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Accounting and Reporting Guidelines for Avoided GHG Emissions

Along the Value Chain of Steel Products and By-products

KBCSD

KOSA
Korea Iron & Steel Association

Participating Organizations

This publication is released in the name of KBCSD and KOSA. POSRI contributed to guideline development.

KBCSD	Founded in 2002, KBCSD is a CEO-led organization of 68 forward-thinking companies that endeavors to put Korean industries on track to economic development in harmony with the environment and social development. It is a global network partner of WBCSD (World Business Council for Sustainable Development). www.kbcsd.or.kr
KOSA Korea Iron & Steel Association	Founded in 1975, KOSA promotes international competitiveness and sustainable growth of the Korean iron and steel industry and strives to contribute to the development of the Korean economy and cooperation among its 44 members. www.kosa.or.kr
POSCO RESEARCH INSTITUTE	Founded in 1994 as a private research institute specializing in corporate management and industrial strategy under the umbrella of the POSCO group with the goal of developing the Korean steel industry and enhancing corporate competitiveness. www.posri.re.kr

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Foreword

With the implementation of the Paris Agreement, global transition to a carbon-neutral society is accelerating. In its special report "Global warming of 1.5℃" published in 2018, the Intergovernmental Panel on Climate Change (IPCC) suggested that achieving global carbon neutrality by 2050 is essential in order to achieve the 1.5℃ target set forth in the Paris Agreement. Contributing to the efforts of the international community to mitigate climate change, the Korean government declared "2050 carbon neutrality vision" in December 2020.

The transition to a carbon-neutral society is a challenging task that requires innovation and transformation in all sectors of the economy and society. A carbon neutral society cannot be achieved without comprehensive changes in all aspects of our lives including industries, transportation, commerce, and our homes in addition to decarbonizing the energy sector.

Expectations for businesses fulfilling their role in reducing emissions and developing innovative technologies are greater than ever. Along with GHG emissions from its own facilities, companies are also required to reduce emissions across the entire value chain. Consumers are demanding products that help contribute to reducing GHG emissions when using them, and investors are demanding that companies expand low-carbon product line-ups and business portfolios. This will soon become a new standard that meets growing interest among stakeholders, and the "new normal" in corporate management. Therefore, companies have no option but to put efforts to develop ways to reduce emissions throughout the entire life cycle of their products and value chains.

The steel industry has recognized that contributing to reducing carbon footprint is essential and has strived to reduce emissions not only in the manufacturing process, but also in the use phase of steel products. This is more holistic and collaborative way of sharing efforts and burdens of emissions reduction among industries.

Despite these new demands and efforts, however, there are no internationally or domestically recognized standards that can help quantify the social reduction effect of goods produced in different industries including the steel industry. On the other hand, there are some guidelines published by individual governments and industry associations such as the Japanese Ministry of Economy, Trade and Industry (METI), the World Business Council for Sustainable Development (WBCSD), and the International Council of Chemical Associations (ICCA). Furthermore, many companies are also actively engaging in discussions related to their contributions to reducing emissions across the various sectors of society.

The Korea Business Council for Sustainable Development (KBCSD) and the Korea Iron and Steel Association (KOSA) published guidelines for quantifying avoided emissions. The purpose of these guidelines is to help businesses in the iron and steel industry understand what "avoided emissions" are, and report their impact on society in a more objective and reliable manner. These guidelines can also be a reference for other industries, and its publication can be an important milestone in transitioning to a carbon neutral society and achieving sustainable development.

Messages from

KBCSD

In 2018, the Intergovernmental Panel on Climate Change (IPCC) warned, in its a special report "Global warming of 1.5℃", that net emissions of CO_2 must be zero around 2050 to limit the global temperature rise above 1.5℃ from pre-industrial levels. Carbon neutrality is a long-term challenge that requires structural and institutional changes across society. Korea became the 14th country in the world to legislate a carbon neutrality act and the Korean government is formulating implementation strategies to achieve a carbon-neutral economy by 2050. Industries that account for 37% of total domestic emissions are the key to achieving the country's NDC (Nationally Determined Contribution) target, 40% or more emission reductions compared to the 2018 levels by 2030.

Centering on GHG emission reductions and green growth, the government's net zero plan is premised on the belief that CCUS (Carbon Capture, Utilization and Storage) and other innovative reduction technologies, and new energy sources such as hydrogen and ammonia are to be introduced by 2030. Although achieving carbon neutrality is a challenging task, developing innovative technologies will be an opportunity for new growth for businesses. In this process, emission reductions throughout the value chain should be pursued to promote innovation and achieve carbon neutrality.

"Avoided emissions" presents a way of looking at emissions from the perspective of an integrated system covering the entire value chain from manufacturing to end use. If the amount of emissions reduced in the use phase of a product is larger than the amount of emissions added in the manufacturing phase, the total amount of emissions decreases. This is an effective approach to manage and minimize emissions from the entire life cycle of low-carbon products and services. In most industries, emissions from worksites (scope 1+2) account for about 10~35% whereas 65~90% of emissions come from value chains (scope 3). It means that the effect and impact of emission reductions in the value chain is greater than worksite emission reductions.

Accordingly, TCFD (Task Force on Climate-Related Financial Disclosures) and other major ESG disclosure agencies around the world recommend businesses disclose avoided emissions as additional information in addition to worksite emissions. Industrial institutions such as WBCSD (World Business Council for Sustainable Development) and ICCA (International Council of Chemical Associations) have developed international standards to measure and report avoided emissions quantitatively and qualitatively.

In order to strengthen industrial competitiveness and respond to international standards with agility, KBCSD (Korea Business Council for Sustainable Development) and KOSA (Korea Iron and Steel Association) published "Accounting and Reporting Guidelines for Avoided GHG Emissions Along the Value Chain of Steel Products and By-products". These guidelines, the first of its kind in Korea, outline the concept, necessity, principles, reduction mechanisms, allocation, verification, and reporting of avoided emissions. KBCSD hopes that the guidelines will contribute to Korea's transition to a carbon neutral society by deepening understanding of avoided emissions among the stakeholders of the steel industry and that it will evolve into more robust guidelines that can serve as a reference for other industries. Thank you.

KBCSD Secretary General / **Hong, Hyun Jong**

KOSA
Korea Iron & Steel Association

Globally, discussions on climate change have been intensified. It is claimed that the world needs to act more proactively to reduce GHG emissions, going beyond acknowledging the impact of climate change on society. The IPCC officially announced that the international community should achieve carbon neutrality by 2050 in order to keep the global temperature rise within 1.5℃ from pre-industrial levels. Since the IPCC announcement many countries and businesses around the world have declared to go carbon neutral by 2050. Becoming the 14th country to enact a 2050 carbon neutrality act, Korea also committed itself to responding more proactively to climate change.

While the world is joining forces to find ways to navigate through the climate crisis and achieve carbon neutrality, the steel industry is facing more significant challenges than ever.

The Korean steel industry has the highest energy efficiency in the world. This means that the current production system requires fundamental changes to reduce further GHG emissions. Although the steel industry is making its best efforts to develop innovative technologies based on hydrogen-reduced iron steelmaking process, it is likely to take considerable cost and time for those technologies to be commercialized.

Changes and innovations are needed to reduce GHG emissions beyond worksite emissions. Transitioning to a carbon neutral society requires considering the entire life cycle of products, from raw material production to the use phase of consumers and end of life of products. Stakeholders of the steel industry demand that steelmakers reduce GHG emissions at worksites, contribute to societal emission reductions, and actively respond to climate change with the development of eco-friendly products and business portfolio. Major ESG assessment organizations are also recommending the disclosure of related information.

While stakeholders' interest and demand for avoided emissions are growing, awareness of avoided emissions is still low in Korea. With the aim of raising awareness of avoided emissions and boosting the transition to a carbon neutral society, KOSA published "Accounting and Reporting Guidelines for Avoided GHG Emissions Along the Value Chain of Steel Products and By-products" jointly with KBCSD.

These guidelines will present objective and transparent standards on how to quantify and report emissions avoided by using low-carbon steel products. Moreover, the guidelines aim to help stakeholders better understand the concept of avoided emissions and to lay the foundation for its utilization.

The steel industry has been leading the industry-wide efforts to reduce GHG emissions, which culminated in these guidelines, the first guidelines on "avoided emissions" ever published by an industrial sector in Korea. We hope the guidelines will serve as a cornerstone for future efforts to devise measures to calculate avoided emissions in other industrial sectors. Thank you.

KOSA Vice President / **Byun, Young Man**

Accounting and Reporting Guidelines for Avoided GHG Emissions

Along the Value Chain of
Steel Products and By-products

Contents

The steel industry has supported the sustainable development of mankind and produced materials essential to creating a low-carbon circular economy. Steel can be found in many goods and services that people use in everyday life: houses and buildings where people live and work; water pipes used to supply water for washing hands or preparing foods. Steel is also the main material of automobiles, subways, buses and other transportation means. If the eras of human civilization are classified mainly based on materials used by humans, then we are still living in the Iron Age as we did thousands of years ago.

| Steel use in 2019 |

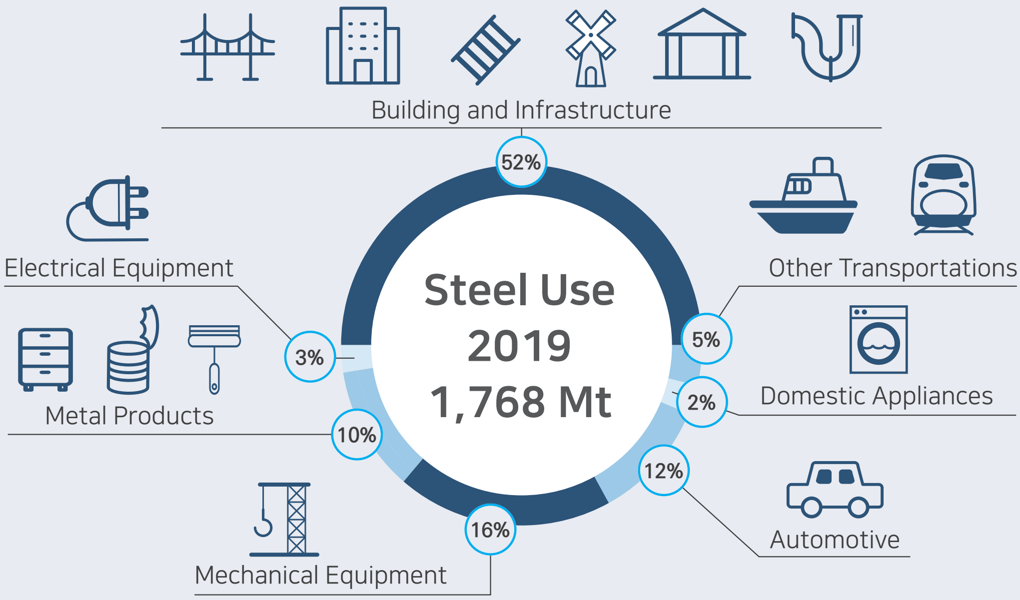


Image from worldsteel (modified)

According to worldsteel, global consumption of steel products in 2019 was 1,768 million tons. 52% of them were used in construction and civil engineering while 16% and 12% of them were consumed in machinery and automobile industries, respectively. For this reason, the steel industry is regarded as a backbone of society.

Used steel products are reused and recycled in various ways, which is one of the strengths of steel. Steel can be recycled indefinitely without loss of its quality. Magnetism makes it easy to sort and collect steel, which is why its recovery and recycling rates are very high compared to other materials. Currently, the recycling rate of steel products is estimated to be 85%. In addition, slag generated during steel production can be used as a raw material for cement or other products such as artificial reefs.

As we move toward a carbon-neutral society, the role of the steel industry is more important than ever. This is because steel is at the center of green transition of all areas including clean energy infrastructure, transportation, buildings and houses. The steel industry is constantly changing and innovating to bring a fundamental shift toward a carbon-neutral production system and making greater social contribution through steel products.

1. Introduction

1.1 Purpose of the guidelines

Efforts by businesses to reduce GHG (Greenhouse Gas) emissions for global carbon neutrality go beyond the boundaries of worksites to include the entire value chain. Globally, there is growing interest of stakeholders in emission reductions in the entire value chain of products and services, and in the disclosure of related information. However, in Korea, awareness of and discussions around emission reductions are still insufficient .

These guidelines were developed to facilitate discussion around avoided emissions in relation to carbon neutrality and to provide consistent guidance that businesses can refer to and use.

The steel industry has contributed to GHG emission reductions across society with its products. Steel companies continue to seek further opportunities for emission reductions and communicate these opportunities to customers and stakeholders by collaborating with value chain partners and developing innovative products.

To support these efforts, a reliable calculation method for avoided emissions is essential. These guidelines provide guidance on how to calculate "avoided emissions" in the value chain. In these guidelines, we define "avoided emissions" as the amount of GHG emissions that can be reduced or avoided compared to the baseline products throughout the life cycle of low-carbon products.

1.2 Reference guidelines and standards

These guidelines were developed with reference to relevant standards and guidelines on avoided emissions, as well as working papers and other related documents. Main references for avoided emissions accounting and reporting are as follows:

ㅣ Table 1-1. Standards and guidelines on avoided emissions ㅣ

Standards and guidelines	Description
The essential role of chemicals. Guidelines: Accounting for and reporting greenhouse gas (GHG) emissions avoided along the value chain based on comparative studies. (WBCSD/ICCA, 2013)	· Principles and frameworks for calculating and reporting avoided emissions of chemical industry and products · 2nd edition (version 2) published in 2017
Guidance on quantifying greenhouse gas emission reductions from the baseline for electrical and electronic products and systems (IEC, 2014)	· Industry standard for quantifying avoided emissions in electrical and electronic products and systems
Accounting and reporting protocol for avoided greenhouse gas emissions along the value chain of cement-based products (LafargeHolcim, 2016)	· Principles and framework for calculating and reporting avoided emissions of the cement industry and products
Guideline for quantifying GHG emission reductions of goods or services through global value chain (METI, 2018)	· Principles and basic procedures for quantifying avoided emissions applicable to all industrial sectors in Japan
Estimating and reporting the comparative emissions impacts of products (WRI, 2019)	· Comprehensive framework for quantifying and reporting the impact of products on GHG emissions (positive and negative)

* WBCSD: World Business Council for Sustainable Development, ICCA: International Council of Chemical Associations, IEC: International Electrotechnical Commission, METI: Ministry of Economy, Trade, and Industry, WRI: World Resources Institute

Furthermore, these guidelines are aligned with internationally accepted requirements and guidelines for product life cycle assessment (LCA) and GHG emission accounting and reporting from ISO standards and GHG Protocols.

- ISO 14040: Environmental Management - Life Cycle Assessment - Principles and Framework (2006)
- ISO 14044: Environmental Management - Life Cycle Assessment - Requirements and Guidelines (2006)
- ISO 14064-1: Greenhouse Gases - Part 1: Specification with Guidance at the Organization Level for Quantification and Reporting of Greenhouse Gas Emissions and Removals (2018)
- ISO 20915: Life Cycle Inventory Calculation Methodology for Steel Products (2018)
- GHG Protocol: A Corporate Accounting and Reporting Standard
- GHG Protocol: Corporate Value Chain (Scope 3) Accounting and Reporting Standard
- GHG Protocol: Policy and Action Standard
- GHG Protocol: Product Life Cycle Accounting and Reporting Standard
- GHG Protocol: Technical Guidance for Calculating Scope 3 Emissions (version 1.0)

1.3 Use of the guidelines and future tasks

These guidelines were developed for various stakeholders including steel companies, governments, investors, consumers and NGOs. Companies that intend to measure, manage, and report avoided emissions in relation to steel products are encouraged to follow the guidelines.

Reporting companies should recognize that the avoided emissions approach does not mean that it can replace or avoid worksite reductions. Rather, they should realize that reducing both worksite emissions and value chain emissions contributes to achieving a carbon neutral society.

By broadly applying the guidelines, companies can secure objectivity and transparency in quantifying and reporting avoided emissions. Companies can use the results with higher reliability and for more effective communication related to avoided emissions, which will help improve the overall sustainability of their products.

Avoided emissions from steel products are attracting greater interest not only from the value chain partners of the steel industry, but also from stakeholders including investors. In this context, these guidelines can serve as a basis for raising awareness and understanding of avoided emissions of stakeholders, and presenting information on the competitiveness and contribution of eco-friendly and low-carbon products more effectively and clearly.

These guidelines are the result of the country's first cooperative effort to quantitatively report avoided emissions through consistent guidance. The guidelines were developed with a focus on the steel industry. However, it is necessary to expand cooperation and discussions by publishing updated and revised versions based on the participation of a wider range of value chain partners and stakeholders. In addition, avoided emissions of the steel industry can be a good example to other industries facing similar challenges, so broadening the scope of the guidelines on avoided emissions to those industries should be considered.

2. Definition and Need of Avoided GHG Emissions

2.1 What are "avoided emissions"?

In general, avoided emissions refer to the amount of emissions that can be reduced or avoided from the entire value chain of low carbon products compared to baseline products.

WBCSD, WRI and other organizations use other terms to refer to the concept of avoided emissions, such as "societal reductions", "climate positive products", "enabling effect", or "scope 4".[1] In these guidelines, the term "avoided emissions" is used.

In GHG Protocol, a company's GHG emissions are classified into scope 1, scope 2 and scope 3 based on the company's activity boundary. Scope 1 emissions are from worksites that a company owns or controls, such as fuel combustion or process emissions from company-owned facilities. Scope 2 emissions are from the process of using electricity and steam purchased from outside. Scope 3 emissions are indirect emissions from corporate value chain. The scope 3 emissions are divided into 15 sub-categories, and calculation methods are suggested for corresponding areas by sector.[2]

Avoided emissions are fundamentally different from Scope 1, 2 or 3 emissions which calculate absolute amount of emissions. The approach of avoided emissions sets a baseline, and then calculates the relative reduction effect of the assessed product.[3]

| Table 2-1. Types of GHG emissions |

Types of GHG Emissions		Description
Direct Emissions	Scope 1	· Emissions from worksites/facilities directly owned or managed by a company
Indirect Emissions	Scope 2	· Emissions from electricity, steam, heating and cooling consumed or generated by a company
	Scope 3	· All indirect emissions occurring in a company's value chain · Emissions generated as a result of a company's activities, but from upstream and downstream sources that the company does not directly own or control (divided into 15 sub-categories)
Avoided Emissions		· Emissions that can be reduced or avoided in the entire life cycle by replacing baseline products with low-carbon and eco-friendly products and services by a company.

[1] WBCSD: Avoided emissions refer to emission reductions in society that result from the use of a certain company's products and solutions compared to alternative products and solutions.

WRI: GHG emissions impact of a product (good or service) relative to the situation where that product does not exist. Positive impacts are commonly referred to as 'avoided emissions', as well as 'environmental load reduction potential', 'enabling effects', and 'contribution to societal reductions'.

METI: Avoided emissions are defined as the "quantified contribution to the GHG emissions reductions which are estimated throughout the life cycle GHG inventory of environmental-friendly goods or services in comparison to goods or services that represent what is most likely occur in the absence of assessed goods or services(baseline scenario)".

2.2 Necessity of avoided emissions

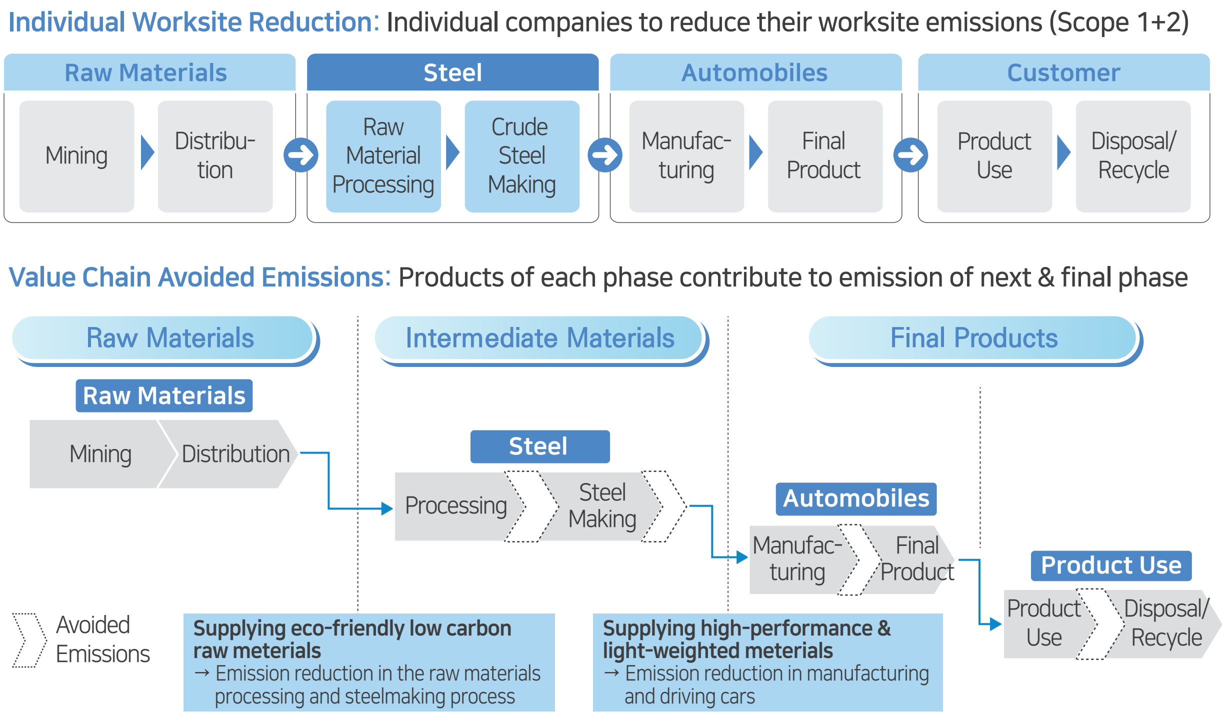
Avoided emissions introduce a new and important approach for the role and responsibility of industry in a pathway to achieve global carbon neutrality. Climate change policies implemented to date have been largely focused on regulating emissions at the company or worksite level.

However, this conventional approach focused on reducing emissions from worksites has limitations in reducing emissions across the different sectors of society as a whole. For example, even if emissions are reduced in the process of producing a product, the same amount of emissions may increase during the use phase. This results in a change in the distribution of GHG emissions across different stages, but the total amount of emissions in the value chain remains the same.

Avoided emissions need to be calculated based on the total amount of emissions generated across the entire value chain. Even if emissions increase during the production of steel products, the total emissions from society may decrease if the sum of emissions reduced in the production process by automobile companies using steel materials and emissions reduced in the end use stage is larger than the increase in emissions from the steel production stage. Similarly, if raw material companies reduce emissions during production and processing of iron ore, and steelmakers emit less emissions in their processing phases, the raw materials companies can be said to make significant contributions to avoided emissions.

The avoided emissions approach can complement the aforementioned limitations of the conventional scope 1, 2 and 3 metrics. It helps to uncover climate response opportunities and capture the positive contributions of businesses toward carbon emission reductions.

| Figure 2-1. Avoided emissions from a value chain perspective |



2.3 Avoided emissions and corporate strategies

Contributing to GHG emission reductions through products produced and sold by a company is the most important component of a company's sustainability strategy. Although avoided emissions are not subject to regulations, its strategic necessity is growing in that it can both contribute to GHG emission reductions, and secure competitiveness of the product for the company.

Above all, more effective and broad corporate reduction strategy is needed beyond current strategies focusing on worksite emission reductions in order to achieve the global 1.5℃ target. An integrated approach to the value chain emissions based on avoided emissions and a comparative analysis of the products that provide the same function can give various implications at the corporate strategy level as follows:

- Promote more comprehensive and effective strategies for carbon neutrality or GHG emission reductions
- Evaluate the company's emission impact and reduction potential
- Evaluate the products' social contribution and identify specific strengths and weaknesses more objectively
- Develop new technologies and products
- Explore cooperation and joint opportunities to achieve carbon neutrality with value chain partners

[2] Scope 3 Categories: 1) Purchased goods and services, 2) Capital goods, 3) Fuel- and energy-related activities (not included in scope 1 or scope 2) 4) Upstream transportation and distribution, 5) Waste generated in operations, 6) Business travel, 7) employee commuting, 8) Upstream leased assets, 9) Downstream transportation and distribution, 10) Processing of sold products, 11) Use of sold products, 12) End-of-life treatment of sold products, 13) Downstream leased assets, 14) Franchises, 15) Investments

[3] Avoided emissions through use of products are distinct from carbon offset through external emission reducing projects. The external emission reducing projects refer to activities that reduces, absorbs, or removes GHG emissions in a way that meets international standards. The activity should be conducted outside of the organizational boundaries. Certified carbon reduction credits can be used to offset emissions to fulfill reduction goals.

3. Principles

The guidelines shall be based on the principles of relevance, completeness, consistency, transparency and accuracy.

Relevance

- Quantifying and reporting of GHG reduction of products should reflect the effect of products' emissions.
- The report should contain sufficient information to support decision making of the interested parties.

Completeness

- Total GHG emissions should be calculated carefully by including every source from the perspective of the product life cycle.
- For specific exceptions made, evidence and clarification should be presented.

Consistency

- A consistent methodology should be used to enable meaningful comparison of greenhouse gas emissions over time.
- Any changes upon data, analysis scope and methodology should be clearly disclosed.

Transparency

- Quantification and reporting should be based on facts and carried out in a consistent way.
- A full explanation is required as to all of data, assumptions, methodologies which are introduced in the report.

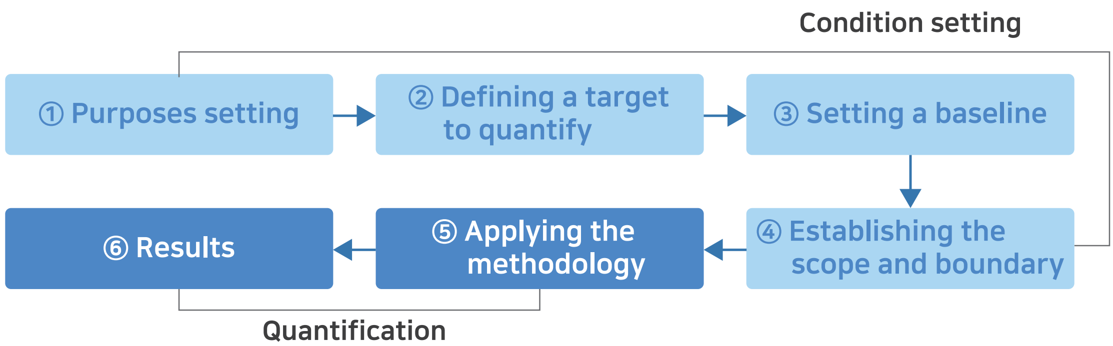
Accuracy

- It is required to minimize ambiguities by securing quality data and presenting appropriate methodology of calculation.
- Correctness as to information provided in the report is compulsory in order to support decisions made by the interested parties.

4. Steps for Quantifying Avoided Emissions

In the guidelines, we define 6 steps to quantify avoided emissions. ▶Purpose setting, ▶Defining a target to quantify, ▶Setting a baseline, ▶Establishing the scope and boundary, ▶Applying the methodology and ▶Results

| Figure 4-1. The procedures for calculating avoided GHG emissions |



4.1 Purpose setting

The purpose for quantifying avoided emissions should be defined above all. There is no certain guidance as to setting the purposes. Companies should set the purposes with their own discretion.

The next steps of quantification (defining a target to quantify, setting a baseline and so on) should be decided accordingly.

4.2 Defining a target to quantify

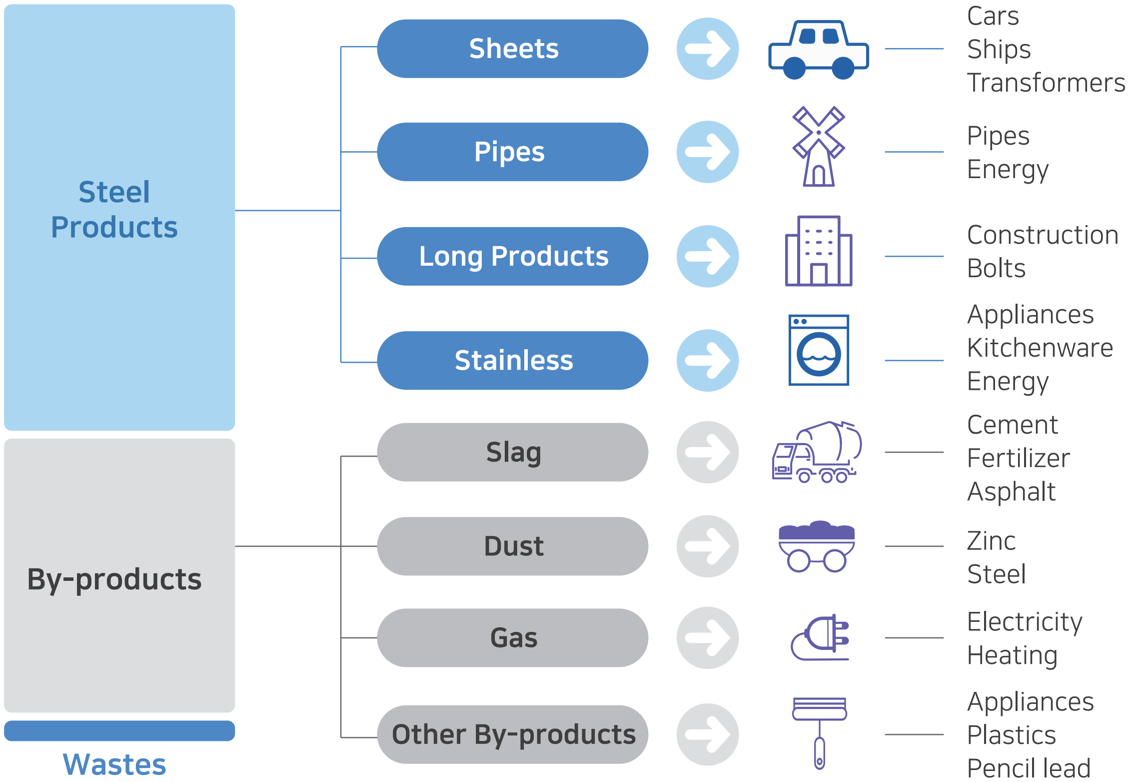
A target can be a product which has a function of reducing GHG emissions. The function can be described as a GHG reduction effect which results from the use of the product. Energy efficiency or recycling rate can be examples of this function.

The correlation between the function of the product and the effect should be demonstrated in a scientific way. And companies should consider this before they choose a product to quantify avoided emissions.

For steelmaking companies, the target can be either steel products or by-products. Steel products refer to sheets, wire rods, pipes, etc., and by-products refer to slag, coke oven gas, blast furnace gas, and so on.[4]

[4] Scrap is one of the main by-products of the steel industry. However, it can be reused as a resource for steelmaking process and it is considered to contribute to reducing worksite emissions of the steel industry. Therefore, the guidelines do not include scrap as a product in the context of quantifying avoided emissions.

| Figure 4-2. Products and by-products of the steel industry |



4.3 Setting a baseline

To quantify avoided emissions, there should be a product or a specific measure to be compared. This product is defined as a "baseline" in the guidelines. In other words, the baseline product refers to a product that replaces the target product, but without the function of avoiding emissions.

The baseline should be determined appropriately, according to the reporting quantification purposes. It is generally set as a product with a high probability of being replaced by an eco-friendly product.

If the baseline is set too low, the amount of avoided emissions will be overestimated compared to the actual emissions reduction. Conversely, if it is set too high, there will be less motivation for the company to account for and report avoided emissions as the outcome will be underestimated.

Therefore, the reporting entity should carefully review the baseline and provide a clear explanation of the rationale for setting it. The baseline product should have the same function as the target and should be used in the same application.

The following methods can be considered for baseline setting.

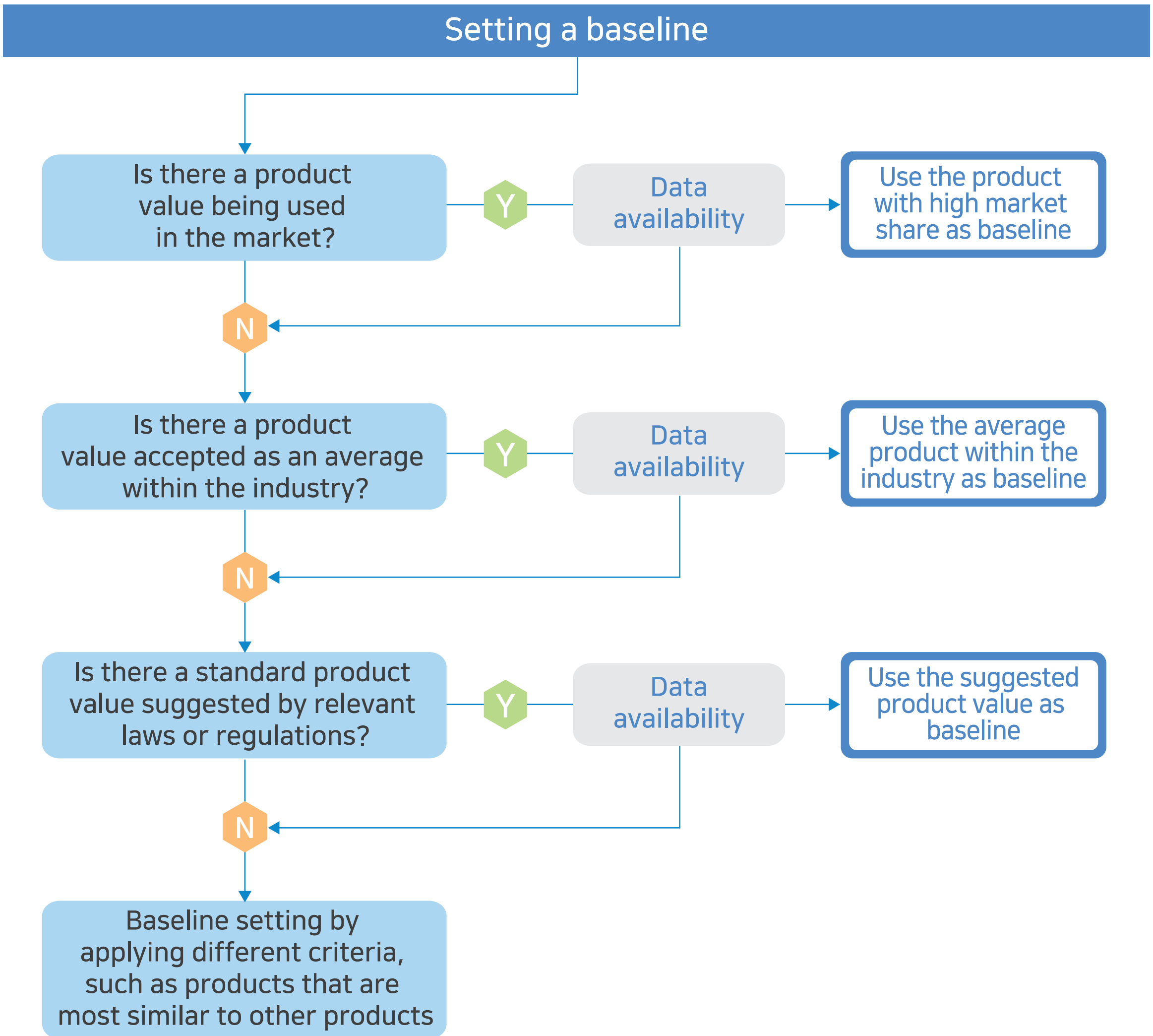
- Products universally used in the market (high market share)
- Products recognized as an average within the industry (average value)
- Standard products suggested by laws or regulations (standard value)

Products universally used in the market should take priority and be selected based on metrics such as market share or sales volume when setting the baseline. If those data are not available, products recognized as an average within the industry and then standard products suggested by laws and regulations should be selected in sequence as alternatives.

If data cannot be obtained for all three methods or cannot be adopted for other reasons, it is recommended to establish a baseline to which other criteria are applied, such as the product most similar to the target product, and describe the reason for the establishment.

In addition, the baseline value needs to be updated and adjusted to reflect market changes and technological development. The reporting company should update and apply the appropriate baseline at that point in the periodic calculation and reporting of avoided GHG emissions.

| Figure 4-3. Baseline Setting Decision Tree |

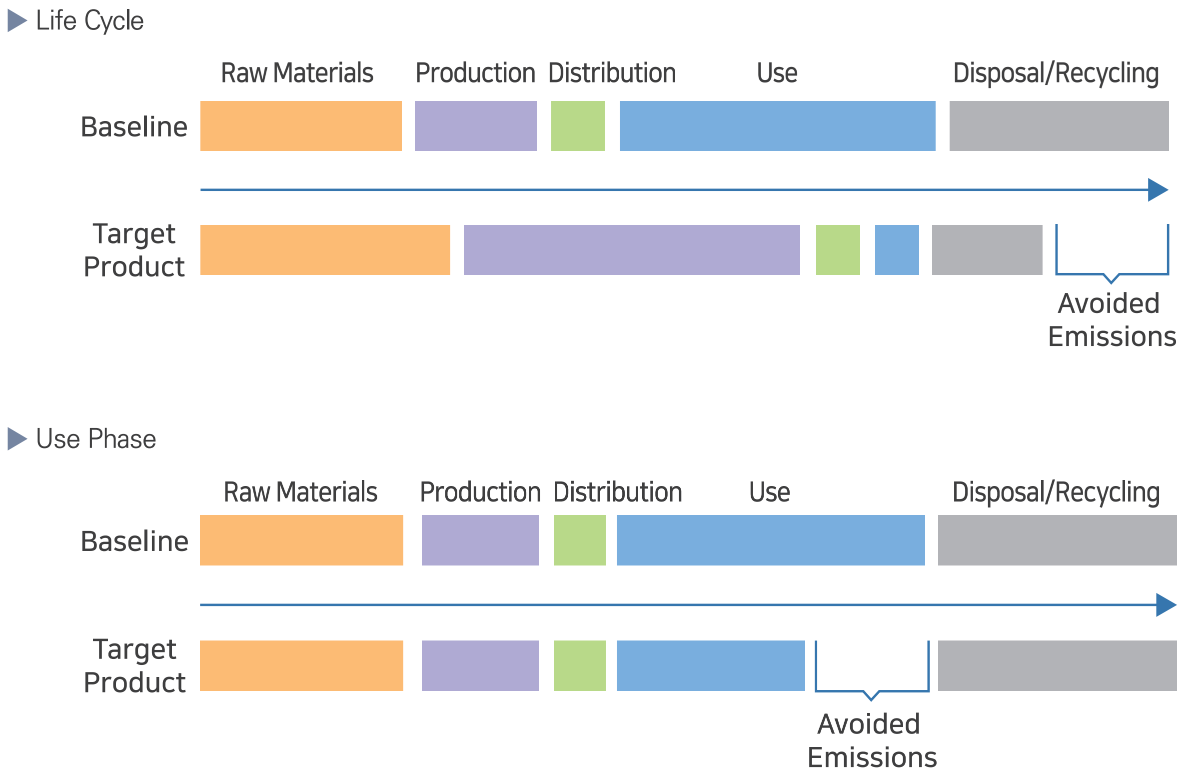


4.4 Establishing the scope and boundary

The calculation range is based on the life cycle in principle. The sub-steps constituting the life cycle may differ depending on the characteristics of the value chain of the calculation target. In the case of steel products, it can consist of raw materials, production, distribution, use, and disposal/recycling stages.

In some cases, it is possible to omit certain sub-steps. If there is no difference in GHG emissions between the calculation target and the baseline or the overall conclusion does not change significantly due to the emission of a very small amount, the sub-step can be excluded.
If a simplified evaluation method is applied, the omitted steps and specific reasons should be presented together.[5]

| Figure 4-4. Establishing the scope and boundary |



[5] ISO 14044(2006) states that the deletion of life cycle stages, such as raw materials or production stages, is only allowed if it does not significantly change the overall conclusions of the study. The reasons for their omission shall be explained.

4.5 Applying the methodology

The reporting company can calculate the reduction amount by calculating the emission difference between the baseline and the product at each stage of the life cycle and adding the difference together.
The detailed calculation method for avoided GHG emissions is explained below. Basically, it is based on the product's unit. Depending on the characteristics of the product, units such as number, mass, area, and volume can be used.

① Avoided emissions (product level) =
② Baseline product emissions – ③ Emissions of the target product

① Avoided emissions per unit of product
② Life cycle emissions of the baseline product
③ Life cycle emissions of the target product

The total amount of reduction at the company level is calculated by adding up the reduction amount of individual product units multiplied by the amount supplied or sales volume.

④ Avoided GHG emissions (company level) =
Σp {① Avoided GHG emissions (product level) X ⑤ Amount supplied (or sales volume)}

④ Total amount of avoided emissions of the company
⑤ Amount supplied (or sales volume) of the target product
p: Assessed product (the product selected among the company's products for the calculation of avoided emissions)

In addition, in order to secure accuracy and reliability when applying the methodology, it is necessary to transparently disclose all the assumptions and conditions used and review whether sufficient and appropriate data have been provided.

A Scenario Approach for Quantifying Avoided Emissions

In the guidelines, a product-based approach is suggested for calculation of avoided emissions. This approach has the advantages of easier data collection and calculation of avoided emissions by comparing the emissions of the baseline and target product. However, it has a limitation in that it is difficult to reflect the direct and indirect impact of each product on the value chain.

Accordingly, the WRI presented a scenario approach. This approach collectively calculates the avoided emission effect at a specific point in the future after a company implements a company-wide strategy and policy scenario (e.g., expansion of an eco-friendly product portfolio).

Avoided emissions (company level) =
Emissions from existing policies (baseline scenario) – Emissions from the new policy (policy scenario)

Since the scenario approach requires comprehensively reflecting many variables on a company-wide basis, such as variable definition, data acquisition, and calculation methods, it can naturally be more complicated. The practical application of the scenario approach is difficult, considering the effort, cost, and time required for quantification process and reporting.

In the future, the introduction of the scenario approach may be expanded along with the development of the avoided emission calculation system. Since strengths and weaknesses vary by each method, it is necessary to determine the most appropriate method by comprehensively considering the current conditions of the company.

| Table 4-1. Product-based approach vs. scenario approach |

	Product-based approach	Scenario approach
How it works?	· Calculate the amount of reduction for each product and derive the total amount by summing them up (bottom-up)	· Calculate the company-wide effect at a specific point in time after the company's strategy and policy implementation (top-down)
Pros	· Simple measurement method · Relatively easy to obtain data	· Systematic management and continuous expansion possible · Able to deliver consistent message in line with corporate strategy and policy direction (publicity effect)
Cons	· Difficult to predict market changes or regulations	· It is difficult to obtain data and the measurement method is complicated (It is difficult to prove the correlation between company policy and actual reduction)

4.6. Results

Results are quantified according to the methodology defined above. From a life cycle perspective, the total amount of GHG emissions reduced compared to the baseline at each stage is presented.

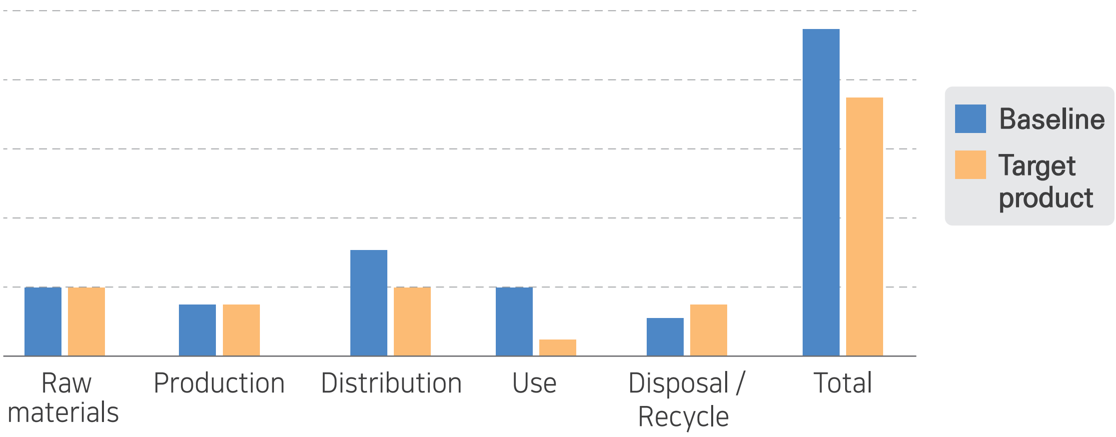
The reduction effect of each step can be expressed as a positive (+) value or a negative (-) value. A positive result indicates that the application of the target product resulted in a relative reduction in GHG emissions while a negative result indicates an increase in GHG emissions. When deriving the results, both positive and negative effects in each life cycle stages should be included.

It is also necessary to conduct a sensitivity analysis to evaluate the effectiveness of the selected methodology or the final results.

| Table 4-2. Results of avoided emissions (example) |

	Value chain emissions and reductions (tCO_2/t)					Total
	Raw materials	Production	Distribution	Use	Disposal/ Recycle	
Baseline emissions (ⓐ)	20	15	30	20	10	95
Target product emissions (ⓑ)	20	15	20	5	15	75
Avoided emissions (ⓐ - ⓑ)	0	0	10	15	- 5	20

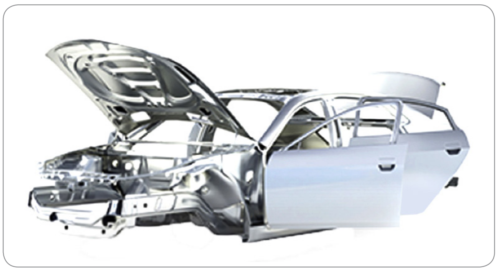
| Figure 4-5. Results of avoided emissions (example) |



Case Study

Case 1 High-strength automotive steel sheet

High-strength automotive steel sheet is thinner and lighter than conventional steel. While it maintains the same strength as the conventional steel, it reduces weight of the final product, automobiles. It contributes to the reduction of CO_2 emissions by improving fuel efficiency. When 10,000 tons of steel sheet are supplied, 6kilotons of CO_2 can be reduced annually.



Purpose setting

- Calculate how much GHG emissions can be avoided when a consumer drives an automobile made with high-strength automotive steel sheets instead of the baseline product

Defining a target to quantify

- Automotive steel sheet with high tensile strength of 340 Mpa or higher - mainly used as a material for automotive BIW
  ※ BIW (Body In White) : car body parts before painting

Setting a baseline

- Automotive steel sheet with tensile strength of less than 340 MPa (conventional steel)
  - Baseline setting criteria : products that are universally used in the current market

Establishing the scope and boundary

- Calculation of CO_2 emissions in the steel production phase and automobile use phase

- Steel production phase : CO_2 emissions from energy input in the rolling process for the production of the assessed steel product
  ※ CO_2 emissions from ironmaking and from steelmaking are assumed to be the same.
- Car use phase : CO_2 emissions from fuel use during the life of the vehicle made with the assessed steel product

Applying the methodology

Product-based approach

1) Assumption

- Supplying 10,000 tons of high-strength automotive steel sheet
- High-strength automotive steel sheet reduces vehicle weight by 20% compared to conventional steel

Applying the methodology	

Applying the methodology

2) Calculation

① Steel production phase

ⓐ CO_2 emissions from conventional steel manufacturing
= Conventional steel production (ton) x Conventional steel rolling process energy (MJ/ton) / Energy conversion factor (MJ/kWh) x CO_2 emission factor for electricity ($kgCO_2$/kWh)
= 12,500ton x 1,446MW/ton / 9.6MJ/kWh x 0.495$kgCO_2$/kWh
= 0.9$ktCO_2$

ⓑ CO_2 emissions (tCO_2) from manufacturing of high- strength steel sheet
= Production of high-strength automotive sheet (ton) x Rolling process energy (MJ/ton) / Energy conversion factor (MJ/kWh) x CO_2 emission factor for electricity ($kgCO_2$/kWh)[1)]
= 10,000ton x 2,691MJ/ton / 9.6MJ/kWh x 0.495$kgCO_2$/kWh
= 1.4$ktCO_2$

② Car use phase

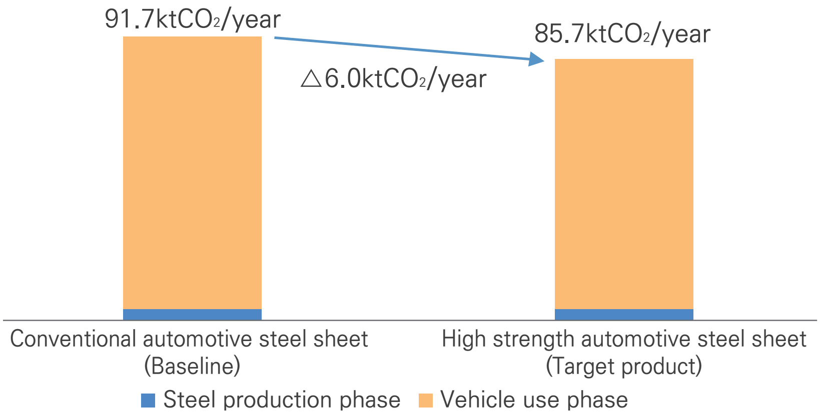
ⓒ Annual CO_2 emissions (tCO_2/year) when using a car made with conventional steel
= Conventional steel supply (ton) x Number of car bodies made per ton of conventional steel (number/ton) x Annual mileage (km/(year x number of cars))[2)] / Conventional steel-applied car fuel efficiency (km/ℓ) x Calorific value conversion coefficient (MJ/ℓ)[3)] x CO_2 emission factor in road transportation ($kgCO_2$/MJ)[4)]
= 12,500ton x 3.51(cars/ton) x 14,308km / 14.72km/ℓ x 31.0MJ/ℓ x 0.0693$kgCO_2$/MJ
= 91.6$ktCO_2$/year

ⓓ Annual CO_2 emissions (tCO_2/year) when using a car made with high-strength automotive steel sheet
= High-strength automotive steel sheet supply (ton) x Number of car bodies made per ton of high-strength automotive steel sheet (cars/ton) x Annual mileage (km/(year x number of cars)) / High-strength automotive steel sheet-applied car fuel efficiency (km/ℓ) x Calorific value conversion coefficient (MJ/ℓ) x CO_2 emission factor in road transportation ($kgCO_2$/MJ)
= 10,000ton x 4.39(cars/ton) x 14,308km / 15.77km/ℓ x 31.0MJ/ℓ x 0.0693$kgCO_2$/MJ
= 85.6$ktCO_2$/year

3) Calculation of avoided GHG emissions

- In steel production stage, the reduction effect occurs one-time at the time of manufacture, and in the vehicle use stage, the reduction effect occurs throughout its lifespan (assumed to be 10 years)
- Annual social reduction due to the supply of high-strength automotive steel sheet
= {Reduction in the steel production phase + Annual reduction in the vehicle use phase X Car lifespan} / Car lifespan
= {(a-b) + (c-d) x Car lifespan} / Car lifespan
= {(0.9 – 1.4)$ktCO_2$ +(91.6 – 85.6)$ktCO_2$/year x 10 years} / 10 years
= △6.0$ktCO_2$/year

※ References
1) CO_2 emission factor for electricity : 0.495$kgCO_2$/kWh (the national LCI factor)
2) Annual mileage per vehicle : 14,308km (the Korea Transportation Safety Authority, 2018)
3) Calorific value conversion coefficient : 31.0MJ/ℓ (the Enforcement Rules of the Framework Act on Energy)
4) CO_2 emission factor in road transportation : 0.0693$kgCO_2$/MJ (IPCC 2006, gasoline standard)

Results	Annual reduction of 6.0kilotons of CO_2 when 10,000 tons of high-strength automotive steel products are supplied 

Case 2 High-efficiency non-oriented electrical steel sheet

High-efficiency non-oriented electrical steel sheet is a steel product applied to the motor core in an electric motor.

It causes lower core loss than a conventional electrical steel sheet product when used in the motor core, thereby reducing power consumption compared to the same output and contributing to CO_2 emissions reduction in the process of using the motor.

When 10,000 tons of high-efficiency non-oriented electrical steel sheet products are supplied, the avoided GHG emission effect of 120kilotons of CO_2 per year is calculated in the steel production phase and motor use phase compared to the existing conventional non-oriented electrical steel sheet.

Purpose setting	· Calculate how much GHG emissions can be avoided when high-efficiency non-oriented electrical steel sheets with low core loss are produced and used instead of the baseline product
Defining a target to quantify	· High-efficiency non-oriented electrical steel sheet (core loss: 4.7W/kg or less) - Used in producing the motor core of high-efficiency electric motors such as traction motors, industrial motors, and large generators
Setting a baseline	· Conventional non-oriented electrical steel sheet (core loss: 13W/kg) - Baseline setting criteria: products used universally in the current market
Establishing the scope and boundary	· Calculation of CO_2 emissions from the steel production phase and motor use phase Raw materials → Production → Distribution → Use → Disposal/Recycle - Steel production stage: CO_2 emissions due to the use of energy input in the rolling process for the production of non-oriented electrical steel sheet ※ CO_2 emissions from iron making and from steelmaking are assumed to be the same. - Motor use phase: CO_2 emissions from electric power use during the life of the motor when using an electric motor product made with an electric steel sheet product
Applying the methodology	**Product-based approach** **1) Assumption** · Supply of 10,000 tons of high-efficiency non-oriented electrical steel sheet

Applying the methodology

2) Calculations

① Steel production phase

ⓐ CO_2 emissions from manufacturing of conventional non-oriented electrical steel sheet (tCO_2)
= Conventional electrical steel sheet production (ton) x Conventional electrical steel sheet rolling process energy (MJ/ton) / Energy conversion factor (MJ/kWh) x CO_2 emission factor for electricity ($kgCO_2$/kWh)[1)]
= 10,000ton x 1,214MJ/ton / 9.6MJ/kWh x 0.495$kgCO_2$/kWh
= 0.6$ktCO_2$

ⓑ CO_2 emissions (tCO_2) from manufacturing of high-efficiency non-oriented electrical steel sheet
= Production of high-efficiency non-oriented electrical steel sheet (ton) x High-efficiency non-oriented electrical steel sheet rolling process energy (MJ/ton) / Energy conversion factor (MJ/kWh) x CO_2 emission factor for electricity ($kgCO_2$/kWh)
= 10,000ton x 3,508MJ/ton / 9.6MJ/kWh x 0.495$kgCO_2$/kWh
= 1.8$ktCO_2$

② Motor use phase

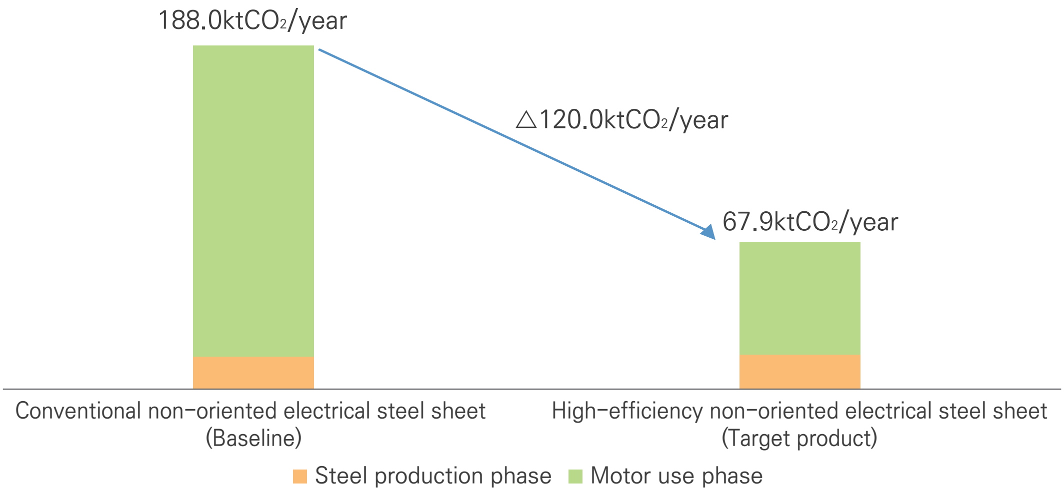
ⓒ Annual CO_2 emissions (tCO_2/year) when using a motor made with conventional non-oriented electrical steel sheet
= Conventional electrical steel sheet supply (ton) x Conventional electrical steel sheet core loss (W/kg) x Motor operation time (hours/days) x 365 (days/year) x CO_2 emission factor for electricity ($kgCO_2$/kWh)
= 10,000ton x 13.0W/kg x 8hours/day x 365days/year x 0.495$kgCO_2$/kWh
= 188.0$ktCO_2$/year

ⓓ Annual CO_2 emissions (tCO_2/year) when using a motor made with high-efficiency non-oriented electrical steel sheet
= Conventional electrical steel sheet supply (ton) x Conventional electrical steel sheet core loss (W/kg) x Motor operating time (hours/days) x 365 (days/year) x CO_2 emission factor for electricity($kgCO_2$/kWh)
= 10,000ton x 4.7W/kg x 8hours/day x 365days/year x 0.495$kgCO_2$/kWh
= 67.9$ktCO_2$/year

3) Calculation of avoided emissions

- In the steel production phase, the reduction effect occurs one-time at the time of manufacture, and when the motor is used, the reduction effect takes place throughout its lifespan (assumed to be 18 years).
- Annual avoided GHG emissions due to the supply of high-efficiency non-oriented electrical steel sheet
  = {Reduction in Steel production phase + Annual reduction in the Motor use stage x Motor lifespan} / Motor lifespan
  = {(a-b) + (c-d) x Motor lifespan} / Motor lifespan
  = {(0.6 – 1.8)$ktCO_2$ + (188.0 – 67.9)$ktCO_2$/year X 18 years} / 18 years
  = △120$ktCO_2$/year

※ References
1) Motor operating time: 8hours/day (the Korea Energy Information Center)

Results	Annual reduction of 120.0kilotons of CO_2 when 10,000 tons of high-efficiency non-oriented electrical steel sheet products are supplied 

Case 3 Blast Furnace Slag Cement

Blast furnace slag cement, which is mixed with granulated slag, a by-product of steel, supplied to cement companies, contributes to CO_2 emission reduction by reducing the use of clinker and energy consumption in the cement production process compared to the existing Ordinary Portland Cement (OPC) product. When blast furnace slag cement manufactured by supplying 10,000 tons of granulated slag to cement manufacturers replaces the existing OPC, the GHG emission reduction effect is calculated to reach 6.8kilotons of CO_2 in the cement production stage where granulated slag is used. The blast furnace slag cement case demonstrates a contribution to the reduction of GHG emissions through joint efforts between the steel industry that supplied granulated slag and the cement industry that made an effort to replace the existing cement with more eco-friendly cement.

Purpose setting	· Calculate how much GHG emissions can be avoided when blast furnace slag cement is produced by using both Ordinary Portland Cement and granulated slag instead of entirely using OPC, the baseline product
Defining a target to quantify	· Blast furnace slag cement (granulated slag 45%, Ordinary Portland Cement 55%) - Blast furnace slag cement is produced by mixing OPC with granulated slag manufactured by water cooling some of blast furnace molten slag generated along with the production of molten iron in the steel blast furnace process and supplied to cement companies ※ As of 2020, POSCO produced 93% of 11 million tons of blast furnace slag as granulated slag, 98% of which was supplied to cement companies.
Setting a baseline	· Ordinary Portland Cement (more than 85% clinker) - Ordinary Portland Cement is produced by mixing limestone raw materials and clay raw materials in an appropriate ratio, sintering them to make clinker, and then pulverizing them. - Baseline setting criteria: products that are universally used in the current market
Establishing the scope and boundary	· Cement production phase where steel slag is used  - Granulated slag use phase: CO_2 emissions due to the use of clinker as raw materials and energy used in cement production
Applying the methodology	**Product based approach** **1) Assumption** · 10,000 tons of granulated slag will be supplied to cement companies. · Granulated slag content of blast furnace slag cement is 45% on average, and Ordinary Portland Cement is replaced at a ratio of 1:1. · Clinker content of Ordinary Portland Cement is assumed to be 85%.

Applying the methodology

| Proportion and quantity needed for calculation |

Classification			Unit	Ordinary Portland Cement	Blast furnace slag cement
Proportion	Granulated Slag		%	0	45
	Ordinary Portland Cement			100	55
Quantity	Granulated Slag		kilotons	0	10
	Ordinary Portland Cement			22.2	12.2
		Clinker		18.9	10.4

2) Calculations

① Using granulated slag (cement production)

ⓐ CO_2 emissions (tCO_2) from Ordinary Portland Cement production

= Clinker consumption (t-clinker) x (Clinker raw material CO_2 emission factor (tCO_2/t-clinker)[1]
+ Sintering process energy consumption (Gcal/t-clinker)[2] x Heat conversion factor (GJ/Gcal) x Emission factor per calorie ($kgCO_2$/ GJ)[3])

= 18.9kt-clinker x (0.51tCO_2/t-clinker + 0.7417Gcal/t-clinker x 4.1868GJ/Gcal X 92.449$kgCO_2$/GJ)

= 18.9kt-clinker x (0.51+0.29)tCO_2/t-clinker

= 15.1$ktCO_2$

ⓑ CO_2 emissions from blast furnace slag cement production

= Clinker consumption (t-clinker) x (Clinker raw material CO_2 emission factor (tCO_2/t-clinker)
+ Sintering process energy consumption (Gcal/t-clinker) x Heat conversion factor (GJ/Gcal) x Emission factor per calorie ($kgCO_2$/ GJ))

= 10,4kt-clinker x (0.51tCO_2/t-clinker + 0.7417Gcal/t-clinker x 4.1868GJ/Gcal x 92.449$kgCO_2$/GJ)

= 10.4kt-clinker x (0.51+0.29)tCO_2/t-clinker

= 8.3$ktCO_2$

3) Calculating avoided emissions

Avoided GHG emissions according to granulated slag supply

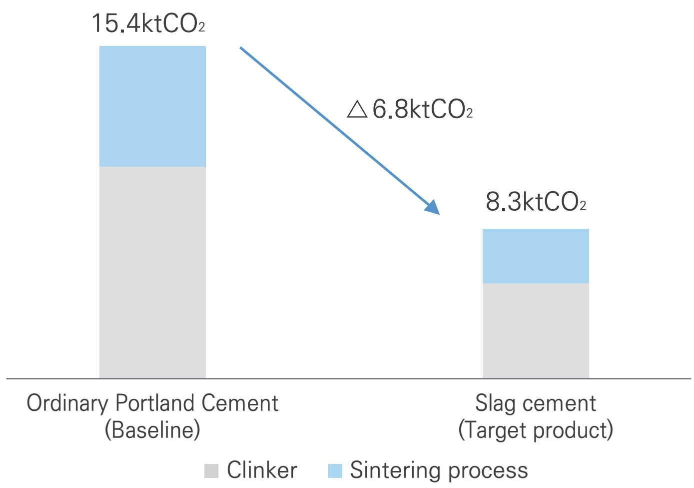
= Emissions in the granulated slag use (cement production) phase = ⓐ - ⓑ

= (15.4 – 8.3)$ktCO_2$

= △6.8$ktCO_2$

※ References

1) Clinker CO_2 emission factor: 0.51tCO_2/t-clinker (2006 IPCC Guidelines for National Inventory)
2) Sintering process energy consumption: 0.7517Gcal/t-clinker (the Korea Cement Association, energy use status (2011))
3) Emission factor per calorie: 92.449$kgCO_2$/GJ (weighted average between the national emission factor for each fuel and WBCSD cement sustainability initiative basic emission factor)

Results	When blast furnace slag cement is produced with the supply of 10,000 tons of granulated slag to cement companies, 6.8ktCO_2 reduction effect is generated. 

5. Additional Steps and Considerations

This chapter provides additional considerations and recommendations for accounting for and reporting avoided GHG emissions. The reporting company may describe its product's GHG saving mechanisms and report figures for attributed avoided emissions as described in the following sections in order to ensure better understanding and reliability for the readers and stakeholders.

5.1 Assessing mechanisms for emission reductions

GHG saving mechanisms address the aspects of how GHG emissions are avoided when applying a specific steel product or by-product. There is a range of different saving mechanisms available. An overview of various saving mechanisms and GHG savings categories is provided in Table 5-1. The reporting company may describe the specific role of its product in such a way that the reader understands how it is related to the GHG emission avoiding function of the end-use solution.

Depending on its features and applications, a steel product can be categorized into one or multiple GHG savings categories. These guidelines do not mandate the measurement of GHG emissions saved from each category.

Steel products are mainly used in buildings, infrastructure, machinery and automobiles. Thus, specific saving mechanisms depend on product categories, specific solutions and their actual applications. The five GHG saving mechanisms are described below.

High energy efficiency

One of the important mechanisms for enabling avoided emissions is to provide innovative steel products which can improve energy efficiency of the final product. For example, Non-oriented electrical steel (NO) is a type of steel with uniform power loss in all directions, and suitable for rotating devices such as motors. NO minimizes energy loss that occurs inevitably in the process of converting electrical energy to rotational energy, which results in increased efficiency.

Lower weight

Light-weighting of steel products is another important mechanism which can enable avoided emissions. With increasingly strict car emissions and safety standards, car makers have been looking for new ways to make cars lighter, stronger, and more eco-friendly. Since roughly 55-60% of a car's weight comes from steel, it is logical and sensible to make light-weighting a priority, which is exactly what took place in the industry.

In case of electric vehicles, as the average weight of a lithium-ion battery is 400-600kg, their energy efficiency is very much tied to the weight of the vehicle structure. Advanced high-strength steel allows car makers to use less material, thus greatly reducing a vehicle's weight.

Longer service life

With wear-resistant high strength steel, a machine can be made to last longer. An extended lifespan results in reduced impact of CO_2 emissions from production. If the lifespan is doubled, CO_2 emissions over the product life cycle will be halved.

Zinc-aluminum-magnesium alloy coated steel is an innovative steel product with superior corrosion resistance. Improving corrosion resistance means longer service life and less steel used and ultimately less CO_2 emissions.

Process optimization

Optimizing steelmaking processes can increase energy efficiency, thus saving CO_2 emissions. For example, a non-heat-treated steel wire rod offers high strength and good formability even without being heat-treated. It contributes to saving energy and reducing CO_2 emissions as well as cutting the costs of final processing.

Recycle and reuse

Recycling and reuse of by-products in the steel industry have a huge CO_2 savings potential. Steel slag is one of the most widely-used by-products and used in various applications.

Granulated blast furnace slag is utilized as a substitute for cement clinker. Its similar chemical composition with that of cement enables slag powder to be used as a substitute for cement. When compared to conventional slag cement, granulated slag has higher slag content and comes with improved physical properties such as high compressive strength which mitigates CO_2 generation significantly.

Steel slag is utilized as a material for artificial reefs, which are installed in the ocean to create marine forests. Steel slag artificial reefs are high in iron and minerals, which greatly help restore the marine ecosystem by promoting the growth of marine plankton and the attachment of algae spores. Also, it can withstand typhoons and tsunamis due to its high gravity and strength and is highly resistant to seawater corrosion.

Another use of recycled steel slag is for farming. Granulated blast furnace slag is rich in silicic acid (SiO_2), which is essential for rice farming, so it is made into a silicate slag fertilizer. Rice fields sprayed with calcium silicate fertilizers have the effect of reducing emissions of methane, a greenhouse gas more potent than carbon dioxide.

| Table 5-1. GHG saving categories for steel products |

Categories	GHG saving mechanisms
High energy efficiency	· Improving energy efficiency by reducing core loss
Light weight	· Improving energy/fuel efficiency by reducing the weight of final products
Longer service life	· Increasing service life and reducing replacement demand
Process optimization	· Reducing energy consumption with optimized processing stages
Recycle and reuse	· Reducing demand for primary feedstock by improving recycling or reuse of by-products

5.2 Allocating contributions of emission reductions

Multiple entities in a value chain, including raw material suppliers, manufacturers, distributors, retailers, and consumers, influence both emissions and reductions. As a result, changes in emissions are not easily attributable to any single entity and thus double counting is considered as an inherent part of avoided emissions accounting.

Nonetheless, accounting for avoided emissions occurs outside of a company's scope 1, scope 2 and scope 3 inventories. Any estimates of avoided emissions shall be reported separately from a company's scope 1, scope 2 and scope 3 emissions. It is recommended that companies disclose total avoided emissions, reflecting the collective efforts of the entire value chain.

In these guidelines, allocating contributions of emissions reduction is optional. If companies see a compelling need to attribute a fraction of the avoided emissions to the use of their products, they should do so very transparently. It is also important to have a consensus with the key value chain partners.

The reporting company is recommended to use the decision tree in Figure 8 when assessing and reporting avoided emissions to which several partners along the value chain contribute.

| Figure 5-1. Decision tree on attribution to be used by companies when assessing and reporting avoided emissions |

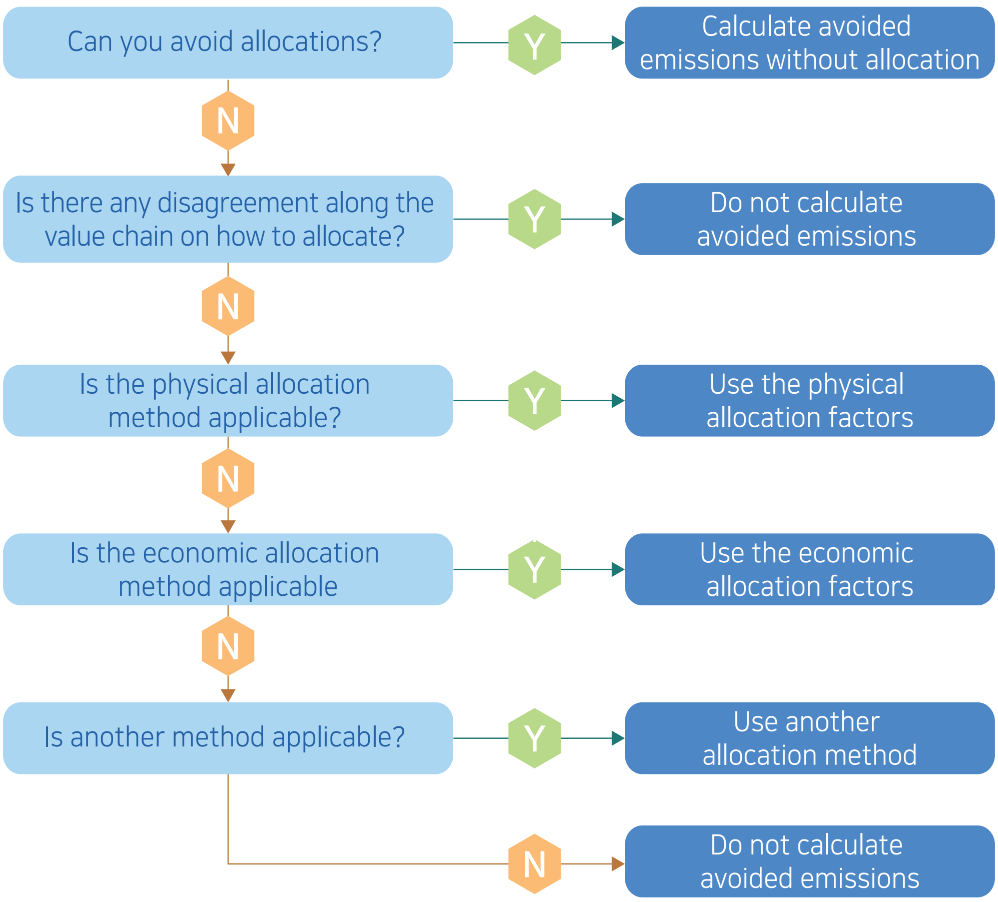


Table 5-2 illustrates an example of allocation factors. When selecting allocation factors, physical allocation shall be considered as a priority. It means allocating emissions of an activity based on the underlying physical relationship between the multiple inputs/outputs and the quantity of emissions generated. Physical allocation factors may include mass, volume and energy.

If applying physical factors is not possible, economic factors can be applied instead. It indicates allocating emissions of an activity based on the market value of each output/product. Reporting companies may apply other industry-specific or company-specific methods if necessary.

It should be recognized that different allocation methods and factors may yield significantly different results. Companies should evaluate each method to determine the range of possible results before selecting a single method.

| Table 5-2. Allocation factors (examples) |

Allocation	Factors	Examples of Factors & Formulas
Physical allocation	Mass	Mass of individual parts $\text{Contribution} = \frac{\text{Mass of Target Product}}{\text{Total Mass of Final Product}} \times \text{Total Reduction}$
	Volume	Volume of cargo transported $\text{Contribution} = \frac{\text{Volume of Target Product}}{\text{Total Volume of Final Product}} \times \text{Total Reduction}$
	Energy	Energy content of heat and electricity of individual parts $\text{Contribution} = \frac{\text{Energy Content of Target Product}}{\text{Total Energy Content of Final Product}} \times \text{Total Reduction}$
	Number of Units	Number of units shipped $\text{Contribution} = \frac{\text{Number of Units of Target Product}}{\text{Total Number of Units Final Product}} \times \text{Total Reduction}$
	Other Factors	Proportion of target product to the final product's surface area (%)
Economic allocation	Market Value	Market value and price of individual parts $\text{Contribution} = \frac{\text{Market Value of Target Product}}{\text{Total Market Value of Final Product}} \times \text{Total Reduction}$
Other	Other Factors	Other factors/formulas

5.3 Other issues

This section discusses potential issues in relation to accounting for and reporting avoided emissions. These guidelines are designed to promote further discussions and improvements on these issues, greater cooperation with value chain partners and different stakeholders.

Scenarios of future developments and uncertainties

Assumptions about future conditions can considerably impact the amount of avoided emissions calculated. Uncertainties over future conditions may include changes in energy mix and energy efficiency, regulatory policies, market conditions, recycling practices, etc.

Particularly for products with a long use phase, the reporting company is recommended to undertake a qualitative scenario analysis taking into account alternative future developments.

Cherry-picking products and product applications

When the reporting company chooses products to evaluate, it is important not to limit analyses to products that are known or expected to reduce emissions. Analyses those aggregate results at the portfolio-level should represent the company's full product portfolio, rather than a subset of products known or expected to have a positive impact.

Thus, it is recommended that companies transparently disclose why avoided emissions have been calculated for the selected products. Also, the company may describe the percentage this product represents in terms of its product portfolio and products that are excluded from the assessment.

Tackling Environmental Trade-Offs

It is important to note that there are possible trade-offs between GHG emissions reduction and other environmental impacts. GHG emissions are one of the many environmental impacts that LCA can quantify. It is needed to further studies to systematically reflect those trade-offs with authoritative references, reflecting scientific discussions and methodologies.

6. Verification and Reporting

6.1 Verification

The purposes of verifying avoided emissions are ▶ To verify whether the data was properly collected (appropriateness of data collection) and ▶ Whether the quantification methodology is appropriate (appropriateness of avoided emission quantification)

Various methods can be used depending on the need, purpose, and applicability of the company for verification. Furthermore, it can be considered to use internal verification or external verification depending on the verification entity.

1) **Internal Verification** – verification conducted by an in-house verification team
2) **External Verification** – verification conducted by a qualified third-party or an external professional organization

In general, external verification is recommended. However, considering the fact that the concept and application of avoided emissions are at an early stage of development, internal verification can also be used. The key requirements for internal verification are:

- Determine the qualifications of verification personnel and organize a verification team.
- Conduct verification in accordance with documents or internal guidelines established by credible organizations
- Review and approval of verification results by management

External verification is recommended if the main purpose is to report avoided emissions externally. The key requirements for external verification are:

- Conduct verification by an external professional organization that has been recognized for its competence in verification activities and the subject.
- Conduct verification in accordance with documents or internal guidelines established by organizations with public confidence.
- Document the final assurance results, and review and approval of verification results from management hierarchy

For any matters that are not defined in these guidelines in relation to verification of avoided emissions, internationally accepted standards, such as standards approved by the International Organization for Standardization (ISO), can be applied.[6]

[6] ISO 17029:2019 – Conformity assessment, ISO 14065:2020 – General principles and requirements for bodies validating and verifying environmental information, ISAE(International Standard on Assurance Engagements) 3000

6.2 Reporting

This section provides guidance on how to report avoided emissions. The reporting company shall comply with the requirements in Table 6-1 and additional reporting suggestions as specified in Table 6-2.

| Table 6-1. Guidance on reporting |

Category	Instructions
Quantification Purposes	· Define quantification purposes · Define which stage of the life cycle is selected for quantification
Target Product	· Describe the target product for avoided emissions Ex) unit of product (1t or 1m^3), life span, market information, etc. · Provide the product's function and application
Setting a Baseline	· Describe the baseline product for avoided emissions Ex) unit of product (1t or 1m^3), life span, market information, etc. · Provide the reasons for selection (functional similarity, market shares, etc.)
Scope and Boundary	· Provide a flow chart of value chain life cycle with qualitative explanations · Clarify omitted stages of quantification
Methodology	· Clarify the reasons why the selected quantification methodology was chosen
Results	· Disclose results of both products' emissions of each life cycle stage · Provide the reasons for omission in quantification process · Use an absolute value for avoided emissions, not percentages
Others	· Explain the quality of data sources and its transparency · Indicate whether verification was conducted

Optional information, such as mechanisms and allocation of contribution of emission reduction can be provided.

| Table 6-2. Additional elements to report |

Category	Instructions
Mechanisms	· Provide mechanisms and explanations of the product's emission reductions
Allocations	· Provide information on whether the contribution was allocated. If yes, information on the factor used to allocate should also be included · Amount of avoided emissions allocated across the value chain partners (partners must agree on the allocated emission reductions)

7. Annexes

7.1 Glossary

➤ Artificial reef

A human-created underwater structure, typically built to attract, protect and cultivate marine life.

➤ Automotive steel sheets

Steel sheets used for the production of the body of an automobile. The body consists of an outer sheet and an inner sheet. Various features such as formability, paintability, processability, weldability and corrosion resistances are required depending on the area of the body.

➤ Avoided GHG emissions

GHG emissions that can be reduced or avoided in the entire life cycle if baseline products are replaced with low-carbon and eco-friendly products and services by a company.

➤ Baseline

Specific standards or comparison product designated to calculate the avoided emissions of low-carbon products. The baseline product should be replaceable by low-carbon products in terms of functionality.

➤ By-product

Secondary substances that are generated in the process of manufacturing primary products and that have potential value. In the steel industry, by-products include slag, by-product gases, etc.

➤ Core loss

Power loss of the core caused by heat generation due to time-varying magnetic thermal power.

➤ Double counting

The product's contribution of avoided emissions being counted more than once, which includes both of the following situations: 1) the part included in a corporate's avoided emissions overlaps with Scope 1 or Scope 3 emission reductions, or 2) the amount of a corporate's avoided emissions is overlapped with the reduction amount of other companies in the value chain.

➤ Final products

Products including cars, refrigerators or washing machines that are completed in the final stage of production and used by the end consumer.

➤ High strength steel

Carbon steel that can withstand a higher pulling force compared to ordinary steel. Silicon, manganese, nickel and other elements are added for strengthening purposes.

➤ Intermediate products

Products that are produced by processing raw materials including steel, chemical products, etc. Intermediate products are used as materials or parts by manufacturers instead of being used as the final product by consumers.

➤ Life cycle

The entire cycle of a product. It includes the production of raw materials, production, distribution, product use by consumers, disposal and recycling.

➤ Magnesium-Aluminum-Zinc alloy coated steel sheet

An alloy steel sheet with higher corrosion resistance than ordinary steel sheets. It is manufactured by forming a plating layer with three elements: Aluminum(Al), Magnesium(Mg), and Zinc(Zn).

➤ Non-oriented electrical steel

A steel sheet with excellent average magnetism regardless of the rolling direction. It is mainly used for rotating equipment, such as a motor, in which the magnetization direction is not constant, but continuously changes.

➤ Product-based approach

A quantification method for avoided emissions that simply compares the emission of baseline and target products.

➤ Paris Agreement

Adopted at the 21st Conference of the Parties (COP21) in 2015, the Paris Agreement states that all countries will participate in climate action from 2020 under the global long-term goal of maintaining the global average temperature rise at a level significantly lower than 2°C compared to pre-industrial levels and trying to limit it to 1.5°C, and progressively strengthen their efforts through the monitoring of implementations every five years.

➤ Slag

Non-metallic substances, metal oxides, etc. produced in the process of separating iron (Fe) components from ore during steel manufacturing.

➤ Scenario approach

A quantification method for avoided emissions that collectively calculate company-wide effects at a specific point in the future after implementing a company-wide strategy and policy scenario (e.g., expanding the eco-friendly product portfolio).

➤ Value chain

A full range of activities needed to create a product or service. For companies that produce goods, a value chain comprises raw material procurement, manufacturing, and consumption by end users.

➤ Wear resistance

Ability to resist material loss by some mechanical actions, such as frictions and abrasions.

➤ Worksite reduction of GHG emissions

Reduction of direct and indirect GHG emissions from company-owned business sites, including facilities, factories and office spaces that produce products.

➤ Wire rod

Steel product that is wound in a coil shape with a diameter of 4.5 to 55 mm with a round cross section. It is used for springs, tire cords, bearings, etc. which are core parts of automobiles, construction and bridge building materials, and for basic materials for industries.

7.2 References

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Along the Value Chain of
Steel Products and By-products

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