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Technical specification for life cycle carbon emission accounting of passenger cars

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Annex

Foreword

This document was drafted in accordance with the provisions of GB/T 1.1-2020 "guidelines for Standardization Work Part 1: structure and drafting rules of standardization documents".

The document proposed by the Climate change department of Ministry of Ecology and Environment of People's Republic of China.

This document is under the jurisdiction of XXX.

This document drafting units:

The main drafting units of this document:

The main drafters of this document:

The previous versions of this document and its substitutes are as follows:

——This is the first time.

Technical specification of life cycle carbon emission accounting of passenger cars

1 Scope

This document specifies the technical specifications of life cycle carbon emissions for passenger cars produced or sold in China.

This document applies to M1 vehicles with a maximum design mass not exceeding 3500 kg, including passenger vehicles that only use gasoline or diesel, non-off-vehicle-chargeable hybrid electric passenger vehicle, plug-in hybrid electric passenger vehicle, and battery electric passenger vehicles.

Other M1 vehicles can refer to this document for implementation.

2 Normative references

The following documents for the application of this document are essential. For dated references, only the dated edition is applicable to this document. For undated references, the latest edition (including any amendments) applies to this document.

GB/T 3730.1-2001 Terms and definitions of vehicles and trailers

GB 15089-2001 Classification of motor vehicles and trailers

GB/T18386 Test methods Part I of energy consumption rate and continued mileage of electric vehicles: Light vehicle

GB/ T 19233 Fuel consumption test method of light vehicle

GB 19578 Fuel consumption limited value of passenger car

GB/T 19753 Energy consumption test method of light hybrid electric vehicle

GB/T 24040-2008 Principles and framework of environmental management life cycle assessment

GB/T 24044-2008 Requirements and guidelines of environmental management life cycle assessment

GB 27999-2019 Fuel consumption evaluation methods and targets for passenger cars.

GB/T 30512-2014 Requirements for prohibited substances on automobiles

GB/T 32150-2015 General rules of greenhouse gas emissions of industrial enterprises accounting and reporting

GB/T 32694 Plug-in hybrid electric passenger cars—Specifications

ISO 14067:2018 Greenhouse gases – Carbon footprint of products – Requirements and guidelines for quantification）

3 Terms and Definitions

The following terms and definitions apply to this document.

3.1

M1 vehicle

Passenger vehicles with a maximum of 9 seats, including the driver's seat.

[Source: GB/T 15089—2001, definition 3.2.1]

3.2

Passenger car

In design and technical characteristics, it is mainly used to carry passengers and their carry-on luggage or the temporary articles, with a maximum of 9 seats, including the driver's seat. It can also tow a trailer.

[Source: GB/T 3730.1—2001, definition2.1.1]

3.3

Plug-in hybrid electric passenger car

Hybrid electric passenger car with off-vehicle-chargeable function and a certain pure electric driving range.

[Source: GB/T 32694 , definition 3.1]

3.4

Non off-vehicle-chargeable hybrid electric passenger car

Hybrid electric passenger cars that derive energy from onboard fuel under normal use.

[Source: GB/T 19596-2017 , definition 3.1.1.2.2.2]

3.5

Carbon

Greenhouse gas, GHG

It is gaseous components that naturally exist in the atmosphere and are produced by human activities. It can absorb and emit radiation from the earth's surface, the atmosphere, and clouds that have wavelengths in the infrared spectrum.

[Source: GB/T 32150—2015, definition 3.1]

Note: Unless otherwise specified, the greenhouse gases in this document include carbon dioxide, methane, nitrous oxide, hydrofluorocarbon, perfluorocarbon, sulfur hexafluoride and nitrogen trifluoride.

3.6

Carbon emission

Greenhouse gas emission

The total amount of greenhouse gases (in mass units) released into the atmosphere within a certain period of time.

3.7

Greenhouse gas source

A physical unit or process that releases greenhouse gases into the atmosphere.

3.8

Carbon（GHG）emission factor

Coefficient characterizing unit production or activity levels of consumption of greenhouse gas emissions
It characterizes the greenhouse gas emissions coefficient per unit of production or consumption.
Note: for example, carbon emissions of per kWh of production/supply, etc.
[Source: GB/T 32150—2015, definition 3.13]

3.9

Global warming potential, GWP

Coefficient that relates the influence of radioactive forcing of a certain greenhouse gas per unit mass in a given period to the influence of the equivalent amount of carbon dioxide radiation intensity
Note: The global warming potential in this document refers to a 100-year time frame, i.e. GWP 100A.

3.10

Carbon dioxide equivalent

CO_2e

The amount of carbon dioxide whose radiation intensity is comparable to the quality of a greenhouse gas
Note: The carbon dioxide equivalent is equal to the mass of a given greenhouse gas multiplied by its global warming potential.

3.11

Product system

Collection of unit processes with elementary and product flows, performing one or more defined functions, and which models the life cycle of a product.
[Source: GB/T 24044 - 2008, definition 3.28]

3.12

Life cycle

A series of successive stages in product system, obtaining raw materials from nature and natural resources until final disposal.
[Source: GB/T 24044—2008, definition 3.1]

3.13

Life cycle assessment, LCA

Compile and evaluate the input, output and potential environmental impact of a product system during its life cycle.
[Source: GB/T 24044—2008, definition 3.2]

3.14

Functional unit

Quantified product system performance used as a benchmark unit.
[Source: GB/T 24044—2008, definition 3.20]

3. 15

System boundary

Determine which unit processes are part of the product system through a set of criteria.
[Source: GB/T 24044—2008, definition 3.32]

3. 16

Primary data

Direct measurement value or quantization value of a process or activity calculated based on direct measurement value.

Note 1: The initial data does not necessarily come from the product system under study, because the initial data may be associated with different but comparable system product.

Note 2: The initial data may include GHG emissions factor and/or GHG activity data.

[Source: ISO 14067—2018, definition 3.1.6.1]

3. 17

Site-specific data

Initial data obtained in a production system.

Note: All specific site data are initial data, but not all of the initial data are specific site data, because the initial data may come from different production systems.

[Source: ISO 14067—2018, definition 3.1.6.2]

3. 18

Default value

The average value reflecting the mainstream level of the industry (such as material composition ratio of passenger car, carbon emission factor of material production, carbon emission factor of vehicle production, etc.).

Note: in this document, default values can be replaced by site-specific data or data closer to site-specific data.

3. 19

Secondary data

Data that does not meet the primary data requirements.

Note 1: in this document, secondary data can only be used if specific site data is not available and there is no corresponding default value;

Note 2: Secondary data should be traceable and must be based on field survey data or data released by government authorities.

3. 20

Allocation

The input and output streams in a process or product system are distributed to the product system under research and one or more other product systems.

[Source: GB/T 24040—2008, definition 3.17]

3.21

Process

A group of interrelated or interactive activities that convert input into output.

[ISO 9000: 2005, definition 3.4.1 (notes are excluded)]

3.22

Unit process

The most basic part to quantify the input and output data during the life cycle carbon emission analysis.

3.23

Waste

Substances or articles disposed of or intended to be disposed of.

[GB/T 24044-2008 definition 3.35]

3.24

Life cycle carbon of product

Greenhouse gas emissions in the system are expressed as carbon dioxide equivalent.

3.25

Carbon offsetting

The carbon offsetting mechanism of all or part of carbon emissions in the product life cycle operates by preventing the release, reduction or elimination of greenhouse gas emissions beyond the product system. (Such as: related products beyond the system investment, i.e., renewable energy, energy technology, energy-saving measures, afforestation/reforestation.)

Note: Carbon offset is not allowed in the quantification stage of carbon emissions in product life cycle, and carbon offset is not considered in this document.

3.26

Product category

Product groups that can achieve equivalent functions.

[Source：ISO 14025:2006，3.12]

3.27

Product category rules, PCR

Formulate a set of specific rules, requirements and guidelines for category III environmental statement and life cycle carbon emission communication for one or more product categories.

[Source：ISO 14067:2008，3.1.1.9]

3. 28

Intermediate product

In the system, the output of a process unit that continues to transform as the input of other unit processes is also needed.

[Source：PAS 2050:2011，3.26]

3. 29

Homogeneous material

Parts or components cannot be further separated by mechanical methods (such as unscrewing, cutting, rolling, scraping, grinding, etc.) and the parts are made up of the same material.

[Source: GB/T 30512—2014, definition 3.1]

3. 30

Biomass material

Biological materials, excluding those buried in geological structures and those converted into fossil materials. Note 1: For example, trees, crops, grass, tree garbage, algae, animals, biological fertilizers, etc.

3. 31

Recycled materials

Recycled raw materials.

3. 32

Land use

Human use or management of land within the relevant boundary.

[Source：ISO 14067:2008，3.1.7.4]

3. 33

Cradle-to-gate

The life cycle stage from the extraction or acquisition of raw materials to the product leaving the organization for evaluation

[Source：PAS 2050:2011，3.13]

3. 34

Gate-to-gate

A continuous life cycle stage of a product in the middle.

3. 35

Gradle-to-grave

Life cycle stages from the extraction or acquisition of raw materials to the recovery and treatment of wastes.

[Source：PAS 2050:2011，3.14]

3.36

Green energy

It mainly includes solar energy, wind energy, biomass energy, geothermal energy, nuclear energy and energy derived from it.

4 Life cycle carbon emission accounting method

4.1 Accounting principles

4.1.1 Life Cycle Perspective

This document accounts for life cycle carbon emissions of passenger cars. The life cycle stages include material production stage, vehicle production stage, and use stage.

4.1.2 Functional unit

The life cycle carbon emissions accounting for passenger cars are conducted around the functional unit, and the result is calculated relative to this functional unit.

4.1.3 Priority of scientific method

When accounting for life cycle carbon emissions of passenger cars, natural science (such as physics, chemistry, and biology) methods are preferred.

4.1.4 Consistency

Throughout the life cycle carbon emissions accounting, assumptions, methods, and data are applied in the same way to draw conclusions based on goals and scope definitions.

4.1.5 Accuracy

The life cycle carbon emission accounting for passenger cars is accurate, verifiable, relevant and not misleading, and minimizes deviations and uncertainties as much as possible.

4.1.6 Transparency

It present and record all relevant issues in an open, comprehensive and understandable manner, disclose any relevant assumptions, clearly explain any estimates and avoid deviations. Meanwhile, it gives relevant explanations on the methods and data sources used.

4.1.7 Avoid double counting

Avoid double greenhouse gas emissions counting within system boundaries.

4.2 Accounting boundary

4.2.1 Functional unit

The transportation services provided by a passenger car traveling 1km within life cycle, and the life cycle mileage is calculated by (1.5×10^5) km.

4.2.2 System boundary

4.2.2.1 Life cycle system boundary

This document adds the material production stage (including raw material and recycled material), vehicle production stage and use stage into life cycle carbon emission accounting range, excluding carbon emissions from parts processing and transportation. In the meanwhile, Carbon emissions from people in factories as well as manufacturing process of infrastructure such as roads and factories, equipment in various processes and living facilities, are also excluded. The system boundary is shown in Figure 1.

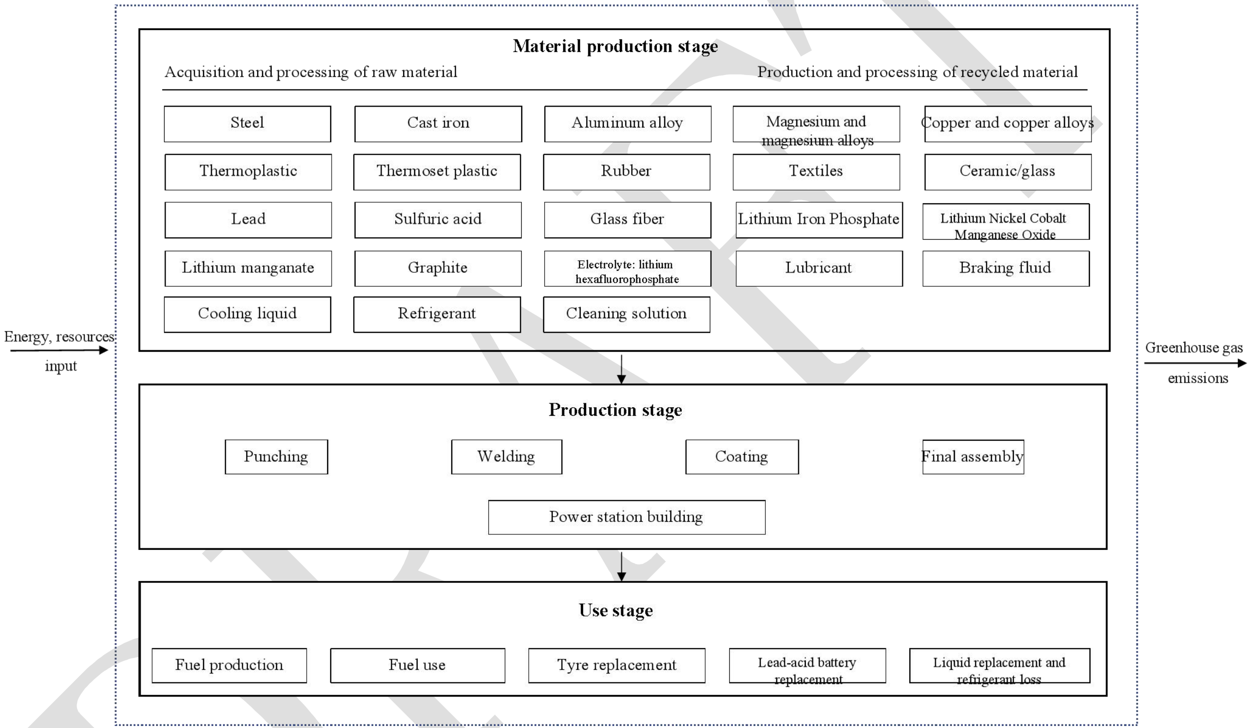

Figure 1 System boundary of life cycle carbon emission accounting for passenger car

4.2.2.2 Accounting scope of material production stage

Material production stage includes acquisition and processing of raw material as well as production and processing of recycled material, excluding use and waste process. Acquisition and processing of raw material is the stage of resource acquisition and material production. The system boundary includes resource exploitation, processing and purification, production and manufacturing, etc. The production and processing of recycled material should include the processes such as processing of recycled materials produced from waste materials. Material categories within the accounting scope of this document can be seen in Table 1. Other homogeneous materials whose weight ratio or carbon emission ratio is greater than 1% of corresponding part (see Appendix A for the description of each part) but not listed in Table 1 should also be included in the accounting scope. The system boundary of carbon emission in the life cycle of each material is shown in Appendix B.

Table 1 Summary of materials within the scope of accounting

Number	Material category
1	Steel
2	Cast iron
3	Aluminum and aluminum alloy
4	Magnesium and magnesium alloys
5	Copper and copper alloys
6	Thermoplastic
7	Thermoset plastic
8	Rubber
9	Textiles
10	Ceramic/glass
11	Lead
12	Sulfuric acid
13	fibreglass reinforced plastics
14	Lithium Iron Phosphate
15	Lithium Nickel Cobalt
16	Lithium manganate
17	Graphite
18	Electrolyte: lithium
19	Lubricant
20	Braking fluid
21	Cooling liquid
22	Refrigerant
23	Detergent

4.2.2.3 Accounting scope of parts processing stage

It mainly includes the production of composite materials, semi-finished products and auto parts. In this document, the carbon emission at this stage is not included in the final life cycle carbon emission accounting results.

4.2.2.4 Accounting scope of vehicle production stage

Vehicle production includes stamping, welding, painting, assembly and power station and other production and manufacturing processes. The specific production process within the accounting boundary is shown in Appendix D.

4.2.2.5 Accounting scope of transport phase

The transport phase includes the transportation process that exists in the stages of material production, parts processing, and vehicle production. The assessment should include both vehicle operational processes and energy operational processes. Among them, the operational process includes the operation of the main engine/motor and auxiliary systems such as the refrigeration of the cargo box. The energy operational process is the life cycle of the fuel consumed in the transport phase, including the upstream process. Production of fuel and use of fuel during transportation. This stage does not include direct emissions from carbon leakage from transport vehicles (such as refrigerant or natural gas fugitives) and additional effects from the formation of contrails and cirrus, etc. In this document, carbon emissions at this stage are not included in the final carbon footprint calculation result.

4. 2. 2. 6 Accounting scope of use stage

The use stage includes fuel production, fuel use, tire replacement, lead-acid battery replacement and refrigerant escape and replacement. Tire replacement is calculated as per 2 times of replacement, 4 pieces of lead-acid battery is replaced twice, and refrigerant is calculated as one time of dissipation.

4. 2. 3 Carbon (greenhouse gas)

The greenhouse gases in this document refer to the seven greenhouse gases specified in the "Kyoto Protocol", see Appendix E.

Greenhouse gases from fuel use in the use phase of this document are considered only carbon dioxide and do not include other greenhouse gas emissions.

4. 2. 4 Carbon emission source

This document considers carbon emissions from the input and output of energy use, combustion processes, chemical reactions, operations, and waste disposal processes in the life cycle of passenger cars. Land use and land use change are not considered.

The carbon emission caused by land use and land use change are not considered in this document.

Carbon offsets are not considered in this document.

The carbon emission generated by means of transport in non-stationary premises is not considered in this document.

The carbon emission accounting requirements of biomass materials are as follows:

A) For recycled biomass materials produced from waste, only the carbon emissions generated in the reuse or recycling process of waste is counted.

B) For biomass materials produced from non-waste (e.g., cash crop used specifically to produce biomass material), the carbon emissions of the production process and crop cultivation process is included in the implementation process, which may involve distribution.

4. 3 Data and data quality requirements

4. 3. 1 Data collection

For all processes included within the system boundary, specific site data should be collected. When specific site data collecting is not feasible, the default value should be used. Specific site data and default values can be mixed. When specific site data is used for material weight, the carbon emission factor of material can use specific site data or default value; when material weight uses default value, material carbon emission factor can only use default value. Secondary data can be used when site-specific data is not available and there is no corresponding default value.

When choosing to use the specific site data of the material carbon emission factor for accounting, you can refer to the summary table of key components (see Appendix C) to collect the specific site data of material weight. The system boundary should be the same as Appendix B, and the accounting report should be prepared according to Appendix F.

4.3.2 Data distribution

There exists a unit process in the product production process that simultaneously produces two or more products, and the materials input and energy input are not separated. Meanwhile, the case there are multiple input channels and only one output. In these cases, the data needed for inventory calculation cannot be obtained directly, and the data of these processes must be distributed according to a certain relationship.

The list is established based on the material balance of input and output, and the distribution relationship needs to reflect the basic relationship and characteristics of input and output. The main principles of distribution are as follows:

a) It is necessary to identify the processes that are shared with other product systems and process them according to the distribution procedures;

b) The sum of the input and output before and after allocation in the unit process must be equal;

c) If there are several allocation procedures that can be used, a sensitivity analysis shall be carried out to show the difference between the results of the other methods and the selected method;

d) Multiple outputs: Allocation is based on changes in resource consumption and carbon emissions after changes in products, functions, or economic relevance provided by the system under study;

e) Multiple inputs: Allocation is based on actual relationships. For example, the emissions in the production process will be affected by changes in the input waste stream.

Dealing with data distribution issues is generally carried out according to the following procedure:

a) Try to avoid or reduce the occurrence of allocations. For example: ① The unit process decomposed when collecting data was further divided; ② Expand the product system boundary to include some units that were originally excluded from the system;

b) Use the method that reflects its physical relationship to allocate. Such as product weight, quantity, volume, area, calorific value and other proportional relationships;

c) When the physical relationship cannot be determined or cannot be used as the basis for distribution, use its economic relationship to distribution, such as product output value or profit ratio relationship. However, the uncertainty of this method is high, and the economic allocation method is generally not recommended.

Recycled material allocation procedure:

a) A closed-loop allocation procedure applies to closed-loop product systems. It also applies to openloop product systems where no changes occur in the inherent properties of the recycled material. In such cases, the waste generated in the system is recycled, which can be regarded as the replacement of the primary material by the recycled material and the emissions reductions of recycled material are not additionally removed.

b) An open-loop allocation procedure applies to open-loop product systems: if the waste generated outside the system is recycled, only carbon emissions of the recycled process will be included, and the emissions of the primary materials before the waste will not be included.

Data quality requirements

4.3.2.1 Time range

The average data of the recent continuous production from 3 months to 1 year should be collected; the average data of the most recent continuous production for 1 year should be used preferentially.

4.3.2.2 Geographical scope

Data on the actual production geographic area should be collected.

4.3.2.3 Technical scope

Data on the actual production technology or technology combination of the vehicle should be collected.

4.3.2.4 Integrity

Data should be collected covering the boundaries of the product system.

4.3.2.5 Reproducibility

It should ensure that independent practitioners can reproduce the accounting results of product carbon emissions.

4.3.2.6 Data source

The methods and sources for obtaining the data should be explained.

4.4 Calculation method

4.4.1 During material production stage

The material production stage includes the acquisition and processing of raw material as well as the production and processing of recycled material, and consists of five sectors: parts material, lead acid batteries, lithium-ion power batteries, tires and fluids. The carbon emission during material production stage shall be calculated with Formula (1), and the calculation result shall be rounded to the nearest to two decimal places:

$$C_{Materials} = C_{Parts} + C_{Lead\ acid\ battery} + C_{Li-ion\ \mathrm{battery}} + C_{\mathrm{Tyres}} + C_{\mathrm{Fluids}} \quad \ldots\ldots\ldots\ldots\ldots\ldots(1)$$

$C_{Material}$——carbon emission during material production stage, in kilogram of carbon dioxide equivalent ($kgCO_2e$);

C_{Parts}——carbon emission of parts, in kilogram of carbon dioxide equivalent ($kgCO_2e$);

$C_{Lead\ acid\ battery}$——carbon emission of lead acid batteries, in kilogram of carbon dioxide equivalent ($kgCO_2e$);

$C_{Li\text{-}Ion\ battery}$——carbon emission of lithium-ion power batteries, in kilogram of carbon dioxide equivalent ($kgCO_2e$);

C_{Tyres}——carbon emission of tires, in kilogram of carbon dioxide equivalent ($kgCO_2e$);

C_{Fluids}——carbon emission of fluids, in kilogram of carbon dioxide equivalent ($kgCO_2e$).

The carbon emission of vehicle parts (excluding tires, batteries and fluids) shall be calculated with Formula (2) or (3), and the calculation results shall be rounded to the nearest to two decimal places:

$$C_{Parts} = \sum (M_{Part\ material\ i} \times U_{Material\ i} \times CEF_{Part\ material\ i}) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(2)$$

$$C_{Parts} = \sum (M_{Part\ pr-material\ i} \times CEF_{Part\ pr-material\ i} \times U_{Part\ material\ i} + M_{Part\ re-material\ i} \times CEF_{Part\ re-material\ i} \times U_{Part\ material\ i}) \quad \ldots\ldots(3)$$

Wherein,

C_{Parts}——carbon emission of parts, in kilogram of carbon dioxide equivalent ($kgCO_2e$);

$M_{Part\ material\ i}$——weight of part material i, rounded to the nearest to two decimal places and in kilogram (kg);

$U_{material\ i}$——the use coefficient of material i, the percentage of the material actually used in the manufacturing process to the content in the vehicle, that is, the value is greater than 100% when the loss is assumed. Refer to Appendix F for the default values of service coefficients of various materials;

$CEF_{Part\ material\ i}$——carbon emission factor of part material i, rounded to the nearest to two decimal places and in kilogram of carbon dioxide equivalent per kilogram ($kgCO_2e/kg$);

$M_{Part\ pr\text{-}material\ i}$——weight of part raw material i, rounded to the nearest to two decimal places and in kilogram (kg);

$M_{Part\ re\text{-}material\ i}$——weight of part recycled material i, rounded to the nearest to two decimal places and in kilogram (kg);

$CEF_{Part\ pr\text{-}material\ i}$——carbon emission factor of part raw material i, rounded to the nearest to two decimal places and in kilogram of carbon dioxide equivalent per kilogram ($kgCO_2e/kg$);

$CEF_{Part\ re\text{-}material\ i}$——carbon emission factor of part recycled material i, rounded to the nearest to two decimal places and in kilogram of carbon dioxide equivalent per kilogram ($kgCO_2e/kg$);

For the weight of part material i, the site-specific data can be used, or it can be calculated based on Appendix A; for the carbon emission factor of part material i, either the site-specific data or the default value in Appendix B can be used (for other homogeneous materials, the site-specific data shall be used for the carbon emission factor). Secondary data can be used when specific site data cannot be obtained and there is no corresponding default value. The functional unit and system boundary for accounting the site-specific data of carbon emission factor of part material i shall be consistent with Appendix B, the carbon (greenhouse gases) and greenhouse gas source shall be consistent with 4.2.3 and 4.2.4 respectively, and the data and data quality requirements shall be consistent with 4.3. Accounting report on the site-specific data of carbon emission factor of materials shall be submitted in accordance with Appendix F, and the values provided in Appendix G shall be adopted for the carbon emission factor for energy production and use.

The carbon emission of lead acid batteries can be calculated separately with Formula (4) or (5), and the calculation results shall be rounded to the nearest to two decimal places:

$$C_{Lead\ acid\ battery} = \sum (M_{Lead\ acid\ material\ i} \times U_{Material\ i} \times CEF_{Lead\ acid\ material\ i}) \quad \cdots\cdots (4)$$

$$C_{Lead\ acid\ battery} = \sum (M_{Lead\ acid\ pr-material\ i} \times CEF_{Lead\ acid\ pr-material\ i} \times U_{Material\ i} + M_{Lead\ acid\ re-material\ i} \times U_{Material\ i} \times CEF_{Lead\ acid\ re-material\ i}) \quad \cdots\cdots (5)$$

Wherein,

$C_{Lead\ acid\ battery}$——carbon emission of lead acid batteries, in kilogram of carbon dioxide equivalent ($kgCO_2e$);

$M_{Lead\ acid\ material\ i}$——weight of lead acid battery material i, rounded to the nearest to two decimal places and in kilogram (kg);

$U_{material\ i}$——the use coefficient of material i, the percentage of the material actually used in the manufacturing process to the content in the vehicle, that is, the value is greater than 100% when the loss is assumed. Refer to Appendix F for the default values of service coefficients of various materials;

$CEF_{Lead\ acid\ battery\ i}$——carbon emission factor of lead acid battery material i, rounded to the nearest to two decimal places and in kilogram of carbon dioxide equivalent per kilogram ($kgCO_2e/kg$);

$M_{Lead\ acid\ pr\text{-}material\ i}$——weight of lead acid battery raw material i, rounded to the nearest to two decimal places and in kilogram (kg);

$M_{Lead\ acid\ re\text{-}material\ i}$——weight of lead acid battery recycled material i, rounded to the nearest to two decimal places and in kilogram (kg);

$CEF_{Lead\ acid\ pr\text{-}material\ i}$——carbon emission factor of lead acid battery raw material i, rounded to the nearest to two decimal places and in kilogram of carbon dioxide equivalent per kilogram ($kgCO_2e/kg$);

$CEF_{Lead\ acid\ re\text{-}material\ i}$——carbon emission factor of lead acid battery recycled material i, rounded to the nearest to two decimal places and in kilogram of carbon dioxide equivalent per kilogram ($kgCO_2e/kg$);

For the weight of lead acid battery material i, the site-specific data can be used, or it can be calculated based on Appendix A; for the carbon emission factor of lead acid battery material i, either the site-specific data or the default value in Appendix B can be used (for other homogeneous materials, the site-specific data shall be used for the carbon emission factor). Secondary data can be used when specific site data cannot be obtained and there is no corresponding default value. The functional unit and system boundary for accounting the site-specific data of carbon emission factor of lead acid battery material i shall be consistent with Appendix B, the carbon (greenhouse gases) and greenhouse gas source shall be consistent with 4.2.3 and 4.2.4 respectively, and the data and data quality requirements shall be consistent with 4.3. Accounting report on the site-specific data of carbon emission factor of materials shall be submitted in accordance with Appendix F, and the values provided in Appendix H shall be adopted for the carbon emission factor for energy production and use.

The carbon emissions of lithium-ion power batteries of battery electric passenger cars, plug-in hybrid electric passenger cars and non-off-vehicle chargeable hybrid passenger cars can be calculated separately, and the weight of power battery of passenger cars fueled solely with gasoline or diesel is taken to be 0 in the calculation. The calculation can be performed with one of formulas (6) ~ (8), and the calculation results shall be rounded to the nearest to two decimal places:

$$C_{Li-Ion\ battery} = \sum (M_{Li-Ion\ material\ i} \times U_{Material\ i} \times CEF_{Li-Ion\ material\ i}) \quad \text{......(6)}$$

$$C_{Li-Ion\ battery} = \sum (M_{Li-Ion\ pr-material\ i} \times U_{Material\ i} \times CEF_{Li-Ion\ pr-material\ i} + M_{Li-Ion\ re-material\ i} \times U_{Material\ i} \times CEF_{Li-Ion\ re-material\ i}) \quad \text{......(7)}$$

$$C_{Li-Ion\ battery} = R_{Li-Ion\ battery} \times CEF_{Li-Ion\ battery} \quad \text{......(8)}$$

Wherein,

$C_{Li\text{-}Ion\ battery}$——carbon emission of lithium-ion power batteries, in kilogram of carbon dioxide equivalent ($kgCO_2e$);

$M_{Li\text{-}Ion\ battery\ material\ i}$——weight of lithium-ion power battery material i, rounded to the nearest to two decimal places and in kilogram (kg);

$U_{material\ i}$——the use coefficient of material i, the percentage of the material actually used in the manufacturing process to the content in the vehicle, that is, the value is greater than 100% when the loss is assumed. Refer to Appendix F for the default values of service coefficients of various materials;

$CEF_{Li\text{-}Ion\ battery\ material\ i}$——carbon emission factor of lithium-ion power battery material i, rounded to the nearest to two decimal places and in kilogram of carbon dioxide equivalent per kilogram ($kgCO_2e/kg$);

$M_{Li\text{-}Ion\ pr\text{-}material\ i}$——weight of lithium-ion power battery raw material i, rounded to the nearest to two decimal places and in kilogram (kg);

$CEF_{Li\text{-}Ion\ pr\text{-}material\ i}$——carbon emission factor of lithium-ion power battery raw material i, rounded to the nearest to two decimal places and in kilogram of carbon dioxide equivalent per kilogram ($kgCO_2e/kg$);

$M_{Li\text{-}Ion\ re\text{-}material\ i}$——weight of lithium ion power battery recycled material i, rounded to the nearest to two decimal places and in kilogram (kg);

$CEF_{Li\text{-}Ion\ re\text{-}material\ i}$——carbon emission factor of lithium-ion power battery recycled material i, rounded to the nearest to two decimal places and in kilogram of carbon dioxide equivalent per kilogram ($kgCO_2e/kg$);

$R_{Li\text{-}Ion\ battery}$——energy of lithium-ion power battery, rounded to the nearest to two decimal places and in kilowatt-hour (kWh);

$CEF_{Li\text{-}Ion\ battery}$——carbon emission factor of lithium-ion power battery pack, rounded to the nearest to two decimal places and in kilogram of carbon dioxide equivalent per kilowatt-hour ($kgCO_2e/kWh$).

For the weight of lithium-ion power battery material i, the site-specific data can be used, or it can be calculated based on Appendix A; for the carbon emission factor of lithium-ion power battery material i, either the site-specific data or the default value in Appendix B can be used (for other homogeneous materials, the site-specific data shall be used for the carbon emission factor). Secondary data can be used when specific site data cannot be obtained and there is no corresponding default value. The functional unit and system boundary for accounting the site-specific data of carbon emission factor of lithium-ion power battery material i shall be consistent with Appendix B, the carbon (greenhouse gases) and greenhouse gas source shall be consistent with 4.2.3 and 4.2.4 respectively, and the data and data quality requirements shall be consistent with 4.3. Accounting report on the site-specific data of carbon emission factor of materials shall be submitted in accordance with Appendix F, and the values provided in Appendix H shall be adopted for the carbon emission factor for energy production and use.

For the carbon emission factor of lithium-ion power battery pack, either the site-specific data or the default value in Appendix B can be used (for other homogeneous materials, the site-specific data shall be used for the carbon emission factor). The functional unit and system boundary for accounting the site-specific data of carbon emission factor of lithium-ion power battery pack shall be consistent with Appendix B, the carbon (greenhouse gases) and greenhouse gas source shall be consistent with 4.2.3 and 4.2.4 respectively, and the data and data quality requirements shall be consistent with 4.3. Accounting report on the site-specific data of carbon emission factor of materials shall be submitted in accordance with Appendix F, and the values provided in Appendix H shall be adopted for the carbon emission factor for energy production and use.

The carbon emission of tyres can be calculated separately with Formula (9) or (10), and the calculation results shall be rounded to the nearest to two decimal places:

$$C_{Tyres} = \sum (M_{Tyre\ material\ i} \times CEF_{Tyre\ material\ i}) \quad \text{......(9)}$$

$$C_{Tyres} = \sum (M_{Tyre\ pr-material\ i} \times CEF_{Tyre\ pr-material\ i} + M_{Tyre\ re-material\ i} \times CEF_{Tyre\ re-material\ i}) \quad \text{......(10)}$$

Wherein,

C_{Tyres}——carbon emission of tyres, in kilogram of carbon dioxide equivalent ($kgCO_2e$);

$M_{Tyre\ material\ i}$——weight of material i of tyres (five, including one spare tyre), in kilogram (kg);

$CEF_{Tyre\ material\ i}$——carbon emission factor of tyre material i, in kilogram of carbon dioxide equivalent per kilogram ($kgCO_2e/kg$);

$M_{Tyre\ pr\text{-}material\ i}$——weight of raw material i of tyres (five, including one spare tyre), in kilogram (kg);

$U_{material\ i}$——the use coefficient of material i, the percentage of the material actually used in the manufacturing process to the content in the vehicle, that is, the value is greater than 100% when the loss is assumed. Refer to Appendix F for the default values of service coefficients of various materials;

$M_{Tyre\ re\text{-}\ material\ i}$——weight of recycled material i of tyres (five, including one spare tyre), in kilogram (kg);

$CEF_{Tyre\ pr\text{-}material\ i}$——carbon emission factor of tyre raw material i, in kilogram of carbon dioxide equivalent per kilogram ($kgCO_2e/kg$);

$CEF_{Tyre\ re\text{-}material\ i}$——carbon emission factor of tyre recycled material i, in kilogram of carbon dioxide equivalent per kilogram ($kgCO_2e/kg$).

For the weight of tyre material i, the site-specific data can be used, or it can be calculated based on Appendix A; for the carbon emission factor of tyre material i, either the site-specific data or the default value in Appendix B can be used (for other homogeneous materials, the site-specific data shall be used for the carbon emission factor). Secondary data can be used when specific site data cannot be obtained and there is no corresponding default value. The functional unit and system boundary for accounting the site-specific data of carbon emission factor of tyre material i shall be consistent with Appendix B, the carbon (greenhouse gases) and greenhouse gas source shall be consistent with 4.2.3 and 4.2.4 respectively, and the data and data quality requirements shall be consistent with 4.3. Accounting report on the site-specific data of carbon emission factor of materials shall be submitted in accordance with Appendix F, and the values provided in Appendix H shall be adopted for the carbon emission factor for energy production and use.

The carbon emission of fluids can be calculated separately with Formula (11), and the calculation results shall be rounded to the nearest to two decimal places:

$$C_{\mathrm{Fluids}} = \sum \left(M_{\mathrm{Fluid\ material\ i}} \times CEF_{Fluid\ \mathrm{material\ i}} \right) \qquad (11)$$

Wherein,

C_{Fluids}——carbon emission of fluids, in kilogram of carbon dioxide equivalent ($kgCO_2e$);

$M_{Fluid\ material\ i}$——weight of fluid material i, in kilogram (kg);

$CEF_{Fluid\ material\ i}$——carbon emission factor of fluid material i, in kilogram of carbon dioxide equivalent per kilogram ($kgCO_2e/kg$);

For the weight of fluid material i, the site-specific data can be used, or it can be calculated based on Appendix A; for the carbon emission factor of fluid material i, either the site-specific data or the default value in Appendix B can be used (for other homogeneous materials, the site-specific data shall be used for the carbon emission factor). Secondary data can be used when specific site data cannot be obtained and there is no corresponding default value. The functional unit and system boundary for accounting the site-specific data of carbon emission factor of fluid material i shall be consistent with Appendix B, the carbon (greenhouse gases) and greenhouse gas source shall be consistent with 4.2.3 and 4.2.4 respectively, and the data and data quality requirements shall be consistent with 4.3. Accounting report on the site-specific data of carbon emission factor of materials shall be submitted in accordance with Appendix F, and the values provided in Appendix G shall be adopted for the carbon emission factor for energy production and use.

4. 4. 2 Part production stage

The carbon emission during part production stage shall be calculated with Formula (12), and the calculation result shall be rounded to the nearest to two decimal places:

$$C_{Part\ production} = \sum \left(E_r \times CEF_r + E_r \times NCV_r \times CEF_r^{'} \right) + M_{CO_2} \quad \text{..............................(12)}$$

Wherein,

$C_{Part\ Production}$——carbon emission during part production stage, in kilogram of carbon dioxide equivalent ($kgCO_2e$);

E_r——purchase quantity of energy or fuel r, in kilowatt-hour (kWh), cubic meter (m^3) or kilogram (kg), etc.;

CEF_r——carbon emission factor for production of energy or fuel r, in kilogram of carbon dioxide equivalent per kilowatt-hour ($kgCO_2e/kWh$), kilogram of carbon dioxide equivalent per cubic meter ($kgCO_2e/m^3$) or kilogram of carbon dioxide equivalent per kilogram ($kgCO_2e/kg$) and referred to in Appendix G;

CEF'_r——carbon emission factor used by energy or fuel r, in ton of carbon dioxide equivalent per giga-joule (tCO_2e/GJ) and referred to in Appendix G;

NCV_r——average low calorific value of energy or fuel r, in giga-joule per ton (GJ/t) or giga-joule per ten thousand cubic meters ($GJ/10^4m^3$);

M_{CO_2}——amount of escaping CO_2 during welding, in kilogram of carbon dioxide equivalent ($kgCO_2e$).

For the carbon emission of part production, enterprises can determine functional units and system boundaries based on components, the carbon emission factor of fuel or energy shall be consistent with Appendix H, the carbon (greenhouse gases) and carbon emission source shall be consistent with 4.2.3 and 4.2.4 respectively, and the data and data quality requirements shall be consistent with 4.3.

4.4.3 Vehicle production stage

The carbon emission during vehicle production stage shall be calculated with Formula (13), and the calculation result shall be rounded to the nearest to two decimal places:

$$C_{Production} = \sum \left(E_r \times CEF_r + E_r \times NCV_r \times CEF_r^{'} \right) + M_{CO_2} \quad \text{..............................(13)}$$

Wherein,

$C_{Production}$——carbon emission during vehicle production stage, in kilogram of carbon dioxide equivalent ($kgCO_2e$);

E_r——purchase quantity of energy or fuel r, in kilowatt-hour (kWh), cubic meter (m^3) or kilogram (kg), etc.;

CEF_r——carbon emission factor for production of energy or fuel r, in kilogram of carbon dioxide equivalent per kilowatt-hour ($kgCO_2e/kWh$), kilogram of carbon dioxide equivalent per cubic meter ($kgCO_2e/m^3$) or kilogram of carbon dioxide equivalent per kilogram ($kgCO_2e/kg$) and referred to in Appendix G;

CEF'_r——carbon emission factor used by energy or fuel r, in ton of carbon dioxide equivalent per giga-joule (tCO_2e/GJ) and referred to in Appendix G;

NCV_r——average low calorific value of energy or fuel r, in giga-joule per ton (GJ/t) or giga-joule per ten thousand cubic meters ($GJ/10^4m^3$);

M_{CO_2}——amount of escaping CO_2 during welding, in kilogram of carbon dioxide equivalent ($kgCO_2e$).

For the carbon emission of vehicle production, the enterprises can use either the default values provided in Appendix D or the site-specific data. While accounting the carbon emission from vehicle production, the functional unit and system boundary shall be consistent with Appendix D, the carbon emission factor of fuel or energy shall be consistent with Appendix G, the carbon (greenhouse gases) and carbon emission source shall be consistent with 4.2.3 and 4.2.4 respectively, and the data and data quality requirements shall be consistent with 4.3.

4. 4. 4 Transport Phase

GHG emissions of transport phase should be calculated according to (14), Calculation results are rounded to two decimal places:

$$C_{\text{transport}} = \sum[(S_{leg,i} \times FC_{VOS,i} \times (CEF_{Fuel} + K_{CO2})] \quad \cdots\cdots\cdots\cdots (14)$$

In the formula,

$C_{transport}$ — carbon emissions during the transport phase, in kilograms of carbon dioxide equivalent ($kgCO_2e$);

leg — The transportation process of target quantification (leg) refers to the distance that materials/semi-finished products/parts are carried by a vehicle, and the whole transportation service is divided into i segments according to the number of vehicle transfers;

VOS—Vehicle Opreation System(VOS) refers to the whole process of continuous transportation service selected for each segment of transportation process (leg), which should include the unloaded part of the vehicle in the system. For example, if a train travels between A and B, the outgoing journey is fully loaded with designated goods, and the return journey is empty, the transportation process (leg) is the transportation service from A to B, and the transportation system (VOS) is the transportation between A and B;

$S_{leg,i}$—Distribution coefficient, the proportion of the carbon emission of the i-th transportation process (leg) in the selected Vehicle Opreation System.

$FC_{VOS,i}$—the total fuel/electricity consumption of the i-th transport system (VOS) selected, in liters (L), cubic (m^3), kilograms (kg) or kilowatt-hours (kWh);

CEF_{Fuel}—Carbon emission factor for fuel/electricity production in kilograms of carbon dioxide equivalent per liter ($kgCO_2e/L$), kilograms of carbon dioxide equivalent per cubic meter ($kgCO_2e/m^3$), kilograms of carbon dioxide equivalent per kilogram ($kgCO_2e/kg$) or kilograms of carbon dioxide equivalent For each kilowatt-hour ($kgCO_2e/kWh$), the carbon emission factor for fuel production is implemented in accordance with the table in Appendix H;

K_{CO2}——The conversion factor for fuel use shall be implemented in accordance with the table in Appendix H.

$$S_{leg} = [(M_{leg} \times D_{leg}) \div \sum(M_{VOS,i} \times D_{VOS,i})] \quad \cdots\cdots\cdots\cdots (15)$$

M_{leg} - The weight of materials/semi-finished products/parts, etc. transported during the target quantified transportation process (leg), in kilograms (kg). For example, if a variety of goods are carried in the transportation vehicle, the total load is y kg, and the target cargo is x kg, M_{leg} = x kg;

D_{leg} - The transportation distance of the target quantified transportation process (leg), in kilometers (km). For road vehicles, the transportation distance of the transportation process (leg) is the shortest feasible distance, for example, the navigation map between two points shows the shortest feasible distance; for railway transportation, the transportation distance of the transportation process (leg) is the track distance between two points ; For waterway transportation, the transportation distance of the transportation process (leg) is the shortest feasible distance of the route; for air transportation, the transportation distance of the transportation process (leg) is the great circle distance between two points plus 95km;

$M_{VOS,i}$ - The load of the selected transport system at each stage of transport (i), in kilograms (kg);

$D_{VOS,i}$——The total transportation distance of each stage (i) of the selected vehicle operation system, the unit is kilometers (km).

4.4.5 Use stage

The carbon emission during use stage shall be calculated with Formula (16), and the calculation result shall be rounded to the nearest to two decimal places:

$$C_{Use} = C_{Fuel\ production} + C_{Fuel\ use} + C_{Tyres\ r} + C_{Lead\ acid\ battery\ r} + C_{Fluids\ r} \quad \cdots\cdots(16)$$

Wherein,

C_{Use}——carbon emission during use stage, in kilogram of carbon dioxide equivalent ($kgCO_2e$);

$C_{Fuel\ production}$——carbon emission from fuel production, in kilogram of carbon dioxide equivalent ($kgCO_2e$);

$C_{Fuel\ use}$——carbon emission during fuel use stage, in kilogram of carbon dioxide equivalent ($kgCO_2e$);

$C_{Tyres\ r}$——carbon emission due to tyre replacement during use stage, in kilogram of carbon dioxide equivalent ($kgCO_2e$);

$C_{Lead\ acid\ battery\ r}$——carbon emission due to lead acid battery replacement during use stage, in kilogram of carbon dioxide equivalent ($kgCO_2e$);

$C_{Fluids\ r}$——carbon emission due to fluid replacement and refrigerant escape during use stage, in kilogram of carbon dioxide equivalent ($kgCO_2e$).

The carbon emission from fuel production for category-M1 cars, non-off-vehicle chargeable hybrid passenger cars and battery electric passenger cars fueled solely with gasoline or diesel shall be calculated with Formula (17), and the calculation results shall be rounded to the nearest to two decimal places:

$$C_{Fuel\ production} = FC \times CEF_{Fuel} \times L / 100 \quad \cdots\cdots(17)$$

Wherein,

$C_{Fuel\ production}$——carbon emission from fuel production, in kilogram of carbon dioxide equivalent ($kgCO_2e$);

FC——fuel consumption, in liter per 100 kilometers (L/100km) or kilowatt-hour per 100 kilometers (kWh/100km), which will be the measurements determined according to GB/T 19233 for category-M1 gasoline cars and category-M1 diesel cars, the measurements determined according to GB/T 19753 for non-off-vehicle chargeable hybrid passenger cars, and the measurements determined according to GB/T 18386 for battery electric passenger cars;

CEF_{Fuel}——carbon emission from fuel production, in kilogram of carbon dioxide equivalent per liter ($kgCO_2e/L$) or kilogram of carbon dioxide equivalent per kilowatt-hour ($kgCO_2e/kWh$), which will be the value provided in Table G.1 in Appendix H;

L——life cycle mileage of passenger cars, taken as (1.5×10^5) km.

The carbon emission from fuel production for plug-in hybrid electric passenger cars shall be calculated with Formula (18), and the calculation results shall be rounded to the nearest to two decimal places:

$$C_{Fuel\ production} = FC_{weighted} \times CEF_{Gasoline} \times L/100 + EC_{weighted} \times CEF_{Electricity} \times L/1000 \quad \cdots\cdots(18)$$

Wherein,

$C_{Fuel\ production}$——carbon emission from fuel production, in kilogram of carbon dioxide equivalent ($kgCO_2e$);

$FC_{weighted}$——type approval value of fuel consumption of plug-in hybrid electric passenger cars, in liter per 100 kilometers (L/100km), which will be the measurements determined according to GB/T 19753;

L——life cycle mileage of passenger cars, taken as (1.5×10^5) km;

$CEF_{Gasoline}$——carbon emission factor of gasoline production, in kilogram of carbon dioxide equivalent per liter ($kgCO_2e/L$), which will be the value provided in Table G.1 in Appendix H;

$EC_{weighted}$——type approval value of electricity consumption of plug-in hybrid electric passenger cars, in watt-hour per kilometer (Wh/km), which will be the measurements determined according to GB/T 19753;

$CEF_{Electricity}$——carbon emission factor of electricity production, in kilogram of carbon dioxide equivalent per kilowatt-hour ($kgCO_2e/kWh$), which will be the value provided in Table H.1 in Appendix H.

The carbon emission during fuel use of category-M1 cars fueled solely with gasoline or diesel, non-off-vehicle chargeable hybrid passenger cars and battery electric passenger cars shall be calculated with Formula (19), and the calculation results shall be rounded to the nearest to two decimal places:

$$C_{\text{Fuel use}} = FC \times K_{CO_2} \times L / 100 \quad \cdots\cdots (19)$$

Wherein,

$C_{Fuel\ use}$——carbon emission during fuel use, in kilogram of carbon dioxide equivalent ($kgCO_2e$);

FC——fuel consumption, in liter per 100 kilometers (L/100km) or kilowatt-hour per 100 kilometers (kWh/100km), which will be the measurements determined according to GB/T 19233 for category-M1 gasoline cars and category-M1 diesel cars, the measurements determined according to GB/T 19753 for non-off-vehicle chargeable hybrid passenger cars, and the measurements determined according to GB/T 18386 for battery electric passenger cars;

K_{CO2}——conversion coefficient, referring to GB 27999-2019, which will be 2.37kg/L for gasoline passenger cars, 2.60kg/L for diesel passenger cars, and 0 for battery electric passenger cars;

L——life cycle mileage of passenger cars, taken as (1.5×10^5) km.

The carbon emission during fuel use of plug-in hybrid electric passenger cars shall be calculated with Formula (20), and the calculation results shall be rounded to the nearest to two decimal places:

$$C_{\text{Fuel use}} = FC_{\text{weighted}} \times K_{CO_2} \times L / 100 \quad \cdots\cdots (20)$$

Wherein,

$C_{Fuel\ use}$——carbon emission during fuel use, in kilogram of carbon dioxide equivalent ($kgCO_2e$);

$FC_{weighted}$——type approval value of fuel consumption of plug-in hybrid electric passenger cars, in liter per 100 kilometers (L/100km), which will be the measurements determined according to GB/T 19753;

L——life cycle mileage of passenger cars, taken as (1.5×10^5) km;

K_{CO2}——conversion coefficient, referring to GB 27999-2019, which will be 2.37kg/L for gasoline passenger cars.

The carbon emission due to tyre replacement (twice, with four tyres in each replacement) during use stage shall be calculated with Formula (21), and the calculation results shall be rounded to the nearest to two decimal places:

$$C_{Tyres\ r} = C_{Tyres} \times \frac{4}{5} \times 2 \quad \cdots\cdots (21)$$

Wherein,

$C_{Tyres\ r}$——carbon emission due to replacement of (four) tyres during use stage, in kilogram of carbon dioxide equivalent ($kgCO_2e$);

C_{Tyres}——carbon emission from tyre production, in kilogram of carbon dioxide equivalent ($kgCO_2e$);

The carbon emission due to lead acid battery replacement during use stage shall be calculated with Formula (22), and the calculation results shall be rounded to the nearest to two decimal places:

$$C_{Lead\ acid\ battery\ r} = C_{Lead\ acid\ battery} \times N_{Lead\ acid\ battery} \qquad (22)$$

Wherein,

$C_{Lead\ acid\ battery\ r}$——carbon emission due to lead acid battery replacement during use stage, in kilogram of carbon dioxide equivalent ($kgCO_2e$);

$C_{Lead\ acid\ battery}$——carbon emission from lead acid battery production, in kilogram of carbon dioxide equivalent ($kgCO_2e$);

$N_{Lead\ acid\ battery''}$——lead acid battery replacements in the life cycle;

The carbon emission due to fluid replacement and (one) refrigerant escape during use stage shall be calculated with Formula (23), and the calculation results shall be rounded to the nearest to two decimal places:

$$C_{Fluids\ r} = \sum(M_{Fluid\ material\ i} \times CEF_{Fluid\ material\ i} \times N_{Fluid\ material\ i}) + M_{Refrigerant} \times GWP_{Refrigerant} \qquad (23)$$

Wherein,

$C_{Fluids\ r}$——carbon emission due to fluid replacement and (one) refrigerant escape during use stage, in kilogram of carbon dioxide equivalent ($kgCO_2e$);

$M_{Fluid\ material\ i}$——weight of fluid material i, in kilogram (kg);

$M_{Refrigerant}$——weight of refrigerant, in kilogram (kg);

$CEF_{Fluid\ material\ i}$——carbon emission factor of fluid material i, in kilogram of carbon dioxide equivalent per kilogram ($kgCO_2e/kg$);

$N_{Fluid\ material\ i}$——replacements of fluid material i in the life cycle;

$GWP_{Refrigerant}$——global warming potential of refrigerant.

For the weight of fluid material i, the site-specific data can be used, or it can be calculated with the calculation principles and Formula (7) based on Appendix A; for the carbon emission factor of fluid material i, either the site-specific data or the default value in Appendix B can be used (for other homogeneous materials, the site-specific data shall be used for the carbon emission factor); for the replacements of fluid material i, either the site-specific data or the default value in Appendix A can be used. The functional unit and system boundary for accounting the site-specific data of carbon emission factor of fluid material i shall be consistent with Appendix B, the carbon (greenhouse gases) and greenhouse gas source shall be consistent with 4.2.3 and 4.2.4 respectively, and the data and data quality requirements shall be consistent with 4.3. Accounting report on the site-specific data of carbon emission factor of materials shall be submitted in accordance with Appendix F, and refer to Appendix E for the global warming potential of refrigerant.

4.4.6 Life cycle carbon emission

The life cycle carbon emission of the passenger cars shall be calculated with Formula (24), and the calculation results shall be rounded to the nearest to two decimal places:

$$C = (C_{Materials} + C_{Production} + C_{Use})/1000 \qquad (24)$$

Wherein,

C——life cycle carbon emission of the passenger car, in ton of carbon dioxide equivalent (tCO_2e);

$C_{Materials}$——carbon emission during material production stage, in kilogram of carbon dioxide equivalent ($kgCO_2e$);

$C_{Production}$——carbon emission during vehicle production stage, in kilogram of carbon dioxide equivalent ($kgCO_2e$);

C_{Use}——carbon emission during use stage, in kilogram of carbon dioxide equivalent ($kgCO_2e$);

The carbon emission per unit mileage during life cycle of the passenger cars shall be calculated with Formula (25), and the calculation results shall be rounded to the nearest to two decimal places:

$$C = (C_{Materials} + C_{Production} + C_{Use}) / L \times 1000 \quad \text{(25)}$$

Wherein,

C——carbon emission per unit mileage during life cycle of the passenger car, in gram of carbon dioxide equivalent per kilometer (gCO_2e/km);

$C_{Materials}$——carbon emission during material production stage, in kilogram of carbon dioxide equivalent ($kgCO_2e$);

$C_{Production}$——carbon emission during vehicle production stage, in kilogram of carbon dioxide equivalent ($kgCO_2e$);

C_{Use}——carbon emission during use stage, in kilogram of carbon dioxide equivalent ($kgCO_2e$);

L——life cycle mileage of passenger cars, in kilometer and taken as (1.5×10^5) km.

5 Preparation method for passenger car life cycle carbon emission report

5.1 Preparation basis

Account the life cycle carbon emission of passenger cars according to the accounting principles, scope, data requirements and calculation formula for life cycle carbon emission of passenger cars given herein, and prepare the accounting report. See Appendix I.

5.2 Report content framework

5.2.1 Basic information

The report shall provide such basic information as report information, accountant information and applicable standard information. The report information includes the report number, preparer, reviewer and release date. The accountant information includes the full name, unified social credit code, address, contact person and contact information of the company.

The report shall indicate the main technical parameters and functions of passenger cars, including vehicle model, registered trademark, time to market, curb mass, fuel type and other information.

5.2.2 Life cycle carbon emission accounting

5.2.2.1 Accounting scope

The report shall provide detailed description of the accounting object, functional unit and product performance, tabular description of the material composition and technical parameters of the product, and plotting and explanation of the system boundary of the product.

5.2.2.2 Inventory analysis

The report shall provide the considered life cycle stages, describe the inventory data considered at each stage and the site-specific data or default values collected, and when data allocation is involved, describe the allocation method and results.

5.2.2.3 Carbon emission

The report shall provide the carbon emission per unit mileage calculated with the carbon emission accounting method set forth in 4.4 herein.

Appendix A

(Informative)

Default value of material weight and replacement times

The vehicle curb mass consists of five parts: weight of parts, weight of tyres, weight of lead acid batteries, weight of lithium-ion power batteries and weight of fluids. The default weight of parts shall be calculated with the following formula, and the calculation result shall be rounded to the nearest to two decimal places:

$$W_{Part} = CM \times P_{part}$$

Wherein,

W_{Part}——weight of parts, kg;

CM——curb mass, kg;

P_{Part}——default weight proportion of parts, %, with the weight proportion of parts calculated according to Table A.1.

The default weight of original tyres (five, including one spare tyre) of the car shall be calculated with the following formula, and the calculation result shall be rounded to the nearest to two decimal places:

$$W_{tyre} = CM \times P_{tyre}$$

Wherein,

W_{Tyre}——weight of original tyres, kg;

CM——curb mass, kg;

P_{Tyre}——default weight proportion of original tyres, %, with the weight proportion of original tyres calculated according to Table A.1.

The default weight of replacement tyres (four) of the car shall be calculated with the following formula, and the calculation result shall be rounded to the nearest to two decimal places:

$$W_{tyre\ \ r} = W_{tyre} \times 80\%$$

Wherein,

$W_{Tyre\ r}$——weight of replacement tyre, kg.

The default weight of lead acid battery shall be calculated with the following formula, and the calculation result shall be rounded to the nearest to two decimal places:

$$W_{Lead\ \ acid\ \ battery} = CM \times P_{Lead\ \ acid\ \ battery}$$

Wherein,

$W_{Lead\ acid\ battery}$——weight of lead acid batteries, kg;

CM——curb mass, kg;

$P_{Lead\ acid\ battery}$——default weight proportion of lead acid batteries, %, with the weight proportion of lead acid batteries calculated according to Table A.1.

The default weight of lithium-ion power battery shall be calculated with the following formula, and the calculation result shall be rounded to the nearest to two decimal places:

$$W_{Li-Ion\ battery} = CM \times P_{Li-Ion\ battery}$$

Wherein,

$W_{Li\text{-}Ion\ battery}$——weight of lithium-ion power batteries, kg;

CM——curb mass, kg;

$P_{Li\text{-}Ion\ battery}$——default weight proportion of lithium-ion power batteries, %, with the weight proportion of lithium-ion power batteries calculated according to Table A.1.

The default weight of fluid shall be calculated with the following formula, and the calculation result shall be rounded to the nearest to two decimal places:

$$W_{Fluids} = CM \times P_{Fluids}$$

Wherein,

W_{Fluids}——weight of fluids, kg;

CM——curb mass, kg;

P_{Fluids}——default weight proportion of fluids, %, with the weight proportion of fluids calculated according to Table A.1.

Table A.1 Default weight proportion of various parts of the vehicle

No.	Name	Category-M1 cars fueled solely with gasoline or diesel	Non-off-vehicle chargeable hybrid passenger cars	Plug-in hybrid electric passenger cars	Battery electric passenger cars
1	Car parts	92.6%	90.0%	85.3%	72.6%
2	Tyres	3.5%	3.4%	3.2%	3.4%
3	Lead acid batteries	1.2%	1.2%	1.1%	0.8%
4	Lithium-ion power batteries	0.0%	2.9%	7.9%	22.2%
5	Fluids	2.6%	2.5%	2.4%	1.0%

The default weight of part material i shall be calculated with the following formula, and the calculation result shall be rounded to the nearest to two decimal places:

$$M_{Part\ material\ i} = W_{part} \times P_{Part\ material\ i}$$

Wherein,

$M_{Part\ material\ i}$——weight of part material i, kg;

W_{Part}——weight of the part, kg;

$P_{Part\ material\ i}$——default weight proportion of part material i, %, with the weight proportion of part material i calculated according to Table A.2.

Table A.2 Default weight proportion of part material

No.	Name of material	Applicable category-M1 cars except Battery electric passenger cars	Battery electric passenger cars
1	Steel	55.6%	63.8%
2	Cast iron	8.2%	3.1%
3	Aluminum and aluminum alloys	10.9%	8.0%
4	Magnesium and magnesium alloys	0.0%	0.2%
5	Copper and copper alloys	1.9%	1.8%
6	Thermoplastic plastics	10.3%	11.2%
7	Thermosetting plastics	1.3%	1.8%
8	Rubber	3.6%	2.7%
9	Fabrics	1.3%	1.0%
10	Ceramics/glass	3.8%	4.2%

The default weight of the material i of original tyres (five, including one spare tyre) of the car shall be calculated with the following formula, and the calculation result shall be rounded to the nearest to two decimal places:

$$M_{Tyre\ \ material\ \ i} = W_{Tyre} \times P_{Tyre\ \ material\ \ i}$$

Wherein,

$M_{Tyre\ material\ i}$——weight of material i of the original tyres, kg;

W_{Tyre}——weight of original tyres, kg;

$P_{Tyre\ material\ i}$——default weight proportion of tyre material i, %, with the weight proportion of tyre material i calculated according to Table A.3.

Table A.3 Default weight proportion of tyre material

No.	Name of material	Applicable category-M1 cars except battery electric passenger cars	Battery electric passenger cars
1	Rubber	85.0%	85.0%
2	Steel	10.0%	10.0%
3	Fabrics	5.0%	5.0%

The default weight of the replacement tyres (four) of the car shall be calculated with the following formula, and the calculation result shall be rounded to the nearest to two decimal places:

$$M_{Tyre\ \ material\ \ r\ \ i} = W_{Tyre\ \ r} \times P_{Tyre\ \ material\ \ i}$$

Wherein,

$M_{Type\ material\ r\ i}$——weight of material i of replacement tyres, kg;

$W_{Tyre\ r}$——weight of replacement tyres, kg;

$P_{Tyre\ material\ i}$——default weight proportion of tyre material i, %, with the weight proportion of tyre material i calculated according to Table A.2.

The default weight of the lead acid battery material i shall be calculated with the following formula, and the calculation result shall be rounded to the nearest to two decimal places:

$$M_{Lead\ \ acid\ \ material\ \ i} = W_{Lead\ \ acid\,battery} \times P_{Lead\ \ acid\ \ material\ \ i}$$

Wherein,

$M_{Lead\ acid\ battery\ material\ i}$——weight of lead acid battery material i, kg;

$W_{Lead\text{-}Acid\ battery}$——weight of lead acid battery, kg;

$P_{Lead\ acid\ battery\ material\ i}$——default weight proportion of lead acid battery material i, %, with the weight proportion of lead acid battery material i calculated according to Table A.4.

Table A.4 Default weight proportion of lead acid battery material

No.	Name of material	Applicable category-M1 cars except battery electric passenger cars	Battery electric passenger cars
1	Thermoplastic plastics	6.6%	7.3%
2	Lead	58.7%	61.0%
3	Sulphuric acid	25.2%	12.5%
4	Fiberglass	1.7%	0.0%

The default weight of fluid i shall be calculated with the following formula, and the calculation result shall be rounded to the nearest to two decimal places:

$$M_{Fluids\ \ material\ \ i} = W_{Fluids} \times P_{Fluids\ \ material\ \ i}$$

Wherein,

$M_{Fluids\ material\ i}$——weight of fluid material i, kg;

$W_{Fluids\ material}$——weight of fluid material, kg;

$P_{Fluids\ material\ i}$——default weight proportion of fluid material i, %, g, with the default weight of fluid material i calculated according to Table A.5.

Table A.5 Default weight proportion of fluid material

No.	Name of material	Applicable category-M1 cars except battery electric passenger cars	Battery electric passenger cars
1	Lubricant	29.1%	10.4%
2	Brake fluid	7.9%	5.0%
3	Coolant	40.9%	69.9%
4	Refrigerant	2.9%	6.4%
5	Detergent	19.2%	8.3%

The default material replacements shall be calculated according to Table A.6.

Table A.6 Default value of material replacements

No.	Name of material	Applicable M1 cars except battery electric passenger cars	Battery electric passenger cars
1	Lead acid battery	2	2
2	Lubricant	29	8
3	Brake fluid	2	2
4	Coolant	2	2
5	Refrigerant	1	1
6	Detergent	14	14

Appendix B
(Informative)
Accounting range and default value of carbon emission factor of materials

B.1 Accounting scope of carbon emission factor of materials

B.1.1 Steel

B.1.1.1 Functional unit

1kg steel product produced by the factory.

B.1.1.2 Accounting boundary

The system boundary for the carbon emission of steel herein includes the main processes of iron ore mining, iron ore dressing, sintering, ironmaking (BF) and steelmaking (BOF, EAF), the production process of relevant auxiliary materials (metallurgical lime, metallurgical coke, ferrosilicon) and the transportation process of main raw materials (ore, coal, etc.), with EAF steel accounting for 10%. See Figure B.1.

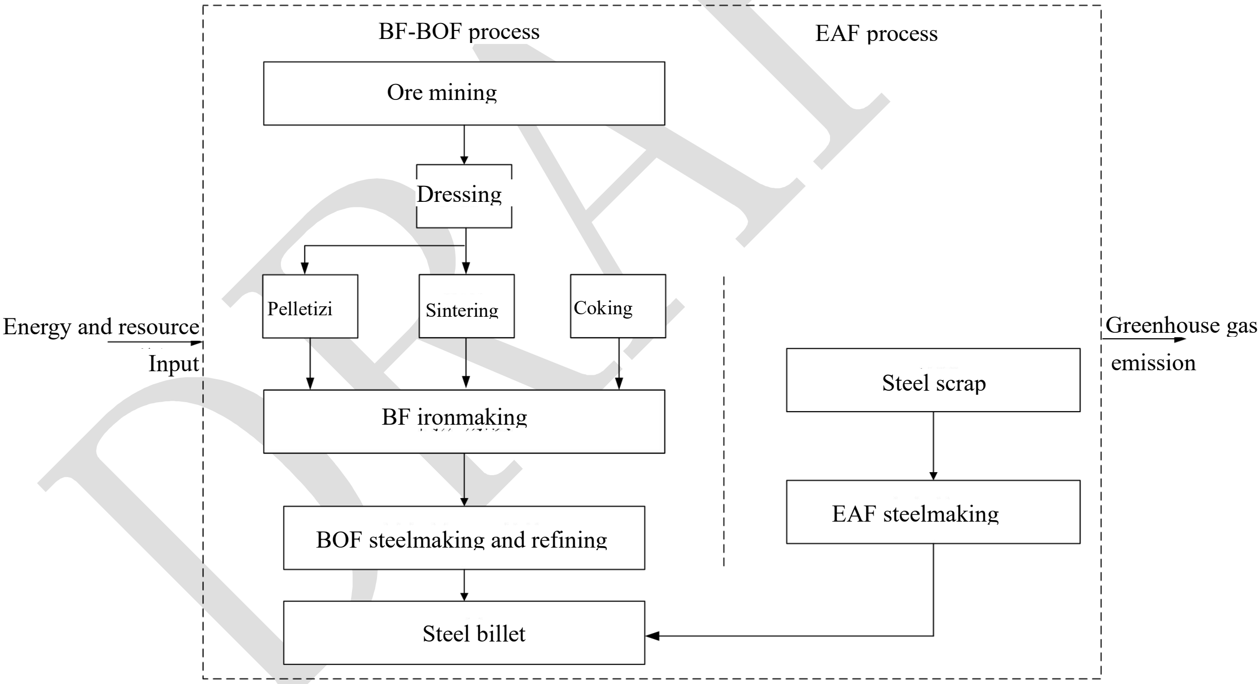

Figure B.1 System boundary for carbon emission accounting for steel (including recycling of steel scrap)

B.1.2 Cast iron

B.1.2.1 Functional unit

1kg cast iron products produced by the factory.

B.1.2.2 Accounting boundary

The system boundary for the carbon emission of cast iron herein includes ore mining, dressing, pelletizing, sintering, coking, blast furnace ironmaking, molten iron pouring, casting separation and other processes. See Figure B.2.

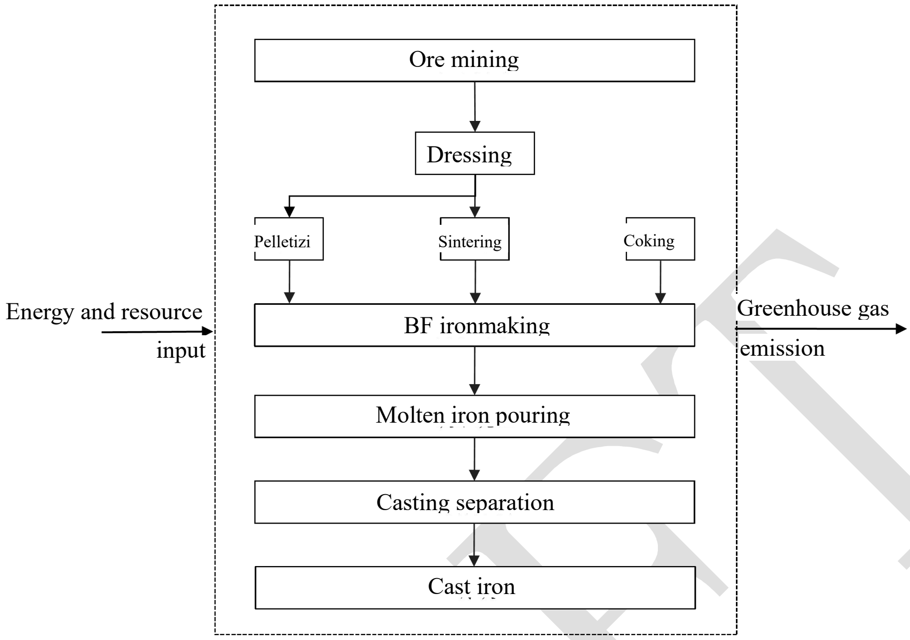

Figure B.2 System boundary for carbon emission accounting for cast iron

B. 1. 3 Aluminum and aluminum alloys

B. 1. 3. 1 Functional unit

1kg aluminum and aluminum alloy products produced by the factory.

B. 1. 3. 2 Accounting boundary

The system boundary for the carbon emission of aluminum and aluminum alloys herein includes bauxite mining, alumina production, cryolite-alumina molten salt electrolysis, purification (impurity removal) of electrolytic aluminum solution and casting of aluminum ingot, extrusion process, production of auxiliary raw materials (carbon anode or anode paste) and transportation of main materials. See Figure B.3.

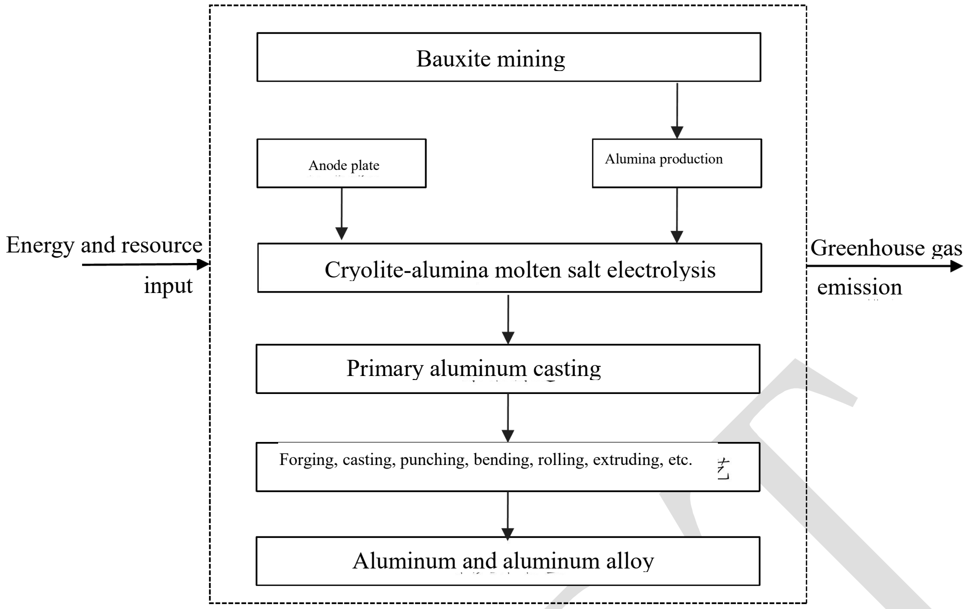

Figure B.3 System boundary for carbon emission accounting for aluminum and aluminum alloys

B. 1. 4 Magnesium and magnesium alloys

B. 1. 4. 1 Functional unit

1kg magnesium and magnesium alloy products produced by the factory.

B. 1. 4. 2 Accounting boundary

The system boundary for the carbon emission of magnesium and magnesium alloys herein includes five stages: dolomite mining; dolomite calcination; batching, pelletizing and reduction; crude magnesium refining and casting processes, together with the production of main auxiliary materials ferrosilicon and fluorspar. See Figure B.4.

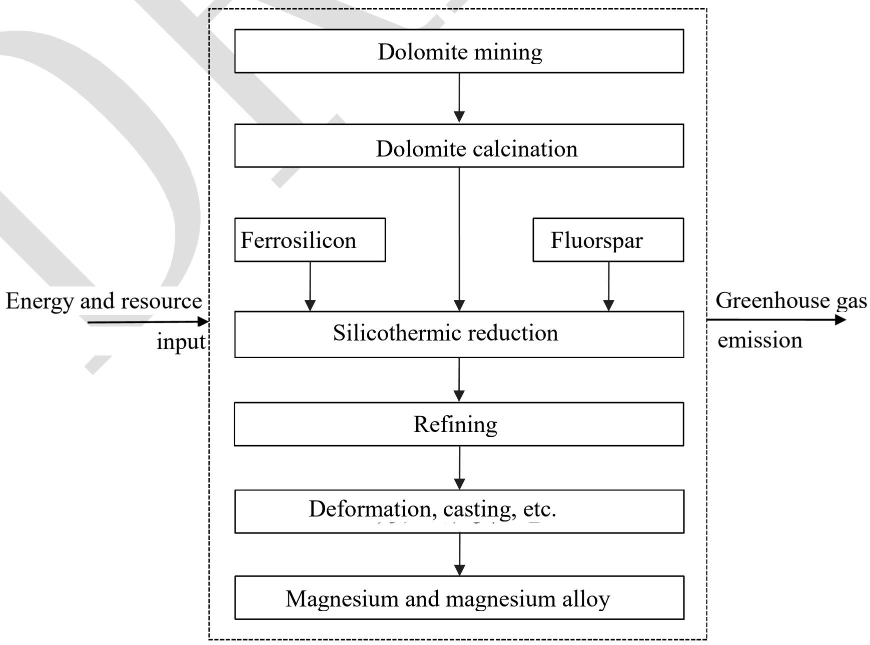

Figure B.4 System boundary for carbon emission accounting for magnesium and magnesium alloys

B. 1. 5 Copper and copper alloys

B. 1. 5. 1 Functional unit

1kg copper and copper alloy products produced by the factory.

B. 1. 5. 2 Accounting boundary

The system boundary for the carbon emission of copper and copper alloys herein includes the copper ore mining (surface mining, underground mining), copper ore dressing, copper smelting (pyrometallurgy, hydrometallurgy), electrolyzing (electrowinning) and other processes. See Figure B.5.

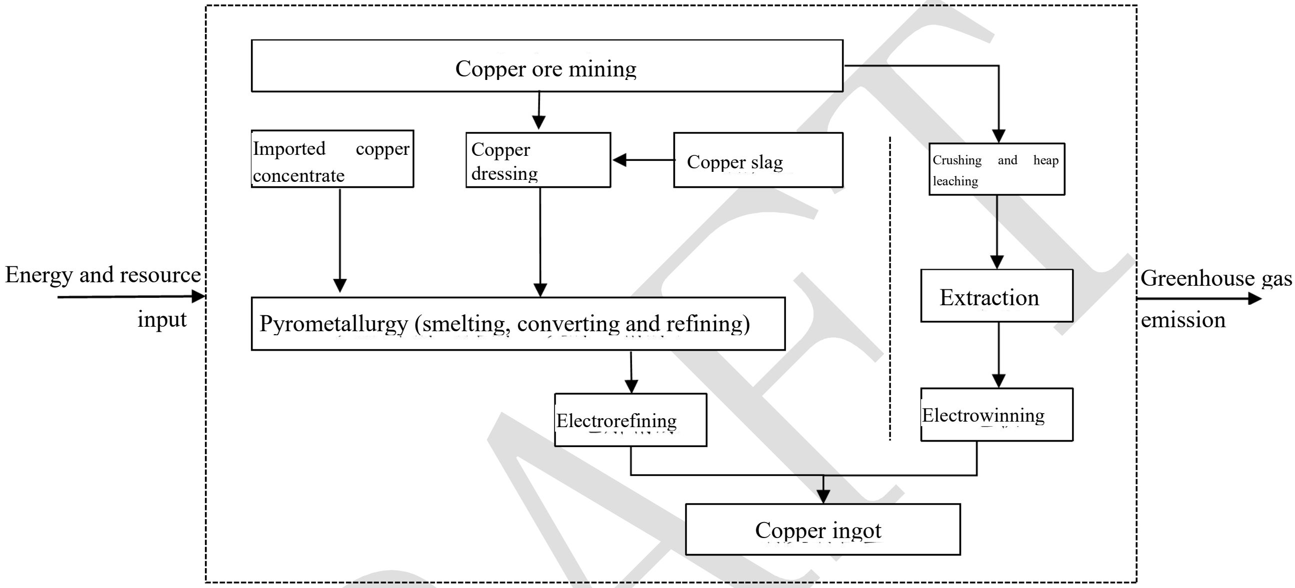

Figure B.5 System boundary for carbon emission accounting for copper and copper alloys

B. 1. 6 Thermoplastic plastics materials

B. 1. 6. 1 Functional unit

1kg thermoplastic plastic products produced by the factory.

B. 1. 6. 2 Accounting boundary

The system boundary for the carbon emission of thermoplastic plastics herein includes the crude oil (raw coal) mining, coke production, calcium carbide production, distillation, cracking, separation and other processes. See Figure B.6.

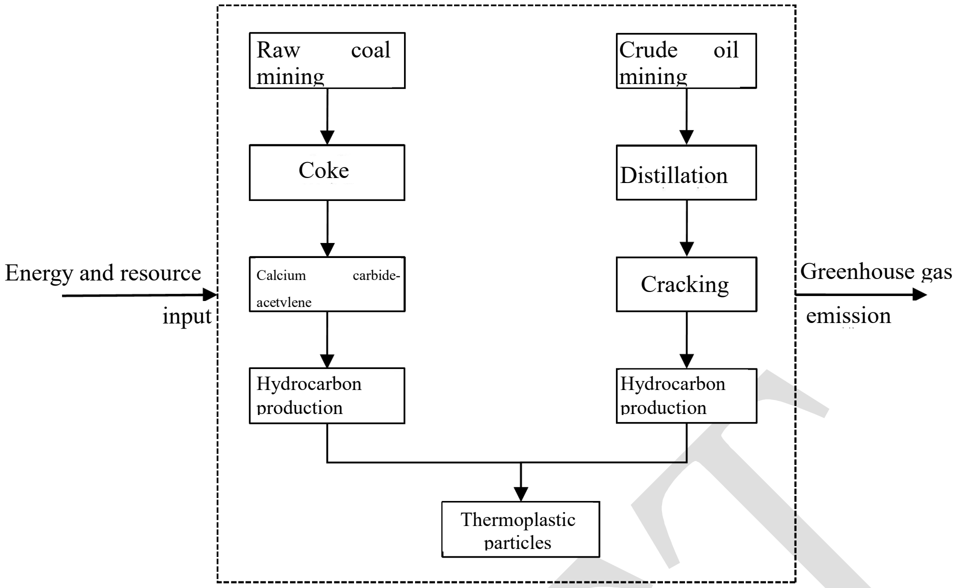

Figure B.6 System boundary for carbon emission accounting for thermoplastic plastics

B. 1. 7 Thermosetting plastics materials

B. 1. 7. 1 Functional unit

1kg thermosetting plastic products produced by the factory.

B. 1. 7. 2 Accounting boundary

The system boundary for the carbon emission of thermosetting plastics herein includes the crude oil mining, crude oil distillation, cracking, separation and other processes. See Figure B.7.

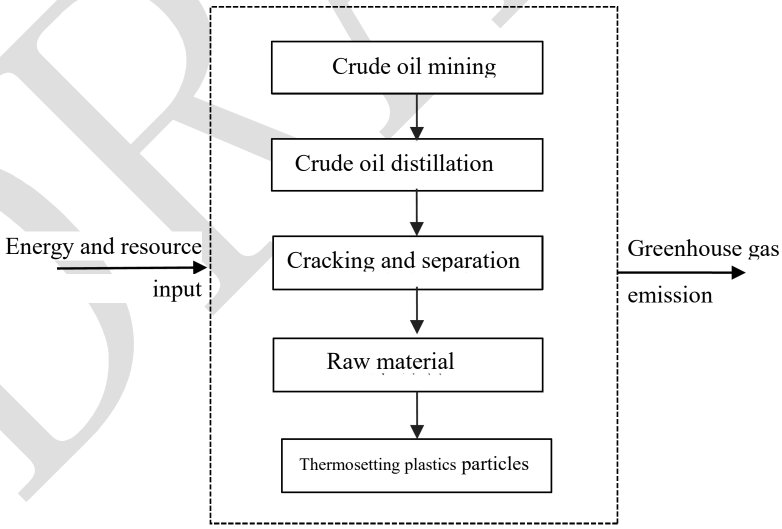

Figure B.7 System boundary for carbon emission accounting for thermosetting plastics

B. 1. 8 Rubber material

B. 1. 8. 1 Functional unit

1kg rubber products produced by the factory.

B. 1. 8. 2 Accounting boundary

The system boundary for the carbon emission of rubber herein includes the plasticizing, mixing, forming, vulcanizing, trimming and other processes. See Figure B.8.

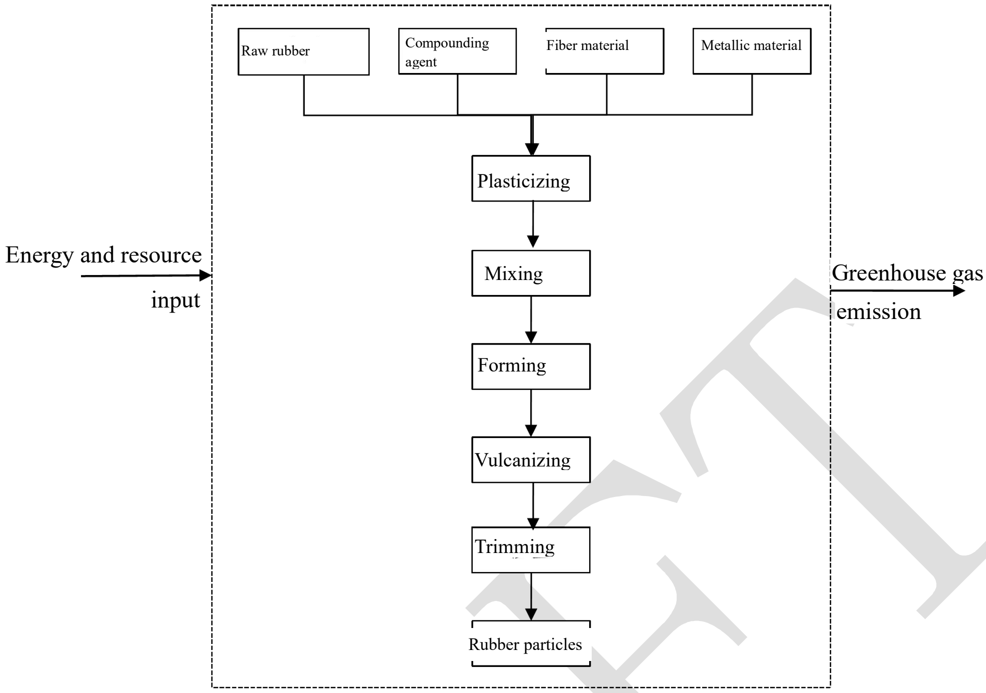

Figure B.8 System boundary for carbon emission accounting for rubber

B. 1. 9 Fabrics

B. 1. 9. 1 Functional unit

1kg fabric products produced by the factory.

B. 1. 9. 2 Accounting boundary

The system boundary for the carbon emission of fabrics herein includes the spinning, weaving, dyeing, finishing and other processes. See Figure B.9.

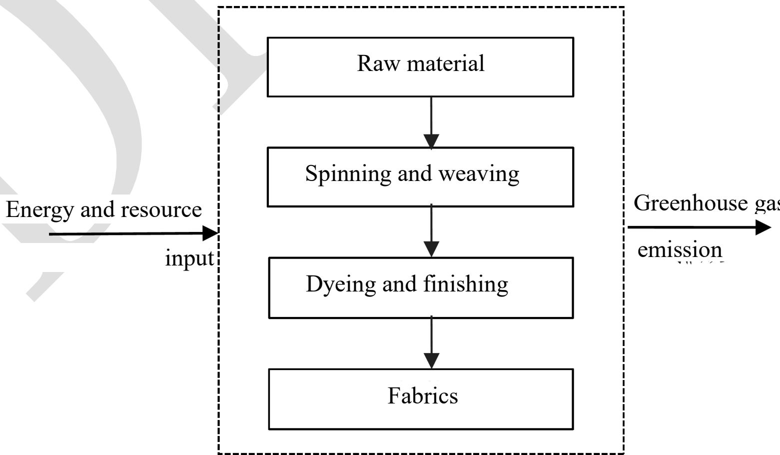

Figure B.9 System boundary for carbon emission accounting for fabrics

B. 1. 10 Ceramics/glass material

B. 1. 10. 1 Functional unit

1kg ceramics/glass products produced by the factory.

B. 1. 10. 2 Accounting boundary

The system boundary for the carbon emission of ceramics/glass herein includes the mining, crushing, mixing, melting, forming, annealing, quenching or ion exchange processes of silica sand, soda ash, feldspar, dolomite, limestone and mirabilite. See Figure B.10.

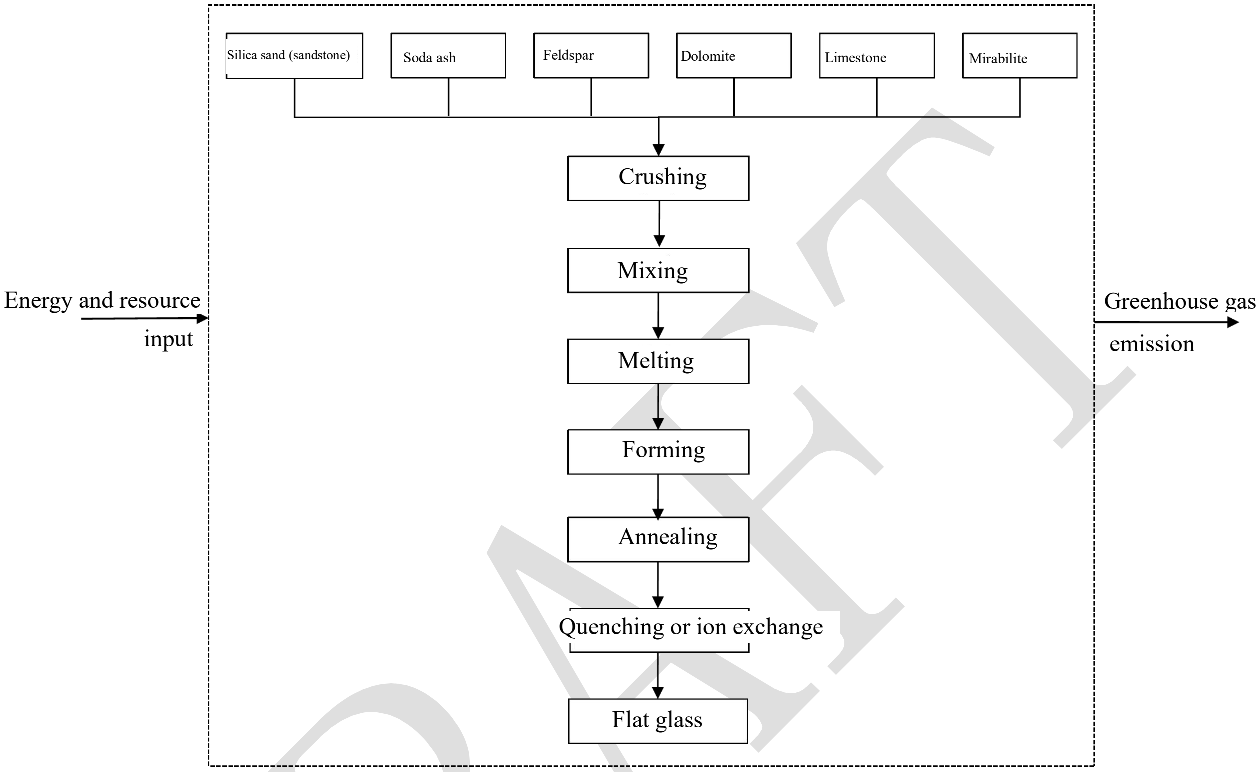

Figure B.10 System boundary for carbon emission accounting for ceramics/glass

B. 1. 11 Lead material

B. 1. 11. 1 Functional unit

1kg lead products produced by the factory.

B. 1. 11. 2 Accounting boundary

The system boundary for the carbon emission of lead material herein includes the lead zinc ore mining (surface mining, underground mining), dressing, pyrometallurgy (sintering machine-blast furnace process, SKS process) and other processes. See Figure B.11.

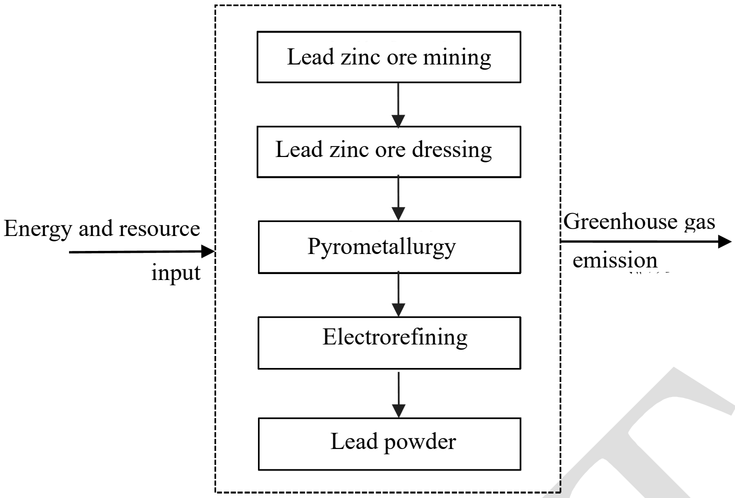

Figure B.11 System boundary for carbon emission accounting for lead

B. 1. 12 Sulphuric acid material

B. 1. 12. 1 Functional unit

1kg sulphuric acid produced by the factory.

B. 1. 12. 2 Accounting boundary

The system boundary for the carbon emission of sulphuric acid herein includes the process from ore (pyrite, sulfur) mining, dressing, transportation to sulfuric acid production; among them, the acid production from metallurgical flue gas only includes the sulfuric acid production process, excluding the mining, production and distribution of metallurgical raw materials. See Figure B.12.

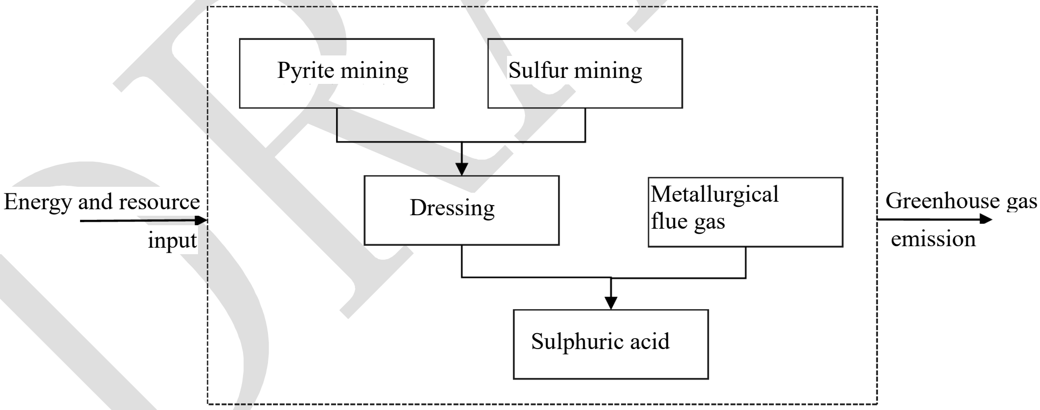

Figure B.12 System boundary for carbon emission accounting for sulphuric acid

B. 1. 13 Fiberglass material

B. 1. 13. 1 Functional unit

1kg fiberglass products produced by the factory.

B. 1. 13. 2 Accounting boundary

The system boundary for the carbon emission of fiberglass herein includes the ore mining, cleaning, drying, heating and melting in the kiln, electric heating for wire drawing, wire drawing and softening processes. See Figure B.13.

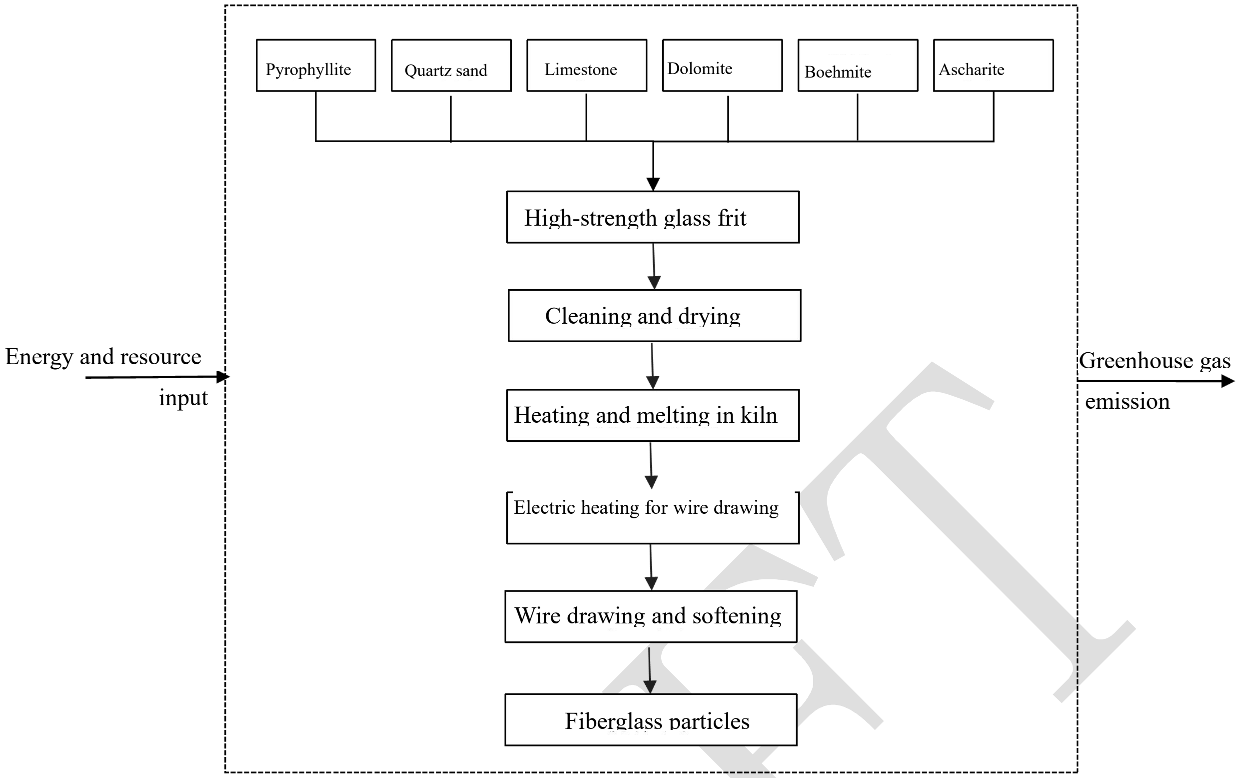

Figure B.13 System boundary for carbon emission accounting for fiberglass

B. 1. 14 Lithium iron phosphate material

B. 1. 14. 1 Functional unit

1kg lithium iron phosphate products produced by the factory.

B. 1. 14. 2 Accounting boundary

In this document, accounting for the carbon emission of lithium iron phosphate of the power batteries of battery electric passenger cars, plug-in hybrid electric passenger cars and non-off-vehicle chargeable hybrid passenger cars is performed, and the system boundary for the carbon emission of lithium iron phosphate includes the ore mining, blending, spray drying, sintering, crushing, mixing, baking and other processes. See Figure B.14.

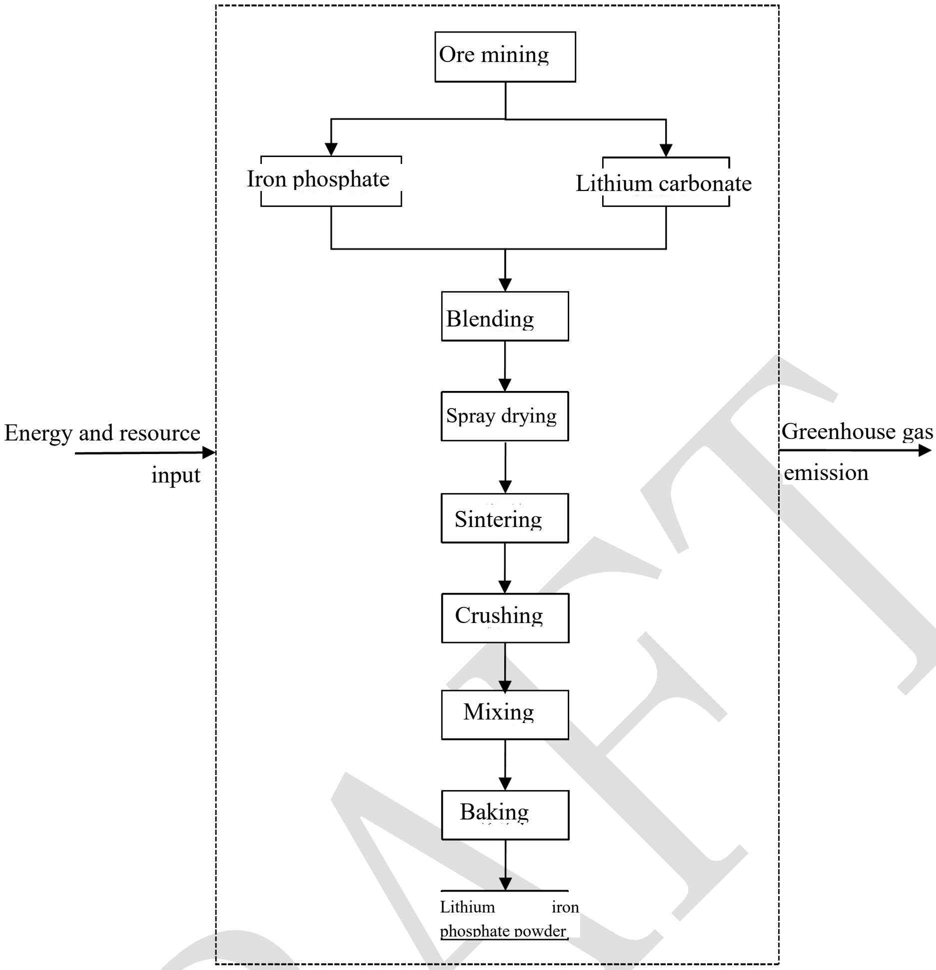

Figure B.14 System boundary for carbon emission accounting for lithium iron phosphate

B. 1. 15 Lithium nickel cobalt manganese oxide material

B. 1. 15. 1 Functional unit

1kg lithium nickel cobalt manganese oxide products produced by the factory.

B. 1. 15. 2 Accounting boundary

In this document, accounting for the carbon emission of lithium nickel cobalt manganese oxide of the power batteries of battery electric passenger cars, plug-in hybrid electric passenger cars and non-off-vehicle chargeable hybrid passenger cars is performed, and the system boundary for the carbon emission of lithium nickel cobalt manganese oxide includes the ore mining, mixing, sintering, crushing, iron removal, screening, packaging and other processes. See Figure B.15.

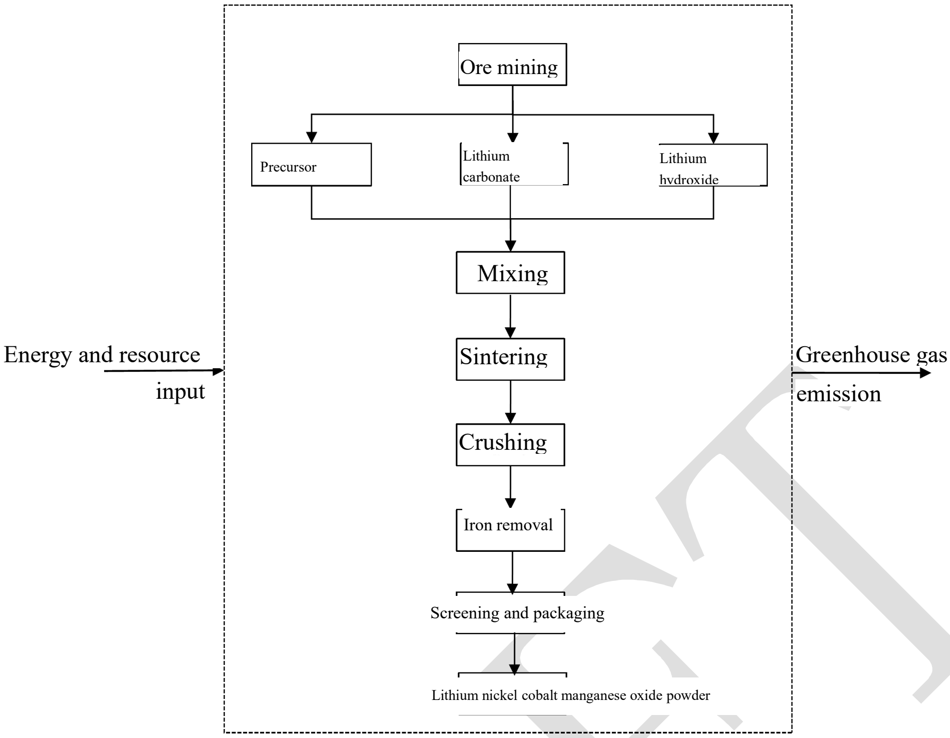

Figure B.15 System boundary for carbon emission accounting for lithium nickel cobalt manganese oxide

B. 1. 16 Lithium manganite material

B. 1. 16. 1 Functional unit

1kg lithium manganate products produced by the factory.

B. 1. 16. 2 Accounting boundary

In this document, accounting for the carbon emission of lithium manganate of the power batteries of battery electric passenger cars, plug-in hybrid electric passenger cars and non-off-vehicle chargeable hybrid passenger cars is performed, and the system boundary for the carbon emission of lithium manganate includes the ore mining, blending, baking, grinding, screening and other processes. See Figure B.16.

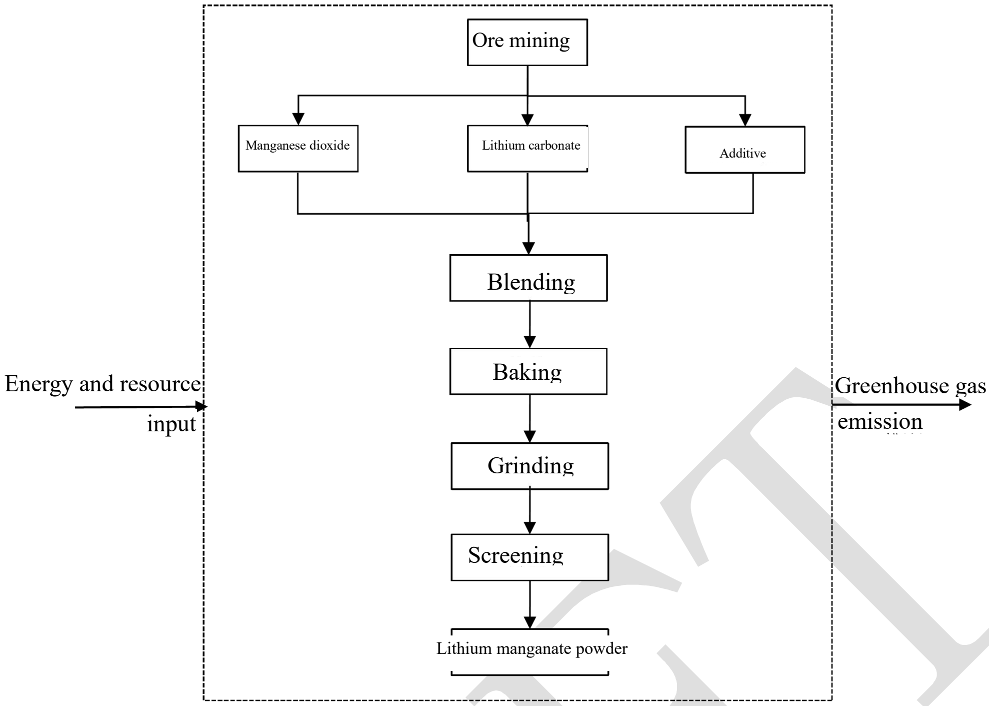

Figure B.16 System boundary for carbon emission accounting for lithium manganate

B. 1. 17 Graphite material

B. 1. 17. 1 Functional unit

1kg graphite products produced by the factory.

B. 1. 17. 2 Accounting boundary

In this document, accounting for the carbon emission of graphite of the power batteries of battery electric passenger cars, plug-in hybrid electric passenger cars and non-off-vehicle chargeable hybrid passenger cars is performed, and the system boundary for the carbon emission of graphite includes the graphite ore mining, crushing, granulation, graphitization, screening and other processes. See Figure B.17.

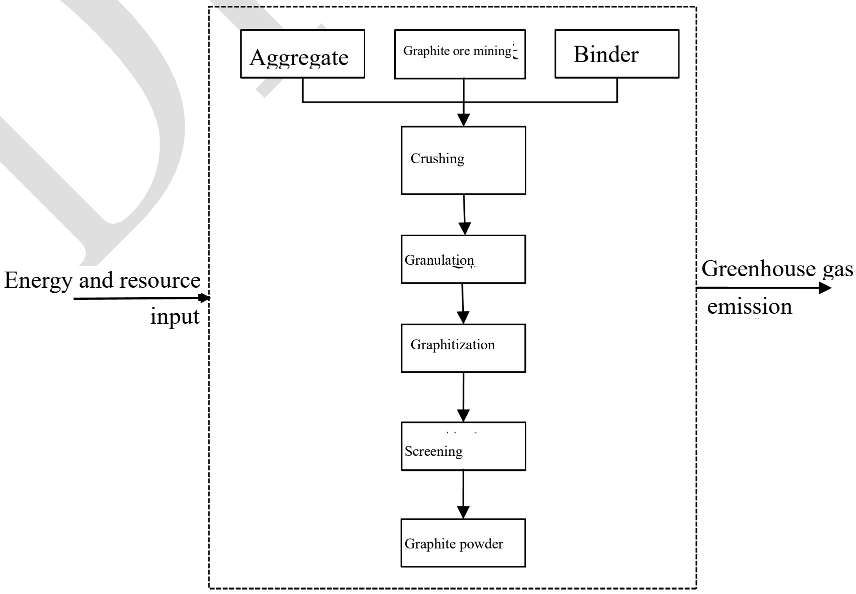

Figure B.17 System boundary for carbon emission accounting for graphite

B. 1. 18 Electrolyte: lithium hexafluorophosphate material

B. 1. 18. 1 Functional unit

1kg lithium hexafluorophosphate products produced by the factory.

B. 1. 18. 2 Accounting boundary

In this document, accounting for the carbon emission of electrolyte lithium hexafluorophosphate of the power batteries of battery electric passenger cars, plug-in hybrid electric passenger cars and non-off-vehicle chargeable hybrid passenger cars is performed, and the system boundary for the carbon emission of lithium hexafluorophosphate includes the ore mining, dissolution, lithium hexafluorophosphate crystallization, separation, drying and other processes. See Figure B.18.

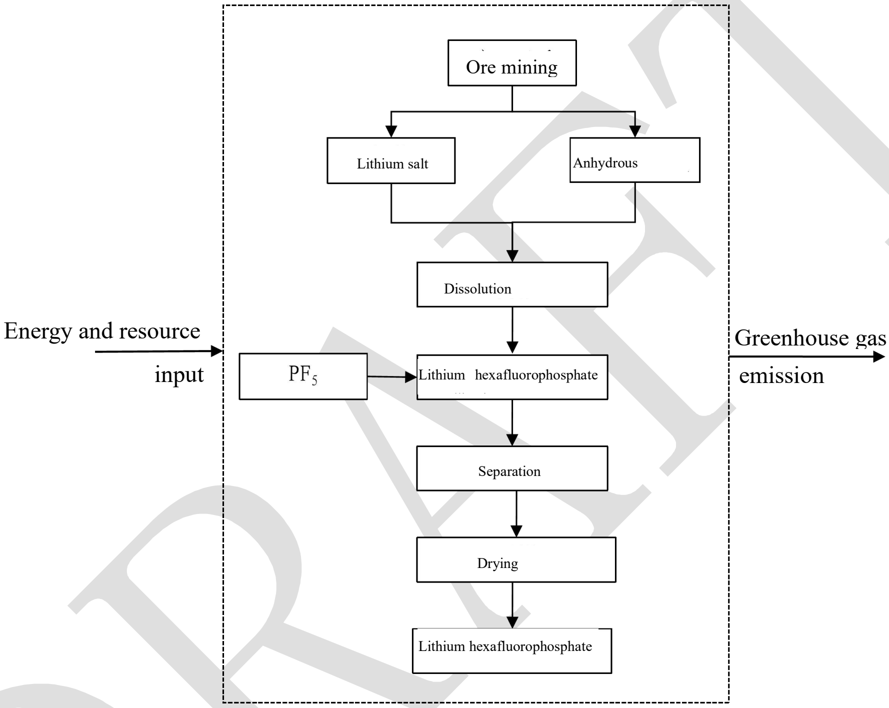

Figure B.18 System boundary for carbon emission accounting for lithium hexafluorophosphate

B. 1. 19 Lubricant material

B. 1. 19. 1 Functional unit

1kg lubricant products produced by the factory.

B. 1. 19. 2 Accounting boundary

The system boundary for carbon emission for lubricant herein includes batching in blending tank, heating, mixing, stirring, filtering, filling and other processes. See Figure B.19.

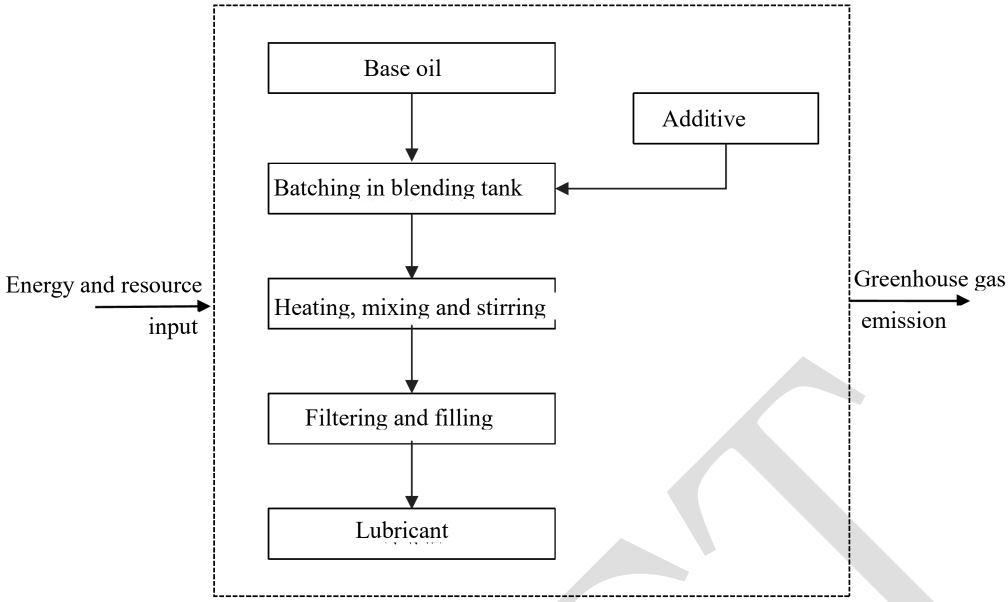

Figure B.19 System boundary for carbon emission accounting for lubricant

B. 1. 20 Brake fluid material

B. 1. 20. 1 Functional unit

1kg brake fluid products produced by the factory.

B. 1. 20. 2 Accounting boundary

The system boundary of carbon emission of brake fluids herein includes the blending, batching, stirring, discharging, filling and other processes. See Figure B.20.

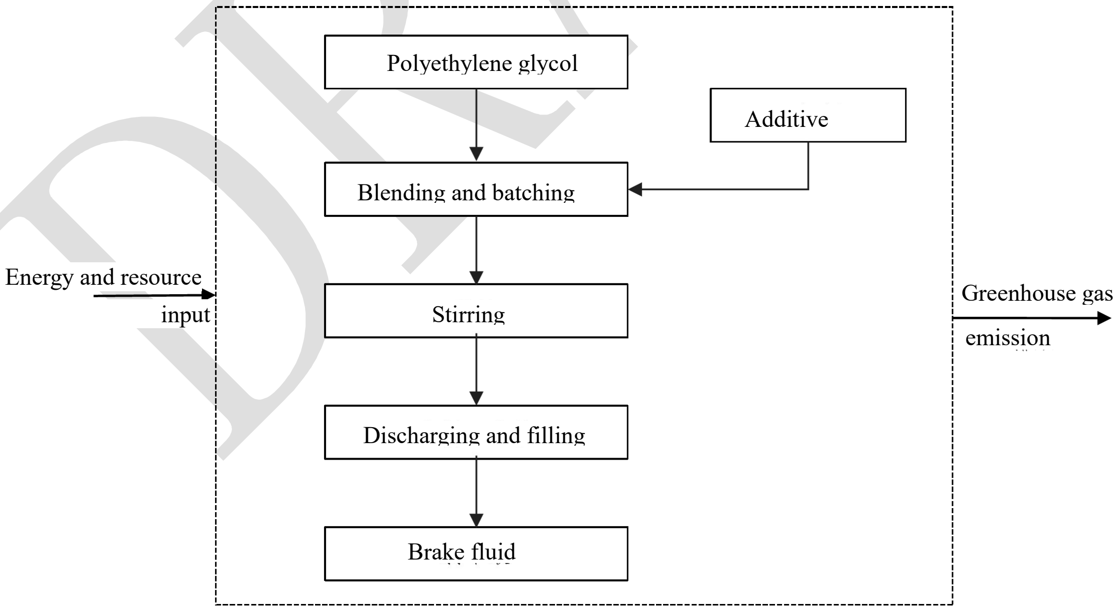

Figure B.20 System boundary for carbon emission accounting for brake fluid

B. 1. 21 Coolant material

B. 1. 21. 1 Functional unit

1kg coolant products produced by the factory.

B. 1. 21. 2 Accounting boundary

The system boundary of carbon emission of coolants herein includes the water softening, stirring, temporary storage, filling and other processes. See Figure B.21.

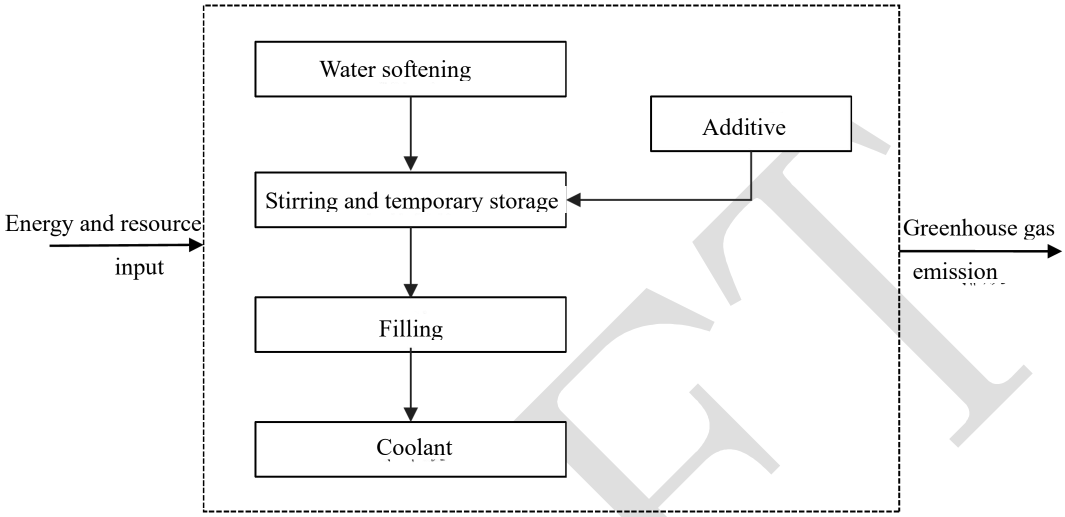

Figure B.21 System boundary for carbon emission accounting for coolant

B. 1. 22 Refrigerant material

B. 1. 22. 1 Functional unit

1kg refrigerant products produced by the factory.

B. 1. 22. 2 Accounting boundary

The system boundary of carbon emission of refrigerants herein includes the production, fluorination of trifluoro chloroethane and other processes. See Figure B.22.

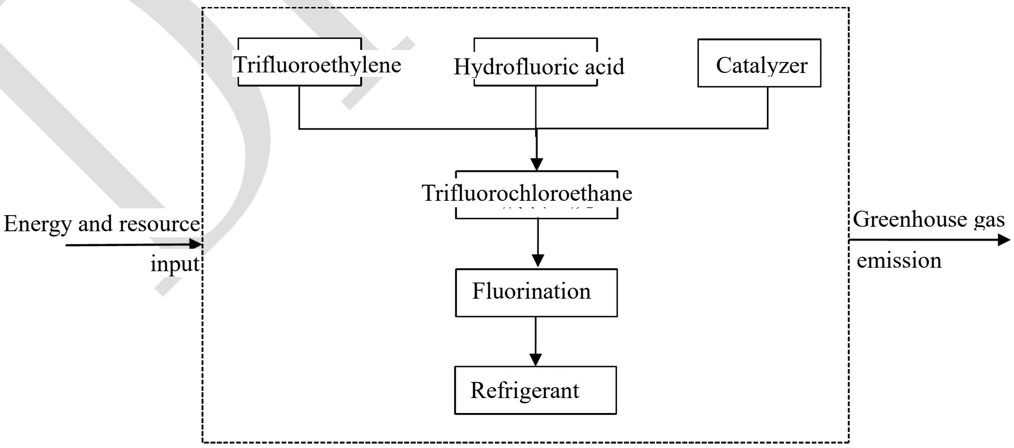

Figure B.22 System boundary for carbon emission accounting for refrigerant

B. 1. 23 Detergent material

B. 1. 23. 1 Functional unit

1kg detergent products produced by the factory.

B. 1. 23. 2 Accounting boundary

The system boundary of carbon emission of detergents herein includes the water softening, stirring, temporary storage, filling and other processes. See Figure B.23.

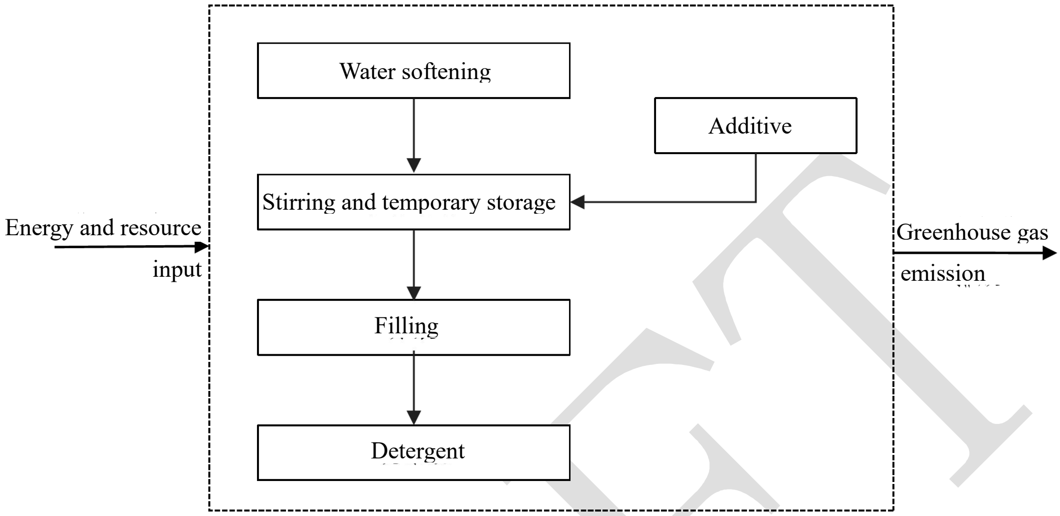

Figure B.23 System boundary for carbon emission accounting for detergent

B. 1. 24 Biomass materials

B. 1. 24. 1 Functional unit

1kg biomass materials produced by the plant.

B. 1. 24. 2 Accounting boundary

In this document, the system of biomass materials produced from non-waste materials includes cultivation, reap and production of biomass materials, etc. See Figure B.25.

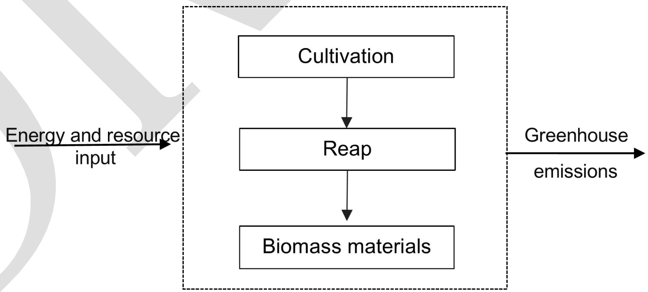

Figure B.23 System boundary for biomass materials produced from non-waste materials

B. 1. 25 Lithium-ion power battery pack

B. 1. 25. 1 Functional unit

1kWh lithium-ion power battery packs produced by the factory.

B. 1. 25. 2 Accounting boundary

The system boundary of carbon emission of lithium-ion power battery pack herein includes the resource mining, processing, refinement, production and manufacturing processes of various raw materials. See Figure B.24.

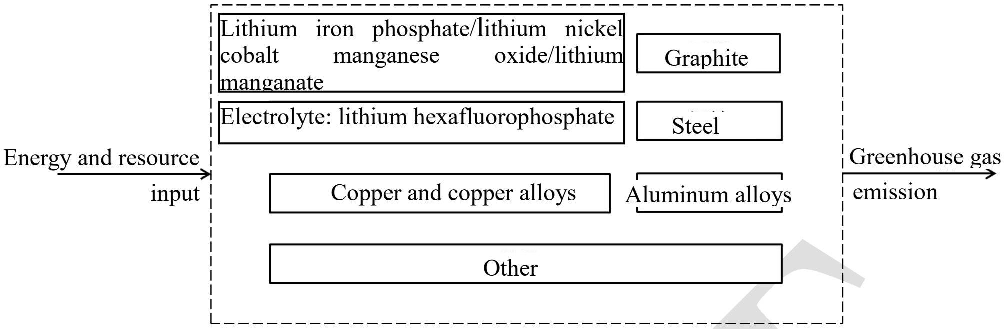

Figure B.25 System boundary for carbon emission accounting for lithium-ion power battery pack

B. 1. 26 Recycled material

B. 1. 26. 1 Functional unit

Certain 1kg recycled materials produced by the factory.

B. 1. 26. 2 Accounting boundary

Delimit the boundary depending on the physical conditions. The processes of processing and re-manufacturing of recycled materials from waste materials shall be included, while the use and abandonment processes shall be excluded; equipment manufacturing, plant construction and other infrastructure for production are not within the boundary.

B. 1. 27 Other homogeneous materials

B. 1. 27. 1 Functional unit

Certain 1kg homogeneous materials produced by the factory.

B. 1. 27. 2 Accounting boundary

Delimit the boundary depending on the physical conditions. The processes of resource mining, processing, refinement, production and manufacturing shall be included, while the use and abandonment processes shall be excluded; equipment manufacturing, plant construction and other infrastructure for production are not within the boundary.

B. 2 Default carbon emission factor of material

See Table B.1 for the default values of carbon emission factor of material.

Table B.1 Default carbon emission factor of material and battery pack

No.	Name of material	Default carbon emission factor	Unit
1	Steel	2.38	$kgCO_2e/kg$
2	Cast iron	1.82	$kgCO_2e/kg$
3	Aluminum and aluminum alloys	16.38	$kgCO_2e/kg$
4	Magnesium and magnesium alloys	39.55	$kgCO_2e/kg$

No.	Name of material	Default carbon emission factor	Unit
5	Copper and copper alloys	4.23	kgCO$_2$e/kg
6	Thermoplastic plastics	3.96	kgCO$_2$e/kg
7	Thermosetting plastics	4.57	kgCO$_2$e/kg
8	Rubber	3.08	kgCO$_2$e/kg
9	Fabrics	5.80	kgCO$_2$e/kg
10	Ceramics/glass	0.95	kgCO$_2$e/kg
11	Lead	2.74	kgCO$_2$e/kg
12	Sulphuric acid	0.10	kgCO$_2$e/kg
13	Fiberglass	8.91	kgCO$_2$e/kg
14	Lithium iron phosphate	2.93	kgCO$_2$e/kg
15	Lithium nickel cobalt manganese oxide	17.40	kgCO$_2$e/kg
16	Lithium manganate	4.73	kgCO$_2$e/kg
17	Graphite	5.48	kgCO$_2$e/kg
18	Electrolyte: lithium hexafluorophosphate	19.60	kgCO$_2$e/kg
19	Lubricant	1.20	kgCO2e/kg
20	Brake fluid	1.20	kgCO2e/kg
21	Coolant	1.85	kgCO2e/kg
22	Refrigerant	15.10	kgCO2e/kg
23	Detergent	0.97	kgCO2e/kg
24	Lithium nickel cobalt manganese oxide battery pack	87.78	kgCO2e/kWh
25	Lithium iron phosphate battery pack	73.51	kgCO$_2$e/kWh
26	Lithium manganate battery pack	67.90	kgCO$_2$e/kWh

Appendix C

(Informative)

Summary of key parts

Table 1 Summary of key parts

NO.	System	Subsystem	Parts	Remarks
1	Power system	Engine	Cylinder	
2			Cylinder head	
3			Cylinder head cover	
4			Crankshaft	
5			Camshaft	Including intake camshaft and exhaust camshaft
6			Piston	Including all pistons
7			Connecting bar	
8			Gearwheel	Crankshaft sprocket, camshaft sprocket, crankshaft pulley, camshaft pulley
9			Flywheel	
10			Intake manifold	
11			Exhaust manifold	
12			Oil pan	
13		Power battery	Box (Shell)	It is suitable for non off-vehicle-chargeable hybrid electric passenger vehicle, plug-in hybrid electric passenger vehicle, and battery electric passenger vehicles.
14			Heat sink	It is suitable for non off-vehicle-chargeable hybrid electric passenger vehicle, plug-in hybrid electric passenger vehicle, and battery electric passenger vehicles.
15			Water cooling connecting pipe	It is suitable for non off-vehicle-chargeable hybrid electric passenger vehicle, plug-in hybrid electric passenger vehicle, and battery electric passenger vehicles.
16			Hard copper	It is suitable for non off-vehicle-chargeable hybrid electric passenger vehicle, plug-in hybrid electric passenger vehicle, and battery electric passenger vehicles.
17			High voltage box	It is suitable for non off-vehicle-chargeable hybrid electric passenger vehicle, plug-in hybrid electric passenger vehicle, and battery electric passenger vehicles.
18			Cell (single)	It is suitable for non off-vehicle-chargeable hybrid electric passenger vehicle, plug-in hybrid electric passenger vehicle, and battery electric passenger vehicles.

NO.	System	Subsystem	Parts	Remarks
19		Drive motor	Shell	Including shell and end caps. It is suitable for non off-vehicle-chargeable hybrid electric passenger vehicle, plug-in hybrid electric passenger vehicle, and battery electric passenger vehicles.
20			Stator	Including iron core and winding. It is suitable for non off-vehicle-chargeable hybrid electric passenger vehicle, plug-in hybrid electric passenger vehicle, and battery electric passenger vehicles.
21			Rotor	Including iron core and rotor.It is suitable for non off-vehicle-chargeable hybrid electric passenger vehicle, plug-in hybrid electric passenger vehicle, and battery electric passenger vehicles.
22	Chassis system	Gearbox	Shell	
23			Precision gearwheel (intermediate shaft)	If it is a three-axis gearbox, precision gearwheel and intermediate shaft is accounted.
24			Input shaft	
25			Output shaft	
26		Decelerator	Shell	
27			Precision gearwheel (intermediate shaft)	
28			Input shaft	
29			Output shaft	
30		——	Transmission shaft	Including shaft tube, telescopic sleeve and universal joint
31		——	Drive half shaft (half shaft)	The shaft that transmits torque between the gearbox decelerator and the drive wheels.
32		——	Subframe	The skeleton of the front and rear axles, a component of the front and rear axles
33		——	Wheel hub	
34		——	Tires	
35		——	Spare tire	
36		——	Brake disc	
37		——	Shock absorber	
38		——	Coil spring	
39		——	Steering (tube) column body	The components of the steering system that connect the steering wheel and the steering gear。
40	Body system	White body	Car door	
41			engine cover	
42			Baggage cover	
43			Top cover	
44			Fender	

NO.	System	Subsystem	Parts	Remarks
45			Other body structure parts and cover parts welded parts	
46		Seat	Seat frame	
47			Seat foam	
48			Seat cover	
49		Glass	front windshield	
50			rear windshield	
51			Side glass	
52			Skylight glass	
53		Interior	Dashboard body	A part installing many holes for various meters
54			Door guard	
55			Column guard plate	
56			Ceiling body	
57		Bumper	Front bumper body	
58			Rear bumper body	
59	Electrical system	Lead-acid batteries	Lead-acid batteries	
60		Air conditioning	Condenser	
61			Compressor	
62			Evaporator core	
63			Shell	
64		High voltage wiring harness	Cable	It is suitable for non off-vehicle-chargeable hybrid electric passenger vehicle, plug-in hybrid electric passenger vehicle, and battery electric passenger vehicles.
65			Sheath	

Appendix D

(Informative)

Scope and default value of carbon emissions accounting for vehicle production

D.1 Scope of carbon emissions accounting for vehicle production

D.1.1 Functional unit

A passenger car produced by factory

D.1.2 Accounting boundary

Account the carbon emissions during the whole vehicle stamping, welding, painting, final assembly, and power station process.

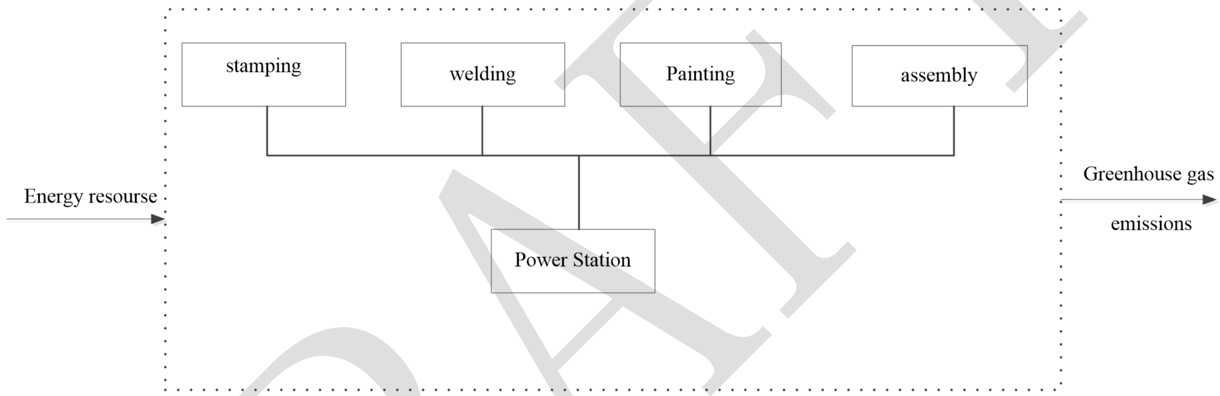

Figure D.1 Accounting boundary of vehicle production

D.2 Emission factor default value of vehicle production

Table D.1 Emission factor default value of vehicle production

Name	Default value	Unit
Vehicle production	550.00	$kgCO_2e$/vehicle

Appendix E

(informative Annex)

Carbon (greenhouse gas) category

Carbon (greenhouse gas) categories and GWP are shown in Table E.1

Table E.1 Carbon (greenhouse gas) category and GWP

Industrial name or common name	**Molecular formula**	**100-year GWP**
Carbon dioxide	CO_2	1
Methane	CH_4	27.9
Nitrous oxide	N_2O	273
Hydrofluorocarbon	HFC-23	14600
	HFC-32	771
	HFC-41	135
	HFC-125	3740
	HFC-134	1260
	HFC-134a	1530
	HFC-143	364
	HFC-143a	5810
	HFC-152	21.5
	HFC-152a	164
	HFC-161	4.84
	HFC-227ca	2980
	HFC-227ea	3600
	HFC-236cb	1350
	HFC-236ea	1500
	HFC-236fa	8690
	HFC-245ca	787
	HFC-245cb	4550
	HFC-245ea	255
	HFC-245eb	325
	HFC-245fa	962
	HFC-263fb	74.8
	HFC-272ca	599
	HFC-329p	2890
	HFC-365mfc	914
	HFC-43-10mee	1600
	HFO-1123	0.005
	HFO-1132a	0.052
	HFO-1141	0.024
	HFO-1225ye(Z)	0.344
	HFO-1225ye(E)	0.118

Industrial name or common name	Molecular formula	100-year GWP
	HFO-1234ze(Z)	0.315
	HFO-1234ze(E)	1.37
	HFO-1234yf	0.501
	HFO-1336mzz(E)	17.9
	HFO-1336mzz(Z)	2.08
	HFO-1243zf	0.261
	HFO-1345zfc	0.182
	3,3,4,4,5,5,6,6,6-Nonafluorohex-1-ene	0.204
	3,3,4,4,5,5,6,6,7,7,8,8,8-Tridecafluorooct-1-ene	0.162
	3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-Heptadecafluorodec-1-ene	0.141
Perfluorocarbon	PFC-14	7380
	PFC-116	12400
	PFC-218	9290
	PFC-C-318	10200
	PFC-31-10	10000
	Octafluorocyclopentene	78.1
	PFC-41-12	9220
	PFC-51-14	8620
	PFC-61-16	8410
	PFC-71-18	8260
	PFC-91-18	7480
	1,1,2,2,3,3,4,4,4a,5,5,6,6,7,7,8,8,8a-octadecafluoronaphthalene	7800
	1,1,2,2,3,3,4,4,4a,5,5,6,6,7,7,8,8,8a-octadecafluoronaphthalene	7120
	PFC-1114	0.004
	PFC-1216	0.09
	1,1,2,3,4,4-hexafluorobuta-1,3-diene	0.004
	Octafluoro-1-butene	0.102
	Octafluoro-2-buene	1.97
Sulfur hexafluoride	SF_6	25200
Nitrogen trifluoride	NF_3	17400

Note:

Data source: Sixth Assessment Report of IPCC.

Appendix F

(Normative)

Default value for material usage factor

Default value for material usage factor see table F.1.

Table F.1 default value for material usage factor

Number	Classification	Usage factorU
1	Steel	142%
2	Cast iron	142%
3	Aluminum and aluminum alloy	122%
4	Magnesium and magnesium alloy	100%
5	Copper and copper alloy	100%
6	Thermoplastic plastics	100%
7	Thermosetting plastic	100%
8	Rubber	100%
9	Fabric	100%
10	Ceramics/ glass	100%
11	Plumbum	100%
12	Sulfuric acid	100%
13	Fiberglass	100%
14	Lithium iron phosphate	100%
15	Lithium nickel-cobalt manganate	100%
16	Lithium manganate	100%
17	Graphite	100%
18	Electrolyte: Lithium hexafluorophosphate	100%

Appendix G

(informative Annex)

Specific site data accounting report template for material emission factor

Product Carbon Emission Data Submission General Form						
1. Basic Information						
1.1 Company Name						
1.2 Industrial classification of national economy	1.3 First classification		1.4Second classification			
1.5 Product Name						
1.6 Specifications						
1.7 Product Type						
1.8 Product Description*						
1.9 Assembly Quantity						
1.10 Functional Unit Description						
1.11 Quantitative Type		1.12 Amount		1.13 Unit		
1.14 System Boundary				1.15g Image*		
1.16 Carbon Emission Factor		1.17 Unit				
1.18 Data Source						
1.19 Third Party Certification*		1.20 Certification Authority		1.21 Certificate No.*		
1.22 Uploading Report*						
1.23 Form Validity						
1.24 Process Description*						
1.25 Reduction Measures*						
2. Inventory Data						
2.1 Inventory Data of Materials / Components/production						
2.1.1 Product Name	2.1.2 Product Type	2.1.3 Consumption	2.1.4 Unit	2.1.5 Carbon Emission Factor	2.1.6 Factor Unit	2.1.7 Factor Source
2.2 Inventory Data of Primary Energy						
2.2.1 Product Name	2.2.2 Product Type	2.2.3 Consumption	2.2.4 Unit	2.2.5 Carbon Emission Factor	2.2.6 Factor Unit	2.2.7 Factor Source
2.3 Inventory Data of Secondhand Energy						
2.3.1 Product Name	2.3.2 Product Type	2.3.3 Consumption	2.3.4 Unit	2.3.5 Carbon Emission Factor	2.3.6 Factor Unit	2.3.7 Factor Source
2.4 Inventory Data of Fugitive Greenhouse Gases						
2.4.1 GHG Name	2.4.2 Fugitive Types	2.4.3 Fugitive Quantity	2.4.4 Unit	2.4.5 Carbon Emission Factor	2.4.6 Factor Unit	2.4.7 Factor Source
2.5 Inventory Data of Secondhand Energy*						
2.5.1 Transport Types*	2.5.2 Transport	2.5.3 Transportation	2.5.4	2.5.5 Carbon Emission Factor	2.5.6 Factor Unit	2.5.7 Factor Source

	facility*	Quantity*	Unit			
Note: Items with "*" are Optional						

Appendix H

(Normative)

Carbon emission factor of energy/fuel

The carbon emission factor for energy/fuel production shall be calculated according to Table H.1, and the carbon emission from fuel consumption shall be calculated with the method in H.2.

H.1 Carbon emission factor for energy/fuel production

Table H.1 Carbon emission factor for energy/fuel production

Name of energy/fuel	**Carbon emission factor for production**	**Unit**	**Accounting boundary**
Average power supply from national power grid	0.635	$kgCO_2e/kWh$	Including energy exploitation, electricity generation and electricity transmission processes
Hydropower	0.035	$kgCO_2e/kWh$	Including energy exploitation, electricity generation and electricity transmission processes
Wind power	0.006	$kgCO_2e/kWh$	Including energy exploitation, electricity generation and electricity transmission processes
Nuclear power	0.014	$kgCO_2e/kWh$	Including energy exploitation, electricity generation and electricity transmission processes
Thermal power	0.971	$kgCO_2e/kWh$	Including energy exploitation, electricity generation and electricity transmission processes
Photovoltaic power generation	0.048	$kgCO_2e/kWh$	Including electricity generation process
Biomass power generation	0.230	$kgCO_2e/kWh$	Including electricity generation process
Natural gas	0.07	$kgCO_2e/m^3$	Including natural gas mining, processing, transportation and other processes, without considering the fugitive emission from the production process
Gasoline	0.487	$kgCO_2e/L$	Including the crude oil mining, processing and transportation processes, without considering the fugitive emission from the production process
Diesel	0.535	$kgCO_2e/L$	Including the crude oil mining, processing and transportation

			processes, without considering the fugitive emission from the production process
Coal	0.08	$kgCO_2e/kg$	Including the raw coal mining and washing processes, without considering the spontaneous combustion of coal or the fugitive emission of gas on the mining site
Low-pressure steam (0.3MPa)	0.31	$kgCO_2e/kg$	Coal used for energy production, including raw coal mining, washing, transportation and steam production in boiler process
Medium-pressure steam (1MPa)	0.38	$kgCO_2e/kg$	Coal used for energy production, including raw coal mining, washing, transportation and steam production in boiler process

Note 1: The carbon emission factor of electricity should be updated in the future based on official data released by the competent authorities.

Note 2: When green energy is actually used through physical connection, the corresponding carbon emission factor of green energy can be adopted.

H.2 Emission factor during fuel use

$$CEF_r' = CC \times OF \times \frac{44}{12}$$

Where,

CEF'r——carbon emissions in the fuel use process, tCO_2e/GJ;

CC——the carbon content per unit calorific value, tC/GJ, using the parameter values provided in Table H.2;

OF——carbon oxidation rate, %, using the parameter values provided in Table G.2;

Table H.2 Specific parameter values of common fossil fuel

Fuel varieties		average lower heating value GJ/t, $GJ/10^4Nm^3$	carbon content per unit of heating value (tC/GJ)	carbon oxidation rate of fuel
Solid fuel	Anthracite	26.700[a]	27.40×10^{-3}[b]	94%
	Bituminous coal	19.570[c]	26.10×10^{-3}[b]	93%
	Lignite	11.900[a]	28.00×10^{-3}[b]	96%
	Coal washing	26.344[d]	25.41×10^{-3}[b]	90%
	Other coal Washing	12.545[d]	25.41×10^{-3}[b]	90%
	Briquette	17.460[c]	33.60×10^{-3}[c]	90%
	Coke	28.435[c]	29.50×10^{-3}[b]	93%
Liquid fuel	Crude	41.816[d]	20.10×10^{-3}[b]	98%
	Fuel Oil	41.816[d]	21.10×10^{-3}[b]	98%

Fuel varieties		average lower heating value GJ/t，$GJ/10^4Nm^3$	carbon content per unit of heating value（tC/GJ）	carbon oxidation rate of fuel
	Gasoline	43.070[d]	18.90×10^{-3}[b]	98%
	Diesel fuel	42.652[d]	20.20×10^{-3}[b]	98%
	General kerosene	43.070[d]	19.60×10^{-3}[b]	98%
	Liquified natural gas	51.44[d]	15.30×10^{-3}[b]	98%
	Liquefied petroleum gas	50.179[d]	17.20×10^{-3}[b]	98%
	Tar	33.453[d]	22.00×10^{-3}[a]	98%
Gaseous fuels	Refinery gas	45.998[d]	18.20×10^{-3}[b]	99%
	Coke oven gas	179.81[d]	13.58×10^{-3}[b]	99%
	Blast furnace gas	33.000[c]	70.80×10^{-3}[a]	99%
	converter gas	84.000[c]	49.60×10^{-3}[c]	99%
	Other gas	52.270[d]	12.20×10^{-3}[b]	99%
	Natural gas	389.310[d]	15.30×10^{-3}[b]	99%

Note：

[a] Data source:《2006 IPCC Guidelines for National Greenhouse Gas Inventory》

[b] Data source:《Guidelines for Compiling Provincial Greenhouse Gas Inventories (for Trial Implementation)》

[c] Data source:《Research on China's Greenhouse Gas Inventory（2007）》

[d] Data source:《China energy statistical yearbook（2019）》

Table H.3 Conversion factor of fuel use

Fuel varieties	Conversion factor	Unit
Gasoline	2.37	$kgCO_2e/L$
Diesel fuel	2.60	$kgCO_2e/L$
Natural gas	2.16	$kgCO_2e/m^3$

Appendix Ⅰ
((Normative))
Life cycle carbon emission accounting report template for passenger vehicle

Ⅰ.1 Foreword

Brief introduction of life cycle carbon emission accounting content for passenger car;

The execution and report time of life cycle carbon emission accounting for passenger car.

Basic information of passenger car products, including model name, enterprise name, vehicle model, sales model, model class, vehicle length, vehicle width, vehicle height, wheelbase, curb weight, fuel category, power consumption/fuel consumption per 100 kilometers (respectively considering full load rate, air conditioning, heating), etc.

Ⅰ.2 Related instructions

Ⅰ.2.1 Reference accounting document

Ⅰ.2.2 Terms and definitions

Ⅰ.3 Life cycle carbon emission accounting method

Ⅰ.3.1 Accounting scope

Ⅰ.3.1.1 Functional unit

The functional unit should be clearly defined and measurable. This document employs a passenger vehicle as a functional unit, the transportation service provided by a passenger car traveling 1km as accounting object. The life cycle mileage is calculated as (1.5×105) km.

Additional main vehicle parameters, such as: curb weights, power performance, electric power consumption, power battery capacity, power battery weight, cruising mileage, etc.

Ⅰ.3.1.2 System boundary

The life cycle system boundaries of automotive product defined in this document include: material production stage, vehicle production stage, and use stage, etc. It does not include carbon emissions from infrastructure such as road and plant, equipment at various processes, personnel and living facilities in the plant. This includes:

a) Materials production stage: namely, acquisition and processing of raw material and production and processing of recycled material. At the same time, the infrastructures, such as the equipment for producing and manufacturing process, and plant construction, etc. are not included in the boundary. This stage includes 23 materials: steel, cast iron, aluminum and aluminum alloy, magnesium and magnesium alloy, copper and copper alloy, thermoplastic, thermoset plastic, rubber, textiles, ceramic/glass, lead, sulfuric acid, glass fiber, lithium Iron Phosphate, lithium nickel cobalt Manganese oxide, lithium manganate, graphite, electrolyte:

lithium hexafluorophosphate, Lubricant, braking fluid, cooling liquid, refrigerant, cleaning solution, etc.;

b) Vehicle production stage: including carbon emissions from vehicle stamping, welding, painting, assembly, and power station;

c) Use stage: including carbon emissions from fuel production, fuel use, tires and Lead-acid batteries replacement, and refrigerants escaping and replacement;

Attached figure: System boundary diagram

I.3.2 Life cycle inventory data

A list of all material/energy input and output within the automotive system boundary should be compiled as the basis for carbon emission accounting. If the data list has special circumstances, abnormal points or other problems, it should be clearly stated in the report.

The data should employ the average value of the most recent continuous production from 3 months to 1 year; priority is given to the data of the most recent continuous production of 1 year. Process data not included in the inventory data needs to be reported, or adjusted according to the provisions of the trade-off criteria.

I.3.2.1 Data collection

For all processes included within the system boundary, specific site data should be collected. When specific site data collecting is not feasible, the default value should be used.

I.3.2.2 Material production stage

This stage begins with extracting resources from nature and scrap processing, ends with the entry of automotive parts into the production facilities.

List raw materials within the system boundary, and not missing, see Tables H.1 to H.5.

Indicate battery power capacity and weight, the tire weight, lead-acid battery weight, refrigerant weight, and other information.

Describe life cycle inventory data source for various types of major raw materials.

Table H.1 Material input list of parts (Please fill in according to the actual situation)

Material name	Unit	Raw material	Recycled material
Steel	kg		
Cast iron	kg		
Aluminum and aluminum alloy	kg		
Magnesium and magnesium alloys	kg		
Copper and copper alloy	kg		
Thermoplastic	kg		
Thermoset plastic	kg		
Rubber	kg		
Textiles	kg		
Ceramic/glass	kg		
Other please specify	kg		

Table H.2 Material input list of tyres (Please fill in according to the actual situation)

Material name	Unit	Raw material	Recycled material
Rubber	kg		
Steel	kg		
Textiles	kg		
Other please specify	kg		

Table H.3 Material input list of lead acid batteries (Please fill in according to the actual situation)

Material name	Unit	Raw material	Recycled material
Thermoplastic	kg		
Lead	kg		
Sulfuric acid	kg		
Glass fiber	kg		
Other please specify	kg		

Table H.4 Material input list of lithium-ion power batteries（For non off-vehicle-chargeable hybrid electric passenger car, plug-in hybrid electric passenger and battery electric passenger cars） (Please fill in according to the actual situation)

Material name	Unit	Raw material	Recycled material
Positive active material：Lithium Iron Phosphate/Lithium Nickel Cobalt Manganese Oxide /Lithium manganate	kg		
Graphite	kg		
Copper and copper alloys	kg		
Aluminum and aluminum alloy	kg		
Electrolyte: lithium hexafluorophosphate	kg		
Thermoplastic	kg		
Steel	kg		
Other please specify	kg		

Table H.5 Material input list of fluids (Please fill in according to the actual situation)

Material name	Unit	Raw material
Lubricant	kg	
Braking fluid	kg	
Cooling liquid	kg	
Refrigerant	kg	
Detergent	kg	
Other please specify	kg	

I.3.2.3 Vehicle production stage

The stage begins with the entry of automotive raw materials, parts, semi-finished products into the production site, and ends with the departure of finished products from the production plant. Production stage accounts carbon emission from stamping, welding, painting, assembly and power station.

The data in the production stage should select representative site data, including the main process flow in the production stage, the input data of energy resources in the production stage, and the data of greenhouse gases discharged into the air in the production stage, etc., without missing, see H.6.

Describe life cycle inventory data source of various types of fuels

Table H.6 Input and output list of fuel in the vehicle production stage (please fill in according to the actual situation)

Process	Name	Unit	Amount
Vehicle production	Electricity	kWh/vehicle	
	Natural gas	m^3/ vehicle	
	CO_2 escaping	kg CO_2/vehicle	
	Gasoline	kg CO_2/vehicle	
	Diesel fuel	kg CO_2/vehicle	
	Purchased steam (Remark pressure required)	kg/vehicle	

I.3.2.4 Use stage

This stage mainly includes carbon emissions from fuel production, fuel use, tires replacement, and refrigerant escaping and replacement.

Introduce carbon emissions from fuel consumption, fuel use, tire replacement, Lead-acid battery replacement, fluid replacement and refrigerant escaping, replacement times of lead acid battery and fluids can be seen in Table H.7.

Table H.7 The number of parts replacement

Number	The number of replacement
Lead acid battery	
Lubricant	
Brake fluid	
Coolant	
Refrigerant	
Detergent	
Other please specify	

I.3.2.5 Data distribution

If data distribution is involved, the method of data distribution must be explained.

I.3.3 Life cycle carbon emissions accounting formula

Employ formula in section 4.4 of this document to account life cycle carbon emissions.

I. 4 Life cycle carbon emissions

Introduce the accounting results of life cycle carbon emissions for this model: