

GHG Verification: Introduction to Supply Chain Emissions (Scope 1, 2, 3)

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1. BACKGROUND

“Climate change” refers to the phenomenon of long-term changes in the global climate. “Global warming”, which is one factor in climate change, is the phenomenon of rising temperatures due to increased levels of greenhouse gases (hereinafter, GHG, abbreviation: GHG^{*1}) in the atmosphere worldwide. It has been reported that global warming has a wide range of effects on the planet as a whole, including the following:

- 1) Temperature rise: The average temperature of the planet is rising due to increasing levels of GHG, causing extreme temperature changes and changes in weather patterns.
- 2) Melting of glaciers and rising sea levels: Glaciers and ice sheets are melting as a result of warming, contributing to rising sea levels.
- 3) Extreme weather events: Extreme weather events such as heat waves, torrential rain, typhoons, *etc.* are increasing, causing abnormal weather conditions that are impacting agricultural products and ecosystems.
- 4) Impacts on ecosystems: Ecosystems are changing due to warming, and decreased biodiversity and ecosystem collapse are feared.
- 5) Impacts on agriculture and food supplies: Global warming also affects agricultural production, and reduced harvests and destabilized food supplies may become problems.

Measurement and reporting of GHG emissions are the foundation for global warming countermeasures, and a number of international standards and guidelines have been established. Understanding these makes it possible for companies and organizations to reduce environmental loads and build the foundation for realizing a sustainable economy. This paper describes the concrete standards and guidelines, focusing on the importance of GHG verification and evaluation of emissions in supply chains.

2. INTERNATIONAL STANDARDS AND GUIDELINES FOR MEASUREMENT AND REPORTING OF GHG EMISSIONS

A number of international standards and guidelines for measurement and reporting of GHG emissions exist, including the following:

- 1) United Nations Framework Convention on Climate Change (UNFCCC) guidelines: Under the UNFCCC, each country is required to report its own GHG emissions. The UNFCCC provides international guidelines on measurement, reporting and verification of GHG, supporting reporting by each country based on a methodology with international consistency.
- 2) Greenhouse Gas Protocol (hereinafter, GHG Protocol): This is a standard for evaluating and reporting GHG emissions by companies and organizations, and defines the concepts of Scope 1, Scope 2 and Scope 3.
- 3) ISO 14064: This is an international standard on measurement, reporting and verification of GHG, which provides comprehensive guidelines for GHG measurement and reporting methods, data management and verification processes. ISO 14064 comprises the following parts.
 - ① ISO 14064-1: Quantification and reporting of GHG – Provides methods for evaluation of GHG emissions by companies (organizational level).
 - ② ISO 14064-2: Quantification and reporting of GHG – Focuses on project-based efforts, providing methods for evaluating

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*1 The revised UNFCCC reporting guidelines on annual inventories for Parties included in Annex I to the Convention (Decision 24/CP.19, Annex) specify seven types of greenhouse gases (GHG): carbon dioxide (CO₂), methane (CH₄), dinitrogen oxide (N₂O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF₆) and nitrogen trifluoride (NF₃).

the effects of specific projects in reducing or removing GHG (project level).

- ③ ISO 14064-3: Quantification and reporting of GHG – Provides methods for verification and validation of GHG statements and qualification of verifiers.
- 4) IASE 3410: An international standard established by the Institute of Internal Auditors (IIA) which focuses mainly on GHG reports as part of assurance work for nonfinancial information by financial auditors. IASE 3410 secures the reliability of environment-related data and reports, and contributes to enhancing the transparency of information related to sustainability. These standards and guidelines have the following important roles in evaluations of environmental impacts by countries and organizations and promotion of initiatives toward sustainability.
- 1) Enhancement of transparency and reliability: Measurement and reporting in accordance with these standards and guidelines ensure the transparency and reliability of the emissions data of organization and companies, and allows stakeholders to make judgments based on accurate information.
 - 2) Possibility of comparison and evaluation: Data based on these guidelines makes it possible to compare and evaluate emissions between different organizations, companies and industries, making it possible to promote efforts to achieve sustainability and improvement of corporate performance.
 - 3) Observance of regulations and risk management: Although regulations related to GHG emissions exist in many countries and regions, data collection and reporting in accordance with these standards and guidelines supports observance of those regulations and aids in reducing the risk of violations.
 - 4) Sustainable management: Measurement and improvement of emissions by the reporting organization or company makes it possible to carry out initiatives to reduce environmental impacts. This contributes to long-term management strategy and improvement of brand value.
 - 5) Response to requests by customers and consumers: With heightened concern about the environment, many customers and consumers are interested in information about sustainability. Reporting based on these standards and guidelines is one means of responding to their requests.
 - 6) International cooperation and initiatives: Because these standards and guidelines are widely referenced internationally, they can be used as common standards by different countries and regions, facilitating international cooperation and initiatives, and thus have the potential to strengthen the response to global issues.

It can be said that measurement of GHG emissions using these standards and guidelines is an important step for evaluating and improving environmental loads as part of the sustainability strategy of an organization or company. Which standard is selected will depend on the purpose of the organization, industry, local regulations, available resources, *etc.* Large companies and organizations may also use a combination of the elements of these standards. Regardless of which standard or guideline is selected, proper understanding and use of the selected standard/guideline is essential, but in particular, this paper will explain the GHG Protocol and the theoretical and practical methods for evaluating emissions in Scope 1, Scope 2 and Scope 3 in supply chains.

3. OVERVIEW OF THE GHG PROTOCOL

The GHG Protocol Corporate Accounting and Reporting Standard (GHG Protocol) is an international framework for measurement, reporting and verification (MRV) of GHG which was developed jointly by the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD) in 1998, and now is used by companies and organizations when evaluating GHG emissions and establishing sustainable business strategies. The GHG Protocol is widely accepted as an important tool for supporting evaluation and reduction of emissions as part of a sustainable management strategy, and is mainly used by companies and organizations as a tool when evaluating their own GHG emissions and managing impacts on the environment.

The GHG Protocol has the following distinctive features.

- 1) Coverage of emissions sources: The Protocol covers GHG emissions across all the activities of the reporting company, including emissions from process and combustion of fuel, emissions in the process of generating electric power for use, and other emissions related to the supply chain and life cycles of products.
- 2) Methods of calculating and reporting GHG emissions (GHG emissions accounting reporting methods): The Protocol

provides methods for GHG emissions accounting reporting methods for each Scope. Companies are required to select the proper methods for detailed measurement and reporting of the GHG emissions attributable to their own activities.

- 3) Response of companies to sustainability: The GHG Protocol supports the efforts of companies to develop sustainable management strategies. Based on evaluations of the amount of GHG emissions, companies can implement countermeasures such as energy-saving measures, introduction of renewable energy, *etc.*, and can construct a sustainable business model that reduces loads on the environment.
- 4) International standardization: Because the GHG Protocol is widely recognized as a common international framework, it is used by companies and organizations in countries throughout the world. This facilitates evaluation and comparison of the GHG emissions of different countries and regions.

By chapter, the content of the GHG Protocol is as follows.

Chapter 1 GHG Accounting and Reporting Principles Guidance on the principles of accounting and reporting of GHG emissions.

Chapter 2 Business Goals and Inventory Design

Chapter 3 Setting Organizational Boundaries Guidance for setting organizational boundaries.

Chapter 4: Setting Operational Boundaries Guidance on setting operational boundaries.

Chapter 5: Accounting for GHG Reductions

Chapter 6: Tracking Emissions Over Time Guidance on setting temporal performance data.

Chapter 7: Identifying and Calculating GHG Emissions

Chapter 8: Managing Inventory Quality

Chapter 9: Reporting GHG Emissions Guidance and calculation and reporting of GHG emissions.

Chapter 10: Verification of GHG Emissions

4. CALCULATION OF GHG EMISSIONS BY THE GHG PROTOCOL

The GHG Protocol provides the classification of Scope 1, Scope 2 and Scope 3 for GHG emissions accounting.

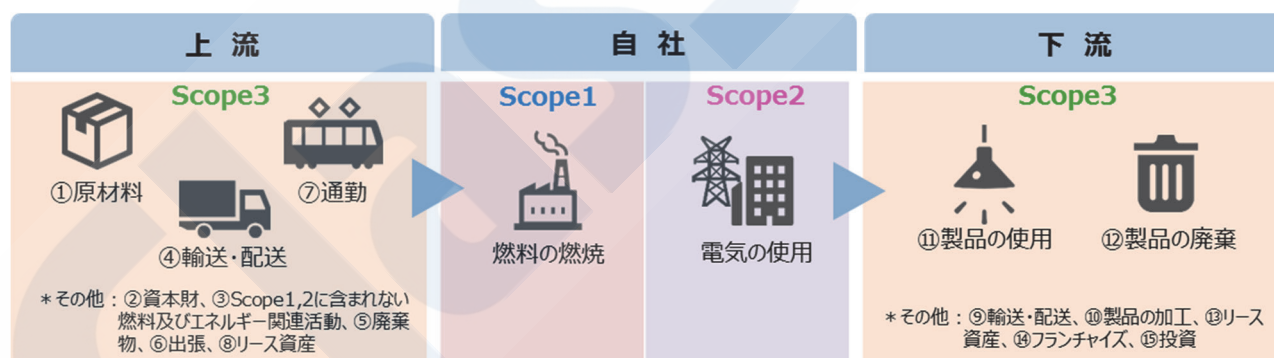


Fig.1 Source: Ministry of the Environment materials, “Toward calculation and reduction of supply chain emissions”.

- 1) Scope 1: Direct emissions = Direct emissions of GHG by the reporting company (fuel combustion, industrial processes)
 Scope 1 means GHG emissions attributable to the direct activities of the reporting company. Concretely, emissions of the following GHG are included:
 - ① Combustion of fuels: GHG emissions generated when using fuels owned by the company. For example, emissions from gasoline- and diesel-fueled vehicles and combustion in gas boilers are included.
 - ② Emissions from processes: GHG emissions generated by the manufacturing processes or industrial processes of a company. As examples, this includes the production of cement and steel.
 - ③ Leaks: GHG emissions generated unintentionally by activities of the reporting company. As examples, this includes leaks of cooling liquids and methane gas.
- Scope 1 GHG emissions are emissions that can be controlled directly by the reporting company itself, and can be reduced by

optimization of fuel use and manufacturing processes, *etc.*

2) Scope 2: Indirect emissions = Indirect emissions accompanying the use of electricity, heat and steam supplied from another company.

Scope 2 refers to GHG emissions indirectly related to the activities of the reporting company, and mainly includes GHG emissions due to consumption of electric power and the use of heat or steam.

3) Scope 3: Other indirect emissions = Indirect emissions other than Scope 1 and Scope 2 (emissions by other companies related to the activities of the company)

Scope 3 indicates other GHG emissions indirectly related to the activities of the reporting company, and includes the company's supply chain and the life cycles of sold products. Since direct control of Scope 3 GHG emissions by the company itself is difficult, the cooperation of supply chain companies, the effect on customers, *etc.* is considered. However, reductions are possible by improvement of supply chain management and manufacturing processes, *etc.* Concretely, Scope 3 includes the following three types of emissions, which are further classified in 15 categories:

- ① Purchases from suppliers: GHG emissions when the company purchases raw materials or products.
- ② Use of sold products: GHG emissions generated when consumers use products manufactured by the company. For example, this includes emissions associated with office supplies and various types of purchased services.
- ③ Waste treatment: GHG emissions generated when the treatment of wastes is consigned to an outside contractor.

15 Categories in Scope 3

Scope 3 categories		Corresponding activities (examples)
1	Purchased good and services	Purchases of raw materials, outsourcing of packaging, purchases of consumables.
2	Capital goods	Increases in production equipment (in the case of equipment constructed or manufactured over multiple years, reported in the final year when construction/manufacture is completed).
3	Fuel- and energy-related activities not included in Scope 1 or Scope 2	Upstream processes (extraction, refining, <i>etc.</i> of purchased fuels. Upstream processes (extraction, refining, <i>etc.</i> of fuels used in power generation) of purchased electric power.
4	Transportation and distribution (upstream)	Inbound logistics purchased by the reporting company, transportation and distribution between the company's own facilities, outbound logistics (where the company is the owner).
5	Waste generated in operations	Transportation and treatment of waste by outside contractors (excluding waste having value, i.e., recyclable content).
6	Business travel	Business travel by employees.
7	Employee commuting	Commuting by employees.
8	Leased assets (upstream)	Operation of leased assets leased by company. (Because these are reported in Scope 1 and Scope 2 in the accounting, reporting and disclosure system, most leased assets do not fall under this category.)
9	Transportation and distribution (downstream)	Shipping transportation (transportation after the company is the owner), storage in warehouses, retail sales.
10	Processing of sold products	Processing of intermediate products by downstream companies.
11	Use of sold products	Use of products by users.
12	End-of-life treatment of sold products	Transportation and treatment of products upon disposal by users.
13	Leased assets (downstream)	Operation of leased assets owned by the company as lessor and leased by other entities.
14	Franchises	Operation of franchise system members supervised by the reporting company falling under Scope 1 or 2.
15	Investments	Operation of investments, including equity and debt investments and project finance.
Others (optional)		Daily lives of employees and consumers.

Source: Ministry of the Environment materials, “Toward accounting and reduction of supply chain emissions”.

5. SUPPLY CHAIN GHG EMISSIONS ACCOUNTING PROCEDURE

The procedure for evaluation of supply chain GHG emissions includes data collection and measurement, the methodology of GHG emissions calculations, and consideration of uncertainties. The following explains the details of these respective items.

1) Data collection and measurement

The amount of GHG emissions generated by various activities in the supply chain is quantified by data collection and measurement. The main procedure is as follows.

- ① Determination of the scope: First, decide the target scope for evaluation (Scope 1, Scope 2 or Scope 3). It is important to clarify which scope applies to activities in the supply chain.
- ② Establishment of a data collection plan: Understand the activities in the supply chain, and plan the range and frequency of data collection. In some cases, cooperation with suppliers and cooperating companies involved in the supply chain may be necessary.
- ③ Data collection: Based on the data collection plan, collect data on the amounts of energy use, fuel use, purchased raw materials, *etc.* These data are necessary in evaluations of the amount of GHG emissions attributable to each activity in the supply chain.
- ④ Improvement of measurement accuracy: It is important to collect data that are as accurate as possible. Therefore, efforts to improve the reliability of measurements are necessary, for example, by improving the accuracy of measuring equipment, *etc.*

2) Calculation of emissions

In calculating supply chain GHG emissions, the appropriate calculation methodology for each scope is to be used. The following is a simple explanation of the measurement methodologies for each scope.

① Scope 1 (direct emissions)

- 1. Collect the types and consumption of fuels used (petroleum, natural gas, *etc.*) = Amount of activity, and the GHG emissions generated by designated processes = Amount of activity
- 2. Confirm the emission factors (emissions unit values) of the GHG generated by combustion of each fuel.
- 3. Volume of greenhouse gas emission (t-CO₂e) = Amount of activity x Emission unit value (emissions per unit of activity).

② Scope 2 (energy-derived indirect emissions)

- 1. Amount of use of energy such as purchased electricity, steam, HVAC, *etc.* = Amount of activity
- 2. Confirm the emissions unit value corresponding to each type of energy used.
- 3. Volume of greenhouse gas emission (t-CO₂e) = Amount of activity x Emission unit value.

③ Scope 3 (other indirect emissions)

Although Scope 3 is divided into 15 respective categories, there are two accounting methods for the emissions of each category, as shown in - 1. and - 2. below. Examples of calculation are shown in - 3.

- 1. Submission of emission data by the related trading partners (method using primary data).
- 2. Reporting by trading partners in the form of “Total emissions (** tons) in production for the reporting company in fiscal year @@”. This method uses the calculation formula “Emissions = Amount of activity x Emission unit value”.

- The reporting company collects the amount of activity.
- The emission unit values are obtained from an external database or provided by the trading partner.

- 3. Examples of calculation

- Calculation of emissions related to raw material purchases (Scope 3, Category 1)
 - Collect the amounts of raw materials and parts necessary in production of products.
 - Confirm the emission unit value related to the production of each raw material and part, and calculate the volume of GHG emissions by multiplying the amounts purchased by the emission unit value.
- Calculation of emissions related to product transportation (Category 4)
 - Collect the product transportation distances and the means of transportation (truck, ship, airplane, *etc.*)
 - Confirm the emission unit value corresponding to each transportation distance and means of transportation, and calculate

the volume of GHG emissions by multiplying the transportation volumes by the emission unit value.

- Calculation of emissions related to employee commuting and business travel (Category 6, 7)
 - Collect the distance and means of employee commuting and business travel.
 - Confirm the emission unit value based on the distance and means of transportation, and calculate the volume of GHG emissions by multiplying the amounts of commuting by the emission unit value.
- Calculation of emissions related to waste treatment (Categories 5, 12)
 - Collect the types of waste and their treatment methods (disposal, recycling, incineration, *etc.*), confirm the emissions unit values for each treatment method, and calculate the GHG emissions by multiplying the volumes of each type of waste by the emission unit value.

*Please refer to the guidance provided by the Ministry of the Environment, *etc.*

https://www.env.go.jp/earth/ondnaka/supply_chain/gvc/estimate.html

3) Consideration of uncertainties

In evaluating supply chain GHG emissions, it is important to consider the uncertainties accompanying measurement and data collection. As a method for understanding the effects of data uncertainty on evaluations of emissions and obtaining highly-reliable results, the following points are to be considered.

- ① Evaluation of uncertainties: Evaluate the uncertainties accompanying data collection and measurement.
- ② Effects of uncertainties: Corrections may be made considering the effect of data uncertainty on the amount of emissions. Corrections are to be made based on a statistical technique that takes uncertainty into account.
- ③ Reporting of uncertainties: The results of evaluations of uncertainties are to be reported appropriately in the report of GHG emissions. As a result, the reliability of the evaluation results can be shown clearly.

Evaluation of supply chain GHG emissions is a complex process, and proper data collection and measurement, use of the GHG emissions calculation methodology, and consideration of uncertainties are indispensable for obtaining accurate evaluation results.

6. SIGNIFICANCE OF THIRD-PARTY VERIFICATION OF GHG EMISSIONS ACCOUNTING REPORTS

Greenhouse gas emissions accounting reports are a method for quantitatively evaluating the GHG emissions generated by the reporting organizations and companies. Third-party verification plays an extremely important role in ensuring the reliability and accuracy of GHG emissions accounting reports. The following explains the significance of third-party verification in GHG emissions accounting reporting.

1) Enhancement of reliability and transparency

Third-party verification is a means of confirming that GHG emissions accounting reports are reliable. The accuracy and transparency of the information is enhanced by verification by an independent third-party verification organization. This increases trust in the content and methodology of GHG emissions accounting reports, and means that stakeholders can accept information on the organization's environmental performance with greater confidence.

2) Compliance with legal requirements and regulations

In some countries and regions, GHG reporting is required based on specific regulations and legal requirements. Third-party verification plays a crucial role in satisfying these requirements. GHG emissions accounting reports that have received third-party verification have legal credibility and support compliance with regulations.

3) Improvement of internal management

Third-party verifications also provide insights into the processes and data management methods of an organization. The verification process highlights points that require improvement in the methods of preparing GHG inventories and the reliability of data collection, and makes it possible for the reporting organization to obtain information for improving its own environmental management process.

4) Strengthening of external reporting

The GHG inventory is the basis for reporting to external stakeholders such as investors, customers, suppliers, *etc.* A GHG emissions accounting report that has received third-party verification can provide information, which has been verified by independent experts, to these stakeholders. This heightens the reliability and transparency of the reporting organization and

strengthens external communications.

The third-party verification is an indispensable element for improving the reliability and value of the GHG inventory. By including third-party verifications in the process of evaluating the environmental impacts of an organization and promoting improvement measures, it becomes possible to realize more effective sustainability.

7. USE OF GHG EMISSIONS ACCOUNTING REPORTS AND DATA

The important points for the use of GHG emissions accounting reports and data are understanding the results of evaluations of GHG emissions, reporting and transparency of the results, and formulation and improvement of a GHG reduction strategy.

1) Understanding the amount of GHG emissions

An understanding of a company or organization's GHG emissions is an important source of information for understanding its efforts for sustainability and impacts on the environment.

- ① Comparison with the previous fiscal year: Trends in GHG emissions and the progress of improvement efforts can be understood by comparison with past results.
- ② Industry benchmarks: The reporting company's own performance can be evaluated by comparison with other companies in the same industry and the average of the industry as a whole.
- ③ Importance of GHG Protocol scopes: It is possible to understand the importance and effects of emissions in each of the categories of Scope 1, Scope 2 and Scope 3.
- ④ Risks and opportunities: An understanding of the amount of GHG emissions is also useful for identifying the risks of climate change and the opportunities of a sustainable business model.

2) Reporting and transparency of results

In GHG emissions accounting reports, sharing with internal and external stakeholders is important. Transparent reports not only enhance the trust of a company, but can also be an important means of communicating the company's initiatives for sustainability.

- ① GHG emissions accounting reports: Measurement methods, evaluation of uncertainties, the status of progress of initiatives, *etc.* are included in GHG emissions accounting reports.
- ② External reporting: GHG emissions accounting reports can be used in external reporting through the company's CSR Report, Sustainability Reports, official website *etc.*
- ③ Guidelines for sustainability reports: Transparency is secured by reporting based on international sustainability reporting guidelines (e.g., Global Reporting Initiative (GRI) Guidance).

3) Formulation and improvement of GHG reduction strategy

The company's GHG reduction strategy is formulated and improved based on its GHG emissions accounting reports. This makes it possible to reduce GHG emissions and promote efforts for sustainable business.

- ① Setting of GHG reduction targets: Based on the results of the GHG emissions accounting report, appropriate GHG emissions reduction targets are set, taking into account setting of concrete, measurable, realistic and planned targets.
- ② Construction of the GHG reduction strategy: Strategies such as countermeasures for activities with large GHG emissions, introduction of renewable energy and improvement of energy efficiency are established.
- ③ Continuous improvement: After the GHG strategy is implemented, periodical verification and improvement are carried out. It is important to grasp the results achieved and the issues to be addressed in order to continuously promote improvement of the strategy.

Use of GHG emissions accounting report data plays an important role in giving concrete form to the sustainability efforts of a company or organization. It is thought that transparent reporting and formulation/improvement of a GHG reduction strategy can contribute to a more sustainable management strategy.

8. ISSUES IN GHG EMISSIONS ACCOUNTING REPORTING AND THEIR SOLUTIONS

Various issues exist in GHG emissions accounting reporting. The following describes the respective issues and possible solutions.

1) Data availability and quality

- Issue: In GHG emissions accounting reports, a large volume of data is necessary, but there are cases where data is difficult to obtain or the quality of the data is inadequate. In particular, collection of information on the supply chain is sometimes difficult.
- Solutions:
 - To improve collection of supply chain data, it is important to strengthen cooperation with suppliers and build a consensus on the provision of data.
 - Efficient data collection can be realized by utilizing technologies that automate the data collection process.
 - To improve the reliability of data, introduce proofreading and verification processes to secure data quality.

2) Issues related to methodology and standardization

- Issue: GHG emissions accounting reporting is a complex process, and differences in methodology and a lack of standards can be problems. There is a possibility that calculation results may differ due to the use of different methods and standards.
- Solutions:
 - Unify calculation methods by introducing an international standard such as the GHG Protocol or ISO 14064-1.
 - With the cooperation of industry groups and experts, formulate a standard methodology and establish common industry-wide standards.
 - Describing the adopted methodology and calculation methods in a report, while maintaining transparency, will enable comparisons with the evaluations of others.

3) Communication with stakeholders

- Issue: In some cases, communications with stakeholders regarding the results of GHG emissions accounting reports and the company's initiatives for sustainability are inadequate. Transparency and dialogue are important for responding to the expectations of stakeholders.
- Solutions:
 - Make GHG reports and CSR reports publicly available, and share the results of GHG emissions evaluations with stakeholders.
 - Give priority to regular dialogues with stakeholders, collect stakeholder feedback, and use that feedback to improve the company's sustainability strategy.
 - Build a relationship of trust by implementing concrete countermeasures for important problems in line with the concerns and expectations of stakeholders.

Action on these issues is extremely important for ensuring the reliability of GHG emissions accounting reports and realizing a sustainable business strategy. Through improvement of data quality, promotion of standardization and transparent communications with stakeholders, companies can establish more sustainable business models.

9. OUTLOOK FOR THE FUTURE

- 1) Evolution of technology and improvement of data accuracy: In data collection and measurement, introduction of new technologies and improvement of data accuracy are expected. This is expected to improve the reliability of GHG emissions accounting reports and contribute to improved sustainability of supply chains.
- 2) Promotion of global standardization: Unification of methodologies for GHG emissions accounting reporting are expected as a result of progress in promoting international standardization. This is expected to facilitate comparisons between companies and improve evaluations of sustainability.
- 3) Strengthening of cooperation with stakeholders: It is important to strengthen communications with stakeholders, and to promote GHG emissions accounting reporting and practice of the company's sustainable business strategy based on the wishes of stakeholders.
- 4) Strengthening of partnership with suppliers: In improvement of the sustainability of supply chains, strengthening of cooperation and collaboration with suppliers is necessary. Joint promotion of sustainable business models by companies and their suppliers will enhance the possibility of realizing sustainability.

ClassNK (the Society) is involved in a large number of certification projects for GHG emissions accounting reporting, but remarkable expansion can also be seen in certification projects and the number of examinations derived from those efforts,

including emissions accounting in the logistics sector, beginning with marine and air transport and also including land transportation, emissions offsetting using credits, green steel utilizing the mass balance method for steel makers, the SHIFT Project sponsored by the Ministry of the Environment, and the J-Credit Scheme, among others. The Society will continue to work to provide a diverse range of certification services responding to market demand, while also maintaining a high level of quality.

REFERENCES

Website of Ministry of the Environment, Japan, Global Warming Countermeasures.

ISO 14064 Series.

Materials of the Greenhouse Gas Protocol Accounting and Reporting Standard

