Guideline Corporate and Product Carbon Footprint

of European Cold Rolling Industry

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Carbon Footprint

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Introduction and objectives

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The climate crisis is real and it has become a part of our daily life whether it is job-related or in private surroundings. It was not until the late 1990s when two of the major resources and sustainability organizations, World Resources Institute (WRI) and World Business Council for Sustainable Development (WBCSD), recognized the need for a standard in greenhouse gas accounting. In 2001 the Greenhouse Gas Protocols (GHG) first edition was published and has been a standard ever since. Various environment treaties have been signed and agreed upon in the following years, such as the Kyoto-Protocol (2005), PAS 2050 (2008), and the probably most well-known Paris Agreement of 2015. In accordance with the various pacts and programs established in international climate summits over the past decades all around the globe, the European Union has called out its goal to be the first climate neutral continent by 2050. Some of the national climate initiatives thrive to reach the greenhouse gases reduction targets or even climate neutrality before that.

This paper serves as a guideline for determining the carbon footprint of the cold rolling industry – both corporate and productwise.

Besides the sustainability aspects, it is particularly important for cold-rollers to actively reduce CO_2-emissions for the following reasons.

With the Kyoto-Protocol in 2005 the European Union has established the European Emissions Trade System (EU ETS), which is until now the main climate protection tool by putting a price-tag on CO_2-emissions. Since the cold-rolling industry is not participating in the EU ETS, it only means that cold-rollers have to deal with the additional costs inflicted by the upstream supply chain.

On the other hand, the downstream markets are demanding to report various operating figures directly to them or via platform like Ecovadis or CDP (Carbon Disclosure Project). If the idea of a climate neutral supply chain turns reality, then tools like this will help feature all of the participants within and companies be forced to take action in order to primarily continue to be part of the supply chain, but also to help achieve the net-zero target 2050.

So, as mentioned before, this paper ought to serve as a guideline for cold-rollers to establish a reliable method for the evaluation of the Corporate Carbon Footprint (CCF) and the Product Carbon Footprint (PCF). This methodological approach will then have to be certified by an external certification body, which then would lead to the introduction of a product pass including all the relevant and transparent information for downstream markets.

1. Terms and definitions

This chapter will give the reader an overview over all the terms used that are related to climate neutrality within this paper. Some terms will be explained a bit more detailed than others due to the significance of the whole matter. Others will simply be listed and if abbreviated, then written out.

Greenhouse Gas Protocol (GHG)

As mentioned in the introduction, the first publication of the Greenhouse Gas Protocol has also been the first standard in greenhouse gas accounting. Even till today it remains to be the corporate accounting and reporting standard in evaluating a carbon footprint.

Carbon footprint

A carbon footprint is defined as the total amount of greenhouse gases produced to support human activities directly and indirectly, usually expressed in equivalent tons of carbon dioxide (CO_2).

Corporate Carbon Footprint (CCF)

The entire company (or a particular business site) is assessed over a specified period. Both direct emissions (e.g., fuel combustion) and indirect emissions are measured (for example, when procuring and consuming electricity or other products that have caused emissions in their production processes).

Product Carbon Footprint (PCF)

This is the most established method for determining the climate impact of a product. Throughout the entire life cycle of a product - from raw material extraction to recycling or disposal - climate-relevant impacts arise in the form of greenhouse gas emissions. The Product Carbon Footprint helps to identify, analyze and, with the right measures, reduce or (ideally) completely avoid these impacts.

Scopes

Greenhouse gas sources are divided into three scopes according to the Greenhouse Gas Protocol. The scopes are used in the greenhouse gas balancing of companies and products. Further details are described in section 7.

A full list of abbreviations can be found in the annex of this paper.

2. Greenhouse gases effect

The main driver of climate change is the greenhouse effect. The greenhouse effect results from the fact that the gaseous atmosphere of the earth allows short-wave solar radiation to pass through, but the gases in the atmosphere absorb long-wave thermal radiation. These gases are called greenhouse gases.

The greenhouse gases reflect the absorbed heat equally in all directions - which means that part of the heat is also reflected to the earth's surface. Without this natural greenhouse effect, the earth would be covered in ice.

Due to anthropogenic influences, a continuous increase in the atmospheric concentration of greenhouse gases (GHG) is taking place. As a result, more and more thermal radiation is absorbed by greenhouse gases and therefore the radiation is blocked to leave the atmosphere. The most significant greenhouse gases include carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), ozone (O3), and fluorinated gases.

More technical information can be found under following website:

https://scied.ucar.edu/learning-zone/how-climate-works

3. Principles of greenhouse gas accounting

The principles of greenhouse gas accounting according to the Greenhouse Gas Protocol include relevance, completeness, consistency, transparency, and accuracy. Terms also used in other forms of accounting such as the GAAP (Generally Accepted Accounting Principles) in the financial world.

According to the GHG-Protocol, the principles can be described as follows:

Relevance
The greenhouse gas accounting reflects on the inventory and therefore serves as a decision-making unit, which is relevant for all activities towards climate-neutrality. Ensure that the methods used, and information gathered support the decision-making process. Prepare information in such a way that the results are understandable and comprehensible to the readers. 95% of all emitters are to be covered.

Completeness
Generally, all greenhouse gas emitters or sources need to be identified and listed

within the inventory boundaries (Scopes). If, however, certain emitters are excluded, then this decision must be disclosed and justified.

Consistency

Choose methods, data and assumptions that enable comparison over time. Methodologies used in greenhouse gas accounting should allow to make comparisons of emissions over a period. If changes in the evaluation process or any other relevant factors are made, then these changes need to be documented.

Transparency

All of the previously mentioned principles run together in this point, as the documentation ought to be as transparent as possible. Any relevant assumptions, references to methodologies should be disclosed. Present and document all relevant issues in a logical sequence. Disclose all relevant assumptions and cross-referencing of methods and data sources used. Present the scopes and balance sheet boundaries to be considered. Explain all estimations and calculations.

Accuracy

Operational figures that are being evaluated within the whole process of greenhouse gas accounting should be as exact as possible. The more accurate the evaluated figures are, the better it will enable users to act and decide based on reasonable assurance.

Observing the principles mentioned before within the data acquisition, the following four stages will ideally lead to climate-neutrality:

I Greenhouse gas accounting
   This stage is inevitable in the whole process, as it displays the organization's and later on all of the product's CO_2-emitters. Evaluating all of the emitters within an organization will by far be the most sumptuous, but yet the most important activity.

II Reduction or avoidance of greenhouse gas emissions
   After identifying all of the company's emitters, specific measures towards a climate-neutral production can be planned and in the best case implemented, if economically possible.

III Compensation
   In practice, it will turn out that some of the activities or emitters cannot be eliminated due to the production process or because these measures are economically unreasonable. In this case, it will be possible to compensate by acquiring certificates such as "green electricity".

IV Verification of climate neutrality

This certificate will be issued by a third party after an audit.

The chart below shows steps I and II in the process of becoming a climate-neutral company. Detailed information on the whole evaluation process, determining operational and organizational boundaries, choosing emissions factors, and so on will be given at a later point of this paper.

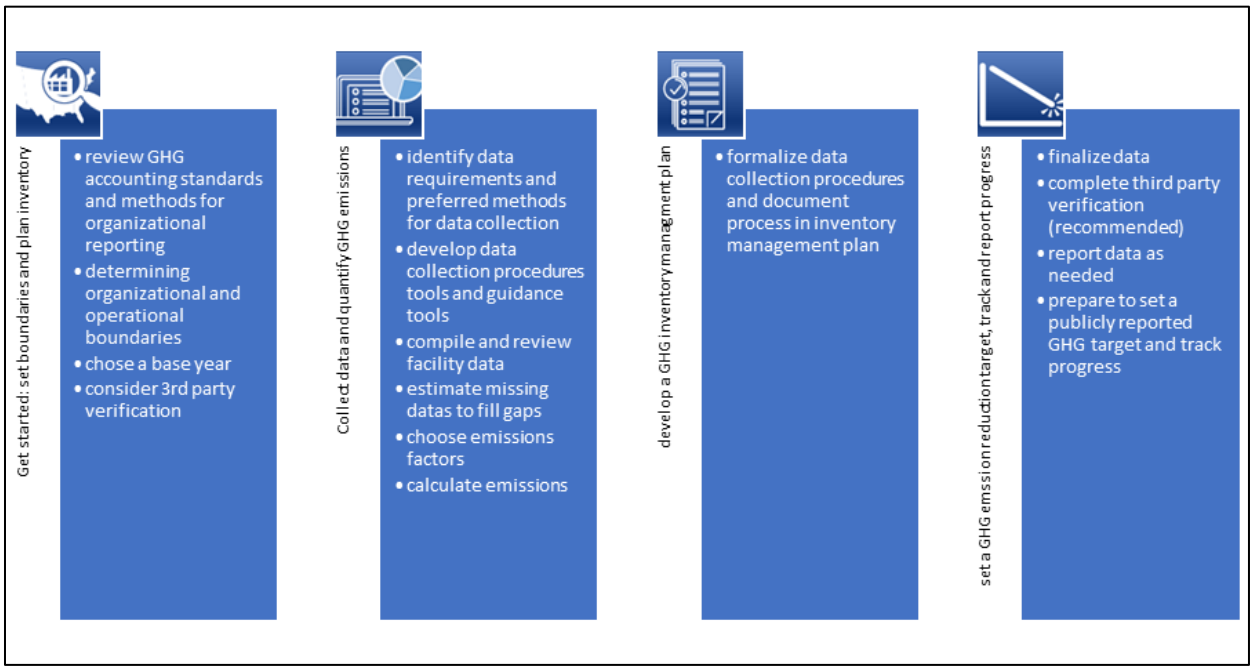


Figure 1: *Roadmap towards climate-neutrality*
Source: *Own creation of working group member company*

4. Standards and norms

This chapter is set out to give the reader an overview of the most important standards and norms that are around, when it comes to greenhouse gas accounting and climate-neutrality in general. As already mentioned in the introduction, the climate-crisis is real and various summits regarding climate relevant topics have since then been held and treaties, pacts, and agreements have been signed. Besides those treaties, pacts, and agreements different norms have also been established and are in effect. The upcoming passages are aiming at clarification in this jungle of mainly ISO norms.

ISO 14064-1 (-3)

This norm addresses the Corporate Carbon Footprint (CCF) and therefore views the company at an aggregated level with all its emissions. It helps to evaluate all of the emissions in a structured manner and to make decisions for the right

measures. In terms of content, it is strictly oriented towards the Greenhouse Gas Protocol.

ISO 14067

This norm specifies principles, requirements and guidelines for the quantification and reporting of the carbon footprint of a product (CFP), in a manner consistent with international standards on life cycle assessment (LCA) (ISO 14040 and ISO 14044).
It will play the major role in the following chapters of this paper.

ISO 14040

This norm describes the principles and framework for life-cycle assessment (LCA) and it covers LCA-studies and life cycle inventory (LCI) studies. However, it does not describe the LCA technique in detail, nor does it specify methodologies for the individual phases of the LCA.

ISO 14044

This norm specifies requirements and provides guidelines for life-cycle assessment (LCA). It addresses all of the product's environmental impacts by including the following ISO norms:
(-ISO definition of the goal and scope of the LCA (ISO 14040)),
-the life cycle inventory analysis (LCI) phase (ISO 14041),
-the life cycle impact assessment (LCIA) phase (ISO 14042),
-the life cycle interpretation phase (ISO 14043)

The two ISO norms 14040 and 14044 combined represent the new standard in terms of the LCA.

ISO 50001

This norm deals with energy management and energy management systems and was introduced in 2011. It is widely used in different industrial sectors as well as different enterprise sizes. Its goal is to identify possible savings in terms of energy consumption towards a higher efficiency.
It must be said that this norm is not mandatory, but to have an energy management at one's disposal will surely facilitate the evaluation of energy consumption and allocation of energy current flow within the production process.

ISO 22095

This norm deals with the chain of custody and ensures to be able to trace back a certain product within its supply chain. It helps boost manufacturers and consumers' confidence by ensuring transparency of specific claims and therefore reducing risk and loss for manufactured goods.

5. Corporate Carbon Footprint

The Corporate Carbon Footprint (CCF) refers to the total amount of greenhouse gas emissions generated directly or indirectly by a company's business activities over a defined period. The boundaries of the balance can be drawn, for example, around the entire company, a location or a part of the company. The balance of the individual value-adding and non-value-adding processes within the balancing boundaries is worked out in detail and used as a basis for the targeted determination of the CO_2 balance of the individual products via the process route, input materials, transports, etc.

The CCF supports companies in identifying the greatest potential for reducing GHG emissions along the entire value chain and deriving suitable improvement measures from this. In addition, the CCF ensures transparency and allows opportunities and risks, such as climate-related risks, legal regulations and supply chains, to be evaluated.

Emissions (Scope 1 and 2) are mandatory to determine according to ISO 14064-1 and GHG. Scope 3 emissions are voluntary but must be considered and assessed for materiality. A detailed description of the scopes will be found in chapter 7.

For the consideration of CCF, the first priority is to fulfill relevance, completeness, consistency, transparency and accuracy according to the GHG Protocol.

As an organizational boundary of the cold rolling industry, the control approach should be adopted for data collection and reporting of GHG emissions. The scope of the CCF should include all sites that are under the control of the company. This means that only GHG emissions or removed quantities from operations that are either under the financial control or under the operational control/direction of the organization are considered. The organization has full authority to initiate and implement its business policies at the sites. In addition, the emissions of the supporting functions shall be considered. See also Annex A of DIN EN ISO 14064-1.

The quantitative determination of the CCF is carried out on the basis of an annual balance sheet. A so-called "base year" is defined, as described in the standard under chapter 6.4 "Base-year GHG inventory". This makes it possible to compare annual emissions with a reference and to quantify developments, as well as to evaluate the success of measures taken.
There are several standards for balancing. However, ISO 14064-1 and the GHG Protocol Corporate Standard are authoritative.

- DIN EN ISO 14064-1, Greenhouse gases - Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals.
- GHG Protocol Corporate Accounting and Reporting Standard for Scope 1 and 2 categories.
- GHG Corporate Value Chain Accounting and Reporting Standard for Scope 3 categories of a company's upstream and downstream value chain.
- DIN EN ISO 14040, Environmental management –(LCA) Principles and framework (ISO 14040:2006 + Amd 1:2020); German version EN ISO 14040:2006 + A1:2020

6. Product Carbon Footprint

The Product Carbon Footprint (PCF) describes all greenhouse gases emitted over the entire life cycle of a product.
The PCF aims to determine the climate impact of a product throughout its entire life cycle ("cradle to cradle") - from raw material extraction to disposal/recycling. This goal is not achievable for the products of the cold rolling industry, as they are semi-finished products and therefore an analysis according to Life Cycle Economy is only possible with the production of parts and their use in the finished product. Due to the lack of data and the complexity of tracking the products produced, the calculation of the climate-relevant impact of greenhouse gases that occur after cold strip production cannot be presented in accordance with the principles of the GHG Protocol (completeness, consistency, transparency and accuracy). For this reason, the "partial" variant of the PCF described in the standard can be used in the cold rolling industry (3.1.1.2, DIN EN ISO 14067).

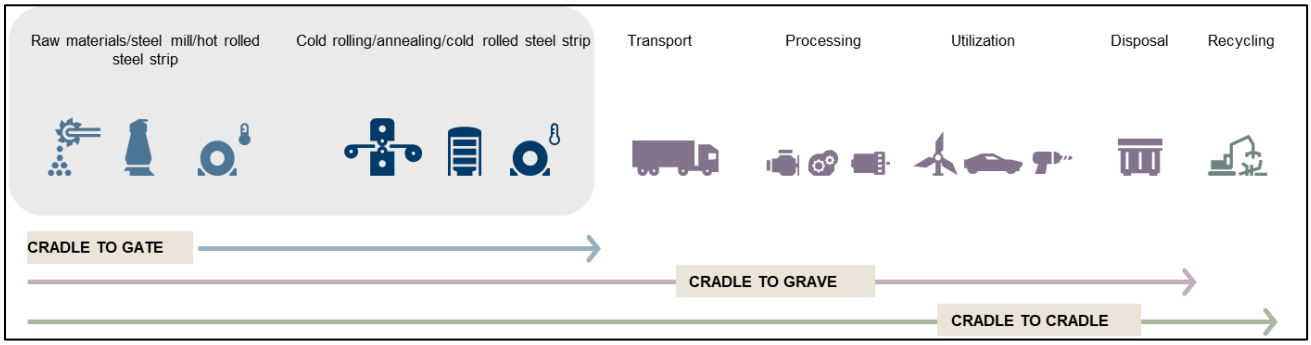


Figure 2: *Greenhouse gas emissions along the life cycle of a product*
Source: *Own creation of working group member company*

For the PCF in the cold rolling industry, the amounts of GHG emitted and removed by selected processes within the life cycle of a product are calculated. For these

selected processes, the "cradle to gate" approach is most appropriate for the cold-rolled strip produced. With this approach, everything that occurs from raw material extraction to product shipment at the factory gate is accounted for and thus represents the company's sphere of activity. All emissions caused within the company's own plant gates are accounted for, taking upstream emissions into account. Both direct and indirect emissions are considered. Transport to the customer, further processing, use and disposal phases are not taken into account. ISO14067 and the GHG Protocol Corporate Standard are used as the basis for accounting.

The main emissions from cold-rolled products are caused by the purchased starting material (hot-rolled strip, cold-rolled strip, wire rod). It is therefore necessary to pay particular attention to these. The aim should be to use verified emission values from the starting material suppliers as far as possible for the calculation. With these, ideally, verified values, you can calculate the PCF, taking into account the emissions generated within the company itself for the manufacture of the product under consideration.

The Corporate Carbon Footprint forms the basis of the calculation for the Product Carbon Footprints. The basic goal should be that the sum of the PCF's is approximately equal to the balance of the CCF.

- DIN EN ISO 14067, Greenhouse gases - Carbon footprint of products - Requirements and guidelines for quantification.
- GHG Protocol Corporate Accounting and Reporting Standard for Scope 1 and 2 categories.
- GHG Corporate Value Chain Accounting and Reporting Standard for Scope 3 categories of a company's upstream and downstream value chain.
- Greenhouse Gas Protocol Product Life Cycle Accounting and Reporting Standard.

6.1 Evaluation of Scrap

The CO2 emissions that are avoided by using recycled scrap in steel production are already allocated to the input side of the steel companies. Steel companies calculate their PCF with a database of 0 kg CO2 per t of scrap.

To avoid a double count in the downstream calculation in the PCF calculation of the cold rolling industry it is necessary to evaluate scrap with a 0 kg CO2 per t of scrap also. This means that the CO2 emissions of scrap produced must be added to the cold-rolled product.

The possibility of the DIN EN ISO 14067 according to "D.3 allocation in a closed loop" cannot be chosen. Because only one organization takes the CO2 benefit of scrap into account.

7. Scope definition

The GHG Protocol provides the most widely used accounting standards for greenhouse gases (GHG) worldwide. In order to better describe direct and indirect emissions and to subdivide them into appropriate categories, so-called scopes are used in GHG accounting. A distinction is made between three scopes.

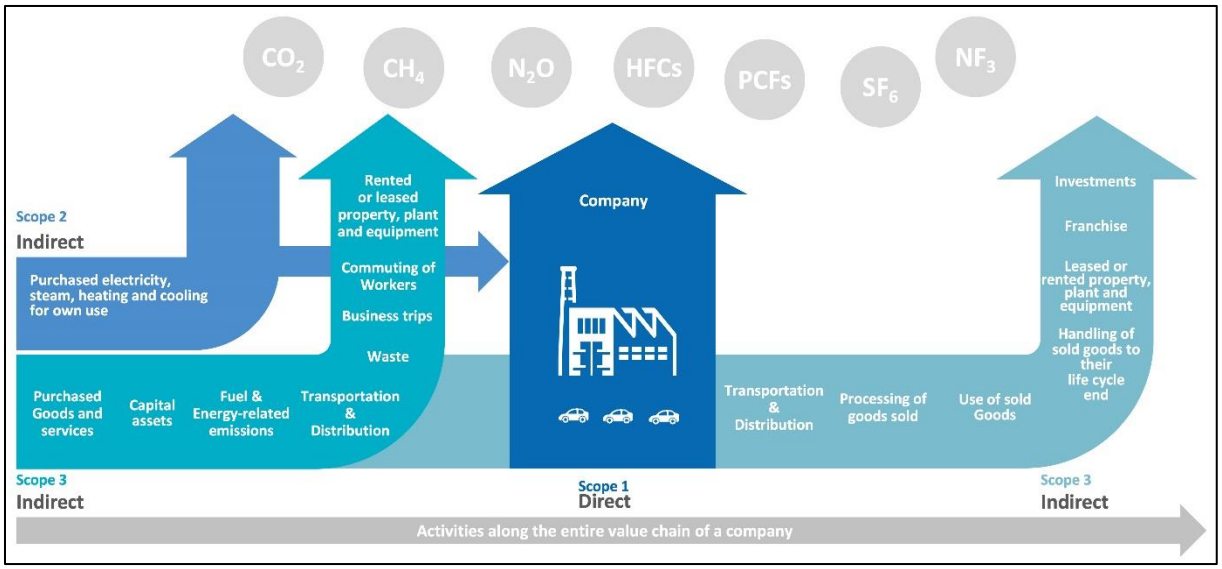


Figure 3: *Activities along the entire value chain of a company*
Source: *https://www.gut-cert.de/leistungen/treibhausgasbilanzen/carbon-footprint/corporate-carbon-footprint*

The presentation of the results of the greenhouse gas calculation are often oriented to the classification of emission sources according to the GHG Protocol (Scope 1, 2, 3). If the reporting is done according to the requirement of ISO 14064-1, a correlation to the categories of direct and indirect emissions (mentioned in ISO14064-1) should be established. The classification is based on the categories 1 to 6 described in Appendix B "Classification of direct and indirect greenhouse gas emissions" of ISO 14064-1.

7.1 Scope 1

Scope 1 describes the direct emissions from combustion processes, emissions from vehicles, and direct process emissions from spills, chemical processes, etc.

that result from the processes, arising from the activities of an organization and its associated business units.
The cold rolling industry uses annealing and hardening processes for heat treatment. For this purpose, mostly natural gas-fired bell and continuous furnaces with corresponding emissions are used, which are considered in the balance sheet.

Scope category	Description according to the GHG protocol	Description
1.1	Direct emissions from combustion processes of stationary plants	For example, the natural gas and heating oil consumptions from the stationary plants are considered. Data basis are e.g. meter readings and invoices.
1.2	Direct emissions from combustion processes from mobile plants	For example, liquid gas consumption for forklifts and the fuel consumption of company vehicles are considered.
1.3	Direct emissions of volatile gases	Climate-relevant gases are considered, which can escape through leakages, e.g. in air conditioning and refrigeration systems, as well as in CO_2 extinguishing systems.
1.4	Direct emissions from processes	Installations covered by the EU Emissions Trading System. (if applicable)
1.5	Direct emissions from land uses or changes in land uses.	(if applicable)

7.2 Scope 2

Scope 2 emissions are indirect emissions from imported energy. This includes, for example, electricity, heat, or steam purchased by the company and used within the organizational boundaries.

A typical example in cold rolling mills are the emissions generated during the production and use of purchased electricity for production operations.

Scope category	Description according to the GHG protocol	Description
2.1	Indirect emissions from purchased electricity	The electricity consumption is considered. Data basis are e.g. meter readings and invoices of the energy supplier.
2.2	Indirect emissions from district heating/cooling	For example, purchased district heating/cooling is considered. Data basis are e.g. meter readings and invoices.
2.3	Indirect emissions from purchased steam	For example, purchased water vapor is considered. Data basis are e.g. meter readings and invoices.

7.3 Scope 3

Scope 3 includes all other indirect GHG emissions along the upstream or downstream value chain. The emissions listed in Scope 3 are related to a company's business activities, but do not occur at sites owned or controlled by the organization. Scope 3 emissions include indirect emissions related to the production and use of purchased goods and services, the transport of goods, and other indirect emissions from a company's business activities.

These emission sources occur along the entire value chain, both upstream at suppliers and downstream at customers. For this reason, Scope 3 is divided into 15 subcategories, that are assigned to upstream and downstream activities.

These 15 categories are based on the GHG Protocol. When creating the CCF, all 15 categories according to the GHG Protocol, including the downstream processes, are to be assessed for materiality. At the product level, only the upstream processes are of interest according to the "cradle to gate" approach.

7.3.1 Upstream activities

The term "upstream activities" includes all emissions that occur in the upstream value chain. Thus, all GHG emissions are considered that occur at suppliers for the organization's purchased products / services.

The main Scope 3 emission sources from upstream activities are raw materials, supplies and their delivery.

Scope category	Description according to the GHG protocol	Description
3.1	Purchased goods and services	For example, purchased raw materials and services are considered. The data basis is formed by delivery quantities and invoices.
3.2	Production resources/fixed assets	For example, shielding gases for heat treatment, essential auxiliary and operating materials are considered. Meter readings, delivery quantities and invoices form the data basis.
3.3	Fuel- and energy-related emissions	Production, distribution, transportation, and transmission losses from energy source and fuels (not included in Scope 1 or Scope 2)
3.4	Upstream transport and distribution	For example, transports from suppliers to the company (rail, road, sea and air), as well as internal transport between the sites are considered. The data basis is formed by delivery quantities, distances and invoices.
3.5	Waste generation in the company	For example, scrap disposal, waste and wastewater are considered. Invoices form the data basis.
3.6	Business Travel	All business trips are taken into account. Travel expense reports form the data basis
3.7	Professional trips of Employees	The average distance from the employee's home to the workplace is taken into account. 220 working days are used as a basis.
3.8	Leased assets of the upstream value chain	Emissions from leased/rented facilities, premises and vehicles

7.3.2 Downstream activities

The term "downstream activities" covers all emissions that usually occur in the downstream value chain. Thus, all GHG emissions are considered that occur after the actual entrepreneurial activity.

The emission source "Further life cycle of the products after leaving the organization" should be excluded when determining the organization and system boundary. See section 7 "Product Carbon Footprint" for more information.

Scope category	Description according to the GHG protocol	Description
3.9	Downstream transport and distribution	Are not considered because the effort and complexity of data collection are not commensurate with the purpose. When determining the CCF, all items are to be evaluated accordingly and the exclusion justified. For PCF, the cradle to gate approach is followed and thus insignificant for the determination of GHG emissions
3.10	Further processing of sold intermediate products	
3.11	Use of sold products	
3.12	Disposal of sold products	
3.13	Leased assets in the downstream value chain	
3.14	Franchise operations	
3.15	Investments	

PCF balancing in the cold rolling industry considers the section of the product life cycle from the cradle to the factory gate (cradle-to-gate), since the options for further use and processing of the semi-finished product supplied to customers are so diverse and significantly different that further consideration of product use and the end of the product life cycle would be very difficult to capture and inappropriate in terms of effort.

In addition to the possibility of subdividing the emissions according to the scopes described above in terms of the GHG Protocol, DIN EN ISO 14064-1 offers a possibility for this.
The standard describes this possibility under DIN EN ISO 14064-1 Annex F "GHG inventory report structure and organization". There, the emissions are divided into 6 categories, which make the balance very clear and comprehensible.

8. Data quality requirements

The basic principle is that primary data will collect for all production processes. The requirement for data quality should be as high as possible in all areas and should check at regular intervals for validity and up-to-date status.
The data will collect through continuous measurements as primary data at the respective production facilities and other various measuring points and recorded and documented at best in accordance with the ISO 50001-certified energy management system. High data quality will ensure through the formation of

normalized energy performance indicators and plausibility checks, as well as monitoring and reporting of the data.
Purchased goods and services: Wherever possible, verified PCF data is requested from suppliers and service providers whose products have a significant impact on the carbon footprint. Emission factors for raw material inputs are largely based on information from suppliers and the own assessments. Uncertainties may occur due to unverified information and self-made assumptions when information is not available. The assumptions are made based on reference values. An evaluation of the data quality must be assessed for each individual item of the respective scopes, e.g., very good, good, sufficient, poor...

Scope 1:

I. Stationary combustion
In the cold rolling industry, natural gas is typically used as an energy source. As Scope 1 the natural gas and heating oil consumption from the stationary plants will be considered. Gas consumption shall be divided by type of use e.g. process heating or hall heating.
If any facility is considered "process facility", the gas consumption will be measured in the facility. The gas consumption of the bill or the general meter of the plant, can be used to verify that the sum of the different meters is correct.
The national gross calorific value (e.g., Germany: UBA natural gas (Hs) emission factor – Publication "CO2-Emissionsfaktoren für fossile Brennstoffe 2022") is used to calculate emissions from natural gas use.

II. Mobile Combustion
The diesel/petrol consumption can be calculated with the purchase of total diesel/petrol (in liters) with origin of invoices. Or liquid gas consumption e.g. by forklift vehicles will be considered. As well as the fuel consumption of company vehicles.
If there are vehicles of the company (although it does not appear in the diesel purchase data directly), it must also be incorporated into the calculation.

III. Emissions from non-energy products of fuels and solvents
A list of elements that are considered synthetic lubricants will be made. Consumption can be extracted from annual bills (in m^3).

IV. Fugitive emissions
The consumption can be extracted from the gas refills made in the different equipment (such as refrigeration equipment). Climate-relevant gases that can leak from air-conditioning and refrigeration systems, as well as CO_2 fire protection

systems, will be considered. Due to the number of systems, a leakage loss of e.g. 5% on the filling volume of the system can be calculated for a conservative estimation. The data can be taken from the work documentation carried out for the refilling of refrigerant gases.

Scope 2:

I. Imported electricity

Electricity consumption shall be divided by type of installation with different uses:

- Electricity consumption in furnaces
- Electricity consumption in rolling mill
- …

If any facility is considered "process facility", the electricity consumption will be measured in the facility. The electricity consumption of the bill or the general meter of the plant, can be used to verify that the sum of the different meters is correct.

For the accounting of purchased energy, the Greenhouse Gas Protocol, ISO 14064-1 and ISO 14067 require greenhouse gas emissions to be calculated using:

- Market based emission factors: Emission factors of the electricity mix of used energy supplier, placed on the invoice (e.g., emission factor of electricity supplier and BDEW emission factor for power usage in Germany).
- Location based emission factors: Emission factors of the electricity mix of the country (e.g., UBA electricity mix in Germany).

For CCF, both values must always be calculated if market-based factors are available, and the entire GHG inventory must be documented separately based on both values.
For PCF, primarily market-based factors are to be used. If these are not available, location-based factors can be used.

Scope 3 (TRANSPORT):

I. Transport of goods (Raw material)

In order to calculate Raw Material (Steel) transport, we will define for each supplier:

- Annual purchased quantity (in tons)
- Transportation mode for each supplier, including the distance. The total CO_2e of transport can be calculated e.g. by ecotransit.

	Annual quantity (ton)	CO_2e Ship (ton)	CO_2e Train (ton)	CO_2e Truck (ton)	CO_2e Ship (ton/ ton delivery)	CO_2e Train (ton/ ton delivery)	CO_2e Truck (ton/ ton delivery)
Supplier 1	**50.000**			5.400			0,108
Supplier 2	**40.000**		400			0,010	
Supplier 3	**30.000**	1.170			0,039		
Supplier 4							
Supplier 5							
…							
Total CO_2e (ton)		….	…..	…..			

II. Transport of goods (Waste)
The same as in point "transport of goods (Raw material)"

III. Transport between the sites (Material)
The same as in point "transport of goods (Raw material)"

IV. Transport: Workers Mobility
The average distance from the employee's home to the workplace will consider. 220 working days are used as a basis calculated with the worst emission of diesel car.

V. Transport: Business travels
To facilitate the calculation, each company will establish trip types, incorporating an estimate of calculations of distance.
Business trips which are taken by car as well as by plane will consider. For air travel, e.g. 5% will add on to the distance to account for additional distances (re-routing/ waiting loops).

Scope 3 (Products used by the organization)

I. Purchase of raw materials: STEEL
Consumed quantities of each supplier (in tons).
Regarding conversion factors:

- Provided by each supplier
- Standard published value for Hot Rolled Steel, if no supplier data are available (e.g., Worldsteel LCA eco-profile HOT ROLLED COIL → 2,28 ton CO_2e / ton of hot rolled coil)

II. Purchase of other raw materials: Chemical Products and other consumables

Consumed quantities of each product (in tons).
Each product will be multiplied by the related Conversion Factor.

III. Waste management
Managed wastes (in tons).
Each waste will be multiplied by the related Conversion Factor.

9. Allocation procedures

Allocation is based on the quantities produced and the corresponding consumption of energy and operating supplies at the respective cost center. Consumption is recorded for each cost center and considered for one year. Consumption can be calculated in KWh/ton by comparing it with the quantity produced.
Emission factors are used to calculate emissions in ton CO_2e per ton of steel.
Service cost centers are allocated to the produced quantities on a pro rata basis.
The emissions in the production plant, will be divided into 2 groups:

I. Process facilities:
They are those facilities that transform the product, included in the "process flow chart". A list of them will be made with their main consumptions, referring to the annual production in each facility:

Main process facility	Annual main consumpsions	ton CO_2e (According to emission factors)	Annual production per facility (ton)	ton CO_2e/ ton prod.
Pickling line	2 GWh electricity	216	150.000	0,00144
	10 GWh natural gas	1.800		0,01200
Cold rolling mill	10 GWh electricity	1.080	200.000	0,00540
Furnace	3 GWh electricity	324	200.000	0,00162
	40 GWh natural gas	540		0,02700
Skinpass mill		108	100.000	0,00108
Slitting lines + packaging		108	100.000	0,00108

Values in the table for illustration only.

II. Support processes/facilities

We consider "support processes" the emissions that have not been included in the Process Facilities.

These facilities are necessary for the production plant, but do not come into direct contact with the product. They will be considered in the calculation as aggregate data, which will be divided by the Annual production (ton) (for example, 100.000 ton).

In this calculation, all emission concepts that have not been included in the Main Process Facilities point will be incorporated.

	Ton CO_2e	**Annual production (ton)**	**ton CO_2e/ ton production**
Scope1		100.000	
Gas rest	10.000		0,010
Diesel	10.000		0,010
Scope 2			
Electricity rest	10.000		0,010
Scope 3			
Workers mobility	2.000		0,002
Business travels	2.000		0,002
Consumable transport	2.000		0,002
Consumable purchase	2.000		0,002
Waste management	2.000		0,002
Transport wastes	2.000		0,005
Water consumption	2.000		0,005
Subtotal (Support facilities: Scope 1 +2)			**0,030**
Subtotal (Support facilities: Scope 3)			**0,020**
Total			**0,050**

Values in the table for illustration only.

10. Methods

The internationally accepted calculation model of the IPCC (Intergovernmental Panel on Climate Change) is used to determine CO_2 emissions in tons, because it is not possible in all cases to use direct measurements of CO_2 emissions for quantification.

Emissions CO_2e = Σ Reporting quantity sources x f CO_2e Sources

- Emissions CO_2e = sum of CO_2e emissions of all sources (ton).
- Reporting quantity sources = quantity of emitters as reporting units (ton, kg, l, kWh, m^3,...).
- f CO_2e = emission factor related to the emitter (e.g., ton CO_2e/ton).
- Emission factor is the main unit for calculating the amount of CO_2e emitted of each emission source.
- The quantity values for all sources within the company limits are multiplied by the specific emission factor to determine the sum of the resulting CO_2e emissions.

Pre-calculation:

This pre-calculation is based on the values calculated in advance with the consumption rates of the process facilities, which are based on a preferred variant and average scrap loss.

1. Define the preferential **process flow** for one product (**process facilities**). For example (CR= cold rolled):

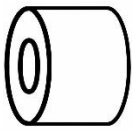
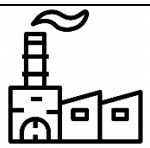
Process flow product	ton CO_2e/ ton CR-Steel
1. Pickling line	0,00144 + 0,012
2. Cold rolling mill	0,0054
3. Furnace	0,00162 + 0,027
4. Cold rolling mill	0,0054
5. Furnace	0,00162 + 0,027
6. Skinpass mill	0,00108
5. Slitting line + packaging line	0,00108
Total (Process facilities)	0,084 ton CO_2e/ton CR-Steel

Values in the table for illustration only.

2. Add the defined emission standard for the "**support facilities**"

Total (Support facilities) Scope 1 + 2	0,030 ton CO_2e/ton CRSteel
Total (Support facilities) Scope 3	0,020 ton CO_2e/ton CRSteel

Values in the table for illustration only.

 Raw material	 Raw material transportation	 Production plant		Total
		Main process facilities	Support facilities	
e.g. • 2,20 ton/ton HR-Steel • estimated scrap 0,20 ton/ton CR-Steel **Input HR-Steel 1,2 ton** 2,2*1,2=**2,640** ton CO_2e/ton	0,108 ton CO_2e/ton	0,084 ton CO_2e/ton	0,050 ton CO_2e/ton	**2,854 ton CO_2e/ton CR-Steel**

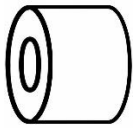
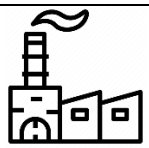
Values in the table for illustration only.

Final calculation:

To confirm the final value, the real fabrication process route with the cost center consumption rate and real scrap loss will calculate. The scrape rate through the production route has a significant impact on the Product Carbon Footprint. The CO_2e resulting from the scrap will allocate to the CO_2e value of the final product.

Process flow	**Pre Calculation ton CO_2e/ton CR-Steel**	**Final Calculation ton CO_2e/ton CR-Steel**
1. Picking line	0,00144 + 0,012	0,002 + 0,01
2. Cold rolling mill	0,0054	0,007
3. Furnace	0,00162 + 0,027	0,0023 + 0,03
4. Cold rolling mill	0,0054	0,007
5. Furnace	0,00162 + 0,027	0,002 + 0,03
6. Skinpass mill	0,00108	0,002
5. Slitting line + packaging line	0,00108	0,001
Total (Process facilities)	**0,084 ton CO_2e/ton CR-Steel**	**0,093 ton CO_2e/ton CR-Steel**

Values in the table for illustration only.

 Raw material	 Raw material transporttation	 Production plant		Total
		Main process facilities	Support facilities	
e.g. • 2,20 ton/ton HR-Steel • scrap 0,15 ton/ton CR-Steel **Input HR-Steel 1,15 ton** 2,2*1,15=**2,530** ton CO_2e/ton	0,108 ton CO_2e/ton	0,093 ton CO_2e/ton	0,050 ton CO_2e/ton	**2,781** ton CO_2e/ton CR-Steel

Values in the table for illustration only.

Scrap: The procedure of scrap calculation is described under 6.1 "Evaluation of Scrap". The CO2 content from the scrap is added to the product and returns CO2 neutral to the recycling cycle.

12 Reporting scope and system boundaries

By specifying the system boundaries, the company defines the scope of the evaluation.
The GHG protocol divides the emissions into 3 scopes. The carbon footprint must contain at least 95% of all emissions.
Regarding the Corporate Carbon Footprint the balancing of greenhouse gas of Scope 1 and 2 emissions must be determined in accordance with ISO 14064-1 and GHG. Scope 3 emissions must be evaluated and considered regarding their significance.
For the Product Carbon Footprint, all greenhouse gas emissions of Scopes 1, 2, 3 are balanced in accordance with ISO 14067 and GHG with the cradle-to-gate approach.

Cielffa Working Group Carbon Footprint

System boundaries of the company

Scope of the study		Organization system boundaries
Base Year / Baseline	The emissions calculated for the base year will be used as a reference for the development of the emissions in the future. Reduction targets are defined with reference to the base year.	Calendar Year / Fiscal year
Reporting Year	Business operations will be accounted for (Calendar Year / Fiscal Year ..)	Calendar Year / Fiscal year
Reporting Limits	In the corporate balance the greenhouse gas emissions of Scopes 1, 2, 3 are evaluated and reported.	Balancing of Scope 1, Scope 2 and Scope 3 Emissions
Control Method	Emissions that fall below the system limits must be assessed at 100%.	Operational control at all locations listed by the organization. This gives the organization the full authority to initiate and implement its business policy at the respective locations.
Greenhouse Gases	All 7 greenhouse gases (GHG) must be included in the calculation.	CO_2e determination was done with the help of the following sources of information: supplier data, authorities, databases e.g. List of some databases: • UBA / BAFA • ecocockpit • ecoinvent • ecotransit • GEMIS • ProBas • Intergovernmental Panel on Climate Change (IPCC)

		• Greenhouse Gas Protocol • VDA • World Steel

Operational system boundaries of the company

Scope	**CCF** assessment according to GHG Protocol	Operational boundaries of the organization
1	will completely collected	Data collection is done for all categories.
2	will completely collected	Data collection is done for all categories.
3	Scope 3 categories are collected according to the principle of materiality and are optional. In accordance with the GHG Protocol, a statement is made for each Scope 3 category. If a category is not scored, this must be explained.	Data collection is done for the categories: ……

You should define a report for certification bodies. In the case of more than one manufacturing plant, all those plants that directly take part in some phase of the process will have to be incorporated. There is a report example in ISO 14064-1 Annex F.

13. Significance assessment

Assessment of the significance of direct & indirect emissions:

- CO_2e volume (e.g., raw material “high”, Transport “low”)
- Degree of influence
- Access to information
- Data Quality
- Stakeholder interest

Depending on the subdivision of the criterion, scores are allocated in the assessment of the scope category. The average of the criteria, a maximum of "x" points can be achieved per category.
Scope 1 and 2 categories are classified as significant regardless of the points achieved.
Scope 3 categories which have a score lower than "x" (value must be defined by the organization) are classified as insignificant.

After the assessment, only positions of Scope 3 that represent more than "x" points or a certain percentage share of "x" of the total carbon footprint will be classified as significant. The sum of the insignificant emissions will be reported separately.

Each emission source will be evaluated as significant or non-significant.

- Direct emissions (Scope 1) must be always significant: Natural gas, diesel…
- Indirect emissions (Scope 2), must be always significant: Electricity…
- Indirect emissions (Scope 3), significance is evaluated with different criteria.
- One mission source will be considered significant when the 4 criterion final addition is > 6.

An example evaluation:

			Significance points
Criterion 1	Magnitude with respect to the total	>10%	4
		3 -10%	3
		1 – 3%	2
		<1%	0
Criterion 2	Level of influence. Capacity to apply actions	There are projects that could decrease it.	1
		There is currently no possibility of reducing it.	0
Criterion 3	Risk or opportunity	Likely	1
		Unlikely	0
Criterion 4	Employee Engagement	Can motivate employees to reduce energy consumption	1

		Do not depend on the employee's behavior	0

For example, the mobility plan accounts (0.05% of the total emissions)

Criterion 1: 0
Criterion 2: 1
Criterion 3: 1
Criterion 4: 1
Result: 3 = Not significant

14. Data collection - Analysis

14.1 Primary data

Mainly scope 1 + scope 2. Consumption data of the company (e.g., acc. ISO 50001). Further breakdown of energy inputs at cost center level. In principle, primary data are collected for all production processes (see ISO 14064-1, chapter 3.2.2).

14.2 Secondary data

These are all those data that are not directly collected, but processed data. For example, to those that you have applied factors, that you estimate, or that you take from some database (see ISO 14064-1, chapter 3.2.4).

15. Calculation of carbon footprints

All emissions that occur within the system or product boundaries must be determined. For consideration of the GHG balance, the first priority is to meet relevance, integrity, consistency, transparency, and accuracy as required by the GHG Protocol. The operational control approach should be used for data collection and reporting of GHG emissions. Depending on the data, a safety margin on the total emissions should be considered to validate the values.

Greenhouse gas balances are created in the following steps:

1. Selection of the base year

For the base year, it is important to select a representative business year with a good and reliable data basis. For the cold rolling industry, 2018 is a good choice as the last "normal" pre -crisis year.

The base year forms the basis for climate targets and measuring the success of specific measures.

2. Initial analysis and significance of the GHG sources

All potential GHG emissions along the value chain are analyzed and divided into direct and indirect emissions (Scope 1-3).

An initial assessment of Scope 3 emissions outside the own sphere of influence and a relevance assessment follows with regard to:

- Quantitative: Do the emissions contribute significantly to the overall balance?
- Qualitative: Are there interests of external stakeholders?

The result is a listing of GHG sources with indication of data sources.

3. Define and apply significance criteria

In this stage, criteria must be developed on the basis of which significance assessments can be carried out (esp. Scope 3). These can take into account the following aspects, for example:

- Order of magnitude / volume of emissions.
- Degree of influence on sources / sinks.
- Access to information and accuracy of allocated data.
- Regulation, standards, sector-specific guidance / industry standards.
- Approaches to mitigating and influencing GHG emissions.
- Relevance and interests of internal / external stakeholders.
- Prioritization by cost shares.

If emissions are classified as insignificant, they must be justified.

4. Check existing data availability and quality

Primary data is preferred over secondary data from models or estimations. These can for example come from measured data, supplier receipts, calculations on literature values, fuel cards or travel expense reports.

Calculation methods must be documented transparently and comprehensibly, and uncertainties must be communicated clearly.

5. Determine emission factors

The following sources of emission factors are available:

- Energy suppliers.
- Free or commercial databases (e.g. GEMIS, ProBas, ecoinvent, GaBi, …).
- Publications of institutes and ministries or scientific publications.

6. Calculation of GHG emissions

To calculate GHG emissions, the activity data is multiplied by the agreed emission factors and summed up.

7. Indication and evaluation of uncertainties and reporting

After the company has set the system boundaries and scopes, it is necessary to start collecting data. Once the data has been collected, the emissions must be calculated. This is followed by the presentation of the results with the corresponding activities for CO_2e reduction. The functional unit is defined as the produced quantity of one ton (1 ton) of the respective product (see ISO 14067, chapter 5.3).

The calculation is based on the quantities produced and the corresponding consumption of energy and operating supplies at the respective plants. The consumption is recorded for each plant and considered for one year. By means of a comparison with the produced quantity, consumption can be calculated in KWh/ton, for example.

The international calculation model of the IPCC (Intergovernmental Panel on Climate Change) is used to determine CO_2e emissions in metric tons, since it is not possible to use direct measurements of CO_2e emissions for quantification in all cases.

The main tool for calculating the amount of CO_2e emitted for each emission source is the emission factor. The quantity values for all sources within the company boundaries are multiplied by the specific emission factor to determine the sum of the resulting CO_2e emissions per ton of steel.

Scope	Indicator	Unit	Base Year	CO2 emission factor	CO2e in ton	Share of total CO2e in %
Reference quantity						
Scope 1.1						
Scope 1.2						
Scope 1.3						
Scope 2.1						
Scope 2.2						
Scope 2.3						
Scope 3.1						
Scope 3.2						
Scope 3..						
Scope 3..						
Total						

	ton CO2e / ton final product	**Scope 1**		
		Scope 2		
		Scope 3		
		Total		

Scope	Emissions	Unit	Value	Source (e.g.)
Scope 1.1	Emission factor natural gas	ton/kWh	0,000182	Umweltbundesamt calorific value
Scope 1.2	Emission factor LPG	ton/kWh	0,000283	ECOCOCKPIT
Scope 1	Emission factor….			
Scope 2.1	Emission factor electricity	ton/kWh	0,000366	Umweltbundesamt electricity mix 2020
Scope 2	Emission factor ….			
Scope 3.1	Emission factor raw material	ton/ton		Supplier data
Scope 3.2	Emission factor hydrogen	ton/m³		Supplier data
Scope 3.2	Emission factor nitrogen	ton/m³		Supplier data
Scope 3	Emission factor ….			

Figure 4: *Calculation table as example of CCF (Calculation based on the company consumption in a specific period)*
Source: *Own creation of working group member company*

The calculation of the PCF requires that a consumption factor is defined for each process step. These consumption factors can consist of consumption values in relation to the manufactured quantities of individual aggregates. The calculated average values of the respective aggregates, which refer, for example, to electricity consumption (kWh) or natural gas consumption (kWh) per ton of processed steel, must be converted into CO_2e using verified data sources (emission factors). Corresponding data could be taken from the GEMIS database, BDEW, BAFA, or the Federal Statistical Office for the Environment. It is important that the data sources and the emission factors are deposited, as these will be updated over time.

In the further course, the determined values should be implemented in an IT structure so that a product-specific calculation can be carried out. The CO_2e is then simply offset against the tonnage processed. It is important here to take a

scrap charge (overcharge) into account since the material used does not always correspond to the output quantity.

16. Evaluation and interpretation

Once the carbon footprint has been calculated, it must be evaluated and interpreted. By evaluating and interpreting the results, priorities are identified. As a result, reduction measures can be defined and reduction targets can be formulated or existing targets can be monitored. The company must evaluate and describe uncertainties related to the quantification approaches. If a company plans GHG reduction initiatives that result in a change in GHG emissions, it must document and describe them.

For target tracking, it is essential that the company defines a base year for GHG accounting and has it verified by an external certification body. To evaluate the carbon footprint, the emissions must first be visualized according to scopes in order to show the shares of the individual scopes in the total emissions of the company or the shares in the product.

In order to identify emission priorities and saving potentials in the own company, a weighting of emitters excluding emissions from Scope 3 is helpful.

All future balance sheets prepared will be compared with this balance sheet. Future targets and plans are set using the base year. For example, the EU has set 1990 as the base year and has set a target to reduce GHG emissions by 55% by 2030 compared to the base year. The implementation of the targets should be continuously monitored so that appropriate measures can be taken at an early stage. In addition, all future developments should be questioned whether there is potential for savings. If targets are not met, there must be open communication so that an appropriate solution can be found. The major goal behind these efforts is to operate and manage in a sustainable and future-oriented manner. New targets must be set continuously, and their implementation must be strictly controlled until GHG neutrality is achieved.

17. GHG reduction initiatives

An ongoing goal should be to reduce all sources of emissions. All GHG reduction measures are associated with initial costs from the very beginning. Examples

would be the switch to green electricity, the use of green hydrogen (if technically possible) instead of gas, perhaps the purchase of green steel in the future, further optimization points such as the installation of charging stations for e-vehicles to provide new incentives, job bike offers, cooperation with freight forwarding companies that have switched to an electric fleet or plan to do so in the future. Some of these points cannot be implemented in this way at the present time because the market has not yet brought the technologies up to the required level.

Above all, areas that can be influenced, such as the switch to green electricity, should be treated with the highest priority. In areas with a dependency on the current technical status or the dependency on third parties, the approach is more difficult. The following priorities should be set:

1. Avoid CO_2 emissions
2. Reduce CO_2 emissions
3. Compensate unavoidable CO_2 emissions through selected climate projects

Currently unavoidable emissions can be offset through verified climate protection projects. Only the GHG quantities from Scope 1 and Scope 2 of the CCF are taken into account. The projects should follow the 17 Global Goals. The CO2 certificates of the offset projects certify that the CO2 emissions that were decided to be offset are compensated by removal from the atmosphere.

Compared to energy management, there is a significant advantage in considering the carbon footprint. In energy management, no distinction is made between the individual energy sources. For example, a saved kWh of electricity has a higher "value" than a saved kWh of natural gas, since the emission factor is higher by a factor of >2.

Accordingly, it makes sense to look at the actual CO_2 emissions of the individual activities rather than the absolute kWh in order to focus on the real environmental impact.

18. Reporting

As soon as the accumulation is completed, the next step is to document the gained knowledge in a meaningful report. The preparation of the report is mandatory for external verification. It enables the company to keep records and monitor its own progress over many years. In addition, a report enables public

communication of the footprint to the outside world. Both at company and product level.

The reporting of the CCF as well as the PCFs can be summarized in the form of an annual GHG report. A key question is the purpose for which the report is prepared and to whom it is addressed. This decision is essential about whether or not to make it publicly available. It is sufficient to prepare a report for internal reporting and verification purposes.

The standards present a whole range of reporting requirements. Differences may occur depending on the intended use. There is a required content and a recommended content. While the required content must be reported, the recommended content is optional. The basic requirement is that the GHG report must be fully consistent, accurate, relevant, and transparent. Both required and optional content have to be clearly summarized in a progress documentation checklist.

In order to present the reporting requirements in a clear way, all required and optional contents should first be worked out and listed. This checklist is used to document progress throughout the process and ensure that all required information is included in the report at the end.

Based on the checklist, the previously collected data and information are processed and summarized in a report. For aspects where the standard requires it, detailed descriptions and explanations are formulated. At the end, all required and optional contents of the checklist must be worked through and placed in the report.

19. Verification and validation

Verification or validation of the generated CCF/PCF is the final phase of the carbon footprinting process. It is used for quality assurance of the results and the reports produced. Third party verification of the accounting ensures that the survey is compliant with standards and includes all necessary information. The CCF can be verified on the basis of the DIN EN ISO 14064 series of standards and the PCF or the method for calculating it on the basis of DIN EN ISO 14067.

Should it be decided to perform a verification of the CCF, the verification must be performed according to the needs of the expected users of the reports. Requirements for verification as well as verifiers and verifying persons are described in the standards ISO 14064-3, ISO 14065 and ISO 14066. These are primarily addressed to the verifier and are not the subject of the standard analysis of this work.

The objective of verification is to check the organization's approach and documentation with the requirements of the 14064-1 and 14067 standards. It serves the credibility and has the consequence that the prepared balance is meaningful. For this reason, verification is mandatory.

An accredited certification body is commissioned with the verification or validation of the CCF/PCF. The verification consists of several preliminary discussions with the service provider, the preliminary review of the data basis and reports, as well as appointments for site visits and a final review of the data basis and reports.

20. Balancing method used for CO2 savings

The balancing method describes the handling of achieved CO_2 savings. The target is a sustainable product where CO_2 savings are applied to help our customers to achieve their Scope 3 emission reduction targets. It is therefore necessary to take the initiative to collect CO_2 reductions and to allocate them according to customer needs.

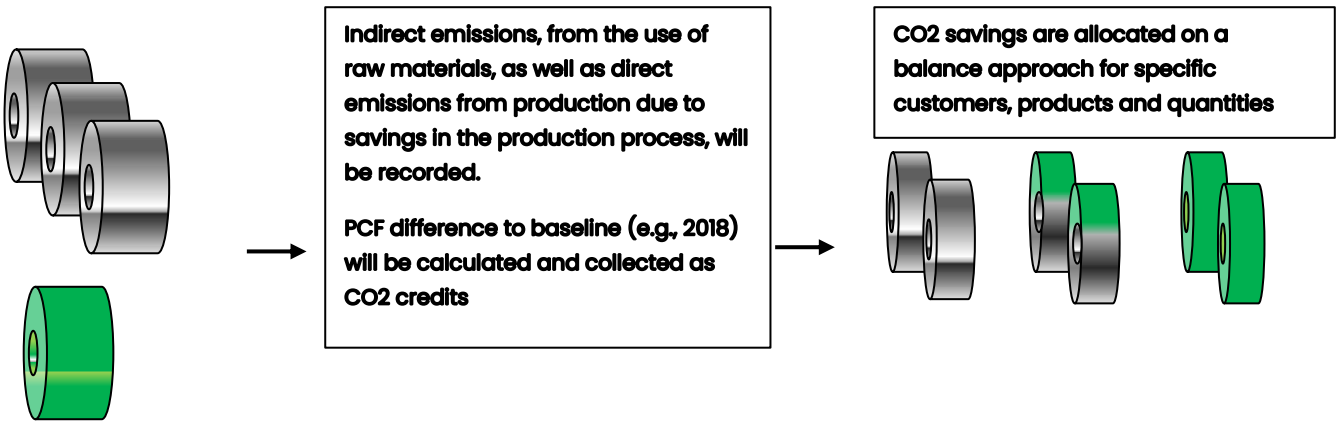


Figure 5: *Balancing method used for CO_2 savings and allocation on product*
Source: *own creation of working group member company*

The GHG balance of single products is compared with PCF of the defined base year. Ideally, emission savings are identified and quantified. Such a requirement is represented, for example, by increased using of CO_2 reduced steel.

Customers expect reliable and transparent Product Carbon Footprint (PCF) data to support their Scope 3 activities and their own calculation or reporting. For this

reason, it is important to calculate product-based PCF data and make it available to customers.

The way to distribute the CO_2 reductions achieved in real processes via an accounting approach calculated for the product is currently the only sensible way to enable CO_2 reductions at product level and the only sensible way to pass on CO_2 reductions to the supply chain in a systematic process. This gives the customer the opportunity to procure CO_2-reduced or even CO_2-free products via reduction certificates to reduce their own Scope 3. This approach is also used in the steel industry (e.g., bluemint® Steel, XCarb™, Zeremis® Carbon Lite). The steel making mills are using a balancing approach which includes the CO_2 savings projects. The reductions are based on CO2 savings which have been assured by an independent body. The emission savings are quantified as CO_2 credits compared with the defined base year and collected in an "emissions account" that can be drawn on. The total emission reduction will be allocated to selective quantities. As a result, customers have the option of obtaining products with a reduced CO_2 footprint via a balance sheet approach, provided there is a willingness to pay via the CO_2 avoidance costs. The customer can choose continuously between CO_2-neutral and conventional steel. The goal is a sustainable product where CO_2 savings are applied to reduce the PCF.

CO_2 savings both within the company and externally through the purchase of CO_2-reduced steels and energy sources, as well as savings from efficiencies, are recorded and allocated to the product. The recording, calculation and allocation is carried out in the PCF calculation tool. The transparency and accuracy will be verified and confirmed by an external certification body.

21. Summary

This guideline was developed within the working group “Carbon Footprint” of Cielffa member companies. Driven by climate change and increased requirement in the supply chain, the need for companies to achieve more sustainability is growing. The calculation of the CO_2 footprint can make a contribution. This is used to analyze the main sources of emissions and their potential for reduction. Following guideline presents the major rules of CO_2 calculation on product and company level in the production of cold-rolled steel strip. The contents of this guideline will support and assist companies during the creation and implementation of their own footprints.

Authors of this guideline were the following members of the working group:

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- BILSTEIN GmbH & Co. KG
- ARANIA S.A.
- Risse + Wilke Kaltband GmbH & Co. KG
- HFP Bandstahl GmbH & Co. KG
- Brockhaus Stahl GmbH
- Bandstahl Schulte & Co. GmbH
- Stahlwerk Unna GmbH & Co. KG

List of figures:

List of abbreviations:

BAFA	: Bundesamt für Wirtschaft und Ausfuhrkontrolle / Federal Office of Economics and Export Control (https://www.bafa.de)
BDEW	: Bundesverband der Energie- und Wasserwirtschaft / Federal Association of the Energy and Water Industry (https://www.bdew.de)
CCF	: Corporate Carbon Footprint
CDP	: Carbon Disclosure Project (https://www.cdp.net)
CFP	: Carbon footprint
CH_4	: Methane
CO_2	: Carbon dioxide
CO_2e	: Carbon dioxide equivalent
CR	: Cold rolled
CR-steel	: cold-rolled steel

DIN EN	: Deutsches Institut für Normung; Europäische Norm / DIN European Standard (https://www.din.de)
e.g.	: for example (lat. exempli gratia)
EU	: European Union (https://european-union.europa.eu)
EU ETS	: European Emissions Trading System (https://climate.ec.europa.eu/eu-action/eu-emissions-trading-system-eu-ets_en)
GAAP	: Generally Accepted Accounting Principles
GaBi	: Software and Data solution on product sustainability by Sphera (https://sphera.com/product-sustainability-software)
GEMIS	: Global Emissions model of integrated systems
GHG	: Greenhouse gas (https://ghgprotocol.org)
GWh	: Gigawatts per hour
HR-steel	: hot-rolled steel
IPCC	: Intergovernmental Panel on Climate Change (https://www.ipcc.ch)
ISO	: International Organization for Standardization (https://www.iso.org)
Kg	: Kilogram
kWh	: Kilowatts per hour
LCA	: Life cycle assessment
LCI	: Life cycle inventory
LCIA	: Life cycle impact assessment
m^3	: cubic meter
N_2O	: Nitrous oxide
O_3	: Ozone
PAS 2050	: LCA of GHG emissions of goods and services – British Standards Institute
PCF	: Product Carbon Footprint
t	: metric ton
UBA	: Umweltbundesamt / Federal Environment Agency (https://www.umweltbundesamt.de)
VDA	: Verband der Automobilindustrie / German Association of the automotive industry (https://www.vda.de)

WBCSD	: World Business Council for Sustainable Development (https://www.wbcsd.org)
Worldsteel	: www. worldsteel.org/steel-topics/life-cycle-thinking/lca-eco-profiles/
WRI	: World Resources Institute (https://www.wri.org)

Disclaimer:

The Cielffa Guideline Corporate and Product Carbon Footprint of European Cold Rolling Industry illustrates a standard approach of calculating the carbon footprint of undertakings active in the cold rolling industry.

This guideline is intended to support the undertakings involved by calculating the carbon emissions in order to provide comparable results to the industry and in particular the customers.

The guideline is not binding for the undertakings involved. The undertakings shall remain free to apply any alternative calculation method.

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