	4. 偏置検査 (検査荷重 25t)			
30	#	±0	±0	積載台			
				左	中央	右	
				(±0kg)	(±0kg)	(±0kg)	
				指示計			
				判定基準: 中央と左・右の計量値の誤差の差が±20kg以内			

判定基準
0~5t迄 = ±10kg以内
5t超~20t迄 = ±20kg以内
20t超~30t迄 = ±30kg以内

検査に使用した基準分銅
二級実用基準分銅 No. 8 1kg~20kg
二級実用基準分銅 No. 9 500kg・1t

検査判定
上記の計量器は、計量法第23条の規定に従って検査を行い合格致しました。

Chapter 5. Calculation and Report of Greenhouse Gas Emissions

This chapter describes the methods of calculating and reporting greenhouse gas emissions. It is necessary for operators to calculate their greenhouse gas emissions, based on the data monitored by the required methods as described in the previous chapters, and then report those emissions in the specified format.

[Keyword]: Calculation Report

5.1 Calculating Greenhouse Gas Emissions

In principle, CO₂ emissions are calculated by using any of the following equations in conjunction with data monitoring by the methods described in the previous chapters.

$$\begin{aligned} \text{<Burning of fuels> } \text{CO}_2 \text{ emission} &= \\ &\quad \text{Amount of activity} \times \text{unit calorific value} \times \text{emissions coefficient} \\ \text{<Others> } \text{CO}_2 \text{ emission} &= \text{Amount of activity} \times \text{emissions coefficient} \end{aligned}$$

For more detailed information about calculating methods, refer to Part II of the “Calculation Manual.” It is possible to calculate CO₂ emissions by using methods other than those described in these guidelines. Other methods include, for example, calculating the CO₂ emissions resulting from the burning of fuels based on the carbon contents provided by a components analysis as well as fuel consumptions, although this method requires obtaining approval by the Competent Authority (CA).

The amount of activity is determined at each monitoring point and presented as an integral value in its unit by rounding off any decimal. The CO₂ emission is calculated at each monitoring point, and presented as an integral value by rounding off any figures less than 1t of CO₂ emission.

5.2 Report of Greenhouse Gas Emissions

Emissions-reducing operators are required to report their calculated CO₂ emissions in the specified format.

The Calculation Report for emissions in the base year is comprised of the principal report containing qualitative descriptions as well as the appendices that provide concrete information on calculation results such as fuel used and the calculated CO₂ emissions.

For the year when emissions-reducing measures were taken, the Monitoring Plan provides information such as the description of an operator and the facilities and equipment conditions. For that year, the Calculation Report that provides only the quantitative information such as the calculated CO₂ emissions is submitted to the CA.

5.3 Flow of Calculation and Reporting

Fig. 11 shows a rough flow chart of calculation and reporting. First, any emissions-reducing operator prepares its monitoring plan, and then submits such monitoring plan to the Competent Authority (CA) for approval. Next, that operator monitors data for the calculation period in accordance with the approved monitoring plan, and calculates the CO₂ emissions using the collected data.

The operator prepares the Calculation Report that supplies the calculation results in the specified format, and entrusts the verification of those results to a verifier. If the verifier requires the operator to correct any data in the Report, the operator amends the Calculation Report.

The verifier verifies the amended Calculation Report (for detailed information, refer to Chapter 6), and submits the Calculation and Verification Reports to the CA for approval. If the CA requires the operator and/or the verifier to correct any data in the Reports, the operator and/or the organization amends the Calculation Report and/or the Verification Report.

If the CA does approve the Calculation and Verification Reports, the results of calculation and verification are established.

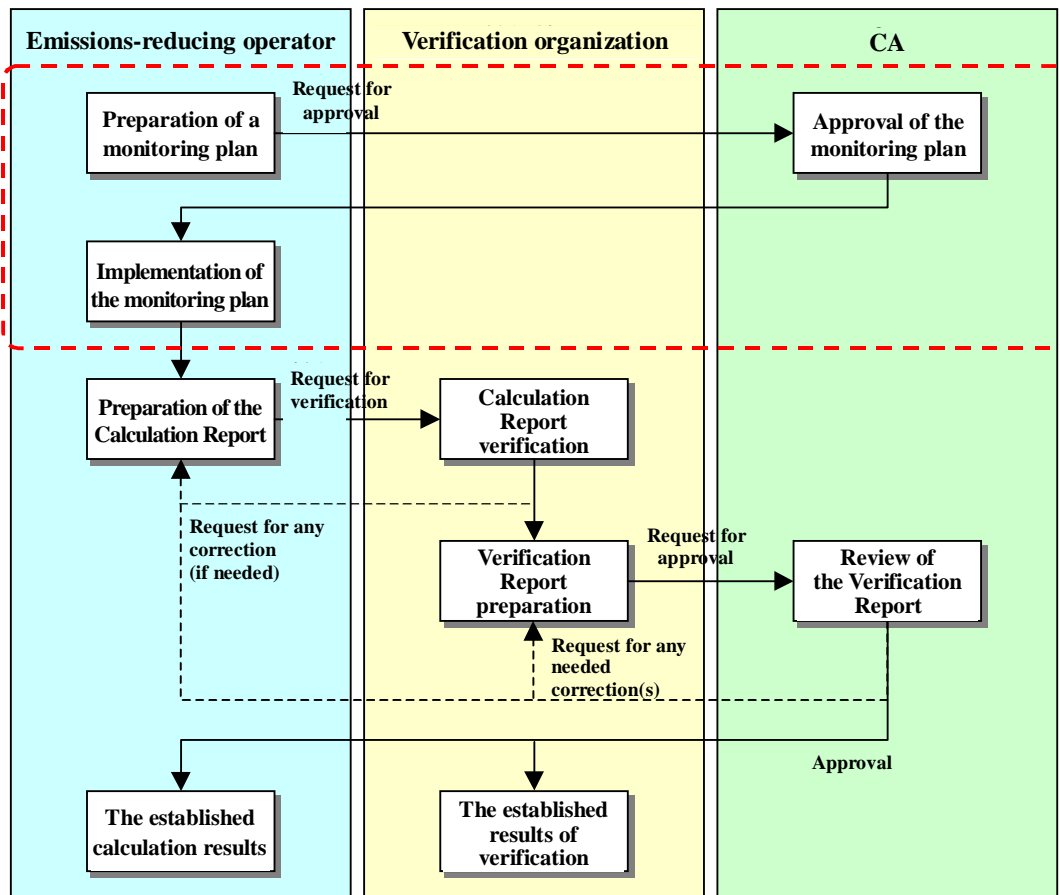


Fig. 11: Flow of Calculation and Reporting

Note: The data enclosed within the red dotted line box are those items not necessary for calculating emissions in the base year.

Chapter 6. Verification

This chapter describes the verification process for the calculated greenhouse gas emissions in which a third party checks the calculation results. The operator who entrusts the verification to a third party should provide the required information and permit the verifying person(s) to visit the field.

[Keywords]: Verification, Verification Report, and verification comments.

6.1 Preface

To be certain to attain a reduction in emissions, the emissions in the base year and the year when emissions-reducing measures were taken must be accurately calculated. The emissions-reducing operators who participate in JVETS are required to report their emissions in accordance with these guidelines. To maintain reliable calculation results, a third party must serve as a verifier independent from the operators to verify those calculations.

To confirm that the Calculation Report to be verified is reliable, it is necessary for the verifier to obtain various pieces of evidence during the verification process. The verifier is required to make the verification process a smooth one by promoting a mutual understanding with any emissions-reducing operator. It is expected that the verifier will improve the management system by evaluating the operator's establishment of the monitoring and calculating systems, especially in the process of verification for emissions in the base year.

Chapter 6 primarily describes the items that emissions-reducing operators should well understand to ensure that the verification process is smooth, including the flow of verification, the Verification Report containing the results of verification, the verification comments contained in the Verification Report, the standards for forming comments, and the materials necessary for verification, etc.

6.2 Roles and Responsibilities

The emissions-reducing operators are responsible for calculating their emissions and preparing their Calculation Reports in accordance with these guidelines. The verifiers are responsible for verifying the information provided by the Calculation Report and for expressing their comments. If the operators and the verifiers fulfill their respective responsibilities, they can maintain reliable emissions information.

6.3 Flow of verification

The verification is comprised of the systematic processes of objectively collecting and assessing related evidence and describing those results in the Verification Report in order to confirm that the information provided by the Calculation Report complies with these guidelines as the standards for calculating and reporting emissions. It is implemented, in general, as the following flow.

Steps	Description	Place
Investigations	Obtain the necessary information, including the operator's activity, the conditions of activity, the processes of identifying the site boundary and the emissions sources, as well as establishing the boundary of calculation, the monitoring method/system, the calculating system, and the data processing method.	Verifier's office (Factory/business facility if necessary)
↓ Risk evaluation	From the investigation results, extract any event that may pose a risk that could lead to any error in the reported emissions, and evaluate that risk level.	Verifier's office
↓ Preparation of verification plan	Based on the results of risk evaluation, select the procedure, time, and extent of evidence collection. The procedure is comprised of reading records and documents, visiting and observing factories/business facilities /equipment, interviewing the interested parties, checking the emissions calculation, etc.	Verifier's office
↓ Implementation of the plan	Implement the plan to collect informational evidence about the identified site boundary and emissions sources and the established boundary of calculation, the method of monitoring the amount of activity, the rationales for the selected unit calorific value and emissions coefficient, the process of calculating emissions, and the method of describing the calculated emissions in the Calculation Report.	Verifier's office or Factory/business facility
↓ Evaluation of the results	Evaluate the collected evidence.	Verifier's office (Factory/business facility if necessary)
↓ Composition of comments	Establish comments, based on the evaluation results.	Verifier's office
↓ Preparation of Verification Report	Prepare the Verification Report.	Verifier's office
↓ Review of quality control	As a part of the QC procedure, each verifier makes the final review on the conclusions drawn by the verifying team as well as the information provided by the Verification Report.	Verifier's office
↓ Submission of Verification Report	Submit the Verification Report to the CA.	Verifier's office
↓ Approval of Verification Report	The verification results are established with the CA's approval.	CA

Fig. 12: Flow of Verification

[Risk evaluation]

To evaluate the possibility (or risk) of causing any errors, incorrect descriptions, or omissions that may lead to incorrect calculation results, it is necessary to investigate the monitoring method/system and the data processing method and evaluate their reliabilities. If the division of tasks and responsibilities is not clarified, if the data processing method cannot be clearly explained, if there is no consistency, or if there is no management, for example, it is evaluated at high risk. In such a case, it is necessary to plan a more detailed and/or broader calculation procedure.

[Conformity with the monitoring plan]

Emissions-reducing operators must monitor and calculate their emissions according to the monitoring plans that have been submitted to and approved by the CA. During the verification process, it is necessary to first check this point.

[Key points for verification]

The key points for verification include the following:

Site boundary: • The site boundary of a factory/business facility is identified after the spatial relationships between the site and the surroundings have been clarified by using the site maps annexed to notifications, reports, and other documents submitted to the competent administrative agency.

Sources of emissions:

- All emissions sources (facilities/equipment) to be calculated are identified after the related activities carried out by any emissions-reducing operator within its site boundary have been identified in accordance with these guidelines.

Boundary of calculation:

- Of all the identified sources of emissions, the sources owned by other operators and the low emissions sources are identified and excluded from the boundary of calculation. The rest of the sources are taken into account or included in the boundary.

Amount of activity:

- The appropriate equation and tier are applied to the amount of activity.
- The monitoring method approved by the CA is applied to “monitoring pattern C” to which any tier is not applied.
- The data for the appropriate period are used to check the relation between the delivery/ordering date on the related statement of delivery/ bill and the period for calculation.
- Measurements (measuring instruments, readings, and original records) are accurate.
- The results of totaling (including the posted data) are accurate.
- The processing of data (rounding and unit conversion) is accurate.
- The amount of activity is based on the real data of emissions/purchases.
- The amount of activity includes all the necessary data.

Unit calorific value/emissions coefficient:

- The appropriate “unit calorific value/emissions coefficient” is selected for the related activity.
- The measurements and calculations (measuring instruments, readings, and original records) are accurate.

Calculation of emissions:

- There is no error in the calculation.
- The calculated values are rounded off in accordance with these guidelines.

Preparation of Calculation Report:

- The Calculation Report is prepared in accordance with these guidelines.

(*) The starting point of calculation is comprised of identifying the sources of emissions and establishing the boundary of calculation. If any source of emission to be identified is omitted, especially in the base year such that the boundary is not correctly established, then the total emissions would be underestimated in the base year. In addition, in the year when emissions-reducing measures were taken, the total emissions could be calculated by using incorrectly identified emission sources and the incorrectly established boundary from the base year. Therefore, special care should be taken to identify the emissions sources and establish the boundary in the base year.

[Place of verification]

Some verifying procedures may be implemented either within a verifier’s office or an emissions-reducing operator’s factory/business facility. The verifier should select the appropriate place of verification, considering the effect, efficiency, and information security that the location offers.

Keeping the goals of effective mutual understanding, efficiency, and information security in mind, it is generally recommended that many of the above procedures be implemented in an emissions-reducing operator’s factory/business facility. Therefore, it is desirable that the verification for the initial base year is made more often within a factory/business facility than that verification for the year when emissions-reducing measures were taken.

6.4 Evaluation of the Results of Verification

The verifier evaluates the collected evidence, and assesses the influences that uncertainty and the error total as follows have on the calculated emissions:

Uncertainty of any measuring instrument (instrumental error)

- This is determined by using the tier for the monitoring patterns A and B.
- This is evaluated by a verifier for the monitoring pattern C.

Possible errors

Any posting error is detected when data are partially verified, and it is estimated that similar errors may be discovered.

Errors detected, but not corrected (*)

For example, the data inspected on the date of a meter reading but not at the end of a period are used.

(*) In principle, any errors detected by the verification, including totaling errors, should be corrected. However, the verifier may not require the correction of any data error if that error causes little effect but requires significant corrective actions to be taken. In such a case, the Verification Report must contain the verifier's reason for the judgment made not to require any correction.

6.5 Verification Report

The verifier evaluates the influences that the above-mentioned uncertainty and total of errors have on the calculated emissions in any Calculation Report, prepares the Verification Report that contains any of the following conclusions or comments, and then submits the Calculation and Verification Reports to the Competent Authority (CA).

Comment of full appropriateness

This comment is made if the verifier judges that the Calculation Report has been appropriately prepared in conformity with these guidelines as the standards for calculation and reports on all critical points.

Comment of limited appropriateness

This comment is made with exceptions (limitations) if the verifier judges that the calculation of any emission contained in the Calculation Report or any information provided by the Calculation Report is not in conformity with these guidelines nor qualifying for the comment of full appropriateness, but that it is not so critical as to be considered inappropriate, and that the Calculation Report is appropriately prepared except for several critical points.

Comment of inappropriateness

This comment is made if the verifier judges that the Calculation Report has not been prepared in conformity with these guidelines in all critical points.

No comment

The verifier must not make any comment if it cannot obtain sufficient, adequate, appropriate, and objective evidence to express its comment because the important verification procedure cannot be implemented.

6.6 Materials Necessary for Verification

To draw up the verification plan, or based upon the verification plan, the verifier should obtain evidence, which is the basis for which the organization expresses its verification comments. Evidence such as data and materials are required to be organized so that they can easily trace the amount of activity, the unit calorific value/emissions coefficient, or the other information contained in the Calculation Report.

The data and materials necessary to make investigations and implement plans include:

Table 6: Examples of Data and Materials Necessary for Verification

Step	Items to be Checked	Examples of Data and Materials
Investigations	<ul style="list-style-type: none"> • Description of business (such as products, services, head office, business facilities, business offices, capital, sales in volume and value, production, personnel, etc.) • Site boundary • Description of activities • Organization • Monitoring method • Monitoring and calculating systems • Data processing method 	<ul style="list-style-type: none"> • Company Guide and factory /business facility brochures • Production/Sales Report • Notifications under and licensing materials on the Factory Location Law, the Building Standards Law, the Fire Service Law, and the High Pressure Gas Safety Law • Site map/building floor plans (which can distinguish an emissions-reducing operator's properties from others') • Organizational chart, and monitoring system and calculating system charts • Manufacturing process charts • List of equipment/equipment arrangement plans • Purchase inventory • Flow chart for identifying the sources of emissions • Flow chart for establishing the boundary • Monitoring plan • Flow chart monitoring the amount of activity for each emission source to calculating/reporting the emission (listing the persons in charge, the names of prepared documents, works such as posting and checkup, etc.) • Sources of unit calorific value/emissions coefficient • Results of daily checking for maintenance and control of measuring instruments (checking table/check list) (Internal inspection) • Results of certification/regular inspection for measuring instruments • Results of internal inspection/management review

Table 6: Examples of Data and Materials Necessary for Verification (continued)

Step	Items to be Checked	Examples of Data and Materials
Implementation of plan	<ul style="list-style-type: none"> • Site boundary • Sources of emissions • Boundary (of calculation) • Amount of activity • Unit calorific value /emissions coefficient • Calculation of emissions • Preparation of the Calculation Report 	<ul style="list-style-type: none"> • Site boundary map/building area plans annexed to the notification under the Factory Location Law/Building Standards Law • Flow chart for identifying emissions sources • Notification under the Fire Service Law /High-Pressure Gas Safety Law • Equipment arrangement plans • Purchase inventory • Results of inspection/observation • Organizational chart, equipment arrangement plans in factory/business facility, etc. • Results of certification/regular inspection for measuring instruments • Rationale for the calculation/selection of unit calorific value/emissions coefficient • Delivery statements, etc.

Part II Calculation Manual

Chapter 1. Calculation of Emissions Resulting from the Use of Fuels, Electricity, and Heat

Any CO₂ emission is calculated at each point in order to monitor the amount of activity. Under this system, CO₂ emissions can be classified into categories resulting from the use and supply of energy, the burning of wastes, industrial processes, and the processes themselves.

Operators should calculate these emissions resulting from the relevant activities as provided in the list of activities for calculation below. (For the flow chart that identifies the activities for calculation, refer to Fig. 1, Part I.) The emissions resulting from each of these activities should be calculated in accordance the method specified on the corresponding page.

List of Activities for Calculation

Category of CO ₂ emissions	Type of activity	Related page
CO ₂ emissions resulting from fuel usage	Combustion of fuels	II-3 ~ 13
CO ₂ emissions resulting from the use of electricity/heat	Use of electricity supplied by another party	II-14 ~ 15
	Use of heat supplied by another party	II-16 ~ 17
CO ₂ emissions resulting from the incineration/use of wastes	Incineration of wastes, the use of wastes for production, or the use of waste fuels	II-25 ~ 29
CO ₂ emissions resulting from industrial processes	Production of cement	II-30 ~ 33
	Production of unslaked lime	II-34 ~ 36
	Production of soda lime glass or iron and steel	II-36 ~ 38
	Production of soda ash	II-38 ~ 40
	Use of soda ash	II-40 ~ 42
	Production of ammonia	II-42 ~ 44
	Production of silicon carbide	II-45 ~ 46
	Production of calcium carbide	II-47 ~ 48
	Production of ethylene	II-48 ~ 49
	Use of acetylene produced from calcium carbide	II-50 ~ 51
	Production of crude steel by using electric furnace	II-51 ~ 52
	Use of dry ice	II-53 ~ 54
	Use of sprayers	II-55 ~ 56

1.1 Emissions Resulting from Fuel Usage

1.1.1 Use of solid fuels

(1) Description of activities and emission forms

If any solid fuel, such as coal or coke, is burned, the carbon in that fuel turns into CO₂, which is then released into the atmosphere.

(2) Calculation method

The CO₂ emission resulting from the burning of any solid fuel can be calculated by the following equation:

$$\begin{aligned} \text{CO}_2 \text{ emission (t-CO}_2\text{)} \\ = \text{Fuel consumption (t)} \times \text{unit calorific value (GJ/t)} \times \text{emissions coefficient (t-CO}_2\text{/GJ)} \end{aligned}$$

(3) Amount of activity

There are three monitoring patterns used for the amounts of activities. The calculation method for each monitoring pattern is described below:

Pattern A-2:	Method based on purchase(s) and inventory change(s)
Pattern B:	Measurement-based method
Pattern C:	Approximation method (optional only if Patterns A and B are prohibitively difficult to use)

A) Method based on purchase(s) and inventory change(s)

Fuel usage is calculated by the following equation, taking into consideration both the purchase of fuel and changes in the fuel inventory within the period of calculation:

$$\boxed{\text{Fuel consumption within the period of calculation}} = \boxed{\text{Fuel purchase(s) within the period of calculation}} + \left(\boxed{\text{Fuel inventory at the start of the period}} - \boxed{\text{Fuel inventory at the end of the period}} \right)$$

For Pattern A-2, the fuel consumption is calculated using the purchases as recorded on the delivery slips received from a fuel supplier, as well as the inventory determined by a measuring instrument in the storage area (such as a yard).

The monitoring points are the fuel receiving point (using the delivery slip) and the measuring instrument in the storage facility, such as a yard, and the data used are those values on the delivery slips and those measuring instrument readings.

- Tier 4: The purchase is measured utilizing a truck scale.
- Tier 3: The purchase is measured utilizing an instrument other than a truck scale.

B) Measurement-based method

For Pattern B, an operator's fuel consumption is measured by that operator's instrument, such as a belt conveyor or a hopper scale. The measuring instrument used must have been certified/regularly inspected (and be within that effective period) pursuant to the Measurement Law. The monitoring point is each measuring instrument installed by the operator, and the data used are those measuring instrument readings.

It is necessary to check the maximum tolerance of each measuring instrument used, and to check the tiers set by using the maximum tolerance values to ascertain that the tiers meet the respective tier requirements.

- Tier 4: The use of fuel is measured by an instrument with a maximum tolerance $\pm 1.0\%$.
- Tier 3: The use of fuel is measured by an instrument with a maximum tolerance $\pm 2.0\%$.
- Tier 2: The use of fuel is measured by an instrument with a maximum tolerance $\pm 3.5\%$.
- Tier 1: The use of fuel is measured by an instrument with a maximum tolerance $\pm 5.0\%$.

* The activity amount is converted into the value of dry coal, together with the unit calorific value and the emissions coefficient.

C) Approximation method

The approximation method is selected depending upon an operator's situation. However, this method may not be approved by the CA unless it is justified.

If Pattern C is selected, the tier cannot be set (the tier evaluation is unnecessary).

(4) Unit calorific value

For the unit calorific value, any of the following is selected:

- Tier 3: The unit calorific value is measured and used by an operator.
- Tier 2: Any of the other unit calorific values, such as those provided by fuel suppliers and industry standard values, is selected and used.
- Tier 1: The default unit calorific value as specified in these guidelines is used (refer to Table 10).

* The default unit calorific value is expressed in terms of dry coal value. Therefore, if the default value is used, that amount of activity should be converted into the value of dry coal.

(5) Emission factor

For the emissions coefficient, any of the following is selected:

- Tier 3: The emissions coefficient that has been calculated by an operator from that operator's component analysis is used.
- Tier 2: Any of the other values, such as the emissions coefficients calculated from the component analysis tables provided by fuel suppliers, and industry standard values, is used.
- Tier 1: The default emissions coefficient as specified in these guidelines is used (refer to Table 10).

1.1.2 Use of liquid fuel at a fixed source of emissions⁶

(1) Description of activities and emission forms

If liquid fuels, such as kerosene, light oil, or heavy oil A, B, or C, are burned at a fixed source of emission, such as a boiler, carbon in those fuels becomes CO₂, which is then released into the atmosphere. Such activities also include vehicle refueling at any on-site service station. For information about refueling with a refueling car, refer to Section 1.1.3.

(2) Calculation method

The CO₂ emission resulting from the combustion of liquid fuel can be calculated by the following equation:

$$\begin{aligned} \text{CO}_2 \text{ emission (t-CO}_2\text{)} \\ = \text{Fuel consumption (kl)} \times \text{unit calorific value (GJ/kl)} \times \text{emissions coefficient (t-CO}_2\text{/GJ)} \end{aligned}$$

(3) Amount of activity

The three following methods are used to monitor the consumption of liquid fuel:

- Pattern A-2: Method based on purchase(s) and inventory change(s)
- Pattern B: Measurement-based method
- Pattern C: Approximation method (optional only if Patterns A and B are prohibitively difficult to use)

The calculation method for each monitoring pattern is described below:

⁶ The fixed source of emission refers to a boiler or any power generating equipment. All emissions sources except on-site vehicles are classified into this category.

A) Method based on purchase(s) and inventory change(s)

The use of fuel is calculated using the following equation, taking into consideration the fuel purchased and the inventory change of fuel within the period of calculation:

$$\boxed{\text{Fuel consumption within the period of calculation}} = \boxed{\text{Fuel purchased within the period of calculation}} + \left(\boxed{\text{Fuel inventory at the start of the period}} - \boxed{\text{Fuel inventory at the end of the period}} \right)$$

For Pattern A-2, the combustion of fuel is calculated from the purchases as recorded on the delivery slips received from a fuel supplier, as well as the inventory as determined by a measuring instrument, such as a level meter on a tank or any other facility. If on-site vehicles are refueled at an on-site service station, the amount of supplied oil is considered to be equal to the consumption of fuel because any tank residue is considered to be significantly less than the consumption.

The monitoring points are the fuel receiving point (using the delivery slip) and the level meter, and the data used are those values on the delivery slips and the level meter readings.

Tier 4: The purchase is measured with a measuring instrument other than a fuel oil flow micrometer.

Tier 3: The purchase is measured with a fuel oil flow micrometer.

B) Measurement-based method

For Pattern B, the use of fuel by an operator is measured by the operator's flow meter. The flow meter used must have been certified/regularly inspected, and be within such effective period, pursuant to the Measurement Law. The monitoring point is each flow meter installed by the operator, and the data used are those readings by the flow meters.

It is necessary not only to check the maximum tolerances of the measuring instruments being used, but also to check the tiers set by using the maximum tolerance values to ascertain whether they meet the respective tier requirements.

Tier 4: The use of fuel is measured by an instrument with a maximum tolerance $\pm 1.0\%$.

Tier 3: The use of fuel is measured by an instrument with a maximum tolerance $\pm 2.0\%$.

Tier 2: The use of fuel is measured by an instrument with a maximum tolerance $\pm 3.5\%$.

Tier 1: The use of fuel is measured by an instrument with a maximum tolerance $\pm 5.0\%$.

C) Approximation method

In many cases, household kerosene tanks, but not the large, fixed tanks covered by the Fire Service Law, are used, and those inventories of kerosene used for space heating are not monitored. Therefore, the use of fuel is calculated such that the purchase of fuel is considered to be equal to the use of fuel. In this scenario, monitoring pattern C, the approximation method, is used.

The approximation method is selected depending upon the operator's situation. However, this

method may not be approved by the CA unless it is justified.

If Pattern C is selected, the tier cannot be set (tier evaluation is unnecessary).

(4) Unit calorific value

For the unit calorific value, any of the following is selected:

- Tier 3: The unit calorific value is measured and used by an operator.
- Tier 2: Any of the other unit calorific values, such as those provided by fuel suppliers and the industry standard values, is selected and used.
- Tier 1: The default unit calorific value as specified in these guidelines is used (refer to Table 10).

(5) Emission factor

For the emissions coefficient, any of the following is selected:

- Tier 3: The emissions coefficient that has been calculated by an operator from that operator's component analysis is used.
- Tier 2: Any of the other values, such as the emissions coefficients calculated from the component analysis tables provided by fuel suppliers, and industry standard values, is used.
- Tier 1: The default emissions coefficient as specified in these guidelines is used (refer to Table 10).

1.1.3 Use of fuel (gasoline, kerosene, or LPG) by on-site vehicles (refueled by oil supply cars)

(1) Description of activities and emission forms

If on-site vehicles consume a fuel, carbon in that fuel turns into CO₂, which is then released into the atmosphere. This method of calculating emissions applies only to cases in which on-site vehicles are being refueled by a small refueling car. For those vehicles refueled with gasoline at an on-site service station, refer to Section 1.1.2.

(2) Formula for calculation

This CO₂ emission resulting from the combustion of liquid fuel, such as gasoline, kerosene, or LPG, can be calculated by the following equation:

$$\begin{aligned} \text{CO}_2 \text{ emission (t-CO}_2\text{)} \\ &= \text{Fuel consumption (kl or t)} \times \text{unit calorific value (GJ/kl or t)} \times \text{emissions coefficient} \\ &\quad \text{(t-CO}_2\text{/GJ)} \end{aligned}$$

For the formula converting the weight of LPG into another unit, refer to Section 1.1.4.

(3) Amount of activity

The two following methods are used to monitor the liquid fuel consumption of on-site vehicles:

Pattern A-1:	Purchase-based method
Pattern C:	Approximation method (optional only if Patterns A is prohibitively difficult to use)

The calculation method for each monitoring pattern is described below:

A) Purchase-based method

Because the tank residue of each vehicle can be considered to be significantly less than that vehicle's consumption, it is not necessary to consider the residue as part of the inventory. Therefore, if the purchase-based method is used, it corresponds to Pattern A-1.

Tier 4: The purchase is measured by a measuring instrument other than a fuel oil flow micrometer.

Tier 3: The purchase is measured by a fuel oil flow micrometer.

C) Approximation method

The approximation method is selected depending upon the operator's situation. However, this method may not be approved by the CA unless it is justified.

If Pattern C is selected, the tier cannot be set (the tier evaluation unnecessary).

(4) Unit calorific value

For the unit calorific value, any of the following is selected:

Tier 3: The unit calorific value is measured and used by an operator.

Tier 2: Any of the other unit calorific values, such as those provided by fuel suppliers and industry standard values, is selected and used.

Tier 1: The default unit calorific value as specified in these guidelines is used (refer to Table 10).

(5) Emission factor

For the emissions coefficient, any of the following is selected:

Tier 3: The emissions coefficient that has been calculated by an operator from that operator's component analysis is used.

Tier 2: Any of the other values, such as the emissions coefficients calculated from the component analysis tables provided by fuel suppliers, and industry standard values, is used.

Tier 1: The default emissions coefficient as specified in these guidelines is used (refer to Table 10).

1.1.4 Use of fuel gas (LPG or municipal gas)

(1) Description of activities and emission forms

If a fuel gas (LPG or municipal gas) is burned, carbon in that fuel becomes CO₂, which is then released into the atmosphere.

(2) Formula for calculation

This CO₂ emission resulting from the combustion of fuel gas, such as municipal gas, can be calculated by the following equation:

$$\text{CO}_2 \text{ emission (t-CO}_2\text{)} = \text{Fuel consumption (1,000 m}^3\text{N)} \times \text{unit calorific value (GJ/1,000 m}^3\text{N)} \times \text{emissions coefficient (t-CO}_2\text{/GJ)}$$

(3) Amount of activity

The four following methods are used to monitor the consumption of fuel gas, such as LPG or municipal gas:

- Pattern A-1: Purchase-based method (in gas form)
- Pattern A-2: Method based on purchase(s) and inventory change(s) (in liquid form)
- Pattern B: Measurement method
- Pattern C: Approximation method (optional only if Patterns A and B are prohibitively difficult to use)

The calculation method for each monitoring pattern is described below:

A) Purchase-based method

When utilizing Patterns A-1 and A-2, fuel consumption is calculated from the purchases as recorded on the delivery slips received from a fuel supplier (as well as the inventory change(s)).

The monitoring points are the gas meters installed by the gas supplier and the measuring instruments, such as level meters on tanks. The tier is set depending upon the accuracy of each measuring instrument as follows:

< Municipal gas >

(Purchased in gas form)

Tier 2: The purchase is determined by a measuring instrument other than a temperature conversion meter.

Tier 1: The purchase is measured by a temperature conversion meter.

(Purchased in liquid form (LNG))

Tier 4: The purchase is measured by a truck scale.

Tier 3: The purchase is determined by a measuring instrument other than a truck scale.

< LPG >

(Purchased in gas form)

Tier 3: The purchase is measured by a LPG meter.

(Purchased in liquid form)

Tier 4: The purchase is measured by a truck scale.

Tier 3: The purchase is determined by a measuring instrument other than a truck scale.

B) Measurement method

The use of fuel is measured by a gas meter that has been certified/regularly inspected (and is within such effective period) pursuant to the Measurement Law. It is not only necessary to check the maximum tolerances of the measuring instruments being used, but also to check the following tiers set by using the maximum tolerance values to ascertain whether they meet the respective tier requirements.

Tier 4: The use of fuel is measured by an instrument with a maximum tolerance $\pm 1.0\%$.

Tier 3: The use of fuel is measured by an instrument with a maximum tolerance $\pm 2.0\%$.

It is measured by utilizing a rotor, turbine, or temperature conversion type flow meter.

Tier 2: The use of fuel is measured by an instrument with a maximum tolerance $\pm 3.5\%$.

This is determined by utilizing a measuring instrument other than a rotor, turbine, or temperature conversion type flow meter.

Tier 1: The use of fuel is measured by an instrument with a maximum tolerance $\pm 5.0\%$.

The volume during measurement is converted into the standard condition by using the following equation:

$$\text{Volume (Nm}^3\text{) in the standard condition} = 273 \times \frac{\text{pressure (atm) during measuring}}{(273 + \text{temperature (}^\circ\text{C) during measuring})} \times \frac{\text{volume (m}^3\text{) during measuring}}{\text{during measuring}}$$

If the consumption of LPG in gas form is measured, the volume in the standard condition shall be calculated by using the appropriate value of the standard gas production rates⁷ as provided in Table 7 below.

⁷ The standard gas production rate is defined as the volume (m³) of 10kg LPG that is completely gasified and passes through a gas meter. In 1963, the standard gas production rate was established for each of four blocs within the Japanese territory because that rate depends upon the atmospheric temperature surrounding a cylinder of LPG. The standard gas production rates for the four blocs were measured by gasification experiments, which the Institution for The High Pressure Gas Safety Institute conducted by using samples with typical properties taken from the LPG, JIS class 1, No. 1 (LPG for civil use), that was marketed nationwide. The standard gas production rates were finally established by the Cabinet. These established values are official, and used to calculate taxes and public charges for inventories.

Table 7 Standard Gas Production Rate

Bloc number	Standard gas production rate (m ³ /10kg)	Prefectures in each bloc
No. 1	4.69	Hokkaido, Aomori, Iwate, and Akita
No. 2	4.78	Miyagi, Yamagata, Fukushima, Niigata, Toyama, and Ishikawa
No. 3	4.82	All prefectures except those located in bloc Nos. 1, 2, and 4
No. 4	4.80	Okinawa

However, the appropriate gas production rates are calculated and used in the following scenarios:

- When the annual average atmospheric temperature in any area is significantly different from that of the bloc that contains the area.
- When a gas meter with a temperature compensator is used.

< Calculation of gas production rate >

$$V \left[\text{m}^3/10\text{kg} \right] = 10 \times \frac{10.33}{(10.33 + H)} \times \frac{22.4}{273} \times \frac{273 + t}{\frac{M_p \times X_p}{100} + (M_b \times X_b)}$$

Wherein:

H: Gas pressure [mmH₂O]

t: Gas temperature [°C]

M_p: Molecular weight of propane [44.1]

M_b: Molecular weight of butane [58.1]

X_p: Capacity of propane [Vol. %]

X_b: Capacity of butane [Vol. %]

C) Approximation method

If LPG is purchased in LPG cylinders without a meter from a gas supplier, the use of that LPG is determined by the number of LPG cylinders used. In this scenario, the monitoring pattern is Pattern C, the approximation method.

The approximation method is selected depending upon the operator's situation. However, this method may not be approved by the CA unless it is justified.

If Pattern C is selected, the tier cannot be set (the tier evaluation is unnecessary).

(4) Unit calorific value

For the unit calorific value, any of the following is selected:

- Tier 3: The unit calorific value is measured and used by an operator.
- Tier 2: Any of the other unit calorific values, such as those provided by fuel suppliers and industry standard values, is selected and used.
- Tier 1: The default unit calorific value as specified in these guidelines is used (refer to Table 10).

(5) Emission factor

For the emissions coefficient, any of the following is selected:

- Tier 3: The emissions coefficient that has been calculated by an operator from that operator's component analysis is used.
- Tier 2: Any of the other values, such as the emissions coefficients calculated from the component analysis tables provided by fuel suppliers, and industry standard values, is used.
- Tier 1: The default emissions coefficient as specified in these guidelines is used (refer to Table 10).

1.1.5 Method of measuring the unit calorific value/emissions coefficient

The method of calculating the unit calorific value of a fuel by using the relevant measured values, as well the method of calculating the emissions coefficient for a fuel by using the relevant measurement or other values, will be illustrated below:

(1) Unit calorific value

The unit calorific value of a fuel is calculated by making the component analysis based upon the measuring method in accordance with the JIS standard. The JIS standards for the primary fuels are provided in the table below. The higher heating values (HHV) are applied to the calorific values.

Table 8: JIS Standard for Calculating the Unit Calorific Value

Type of fuel	JIS standard
Coal	M8814
Oil-based fuel	K2279
Municipal gas	K2301
LPG	K2240

(2) Emission factor

The emissions coefficient is set by using the component analysis table provided by a supplier, or the results of the component analysis made by an operator in accordance with the applicable JIS standards, assuming that all the carbon content (C) in a fuel becomes carbon dioxide (CO₂), which is

then released into the atmosphere.

A calculation example is described below:

< Results of component analysis for municipal gas >	
Composition	Content
CH ₄ (methane)	88%
C ₂ H ₆ (ethane)	5%
C ₃ H ₈ (propane)	5%
C ₄ H ₁₀ (butane)	2%
Total	100%

The amount of carbon (C) in one mole of municipal gas having a composition as illustrated in the above table is calculated by multiplying the amount of carbon in each component by the content of each component in the municipal gas, assuming that the molecular weight of carbon is 12, as follows:

$$\begin{aligned} \text{The amount of carbon in one mole of municipal gas} &= 12 \times 88\% + 24 \times 5\% + 36 \times 5\% + 48 \times 2\% \\ &= 14.52 \text{ g-C} \end{aligned}$$

Assuming that the total amount of carbon in municipal gas is released into the atmosphere, the production of CO₂ is calculated as follows:

$$\text{The production of CO}_2 = 14.52 \times 44/12 = 53.24 \text{ g-CO}_2$$

One mole of municipal gas is equivalent to 0.0224 m³_N, and the calorific value is 0.921 MJ at the unit calorific value of 41.1 GJ/1,000 m³_N. The emissions coefficient is calculated by dividing the calorific value by the production of CO₂ as follows:

$$\text{Emission factor} = 53.24 \text{ g-CO}_2/0.921\text{MJ} = 57.83 \text{ g-CO}_2/\text{MJ} = 0.0578 \text{ t-CO}_2/\text{GJ}$$

If the data on combustion products are provided by a fuel supplier, the emissions coefficient may be calculated by using that data.

For the unit calorific value/emissions coefficient, the measured value, the default value as specified in these guidelines, or any other value, such as a value provided by a fuel supplier or a value used as an industry standard, may be used. To use any value, however, the reasonability of using it should be confirmed.

Table 9: Checking Items Established by a Verifier for
Unit Calorific Value /Emission Factor

	Accuracy of value (determined by the measurement method, instrument, etc.)	Reasonability of applying calorific value/emissions coefficient to a specific fuel
Measured value		
Default value		
Others		

1.2 Use of Electricity Supplied by an Electric Power Company

(1) Description of activities and emission forms

If the electricity supplied by an electric power company is used, CO₂ is released indirectly as a result of the power generation activity carried out by that company.

(2) Calculation method

The CO₂ emission resulting from the use of the electricity supplied by an outsider can be calculated by the following equation:

$$\text{CO}_2 \text{ emission (t-CO}_2\text{)} = \text{The use of electricity (kWh)} \times \text{emissions coefficient (t-CO}_2\text{/kWh)}$$

(3) Amount of activity

There are three monitoring patterns used to monitor the use of electricity as follows:

Pattern A-1:	Purchase-based method
Pattern B:	Measurement method
Pattern C:	Approximation method (optional only if Patterns A and B are prohibitively difficult to use)

The calculation method for each monitoring pattern is described below:

A) Purchase-based method

The use of electricity is monitored by using the purchase of electricity. For Pattern A-1, the monitoring point is the wattmeter installed by an electric power company. Any monitoring error during the use of electricity is caused by an inaccuracy of the wattmeter. Therefore, the tier is established dependent upon the type of wattmeter installed as follows:

Tier 4: The purchase of electricity is measured by a custom precision wattmeter.

Tier 3: The purchase of electricity is measured by a precision wattmeter.

Tier 2: The purchase of electricity is measured by an ordinary wattmeter.

B) Measurement-based method

The use of electricity is measured. For Pattern B, the monitoring point is a wattmeter installed by the user of electricity, and any monitoring error during that use of electricity is caused by an inaccuracy of the wattmeter. Therefore, the tier is established depending upon the type of wattmeter installed as listed below.

It is not only necessary to check the maximum tolerance of the measuring instrument used, but also to check the following tiers set by using the maximum tolerance values to ascertain whether they meet the tier requirements:

- Tier 4: The use of electricity is measured by a wattmeter with a maximum tolerance $\pm 1.0\%$ (custom precision wattmeter).
- Tier 3: The use of electricity is measured by a wattmeter with a maximum tolerance $\pm 2.0\%$ (precision wattmeter).
- Tier 2: The use of electricity is measured by a wattmeter with a maximum tolerance $\pm 3.5\%$ (ordinary wattmeter).
- Tier 1: The use of electricity is measured by a wattmeter with a maximum tolerance $\pm 5.0\%$.

C) Approximation method

The approximation method is selected depending upon the operator’s situation. However, this method may not be approved by the CA unless it is justified.

If Pattern C is selected, the tier cannot be set (the tier evaluation is unnecessary).

(4) Emission factor

Only the default value can be used for the emissions coefficient related to the use of electricity supplied by an electric power company (the same default value is used regardless of the suppliers).

Tier 1: The default value of the emissions coefficient as specified in these guidelines is used.

Electricity supplied by an electric power company	0.000391 t-CO ₂ /kWh
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The CO₂ emission may be calculated from the accurately monitored use of fuel or energy, but only if electricity is supplied by the power generation equipment installed within a site boundary and owned by a person other than the site owner, as multiple power sources are dispersedly installed by an ESCO operator within a site boundary. In this scenario, Sections 1.1.1 through 1.1.4 apply to the measurement of fuel usage and setting the tier.

1.3 Use of Heat (Warm Water, Cold Water or Steam) Supplied by a Heat Supplier

(1) Description of activities and emission forms

If heat, industrial or non-industrial steam, warm water, or cold water, supplied by a heat supplier is used, the CO₂ released by that heat supplier to produce such heat is considered to be an indirect emission.

(2) Formula for calculation

For each type of heat, the CO₂ emission is calculated by multiplying the use of heat by the emissions coefficient. The CO₂ emission is calculated by using the following equation:

$$\text{CO}_2 \text{ emission (t-CO}_2\text{)} = \text{The use of heat (GJ)} \times \text{emissions coefficient (t-CO}_2\text{/GJ)}$$

(3) Amount of activity

The three following monitoring patterns are used to monitor the use of heat (warm water, cold water, or steam) supplied by a heat supplier:

Pattern A-1:	Purchase-based method
Pattern B:	Measurement-based method
Pattern C:	Approximation method (optional only if Patterns A and B are prohibitively difficult to use)

A) Purchase-based method

For Pattern A-1, the use of heat is monitored by the purchases recorded on the delivery slips received from a fuel supplier.

The monitoring point is the heat receiving point (using the delivery slip), and the data used are those values on the delivery slips.

Tier 1: The purchase is measured by utilizing an integrating calorimeter.

B) Measurement-based method

For Pattern B, the use of heat is measured by utilizing a measuring instrument, such as a gas flow meter, installed by an operator. The gas flow meter used to monitor the use of heat must be regularly inspected.

The monitoring point is a measuring instrument such as a gas flow meter, and the data used are those readings by such instrument. It is not only necessary to check the maximum tolerance of the measuring instrument used, but also to check the following tiers set by using the maximum tolerance

values in order to ascertain whether they meet the tier requirements:

- Tier 4: The use of heat is measured by a measuring instrument with a maximum tolerance $\pm 1.0\%$.
- Tier 3: The use of heat is measured by a measuring instrument with a maximum tolerance $\pm 2.0\%$
- Tier 2: The use of heat is measured by a measuring instrument with a maximum tolerance $\pm 3.5\%$.
- Tier 1: The use of heat is measured by a measuring instrument with a maximum tolerance $\pm 5.0\%$.

C) Approximation method

The approximation method is selected depending upon the operator's situation. However, this method may not be approved by the CA unless it is justified.

If Pattern C is selected, the tier cannot be set (the tier evaluation is unnecessary).

(4) Emission factor

Only the default value can be applied to the emissions coefficient related to the use of heat supplied by a heat supplier (the same value is used regardless of heat suppliers).

Tier 1: The default emissions coefficient as specified in these guidelines is used.

Type of heat	Emission factor
Industrial steam	0.060 t-CO ₂ /GJ
Warm water, cold water, or steam (non-industrial)	0.057 t-CO ₂ /GJ

The CO₂ emission may be calculated from the accurately monitored use of heat, but only if that heat is supplied by heat supply equipment installed within a site boundary and owned by a person other than the site owner, as boilers are installed by an ESCO operator within a site boundary. In this scenario, Sections 1.1.1 through 1.1.4 apply to measuring the use of heat and setting the tier.

1.4 Special Cases

1.4.1 Emissions Resulting from the Production of Electricity/Heat by Using the Fuel Supplied to the Exterior of a Factory/Business Facility

(1) Description

The direct CO₂ emission resulting from the production of electricity or heat by using fuel supplied to the exterior of a factory/business facility can be deducted from the total emissions caused by an operator within that factory/business facility, provided that the supply of electricity or heat to the exterior is monitored by a measuring instrument that is within its effective period of certification or has been regularly inspected pursuant to the Measurement Law.

(2) Formula for calculation

If the electricity/heat produced by using a fossil fuel in a factory/business facility is used in the factory/business facility and supplied to the exterior thereof, CO₂ emissions are calculated in proportion to the consumption by that factory/business facility and the supply to the exterior:

$$\text{CO}_2 \text{ emission (t-CO}_2\text{) from a factory/business facility} \\ = \frac{E_i \times 0.0036 \text{ (GJ/kWh)} + T_i}{(E_i + E_o) \times 0.0036 \text{ (GJ/kWh)} + (T_i + T_o)} \times \text{fuel consumption} \times \text{emissions coefficient}$$

E_i: Power consumption (kWh) within the factory/business facility **T_i: Heat consumption (GJ) within the factory/business facility**
E_o: Supply of electricity (kWh) to the exterior **T_o: Supply of heat (GJ) to the exterior**

If the use of heat in the factory/business facility is not monitored, the design value of exhaust heat recovery (T_d) is applied to the value (T_i + T_o). In this scenario, the following equation is used:

$$\text{CO}_2 \text{ emission (t-CO}_2\text{) from a factory/business facility} \\ = \frac{E_i \times 0.0036 \text{ (GJ/kWh)} + (T_d - T_o)}{(E_i + E_o) \times 0.0036 \text{ (GJ/kWh)} + (T_d)}$$

(3) Amount of activity

The above-described method of calculating by fuel type applies to fuel usage. The following methods are used to monitor the supply of electricity/heat to the exterior:

A) Purchase-based method

(Electric power)

Tier 4: The sales of electric power are measured by a custom precision wattmeter.

Tier 3: The sales of electric power are measured by a precision wattmeter.

Tier 2: The sales of electric power are measured by an ordinary wattmeter.

(Heat)

Tier 1: The purchase of heat is measured by an integrating calorimeter.

B) Measurement-based method (if the supply to the exterior is monitored from any measured value other than the sales)

It is not only necessary to check the maximum tolerance of the measuring instrument being used, but also to check the following tiers set by using the maximum tolerance values to ascertain whether they meet the tier requirements:

Tier 1b: The supply to the exterior is measured by a measuring instrument with a maximum tolerance $\pm 5.0\%$.

Tier 2b: The supply to the exterior is measured by a measuring instrument with a maximum tolerance $\pm 3.5\%$

Tier 3b: The supply to the exterior is measured by a measuring instrument with a maximum tolerance $\pm 2.0\%$.

Tier 4b: The supply to the exterior is measured by a measuring instrument with a maximum tolerance $\pm 1.0\%$.

(4) Unit calorific value and emissions coefficient

The above-described method that calculates by fuel type is used to determine the unit calorific value and the emissions coefficient.

1.4.2 Emissions resulting from electricity or heat received from an electric power or heat supplier and supplied to the exterior

(1) Description

If all or part of the electric power or heat received from an electric power or heat supplier is supplied beyond a site boundary, the emission related to that supply can be deducted from the total emission within the boundary, if the supply is determined by a measuring instrument that is within its effective period of certification or has been regularly inspected pursuant to the Measurement Law.

(2) Formula for calculation

The equation as specified in Part II, 1.2 “Use of Electricity Supplied by an Electric Power Company” or Part II, 1.3 “Use of Heat (Warm Water, Cold Water or Steam) Supplied by a Heat Supplier” is used to calculate the emission resulting from the electricity or heat received from an electric power or heat supplier and supplied to the exterior.

(3) Amount of activity

The following methods are used to monitor the supply of electricity/heat to the exterior:

A) Purchase-based method

(Electric power)

- Tier 4: The sales of electric power are measured by a custom precision wattmeter.
- Tier 3: The sales of electric power are measured by a precision wattmeter.
- Tier 2: The sales of electric power are measured by an ordinary wattmeter.

(Heat)

- Tier 1: The purchase of heat is measured by an integrating calorimeter.

B) Measurement-based method, if the supply to the exterior is monitored from any measured value other than the sales

It is not only necessary to check the maximum tolerance of the measuring instrument being used, but also to check the following tiers set by using the maximum tolerance values to ascertain whether they meet the tier requirements:

- Tier 4: The supply to the exterior is measured by a measuring instrument with a maximum tolerance $\pm 1.0\%$.
- Tier 3: The supply to the exterior is measured by a measuring instrument with a maximum tolerance $\pm 2.0\%$.
- Tier 2: The supply to the exterior is measured by a measuring instrument with a maximum tolerance $\pm 3.5\%$.
- Tier 1: The supply to the exterior is measured by a measuring instrument with a maximum tolerance $\pm 5.0\%$.

(4) Emission factor

Part II, 1.2 “Use of Electricity Supplied by an Electric Power Company” or Part II, 1.3 “Use of Heat (Warm Water, Cold Water or Steam) Supplied by a Heat Supplier” applies to the calculation of the emissions coefficient.

1.4.3 Treatment of Cogeneration

(1) Description

- The Kyoto Protocol Target Achievement Plan also considers cogeneration as one of the new energy measures taken on the demand side, and expects it to have a reduction effect on greenhouse gases. The Japanese government is promoting implementation of this efficient cogeneration technology.
- Under this system, the CO₂ emissions resulting from the use of electricity are evaluated by using the average emissions coefficient of all power sources as described in P. II-14. In these scenarios, it is expected that the effect of a cogeneration system on the reduction of emissions will not be fully appreciated, and that the cogeneration system will be unfavorably treated.
- Therefore, in the base year and in the year when emissions-reducing measures are taken, the credit per power unit is separately granted to the power production by using a cogeneration system such that the cogeneration system will not be unfavorably treated. Specifically, the credit per kWh of electric power (except the use of electric power by auxiliaries) as provided in the table below is granted to the power production by using a cogeneration system.

Cogene-credit	0.000210 t-CO ₂ /kWh
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(2) Formula for calculation

- The amount of cogene-credit granted is determined by using the following equation:

$$\text{Amount of cogene-credit granted (t-CO}_2\text{)} \\ = \text{Power production (kWh) by cogeneration in a year} \times \text{cogene-credit (t-CO}_2\text{/kWh)} \\ \text{(* Any amounts less than 1 t-CO}_2\text{ are rounded.)}$$

* The power production by cogeneration does not include the use of power for auxiliaries.

- The cogene-credit is granted to any cogeneration using any fossil fuel (regardless of the type of fossil fuel, its power generation efficiency, or its efficiency in the utilization of exhaust heat, etc).
- The cogene-credit will not be granted to any cogeneration using any non-fossil fuel, such as biomass fuel.
- No credit is granted to power that is produced by cogeneration and supplied to the exterior, as described in the previous section, because such power is excluded from the calculation of CO₂ emissions. Therefore, in this scenario, the amount of cogene-credit granted is calculated by converting the “power production (kWh) by cogeneration” in the equation above into “self-consumption of power produced by cogeneration.”
- The cogene-credit is granted after the CO₂ emissions and the power production by cogeneration have both been verified by a verifier.

Example 1: Credit granted to cogeneration when using fossil fuel

Amount of cogene-credit granted (t-CO₂)

$$= \text{Power production (kWh) by cogeneration} \times \text{cogene-credit (t-CO}_2\text{/kWh)}$$

(* Any figures less than 1 t-CO₂ are rounded.)

Example 2: Credit granted to cogeneration when using biomass fuel

Amount of cogene-credit granted (t-CO₂) = 0

Example 3: Credit granted to cogeneration with a 60% input rate of fossil fuel (in terms of calorific value)

Amount of cogene-credit granted (t-CO₂)

$$= \text{Power production (kWh) by cogeneration} \times 0.6 \times \text{cogene-credit (t-CO}_2\text{/kWh)}$$

(* Any figures less than 1 t-CO₂ are rounded.)

* Assuming that the input of fossil fuel is x GJ and that the input of biomass is y GJ, the input rate of fossil fuel is determined by the following equation:

$$\text{The input rate of fossil fuel (\%)} = x / (x + y) \times 100$$

Example 4: Credit granted to cogeneration using fossil fuel, if 30% of the total power production is supplied to the exterior

Amount of cogene-credit granted (t-CO₂)

$$= \text{Power production (kWh) by cogeneration} \times (1 - 0.3) \times \text{cogene-credit (t-CO}_2\text{/kWh)}$$

(* Any figures less than 1 t-CO₂ are rounded.)

Example 5: Credit granted to cogeneration with a 60% input rate of fossil fuel (in terms of calorific value), if 30% of the total power production is supplied to the exterior

Amount of cogene-credit granted (t-CO₂)

$$= \text{Power production (kWh) by cogeneration} \times 0.6 \times (1 - 0.3) \times \text{cogene-credit (t-CO}_2\text{/kWh)}$$

(* Any figures less than 1 t-CO₂ are rounded.)

(3) Amount of activity

The above-described method of calculating by type of fuel applies to fuel usage. The following methods are used to calculate the power production by cogeneration:

Pattern B:	Measurement-based method based
Pattern C:	Approximation method (optional only if Pattern B is prohibitively difficult to use)

B) Measurement based-method

It is not only necessary to check the maximum tolerance of the measuring instrument used, but also to check the following tiers set by using the maximum tolerance values in order to ascertain whether they meet the tier requirements:

- Tier 4: The power generation is measured by utilizing a wattmeter with a maximum tolerance $\pm 1.0\%$
(custom precision wattmeter).
- Tier 3: The power generation is measured by utilizing a wattmeter with a maximum tolerance $\pm 2.0\%$
(precision wattmeter).
- Tier 2: The power generation is measured by utilizing a wattmeter with a maximum tolerance $\pm 3.5\%$
(ordinary wattmeter).
- Tier 1: The power generation is measured by utilizing a wattmeter with a maximum tolerance $\pm 5.0\%$.

C) Approximation method

The approximation method is selected depending upon the operator's situation. However, this method may not be approved by the CA unless it is justified.

If Pattern C is selected, the tier cannot be set (the tier evaluation is unnecessary).

Reference: Unit Calorific Value/Emission Factor of Fuel (Default Value)

The default values of unit calorific value and emissions coefficient by type of fuel are provided in the table below:

Table 10: Unit Calorific Values and Emission Factors (Default Values)

No.	Types of fuel	Fuel forms	Units	Units calorific value	Emission factors
1	General coal	Solid	t	26.6 GJ/t	0.0906 t-CO ₂ /GJ
2	Gasoline	Liquid	kl	34.6 GJ/kl	0.0671 t-CO ₂ /GJ
3	Kerosene	Liquid	kl	36.7 GJ/kl	0.0678 t-CO ₂ /GJ
4	Light oil	Liquid	kl	38.2 GJ/kl	0.0686 t-CO ₂ /GJ
5	Heavy oil A	Liquid	kl	39.1 GJ/kl	0.0693 t-CO ₂ /GJ
6	Heavy oil B/C	Liquid	kl	41.7 GJ/kl	0.0715 t-CO ₂ /GJ
7	LPG	Gas	t	50.2 GJ/t	0.0598 t-CO ₂ /GJ
8	Municipal gas	Gas	1,000 Nm ³	41.1 GJ/1,000 m ³ _N	0.0506 t-CO ₂ /GJ
9	Coal for coke making	Solid	t	28.9 GJ/t	0.0898 t-CO ₂ /GJ
10	Anthracite	Solid	t	27.2 GJ/t	0.0935 t-CO ₂ /GJ
11	Coke	Solid	t	30.1 GJ/t	0.108 t-CO ₂ /GJ
12	Petroleum coke	Solid	t	35.6 GJ/t	0.0931 t-CO ₂ /GJ
13	Coal tar	Solid	t	37.3 GJ/t	0.0766 t-CO ₂ /GJ
14	Petroleum asphalt	Solid	t	41.9 GJ/t	0.0763 t-CO ₂ /GJ
15	NGL	Liquid	kl	35.3 GJ/kl	0.0675 t-CO ₂ /GJ
16	Crude oil	Liquid	kl	38.2 GJ/kl	0.0686 t-CO ₂ /GJ
17	Naphtha	Liquid	kl	34.1 GJ/kl	0.0667 t-CO ₂ /GJ
18	Jet fuel oil	Liquid	kl	36.7 GJ/kl	0.0671 t-CO ₂ /GJ
19	Petroleum-based hydrocarbon gas	Gas	1,000 Nm ³	44.9 GJ/1,000 m ³ _N	0.0521 t-CO ₂ /GJ
20	LNG	Gas	t	54.5 GJ/t	0.0495 t-CO ₂ /GJ
21	Natural gas	Gas	1,000 Nm ³	40.9 GJ/1,000 m ³ _N	0.0510 t-CO ₂ /GJ
22	Coke oven gas	Gas	1,000 Nm ³	21.1 GJ/1,000 m ³ _N	0.0403 t-CO ₂ /GJ
23	Blast furnace gas	Gas	1,000 Nm ³	3.4 GJ/1,000 m ³ _N	0.0975 t-CO ₂ /GJ
24	Converter gas	Gas	1,000 Nm ³	8.4 GJ/1,000 m ³ _N	0.141 t-CO ₂ /GJ

Note 1: The temperature and pressure compensations are made to calculate the use of gas.

For the calculating method, refer to Section 1.1.4.

Note 2: Natural gas (except LNG); domestic natural gas (except liquefied natural gas (LNG)).

Note 3: LPG and LNG fall into the category of gas because they are generally used in gas form.

Chapter 2. Incineration of Wastes and Use of Waste Fuels

(1) Description of activities and emission forms

All wastes incinerated or used as materials within a site boundary are included in the emissions calculation. If the processing of wastes is entrusted to an outside party, the wastes are not included in the emissions calculation because they do not produce any CO₂ within the site boundary.

The waste-related activities that are relevant in the calculation of emissions can be primarily divided into three categories as shown in the table below:

Table 11: Waste-Related Activities Relevant to the Calculation of Emissions

Incineration of wastes	All wastes produced from fossil fuels, such as waste oil, synthetic fibers, rubber tires, and plastics
Use of wastes for production	Wastes to be effectively recycled as materials, such as rubber tire waste recycled for cement materials and plastic waste recycled in blast furnaces
Fuel usage produced from wastes	Wastes recycled for fuels, such as fuel oil produced from waste oil and plastics and solid fuels (RPF & PDF) produced from refuse

The waste categories included in the emissions calculation are provided in the table below. All the wastes listed below are included in the emissions calculation, whether the wastes are being traded or are free of charge. Only the fossil fuel-derived wastes are included in the emissions calculation, while the plant- and animal-based wastes are not.

All the wastes listed in the table below are included in the emissions calculation, whether they are classified into general wastes, industrial wastes, specially-controlled general wastes, or specially-controlled industrial wastes in accordance with the Waste Disposal and Public Cleaning Law (the Waste Disposal Law). However, care should be taken regarding plastic waste for which different emissions coefficients apply to both general and industrial wastes.

Table 12: Types of Wastes Included in the Emissions Calculation

Waste categories	Examples of wastes
Waste oil	Waste lubrication oils (such as spindle, freezer, DC generator, hardening, turbine, machine, engine oils, and greases), waste cutting oils (water-soluble and non-water soluble), waste cleaning oils, waste insulation oils, waste rolling oils, waste hydraulic fluids, waste solvents (such as thinners, trichloroethylene and tetrachloroethylene, benzene, toluene, and alcohol), antifoaming oil agents, bilge, tanker cleaning drain, tar pitches (such as tar pitches, asphalt, wax, and paraffin), sulfate pitch (mixture of waste oil and acid), and waste white clay (mixture of waste oil and sludge)
Waste synthetic fibers	Waste fibers and fossil fuel-derived fiber wastes in the textile industry
Waste rubber tires	Waste rubber tires
Waste plastics	All waste plastics as defined in the Waste Disposal Law, except those included in items and : Waste polyurethane, styrol, bakelite (such as printed circuit boards), agricultural films, synthetic-resin package materials, synthetic papers, photographic films, synthetic leathers, synthetic construction materials (such as tiles, insulators, synthetic timbers, and soundproofing materials), etc.
Fuel oil produced from waste oil and plastics	<ul style="list-style-type: none"> • Fuel oil produced from waste oil • Fuel oil produced from waste plastics
Solid fuels produced from refuses (RDF and RPF)	<ul style="list-style-type: none"> • RPF (Refuse Paper & Plastic Fuel): Solid fuel produced with the mixture of waste paper and plastics) • RDF (Refuse Derived Fuel): Solid fuel produced with all combustibile refuses

(2) Formula for calculation

An emission resulting from a waste category is calculated by multiplying the incineration/use of waste by an emissions coefficient:

$$\text{CO}_2 \text{ emission (t-CO}_2\text{)} = \text{Incineration/use of waste (t)} \times \text{emissions coefficient (t-CO}_2\text{/t)}$$

* The use of “fuel oil produced from waste oil/plastics” is expressed in kl.

(3) Amount of activity

The three methods listed below are used to monitor the incineration/use of waste. The calculation method for each monitoring pattern is described below:

Pattern A-2:	Method based on purchase(s) and inventory change(s)
Pattern B:	Measurement-based method
Pattern C:	Approximation method (optional only if Patterns A and B are prohibitively difficult to use)

Wastes are generally monitored by operator-controlled measuring instruments. Therefore, the assumption is that there are different scenarios in which the measuring instruments are regularly inspected. Monitoring pattern C (the approximation method) applies to those measuring instruments that are used without receiving the certification/regularly inspection (or beyond such effective period) pursuant to the Measurement Law. Generally, the daily waste control should be sufficient to monitor wastes, but does not require the high level of accuracy used to monitor fuel usage.

A) Method based on purchase(s) (receipts) and inventory change(s)

The use of “ fuel oil produced from waste oil and plastics” or “ solid fuel produced from refuses” can be calculated from the purchase of fuel, because it is typically purchased from a supplier. Fuel usage is calculated by using the following equation, taking into consideration the purchase of fuel and the inventory change of fuel during the period of calculation:

$$\begin{array}{|c|} \hline \text{Incineration /use} \\ \text{of waste within} \\ \text{the period of} \\ \text{calculation} \\ \hline \end{array} = \begin{array}{|c|} \hline \text{Purchase of} \\ \text{waste fuel within} \\ \text{the period of} \\ \text{calculation} \\ \hline \end{array} + \left(\begin{array}{|c|} \hline \text{Inventory of} \\ \text{waste fuel} \\ \text{at the start of} \\ \text{the period} \\ \hline \end{array} - \begin{array}{|c|} \hline \text{Inventory of} \\ \text{waste fuel} \\ \text{at the end of} \\ \text{the period} \\ \hline \end{array} \right)$$

For Pattern A-2, fuel consumption is calculated from the purchases as recorded on the delivery slips received from a fuel supplier, as well as the inventory determined by the measuring instrument installed in the storage facility.

The monitoring points are the fuel receiving point (using the delivery slip) and the measuring instrument in the storage area, and the data used are the values on the delivery slips and the measuring instrument readings.

- Tier 4: The purchase is measured by utilizing a truck scale.
- Tier 3: The purchase is measured by utilizing an instrument other than a truck scale.

B) Measurement-based method

For Pattern B, the incineration/use of waste by an operator is measured by that operator’s instrument. The measuring instrument used must have been certified/regularly inspected (and be within such effective period) pursuant to the Measurement Law. The monitoring point is each measuring instrument installed by the operator, and the data used are the measuring instrument readings.

It is necessary to check the maximum tolerances of the measuring instruments being used, and to check the tiers set by using the maximum tolerance values to ascertain whether the tiers meet the respective tier requirements.

- Tier 4: The incineration/use of waste is measured by an instrument with a maximum tolerance $\pm 1.0\%$.
- Tier 3: The incineration/use of waste is measured by an instrument with a maximum tolerance $\pm 2.0\%$.
- Tier 2: The incineration/use of waste is measured by an instrument with a maximum tolerance $\pm 3.5\%$.
- Tier 1: The incineration/use of waste is measured by an instrument with a maximum tolerance $\pm 5.0\%$.

* Whether the emission basis or dry basis is used to monitor the incineration/use of waste depends upon the waste category as follows:

Table 13: Methods of Monitoring the Amount of Activity by Waste Category

Waste category	Basis of monitoring method
Waste oil	Emission basis
Waste synthetic fibers	Dry basis
Waste rubber tires	Dry basis
Waste plastics (industrial wastes) except for 2 and 3	Emission basis
Waste plastics (general waste plastics) except for 2, 3, and 4	Dry basis
Solid fuels produced from refuses (RPF & RDF)	Dry basis

C) Approximation method

The approximation method is selected depending upon the operator’s situation. If Pattern C is selected, the tier cannot be set (the tier evaluation is unnecessary).

(4) Emission factor

The emissions coefficient is selected from the following:

- Tier 3: The emissions coefficient that has been calculated by an operator from that operator's component analysis for each lot is used.
- Tier 2: Any of the other values (such as the emissions coefficients calculated from the component analysis tables provided by fuel suppliers, and industry standard values) is used.
- Tier 1: The default emissions coefficient as specified in these guidelines is used.

Default emissions coefficients are provided in the table below:

Waste categories	Emission factors
Waste oil	2.92 t-CO ₂ /t
Waste synthetic fibers	2.29 t-CO ₂ /t
Waste rubber tires	1.77 t-CO ₂ /t
Waste plastics (industrial wastes) except for and	2.55 t-CO ₂ /t
Waste plastics (general wastes) except for , , and	2.69 t-CO ₂ /t
Fuel oil produced from waste oil	2.63 t-CO ₂ /kl
Fuel oil produced from waste plastics	2.62 t-CO ₂ /kl
Solid fuels produced from refuses (RPF)	1.57 t-CO ₂ /t
Solid fuels produced from refuses (RDF)	0.759 t-CO ₂ /t

* The rationales for setting the emissions coefficients are explained in detail in the "The Calculating and Reporting Manual for Greenhouse Gas Emissions" (Ministry of the Environment and the Ministry of Economy, Trade, and Industry).

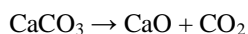
Chapter 3. Emissions from Industrial Processes

3.1 Production of Cement

(1) Description of activities and emission forms

When clinker is produced as an intermediate product during the cement production process, CO₂ is released by the burning of limestone containing calcium carbonate (CaCO₃) as its primary component.

[Chemical reaction formula]



(2) Formula for calculation

This CO₂ emission is calculated by multiplying the production of clinker by the emission per unit production of clinker:

$$\text{CO}_2 \text{ emission (t-CO}_2) = \text{Production of clinker (t)} \times \text{emission per unit production of clinker (t-CO}_2/\text{t)} \\ \times \text{compensation factor of cement kiln dust (CKD)}$$

The emissions coefficient as specified in item (4) below applies to the “emission per unit production of clinker.” The cement kiln dust (CKD) compensation factor of 1.00 is used because the total amount of CKD is recovered in any domestic cement plant.

(3) Amount of activity

The two monitoring patterns listed below are used to monitor the production of clinker. The calculating method for each of the monitoring patterns is described below:

Pattern B:	Measurement-based method
Pattern C:	Approximation method (optional only if Pattern B is prohibitively difficult to use)

B) Measurement-based method

For Pattern B, the production of clinker by an operator is measured by that operator’s instrument. The measuring instrument used must have been certified/regularly inspected (and be within such effective period) pursuant to the Measurement Law. The monitoring point is each measuring instrument installed by the operator, and the data used are the measuring instrument readings.

It is necessary to check the maximum tolerances of the measuring instruments being used, and to check the tiers set by using the maximum tolerance values to ascertain whether the tiers meet the respective tier requirements.

- Tier 4: The production of clinker is measured by an instrument with a maximum tolerance $\pm 1.0\%$.
- Tier 3: The production of clinker is measured by an instrument with a maximum tolerance $\pm 2.0\%$.
- Tier 2: The production of clinker is measured by an instrument with a maximum tolerance $\pm 3.5\%$.
- Tier 1: The production of clinker is measured by an instrument with a maximum tolerance $\pm 5.0\%$.

C) Approximation method

The approximation method is selected depending upon the operator's situation. If this method is not justified, it may not be approved by the CA.

If Pattern C is selected, the tier cannot be set (the tier evaluation is unnecessary).

(4) Emission factor

The emissions coefficient is selected from the following:

- Tier 3: The emissions coefficient that has been calculated by an operator from that operator's component analysis is used.
- Tier 2: Any of the other values, such as an industry standard value, is used.
- Tier 1: The default emissions coefficient as specified in these guidelines is used.

The production of clinker	0.510 t-CO ₂ /t
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< Method of calculating the emissions coefficient for the production of clinker, excluding that of non-carbonate CaO derived from wastes and by-products >

Step 1: Estimating the dry weight of non-carbonate CaO-containing waste inputted during the material producing process

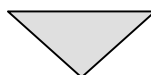
The amount of waste/by-product inputted during the material producing process is monitored by type of waste/by-product. If the wet weight of waste/by-product is monitored, it is compensated by its moisture content and converted into a dry weight. The value as provided in the table below can be applied to the moisture content.

$$\begin{aligned} & \text{Dry weight of waste/by-product by type (t)} \\ &= \text{Wet weight of waste/by-product by type (t)} \\ & \quad \times (1 - \text{the moisture content (\% in the waste/by-product by type / 100)}) \end{aligned}$$

Moisture content in waste/by product (%)

Category	Type of waste/by-product	Moisture content (2000-2003 averages)
Residue of incineration	Coal ash	10.2
Slag	Blast furnace slag (crushed by water)	7.1
	Blast furnace slag (gradually cooled)	6.0
	Steel making slag	8.2
	Non-iron slag	6.9
Dust (trapped by dust collector)	Coal ash	2.7
	Dust	12.0

Source: Data provided by the Japan Cement Association.



Step 2: Estimating the amount and content of non-carbonate CaO containing waste/by-product-derived CaO in clinker

The amount of non-carbonate-derived CaO by type of waste/by-product is calculated by multiplying the dry weight of waste/by-product (as estimated in Step 1) by the content of CaO. Next, the total amount of non-carbonate-derived CaO in clinker is estimated by summing up the amounts of non-carbonate-derived CaO by type of waste/by-product. The value as provided in the table below can be applied to the content of CaO.

$$\begin{aligned} & \text{The Total amount of non-carbonate-derived CaO (t)} \\ &= (\text{the dry weight of waste/by-product by type (t)} \times \text{the content of CaO (\% / 100)}) \end{aligned}$$

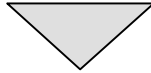
Content of CaO in waste/by product (%)

Category	Type of waste/by-product	Content of CaO (2000-2003 averages)
Residue of incineration	Coal ash	5.3
Slag	Blast furnace slag (crushed by water)	41.2
	Blast furnace slag (gradually cooled)	41.2
	Steel making slag	39.0
	Non-iron slag	7.7
Dust (caught by dust collector)	Coal ash	4.8
	Dust	11.8

Source: Data provided by the Japan Cement Association.

The content of non-carbonate-derived CaO in clinker is calculated by dividing the total amount of non-carbonate-derived CaO as estimated above by the production of clinker.

$$\begin{aligned} & \text{The content of non-carbonate-derived CaO (\%)} \\ & = \text{the total amount of non-carbonate-derived CaO (t)} \div \text{the production of clinker (t)} \times 100 \end{aligned}$$



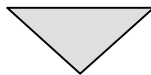
Step 3: Estimating the content of CaO, less the non-carbonate-derived CaO in clinker

The content of CaO, less the non-carbonate-derived CaO, is calculated by subtracting the content of non-carbonate-derived CaO (as estimated in Step 2) from the content of CaO in clinker. The value as provided in the table below can apply to the content of CaO in clinker.

$$\begin{aligned} & \text{The content of CaO less the non-carbonate-derived CaO in clinker} \\ & = \text{the content of CaO in clinker (\%)} \\ & \quad - \text{the content of non-carbonate-derived CaO (\%)} \end{aligned}$$

Content of CaO in clinker
65.0%

Source: Revised 1996 IPCC Guidelines



Step 4: Setting the emissions coefficient for clinker

The emissions coefficient is calculated by multiplying the molecular weight ratio of CaO to CO₂ (0.785) by the content of CaO less the non-carbonate-derived CaO (as estimated in Step 3). The fourth decimal place in the calculated value is rounded off.

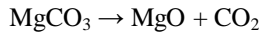
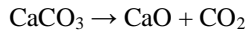
$$\begin{aligned} & \text{The emissions coefficient (t-CO}_2\text{/t) for clinker less the non-carbonate-derived CaO} \\ & = 0.785 \times \text{the content of CaO less the non-carbonate-derived CaO (\%)} \end{aligned}$$

3.2 Production of Unslaked Lime

(1) Description of activities and emission forms

CO₂ is released when limestone and dolomite are burned (or heated to decomposition) as materials in the production of unslaked lime.

[Chemical reaction formula]



(2) Formula for calculation

The CO₂ emission caused by each type of material is calculated by multiplying the use of material by the emission per unit use of material:

$\text{CO}_2 \text{ emission (t-CO}_2\text{)} \\ = \text{The use of material (by type) (t)} \times \text{the emission per unit use of material (t-CO}_2\text{/t)}$
--

(3) Amount of activity

The three methods listed below are used to monitor the use of limestone/dolomite. The calculating method for each monitoring pattern is described below. The component analysis methods for materials in accordance with the corresponding ISO (or JIS standards or the industry standard) methods must be used.

Pattern A-2:	Method based on purchase(s) and inventory change(s)
Pattern B:	Measurement-based method
Pattern C:	Approximation method (optional only if Patterns A and B are prohibitively difficult to use)

A) Method based on purchase(s) and inventory change(s)

The use of limestone/dolomite is calculated by the following equation, taking into consideration the purchase of materials and the inventory change of those materials during the period of calculation:

The use of limestone/ dolomite within the period of calculation	=	The purchase of limestone/ dolomite within the period of calculation	+	The inventory of limestone/ dolomite at the start of the period	-	The inventory of limestone/ dolomite at the end of the period
--	---	--	---	---	---	---

For Pattern A-2, the use of limestone/dolomite is calculated from the purchases as recorded on the delivery slips received from a material supplier, as well as the inventory as determined by a measuring instrument in the storage facility.

The monitoring points are the material receiving point (using the delivery slip) and the measuring instrument in the storage facility, and the data used are those values recorded on the delivery slips and the measuring instrument readings.

Tier 4: The purchase is measured by utilizing a truck scale.

Tier 3: The purchase is measured by utilizing an instrument other than a truck scale.

B) Measurement-based method

For Pattern B, the use of materials by an operator is monitored by the operator's measuring instrument. The measuring instrument used must have been certified/regularly inspected (and be within such effective period) pursuant to the Measurement Law. The monitoring point is each measuring instrument installed by the operator, and the data used are the measuring instrument readings.

It is necessary to check the maximum tolerances of the measuring instruments being used, and to check the tiers set by using the maximum tolerance values to ascertain whether the tiers meet the respective tier requirements.

Tier 4: The use of material is measured by an instrument with a maximum tolerance $\pm 1.0\%$.

Tier 3: The use of material is measured by an instrument with a maximum tolerance $\pm 2.0\%$.

Tier 2: The use of material is measured by an instrument with a maximum tolerance $\pm 3.5\%$.

Tier 1: The use of material is measured by an instrument with a maximum tolerance $\pm 5.0\%$.

C) Approximation method

The approximation method is selected depending upon an operator's situation. However, this method may not be approved by the CA unless it is justified. If Pattern C is selected, the tier cannot be set (the tier evaluation is unnecessary).

(4) Emission factor

For the emissions coefficient, any of the following is selected:

Tier 3: The emissions coefficient that has been calculated by an operator from that operator's component analysis is used.

Tier 2: Any of the other values, such as an industry standard value, is used.

Tier 1: The default emissions coefficient as specified in these guidelines is used.

Limestone	0.428 t-CO ₂ /t
Dolomite	0.449 t-CO ₂ /t

(5) Remarks

If CO₂ released by the production of unslaked lime is re-fixed, that CO₂ emission less the re-fixed CO₂ is reported.

3.3 Production of Soda Lime Glass or Iron/Steel

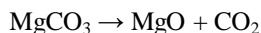
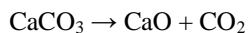
(1) Description of activities and emission forms

When iron/steel or soda lime glass is produced, CO₂ is released from the limestone being used as a production material.

To produce iron/steel, limestone is put into a blast furnace to remove impurities, such as the silicone, sulfur, and phosphorus that are found in iron ores and cokes. These impurities react with lime (CaO) to produce slag, by which CO₂ is released. To produce soda lime glass, the CaO produced by burning limestone is added to the other materials to provide a high durability to glass products. In this production process, CO₂ is released when limestone is burned.

[Chemical reaction formula]

Limestone contains CaCO₃ and a trace of MgCO₃. When limestone is used, CO₂ is released from CaCO₃ and MgCO₃. The mechanisms of producing CO₂ are as shown by the following chemical formulas:



(2) Formula for calculation

The CO₂ emission caused by each type of material is calculated by multiplying the use of material by the emission per unit use of material:

$\begin{aligned} &\text{CO}_2 \text{ emission (t-CO}_2\text{)} \\ &= \text{The use of material (by type) (t)} \times \text{the emission per unit use of material (t-CO}_2\text{/t)} \end{aligned}$
--

(3) Amount of activity

The three methods listed below are used to monitor the use of limestone/dolomite. The calculating method for each monitoring pattern is described below. The component analysis methods for materials in accordance with the corresponding ISO (or JIS standards or the industry standard) methods must be used.

Pattern A-2:	Method based on purchase(s) and inventory change(s)
Pattern B:	Measurement-based method
Pattern C:	Approximation method (optional only if Patterns A and B are prohibitively difficult to use)

A) Method based on purchase(s) and inventory change(s)

The use of limestone/dolomite for the production of iron/steel or soda lime glass is calculated by the following equation, taking into consideration the purchase of materials and the inventory changes of the materials within the period of calculation:

$$\begin{array}{|c|} \hline \text{The use of} \\ \text{limestone} \\ \text{/dolomite within} \\ \text{the period of} \\ \text{calculation} \\ \hline \end{array} = \begin{array}{|c|} \hline \text{The purchase of} \\ \text{limestone} \\ \text{/dolomite within} \\ \text{the period of} \\ \text{calculation} \\ \hline \end{array} + \left(\begin{array}{|c|} \hline \text{The inventory} \\ \text{of limestone} \\ \text{/dolomite} \\ \text{at the start of} \\ \text{the period} \\ \hline \end{array} - \begin{array}{|c|} \hline \text{The inventory} \\ \text{of limestone} \\ \text{/dolomite} \\ \text{at the end of} \\ \text{the period} \\ \hline \end{array} \right)$$

For Pattern A-2, the use of limestone/dolomite is calculated from purchases as recorded on the delivery slips received from a material supplier, as well as the inventory as determined by a measuring instrument in the storage facility. The monitoring points are the material receiving point (using the delivery slip) and the measuring instrument in the storage, and the data used are those values on the delivery slips and the measuring instrument readings.

Tier 4: The purchase is measured by utilizing a truck scale.

Tier 3: The purchase is measured by utilizing an instrument other than a truck scale.

B) Measurement-based method

For Pattern B, the use of material by an operator is monitored by that operator's measuring instrument. The measuring instrument used must have been certified/regularly inspected (and be within such effective period) pursuant to the Measurement Law. The monitoring point is each measuring instrument installed by the operator, and the data used are the measuring instrument readings.

It is necessary to check the maximum tolerances of the measuring instruments being used, and to check the tiers set by using the maximum tolerance values to ascertain whether the tiers meet the respective tier requirements.

Tier 4: The use of material is measured by an instrument with a maximum tolerance $\pm 1.0\%$.

Tier 3: The use of material is measured by an instrument with a maximum tolerance $\pm 2.0\%$.

Tier 2: The use of material is measured by an instrument with a maximum tolerance $\pm 3.5\%$.

Tier 1: The use of material is measured by an instrument with a maximum tolerance $\pm 5.0\%$.

C) Approximation method

The approximation method is selected depending upon an operator's situation. However, this method may not be approved by the CA unless it is justified. If Pattern C is selected, the tier cannot be set (the tier evaluation is unnecessary).

(4) Emission factor

For the emissions coefficient, any of the following is selected:

Tier 3: The emissions coefficient that has been calculated by an operator from that operator's component analysis is used.

Tier 2: Any of the other values, such as an industry standard value, is used.

Tier 1: The default emissions coefficient as specified in these guidelines is used.

Limestone	0.440 t-CO ₂ /t
Dolomite	0.471 t-CO ₂ /t

3.4 Production of Soda Ash

(1) Description of activities and emission forms

When soda ash is produced, CO₂ is used as a material and is released as that form. In Japan, only synthetic soda ash (Na₂CO₃) is produced by the chemical synthesis process that uses industrial salt as a material, but no natural soda ashes are produced by refining trona ores. In the production process for soda ash, limestone and coke are burned in a lime oven to produce CO₂. The CO₂ produced from limestone is recovered and used in the carbonating process to be absorbed by products, but is not released. In contrast, the production of CO₂ by coke is calculated as the value derived from energy such that it is not included here within the calculation of greenhouse gas emissions. Herein, only the amount of CO₂ purchased from outside sources and added to the production process for soda ash is calculated as the CO₂ emission.

(Reference)

For the production process (ammonium chloride method) for synthetic soda ash, the chemical reaction formulas are as follows:

$\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2$ (Unslaked lime is produced by heating limestone at a high temperature.)

$\text{CaO} + \text{H}_2\text{O} \rightarrow \text{Ca(OH)}_2$ (Calcium hydroxide is produced by using unslaked lime.)

$\text{NaCl} + \text{H}_2\text{O} + \text{NH}_3 + \text{CO}_2 \rightarrow \text{NaHCO}_3 + \text{NH}_4\text{Cl}$

(Sodium hydrogencarbonate and ammonium chloride are produced by using sodium chloride and ammonium.)

$2\text{NaHCO}_3 \rightarrow \text{Na}_2\text{CO}_3 + \text{CO}_2 + \text{H}_2\text{O}$ (Soda ash is produced by using sodium hydrogencarbonate.)

$2\text{NH}_4\text{Cl} + \text{Ca(OH)}_2 \rightarrow \text{CaCl}_2 + 2\text{NH}_3 + 2\text{H}_2\text{O}$

(Calcium chloride and ammonium are produced by using ammonium chloride and calcium hydroxide.)

The above-described formulas are summarized as follows: $\text{CaCO}_3 + 2\text{NaCl} \rightarrow \text{Na}_2\text{CO}_3 + \text{CaCl}_2$

(2) Formula for calculation

The amount of CO_2 purchased from outside sources and added to the production process for soda ash is calculated as the CO_2 emission:

$$\text{CO}_2 \text{ emission (t-CO}_2\text{)} = \text{Additional input of CO}_2 \text{ (t-CO}_2\text{)}$$

(3) Amount of activity

The two methods listed below are used to monitor the additional input of CO_2 . The calculating method for each monitoring pattern is described below:

Pattern B: Measurement-based method

Pattern C: Approximation method (optional only if Pattern B is prohibitively difficult to use)

B) Measurement-based method

For Pattern B, the additional input of CO_2 by an operator is monitored by that operator's measuring instrument. The measuring instrument used must have been certified/regularly inspected (and be within such effective period) pursuant to the Measurement Law. The monitoring point is each measuring instrument installed by the operator, and the data used are those measuring instrument readings.

It is necessary to check the maximum tolerances of the measuring instruments being used, and to check the tiers set by using the maximum tolerance values to ascertain whether the tiers meet the respective tier requirements.

- Tier 4: The use of material is measured by an instrument with a maximum tolerance $\pm 1.0\%$.
- Tier 3: The use of material is measured by an instrument with a maximum tolerance $\pm 2.0\%$.
- Tier 2: The use of material is measured by an instrument with a maximum tolerance $\pm 3.5\%$.
- Tier 1: The use of material is measured by an instrument with a maximum tolerance $\pm 5.0\%$.

C) Approximation method

The approximation method is selected depending upon an operator's situation. However, this method may not be approved by the CA unless it is justified. If Pattern C is selected, the tier cannot be set (the tier evaluation is unnecessary).

(4) Emission factor

The following emissions coefficient is used:

Tier 1: The emissions coefficient is as follows:

Production of soda ash	1 t-CO ₂ /t
------------------------	------------------------

3.5 Use of Soda Ash

(1) Description of activities and emission forms

When soda ash (Na₂CO₃) is used, CO₂ is released by the chemical reaction. That CO₂ emission is calculated by multiplying the use of soda ash by the emission per unit use of soda ash.

(2) Formula for calculation

This CO₂ emission is calculated by multiplying the use of soda ash by the emission per unit use of soda ash:

$\text{CO}_2 \text{ emission (t-CO}_2\text{)} = \text{The use of soda ash (t)} \times \text{the CO}_2 \text{ emission per unit production of soda ash}$

(3) Amount of activity

The three methods listed below are used to monitor the use of soda ash. The calculating method for each monitoring pattern is described below. The component analysis methods for soda ash in accordance with the corresponding ISO (or JIS standards or industry standard) methods must be used.

Pattern A-2:	Method based on purchase(s) and inventory change(s)
Pattern B:	Measurement-based method
Pattern C:	Approximation method (optional only if Patterns A and B are prohibitively difficult to use)

A) Method based on purchase(s) and inventory change(s)

The use of soda ash is calculated by the following equation, taking into consideration the purchase of soda ash and the inventory change of soda ash within the period of calculation:

$$\begin{array}{|c|} \hline \text{The use of soda} \\ \text{ash within} \\ \text{the period of} \\ \text{calculation} \\ \hline \end{array} = \begin{array}{|c|} \hline \text{The purchase of} \\ \text{soda ash within} \\ \text{the period of} \\ \text{calculation} \\ \hline \end{array} + \left(\begin{array}{|c|} \hline \text{The inventory} \\ \text{of soda ash} \\ \text{at the start of} \\ \text{the period} \\ \hline \end{array} - \begin{array}{|c|} \hline \text{The inventory} \\ \text{of soda ash} \\ \text{at the end of} \\ \text{the period} \\ \hline \end{array} \right)$$

For Pattern A-2, the use of soda ash is calculated from the purchases as recorded on the delivery slips received from a material supplier, as well as the inventory determined by a measuring instrument in the storage facility.

The monitoring points are the material receiving point (using the delivery slip) and the measuring instrument in the storage facility such as a yard, and the data used are those values on the delivery slips and the measuring instrument readings.

Tier 4: The purchase is measured by utilizing a truck scale.

Tier 3: The purchase is measured by utilizing an instrument other than a truck scale.

B) Measurement-based method

For Pattern B, the use of material by an operator is monitored by that operator's measuring instrument. The measuring instrument used must have been certified/regularly inspected (and be within such effective period) pursuant to the Measurement Law. The monitoring point is each measuring instrument installed by the operator, and the data used are those measuring instrument readings.

It is necessary to check the maximum tolerances of the measuring instruments being used, and to check the tiers set by using the maximum tolerance values to ascertain whether the tiers meet the respective tier requirements.

Tier 4: The use of material is measured by an instrument with a maximum tolerance $\pm 1.0\%$.

Tier 3: The use of material is measured by an instrument with a maximum tolerance $\pm 2.0\%$.

Tier 2: The use of material is measured by an instrument with a maximum tolerance $\pm 3.5\%$.

Tier 1: The use of material is measured by an instrument with a maximum tolerance $\pm 5.0\%$.

C) Approximation method

The approximation method is selected depending upon an operator’s situation. However, this method may not be approved by the CA unless it is justified. If Pattern C is selected, the tier cannot be set (the tier evaluation is unnecessary).

(4) Emission factor

For the emissions coefficient, any of the following is selected:

- Tier 3: The emissions coefficient that has been calculated by an operator from that operator’s component analysis is used.
- Tier 2: Any of the other values, such as an industry standard value, is used.
- Tier 1: The default emissions coefficient as specified in these guidelines is used.

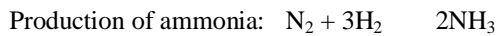
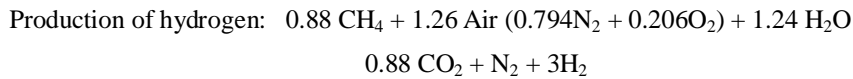
Soda ash	0.415 t-CO ₂ /t
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3.6 Production of Ammonia

(1) Description of activities and emission forms

To produce ammonia, H₂ is extracted from hydrocarbon as a material during the steam reforming process. CO₂ then is released in the process of producing hydrogen H₂.

[Chemical reaction formulas]



(2) Formula for calculation

This CO₂ emission is calculated by multiplying the use of material per type by the emission per unit use of material:

$\text{CO}_2 \text{ emission (t-CO}_2) = \text{The use of material per type (t, kl or m}^3\text{N)}$ $\times \text{the emission per unit use of material (t-CO}_2\text{/ t, kl or m}^3\text{N)}$
--

(3) Amount of activity

The amount of activity is calculated for each type of material used to produce ammonia. The four methods listed below are used to monitor the use of material. The calculating method for each monitoring pattern is described below. The component analysis methods for each material in

accordance with the corresponding ISO (or JIS standards or the industry standard) methods must be used.

Pattern A-1:	Purchase-based method
Pattern A-2:	Method based on purchase(s) and inventory change(s)
Pattern B:	Measurement-based method
Pattern C:	Approximation method (optional only if Patterns A and B are prohibitively difficult to use)

The amount of natural gas, coke oven gas, or petroleum-based hydrocarbon gas should be monitored in terms of the value in the standard conditions at a temperature of 0°C and an atmospheric pressure of one bar. If CO₂ produced by an operator during the ammonia production process is supplied to any other operator without release into the atmosphere, that supply of CO₂ is not included in the emissions calculation.

A) Method based on purchase(s) and inventory change(s)

In this method, the amount of each material used to produce ammonia is calculated by using the material purchase data. The use of material is calculated by the equation as shown below, taking into consideration both the purchase of material and the inventory change within that material during the period of calculation. If only the purchase of material is used, the inventory change is zero (0).

$$\begin{array}{|c|} \hline \text{The use of} \\ \text{material within} \\ \text{the period of} \\ \text{calculation} \\ \hline \end{array} = \begin{array}{|c|} \hline \text{The purchase of} \\ \text{material within} \\ \text{the period of} \\ \text{calculation} \\ \hline \end{array} + \left(\begin{array}{|c|} \hline \text{The inventory} \\ \text{of material} \\ \text{at the start of} \\ \text{the period} \\ \hline \end{array} - \begin{array}{|c|} \hline \text{The inventory} \\ \text{of material} \\ \text{at the end of} \\ \text{the period} \\ \hline \end{array} \right)$$

For Pattern A, the use of material is calculated from the purchases as recorded on the delivery slips received from a material supplier, as well as the inventory as determined by a measuring instrument in the storage facility.

The monitoring points are the material receiving point (using the delivery slip) and the measuring instrument in the storage facility, and the data used are those values on the delivery slips and the measuring instrument readings.

The method for each type of material (Part II, Section 1.1) is used to set the tier for the use of material.

B) Measurement-based method

For Pattern B, the use of material by an operator is monitored by that operator's measuring instrument. The measuring instrument used must have been certified/regularly inspected (and be within such effective period) pursuant to the Measurement Law. The monitoring point is each measuring instrument installed by the operator, and the data used are those measuring instrument readings.

It is necessary to check the maximum tolerances of the measuring instruments being used, and to check the tiers set by using the maximum tolerance values to ascertain whether the tiers meet the respective tier requirements.

- Tier 4: The use of material is measured by an instrument with a maximum tolerance $\pm 1.0\%$.
- Tier 3: The use of material is measured by an instrument with a maximum tolerance $\pm 2.0\%$.
- Tier 2: The use of material is measured by an instrument with a maximum tolerance $\pm 3.5\%$.
- Tier 1: The use of material is measured by an instrument with a maximum tolerance $\pm 5.0\%$.

C) Approximation method

The approximation method is selected depending upon an operator's situation. However, this method may not be approved by the CA unless it is justified. If Pattern C is selected, the tier cannot be set (the tier evaluation is unnecessary).

(4) Emission factor

For the emissions coefficient, any of the following is selected:

- Tier 3: The emissions coefficient that has been calculated by an operator from that operator's component analysis is used.
- Tier 2: Any of the other values, such as an industry standard value, is used.
- Tier 1: The default emissions coefficient as specified in these guidelines is used.
(Each of these emissions coefficients is converted from the same value as the emissions coefficient used to calculate the emission resulting from the fuel usage.)

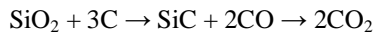
Coal (general/imported coal)	2.4 t-CO ₂ /t
Naphtha	2.3 t-CO ₂ /kl
Petroleum coke	3.3 t-CO ₂ /t
LPG	3.0 t-CO ₂ /t
LNG	2.7 t-CO ₂ /t
Natural gas (except LNG)	2.1 t-CO ₂ /1,000 m ³ _N
Coke oven gas	0.85 t-CO ₂ /1,000 m ³ _N
Petroleum-based hydrocarbon gas	2.3 t-CO ₂ /1,000 m ³ _N

3.7 Production of Silicone Carbide

(1) Description of activities and emission forms

CO₂ is released when petroleum cokes are used as a material in the production of silicon carbide.

[Chemical reaction formula]



(2) Formula for calculation

This CO₂ emission is calculated by multiplying the use of petroleum coke by the emission per unit use of petroleum coke:

$\begin{aligned} &\text{CO}_2 \text{ emission (t-CO}_2\text{)} \\ &= \text{The use of petroleum coke (t)} \times \text{the emission per unit use of petroleum coke (t-CO}_2\text{/ t)} \end{aligned}$

(3) Amount of activity

The three methods listed below are used to monitor the use of petroleum coke. The calculating method for each monitoring pattern is described below. The component analysis methods for each material in accordance with the corresponding ISO (or JIS standards or the typical industry standard) methods must be used.

Pattern A-2:	Method based on purchase(s) and inventory change(s)
Pattern B:	Measurement-based method
Pattern C:	Approximation method (optional only if Patterns A and B are prohibitively difficult to use)

A) Method based on purchase(s) and inventory change(s)

The use of petroleum coke is calculated by the equation as shown below, taking into consideration the purchase of coke and the inventory change of coke during the period of calculation.

The use of petroleum coke within the period of calculation	=	The purchase of petroleum coke within the period of calculation	+	The inventory of petroleum coke at the start of the period	-	The inventory of petroleum coke at the end of the period
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For Pattern A-2, the use of petroleum coke is calculated from the purchases as recorded on the delivery slips received from a petroleum coke supplier, as well as the inventory as determined by a measuring instrument in the storage facility.

The monitoring points are the material receiving point (using the delivery slip) and the measuring instrument in the storage facility, and the data used are those values on the delivery slips and the measuring instrument readings.

- Tier 4: The purchase is measured by utilizing a truck scale.
- Tier 3: The purchase is measured by utilizing an instrument other than a truck scale.

B) Measurement-based method

For Pattern B, the use of petroleum coke by an operator is monitored by that operator’s measuring instrument. The measuring instrument used must have been certified/regularly inspected (and be within such effective period) pursuant to the Measurement Law. The monitoring point is each measuring instrument installed by the operator, and the data used are those measuring instrument readings.

It is necessary to check the maximum tolerances of the measuring instruments being used, and to check the tiers set by using the maximum tolerance values to ascertain whether the tiers meet the respective tier requirements.

- Tier 4: The use of petroleum coke is measured by an instrument with a maximum tolerance $\pm 1.0\%$.
- Tier 3: The use of petroleum coke is measured by an instrument with a maximum tolerance $\pm 2.0\%$.
- Tier 2: The use of petroleum coke is measured by an instrument with a maximum tolerance $\pm 3.5\%$.
- Tier 1: The use of petroleum coke is measured by an instrument with a maximum tolerance $\pm 5.0\%$.

C) Approximation method

The approximation method is selected depending upon an operator’s situation. However, this method may not be approved by the CA unless it is justified. If Pattern C is selected, the tier cannot be set (the tier evaluation is unnecessary).

(4) Emission factor

For the emissions coefficient, any of the following is selected:

- Tier 3: The emissions coefficient that has been calculated by an operator from that operator’s component analysis is used.
- Tier 2: Any of the other values, such as an industry standard value, is used.
- Tier 1: The default emissions coefficient as specified in these guidelines is used.

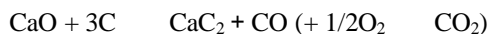
Production of silicone carbide	2.3 t-CO ₂ /t
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3.8 Production of Calcium Carbide (from Limestone/Reducing Reagents)

(1) Description of activities and emission forms

When calcium carbide is produced, CO₂ is released during the process of producing unslaked lime from limestone. When calcium carbide is produced, CO₂ also gets released by the combustion of CO, which is produced when unslaked lime mixed with coke (carbon) is reduced in an electric furnace.

[Chemical reaction formulas]



(2) Formula for calculation

This CO₂ emission is calculated by multiplying the production of calcium carbide by the emission per unit production of calcium carbide:

$$\text{CO}_2 \text{ emission (t-CO}_2) = \text{The production of calcium carbide per type of activity (t)} \\ \times \text{the emission per unit production of calcium carbide (t-CO}_2/\text{t)}$$

(3) Amount of activity

The two methods listed below are used to monitor the production of calcium carbide. The calculating method for each monitoring pattern is described below:

Pattern B:	Measurement-based method
Pattern C:	Approximation method (optional only if Pattern B is prohibitively difficult to use)

If unslaked lime produced in any non-carbide plant is used, that CO₂ emission is monitored as described in Section 3.2, "Production of Unslaked Lime." Therefore, here, the CO₂ emission derived from limestone is not included in the emissions calculation.

B) Measurement-based method

For Pattern B, the production of calcium carbide by an operator is monitored by that operator's measuring instrument. The measuring instrument used must have been certified/regularly inspected (and be within such effective period) pursuant to the Measurement Law. The monitoring point is each measuring instrument installed by the operator, and the data used are those measuring instrument readings.

It is necessary to check the maximum tolerances of the measuring instruments being used, and to check the tiers set by using the maximum tolerance values to ascertain whether the tiers meet the respective tier requirements.

- Tier 4: The production of calcium carbide is measured by an instrument with a maximum tolerance $\pm 1.0\%$.
- Tier 3: The production of calcium carbide is measured by an instrument with a maximum tolerance $\pm 2.0\%$.
- Tier 2: The production of calcium carbide is measured by an instrument with a maximum tolerance $\pm 3.5\%$.
- Tier 1: The production of calcium carbide is measured by an instrument with a maximum tolerance $\pm 5.0\%$.

C) Approximation method

The approximation method is selected depending upon an operator's situation. However, this method may not be approved by the CA unless it is justified. If Pattern C is selected, the Tier cannot be set (the tier evaluation is unnecessary).

(4) Emission factor

For the emissions coefficient, any of the following is selected:

- Tier 3: The emissions coefficient that has been calculated by an operator from that operator's component analysis is used.
- Tier 2: Any of the other values, such as an industry standard value, is used.
- Tier 1: The default emissions coefficient as specified in these guidelines is used.

Production of unslaked lime	0.76 t-CO ₂ /t
Reduction of unslaked lime	1.1 t-CO ₂ /t

3.9 Production of Ethylene

(1) Description of activities and emission forms

CO₂ is released when it is separated in the production process for ethylene (C₂H₄).

(2) Formula for calculation

This CO₂ emission is calculated by multiplying the production of ethylene by the emission per unit production of ethylene:

$\text{CO}_2 \text{ emission (t- CO}_2\text{)} = \text{The production of ethylene (t)} \\ \times \text{the emission per unit production of ethylene (t-CO}_2\text{/t)}$

(3) Amount of activity

The two methods listed below are used to monitor the production of ethylene. The calculating method for each monitoring pattern is described below:

Pattern B:	Measurement-based method
Pattern C:	Approximation method (optional only if Pattern B is prohibitively difficult to use)

B) Measurement-based method

For Pattern B, the production of ethylene by an operator is monitored by that operator's measuring instrument. The measuring instrument used must have been certified/regularly inspected (and be within such effective period) pursuant to the Measurement Law. The monitoring point is each measuring instrument installed by the operator, and the data used are those measuring instrument readings.

It is necessary to check the maximum tolerances of the measuring instruments being used, and to check the tiers set by using the maximum tolerance values to ascertain whether the tiers meet the respective tier requirements.

- Tier 4: The production of ethylene is measured by an instrument with a maximum tolerance $\pm 1.0\%$.
- Tier 3: The production of ethylene is measured by an instrument with a maximum tolerance $\pm 2.0\%$.
- Tier 2: The production of ethylene is measured by an instrument with a maximum tolerance $\pm 3.5\%$.
- Tier 1: The production of ethylene is measured by an instrument with a maximum tolerance $\pm 5.0\%$.

C) Approximation method

The approximation method is selected depending upon an operator's situation. If Pattern C is selected, the tier cannot be set (the tier evaluation is unnecessary).

(4) Emission factor

For the emissions coefficient, any of the following is selected:

- Tier 3: The emissions coefficient that has been calculated by an operator from that operator's component analysis is used.
- Tier 2: Any of the other values, such as an industry standard value, is used.
- Tier 1: The default emissions coefficient as specified in these guidelines is used.

Production of ethylene	0.028 t-CO ₂ /t
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3.10 Use of Acetylene Produced by the Combustion of Calcium Carbide

(1) Description of activities and emission forms

CO₂ is released when acetylene produced by using calcium carbide is burned in the form of an oxyacetylene flame for fusion cutting or metal welding.

[Chemical reaction formula]



(2) Formula for calculation

This CO₂ emission is calculated by multiplying the use of acetylene by the emission per unit use of acetylene:

$$\text{CO}_2 \text{ emission (t-CO}_2) = \text{The use of acetylene (t)} \times \text{the emission per unit use of acetylene (t-CO}_2/\text{t)}$$

(3) Amount of activity

The three methods listed below are used to monitor the use of acetylene. The calculating method for each monitoring pattern is described below. The emission calculation is limited to the combustion of acetylene produced by using calcium carbide.

Pattern A-1:	Purchase-based method
Pattern B:	Measurement-based method
Pattern C:	Approximation method (optional only if Patterns A and B are prohibitively difficult to use)

A) Purchase-based method

For Pattern A, the use of acetylene is calculated by using the purchase amounts of acetylene recorded on the delivery slips received from an acetylene supplier.

Tier 4: The purchase is measured by utilizing a truck scale.

Tier 3: The purchase is measured by utilizing an instrument other than a truck scale.

B) Measurement-based method

For Pattern B, the use of acetylene by an operator is monitored by that operator's measuring instrument. The measuring instrument used must have been certified/regularly inspected (and be within such effective period) pursuant to the Measurement Law. The monitoring point is each measuring instrument installed by the operator, and the data used are those measuring instrument readings.

It is necessary to check the maximum tolerances of the measuring instruments being used, and to check the tiers set by using the maximum tolerance values to ascertain whether the tiers meet the

respective tier requirements.

- Tier 4: The use of acetylene is measured by an instrument with a maximum tolerance $\pm 1.0\%$.
- Tier 3: The use of acetylene is measured by an instrument with a maximum tolerance $\pm 2.0\%$.
- Tier 2: The use of acetylene is measured by an instrument with a maximum tolerance $\pm 3.5\%$.
- Tier 1: The use of acetylene is measured by an instrument with a maximum tolerance $\pm 5.0\%$.

C) Approximation method

Monitoring pattern C (the approximation method) is used if the acetylene usage is calculated by the number of acetylene cylinders purchased from an acetylene supplier.

The other approximation method is selected depending upon an operator's situation. However, this method may not be approved by the CA unless it is justified. If Pattern C is selected, the tier cannot be set (the tier evaluation is unnecessary).

(4) Emission factor

For the emissions coefficient, any of the following is selected:

- Tier 3: The emissions coefficient that has been calculated by an operator from that operator's component analysis is used.
- Tier 2: Any of the other values, such as an industry standard value, is used.
- Tier 1: The default emissions coefficient as specified in these guidelines is used.

Use of acetylene	3.4 t-CO ₂ /t
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3.11 Production of Crude Steel by Using an Electric Furnace

(1) Description of activities and emission forms

CO₂ is released from carbon electrodes when an electric furnace is used to produce crude steel.

(2) Formula for calculation

This CO₂ emission is calculated by multiplying the production of crude steel in an electric furnace by the emission per unit production of crude steel:

$\text{CO}_2 \text{ emission (t- CO}_2\text{)} = \text{The production of crude steel by using an electric furnace (t)} \\ \times \text{the emission per unit production of crude steel (t-CO}_2\text{/t)}$
--

(3) Amount of activity

The two methods listed below are used to monitor the production of crude steel by using an electric furnace. The calculating method for each monitoring pattern is described below:

Pattern B:	Measurement-based method
Pattern C:	Approximation method (optional only if Pattern B is prohibitively difficult to use)

B) Measurement-based method

For Pattern B, the production of crude steel by an operator is monitored by that operator's measuring instrument. The measuring instrument used must have been certified/regularly inspected (and be within such effective period) pursuant to the Measurement Law. The monitoring point is each measuring instrument installed by the operator, and the data used are those measuring instrument readings.

It is necessary to check the maximum tolerances of the measuring instruments being used, and to check the tiers set by using the maximum tolerance values to ascertain whether the tiers meet the respective tier requirements.

- Tier 4: The production of crude steel is measured by an instrument with a maximum tolerance $\pm 1.0\%$.
- Tier 3: The production of crude steel is measured by an instrument with a maximum tolerance $\pm 2.0\%$.
- Tier 2: The production of crude steel is measured by an instrument with a maximum tolerance $\pm 3.5\%$.
- Tier 1: The production of crude steel is measured by an instrument with a maximum tolerance $\pm 5.0\%$.

C) Approximation method

The approximation method is selected depending upon an operator's situation. If Pattern C is selected, the tier cannot be set (the tier evaluation is unnecessary).

(4) Emission factor

For the emissions coefficient, any of the following is selected:

- Tier 3: The emissions coefficient that has been calculated by an operator from that operator's component analysis is used.
- Tier 2: Any of the other values, such as an industry standard value, is used.
- Tier 1: The default emissions coefficient as specified in these guidelines is used.

Production of crude steel with use of an electric furnace	0.0050 t-CO ₂ /t
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3.12 Use of Dry Ice

(1) Description of activities and emission forms

When dry ice is used to conserve foods during the various stages of processing or sales, CO₂ is released from that dry ice. Liquefied carbonic acid gas also is used in the same application as dry ice.

(2) Formula for calculation

This CO₂ emission is equal to the release of CO₂ from dry ice when it is used:

$$\text{CO}_2 \text{ emission} = \text{The use of dry ice (t-CO}_2\text{)}$$

(3) Amount of activity

The three methods listed below are used to monitor the use of CO₂ in the application of dry ice. The calculating method for each monitoring pattern is described below:

Pattern A-2:	Method based on purchase(s) and inventory change(s)
Pattern B:	Measurement-based method
Pattern C:	Approximation method (optional only if Patterns A and B are prohibitively difficult to use)

A) Method based on purchase(s) and inventory change(s)

For Pattern A-2, the use of dry ice is calculated by using the dry ice purchases as recorded on the delivery slips received from a dry ice supplier, as well as the inventories of dry ice monitored by the measuring instrument at the storage facility.

$$\boxed{\text{The use of dry ice within the period of calculation}} = \boxed{\text{The purchase of dry ice within the period of calculation}} + \left(\boxed{\text{The inventory of dry ice at the start of the period}} - \boxed{\text{The inventory of dry ice at the end of the period}} \right)$$

The monitoring points are the dry ice receiving point (using the delivery slip) and the measuring instrument in the storage facility, and the data used are those values recorded on the delivery slips and the measuring instrument readings.

- Tier 4: The purchase is measured by utilizing a truck scale.
- Tier 3: The purchase is measured by utilizing an instrument other than a truck scale.

B) Measurement-based method

For Pattern B, the use of dry ice by an operator is monitored by that operator’s measuring instrument. The measuring instrument used must have been certified/regularly inspected (and be within such effective period) pursuant to the Measurement Law. The monitoring point is each measuring instrument installed by the operator, and the data used are those measuring instrument readings.

It is necessary to check the maximum tolerances of the measuring instruments being used, and to check the tiers set by using the maximum tolerance values to ascertain whether the tiers meet the respective tier requirements.

- Tier 4: The use of dry ice is measured by an instrument with a maximum tolerance $\pm 1.0\%$.
- Tier 3: The use of dry ice is measured by an instrument with a maximum tolerance $\pm 2.0\%$.
- Tier 2: The use of dry ice is measured by an instrument with a maximum tolerance $\pm 3.5\%$.
- Tier 1: The use of dry ice is measured by an instrument with a maximum tolerance $\pm 5.0\%$.

C) Approximation method

Monitoring pattern C (the approximation method) is used if the use of liquefied carbonic gas is determined by the number of liquefied carbonic gas cylinders purchased from the supplier.

The other approximation method is selected depending upon an operator’s situation. However, this method may not be approved by the CA unless it is justified. If Pattern C is selected, the tier cannot be set (the tier evaluation is unnecessary).

(4) Emission factor

The following emissions coefficient is used:

- Tier 1: The emissions coefficient is as follows:

Use of dry ice	1 t-CO ₂ /t
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3.13 Using a Sprayer

(1) Description of activities and emission forms

If a sprayer is used, CO₂ contained in the spray agent in the sprayer is released. Any CO₂ used for welding also is considered to be within this category and is calculated as an agent for spraying would be.

(2) Formula for calculation

This CO₂ emission is equal to the release of CO₂ from sprayers when they are being used:

$$\text{CO}_2 \text{ emission} = \text{The emission of CO}_2 \text{ from sprayers used (t-CO}_2\text{)}$$

(3) Amount of activity

The three methods listed below are used to monitor the sprayer use. The calculating method for each monitoring pattern is described below:

Pattern A-1:	Purchase-based method
Pattern B:	Measurement-based method
Pattern C:	Approximation method (optional only if Patterns A and B are prohibitively difficult to use)

A) Purchase-based method

For Pattern A-1, the use of CO₂ is determined by using the purchase of CO₂ sprayers as recorded on the delivery slips received from a sprayer supplier.

Tier 4: The purchase is measured by utilizing a truck scale.

Tier 3: The purchase is measured by utilizing an instrument other than a truck scale.

B) Measurement-based method

For Pattern B, the use of sprayers by an operator is monitored by that operator's measuring instrument. The measuring instrument used must have been certified/regularly inspected (and be within such effective period) pursuant to the Measurement Law. The monitoring point is each measuring instrument installed by the operator, and the data used are those measuring instrument readings.

It is necessary to check the maximum tolerances of the measuring instruments being used, and to check the tiers set by using the maximum tolerance values to ascertain whether the tiers meet the respective tier requirements.

- Tier 4: The use of sprayers is measured by an instrument with a maximum tolerance $\pm 1.0\%$.
- Tier 3: The use of sprayers is measured by an instrument with a maximum tolerance $\pm 2.0\%$.
- Tier 2: The use of sprayers is measured by an instrument with a maximum tolerance $\pm 3.5\%$.
- Tier 1: The use of sprayers is measured by an instrument with a maximum tolerance $\pm 5.0\%$.

C) Approximation method

Monitoring pattern C (the approximation method) is used if the use of sprayers is determined by the number of CO₂ cylinders purchased from the supplier.

The other approximation method is selected depending upon an operator's situation. However, this method may not be approved by the CA unless it is justified. If Pattern C is selected, the tier cannot be set (the tier evaluation is unnecessary).

(4) Emission factor

Tier 1: The emissions coefficient is as follows:

Use of sprayers	1 t-CO ₂ /t
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< Supplement >

In those industrial processes using limestone/dolomite, it is possible to calculate the CO₂ emission by using the weight of CaCO₃, MgCO₃, or any other alkaline earth metal carbonate or alkaline metal carbonate. In this scenario, the CO₂ emission is calculated by multiplying the use of each carbonate by the coefficient per type of carbonate as provided in the table below:

Carbonate	Coefficient [t-CO ₂ /t-carbonate]	Remarks
CaCO ₃	0.440	
MgCO ₃	0.522	
X _Y (CO ₃) _Z	Coefficient = $[M_{CO_2}] / \{ Y * [M_X] + Z * [M_{CO_3^{2-}}] \}$	X = Alkaline metal or alkaline earth metal [M _X] = Molecular weight of X (g/mol) [M _{CO₂}] = Molecular weight of CO ₂ (44 g/mol) [M _{CO₃²⁻}] = Molecular weight of CO ₃ ²⁻ (60 g/mol) Y = Stoichiometric number of X = 1 (alkaline earth metal) = 2 (Alkaline metal) Z = Stoichiometric number of CO ₃ ²⁻ = 1

