

Collaborating organizations:



港九電器商聯會

Sponsored by:



Project members:

Prof. Winco K.C. Yung

Tel: (852) 2766 6599

E-mail: wincokc.yung@polyu.edu.hk

Miss Jane Zhang

Tel: (852) 2766 4252

E-mail: jane.zhang@polyu.edu.hk

Miss Connie Chan

Tel: (852) 2766 4252

E-mail: cheuk-yi.chan@polyu.edu.hk

Website: <http://www.pctech.ise.polyu.edu.hk/ecodesign/>

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Application Guideline for Embedded GHG Emissions Database and G-BOM Analyzer



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Green Manufacturing and Eco-Design Research Group
The Hong Kong Polytechnic University
香港理工大學綠色生產及環保設計研究小組

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1. Introduction

To cope with the risk of climate change and in response to the shift in environmental policies and laws towards products in different countries, there are increasing pressures for the electrical and electronics industries to measure the Greenhouse Gas (GHG) emissions specific to their products. Therefore, the International Organization for Standardization (ISO) has developed a standard ISO 14067 – the requirements and guidelines for quantification and communication of the carbon footprint of products in 2013, based on GHG emissions and removals over the life cycle of a product.

To address this need, in Asian regions such as Korea, Japan and Taiwan, more electrical and electronics manufacturers have developed their products with carbon footprint labeling and have even developed their own carbon footprint database. For example, Samsung and LG have developed their own database, based on the Korean national database, with their required information from their components suppliers and also their own manufacturing and assembly material and energy consumption, indicating the best way to implement supply chain carbon management. However, their major competitors, the Hong Kong electrical and electronics industries do not have carbon footprint labeling for their products and also not have their own carbon footprint database.

To help the SMEs in the electrical and electronics industries in Hong Kong to increase their competitiveness and the quality of their products by using low carbon manufacturing strategies and exercising corporate social responsibility, the Green Manufacturing and Eco-Design Research Group under the Department of Industrial and Systems Engineering of the Hong Kong

Polytechnic University has launched a project called “*Development of an embedded Greenhouse Gas (GHG) emissions database with a G-BOM analyzer and a SME advisory kit for electrical and electronic Industries to respond to the implementation and compliance of ISO 14067 (carbon footprint of products)*” with the support of the SME Development Fund of the Trade and Industry Department of the Hong Kong SAR Government. This application guideline for embedded GHG emissions database and G-BOM analyzer is one of deliverables for the project.

To guide the SMEs to use the G-BOM analyzer with the embedded GHG emissions database, this application guideline is written for helping them use the G-BOM analyzer to estimate the carbon footprint of their products in a simple and cost-effective way.

2. G-BOM analyzer

In Hong Kong, although SMEs in the electrical and electronics industries have been searching for tools and methods to develop products that have low carbon emissions and environmental impacts, several carbon footprint calculation tools available in Hong Kong only concern human activities as a primary footprint rather than GHG emissions from the whole life cycle (including raw material use, manufacturing, distribution, use and end-of-life) of products in the secondary footprint. No existing carbon footprint calculation tool in Hong Kong calculates the product carbon footprint based on a whole product life cycle approach.

To fill this gap, the Green Manufacturing and Eco-Design Research Group have developed a G-BOM analyzer, a free of charge product carbon footprint analyzing tool, which is specially designed for local electrical and electronics SMEs to calculate their product carbon footprint based on a whole product life cycle method. This G-BOM analyzer can be applied for both “downstream” end-product manufacturers and “upstream” component/part manufacturers, and acts as a niche compared to existing carbon footprint calculation tools which allow manufacturers to input their product information according to the product life cycle, which includes raw material stage, manufacturing stage, distribution stage, use stage and end-of-life stage, to simply calculate the product carbon footprint using the embedded greenhouse gas (GHG) emissions database provided.

In principle, the G-BOM analyzer is based on the bill of materials (BOM) of the products, with the combination of the embedded greenhouse gas (GHG)

emissions of the raw materials/components/processes/activities to assess GHG emissions of the products throughout the whole life cycle. For the raw material stage, the data input includes the names, emission factors and quantity of components, product packaging materials, packaging of both components and product packaging materials and transportation of both components and product packaging materials. For the manufacturing stage, the data input includes the names, emission factors and quantities of electricity, consumables, packaging of consumables, transportation of consumables, and the transportation, recycling and disposal activities of the liquid/solid wastes. For the distribution stage, the data input includes the names of the route, the emission factors of the transportation activities from the GHG emissions database and their corresponding transportation distances. For the use stage, the data input includes the names of the use/ maintenance, the energy/ material used from the GHG emissions database and their corresponding quantities. For the end-of-life stage, the data input includes the names of the activity, the emission factors of the disposal or recycle activities from the GHG emissions database and their corresponding quantities.

Compared with other carbon footprint assessment interfaces/software, the G-BOM analyzer is more user-friendly and can guide the manufacturers to input the product information/data step by step from the beginning to the end without the need of external experts for product carbon footprint analyzing. After using the G-BOM analyzer, local SMEs can get the GHG emissions in each stage, even in each component/ activity, thus SMEs can recognize which stage and which component/ activity they should improve in regard to product design and manufacturing so as to reduce the product carbon footprint. The G-

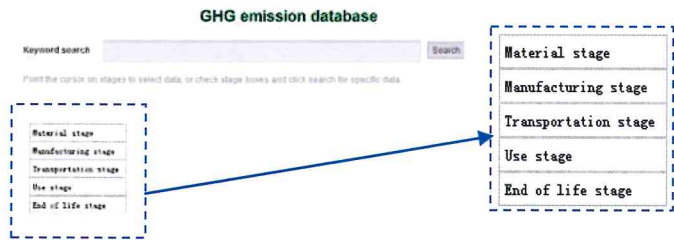
BOM analyzer can also help the SMEs disclose their product carbon footprint in claim format according to ISO 14021 (Type II environmental labeling).

The procedures of how to use this G-BOM analyzer with the embedded carbon footprint database is given in detail in Section 4 to Section 8 of this application guideline. There are totally four showcases, with an electronic scale and an induction cooker as showcases of the end products; a LCD panel and a printed circuit board (PCB) as showcases of components corresponding to the previous two end products. Both English and Chinese versions are provided for user's convenience.

3. Embedded GHG emissions database

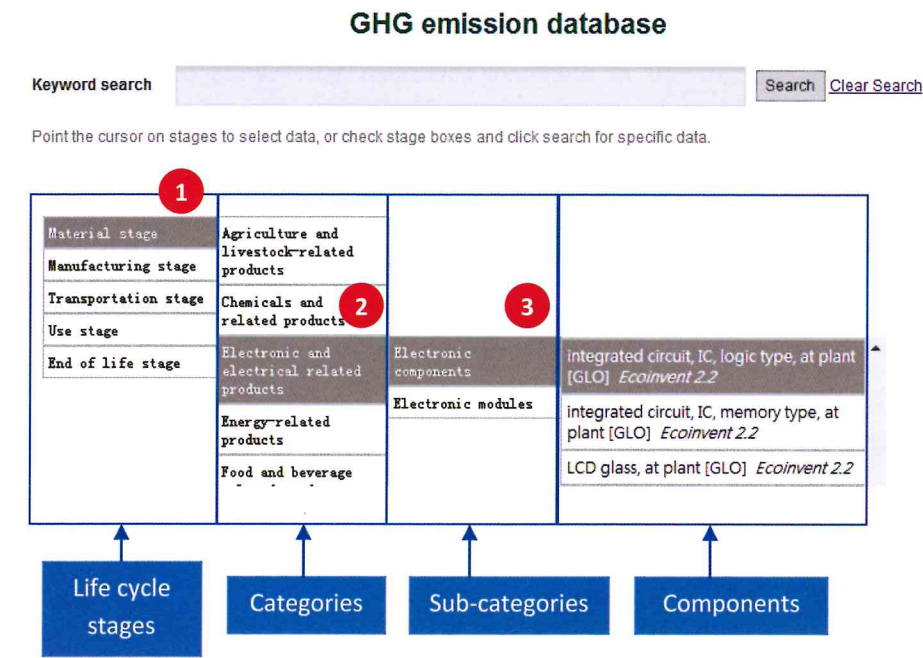
To meet the requirements and to implement ISO 14067, an embedded GHG emissions database in G-BOM analyzer has been developed for Hong Kong electrical and electronics SMEs to check the greenhouse gas data related to product design and development during the entire product life cycle. This embedded GHG emissions database includes the GHG emission factors of the raw materials, components, processing and activities etc. and is divided into five stages of the whole life cycle, namely “Material stage”, “Manufacturing stage”, “Transportation stage”, “Use stage” and “End-of-life stage” as shown in the interface of the embedded GHG emissions database in Figure 1.

Figure 1. Five life cycle stages in the interface of the embedded GHG emissions database



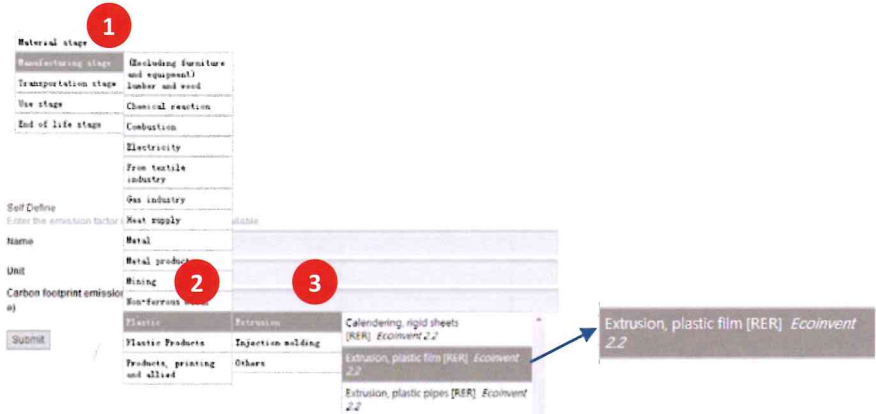
In each stage, the GHG emission factors are sorted into different categories and sub-categories so that users can find the suitable GHG emission factor more easily. For example, the GHG emission factor of the component, logic type integrated circuit (IC), can be searched under category (2) “Electronic and electrical related products” and the sub-category (3) “Electronic components” in (1) “Material stage”, as shown in Figure 2 on the next page.

Figure 2. Five life cycle stages, categories, sub-categories and components in the interface of the embedded GHG emissions database



Similarly, the GHG emission factor of the process, e.g. extrusion of plastic film, can be found under category “Plastic” and sub-category “Extrusion” in “Manufacturing stage”, as shown in Figure 3 on the next page.

Figure 3. Demonstration of how to find the process “extrusion of plastic film” in “Manufacturing stage”



There are totally around 3,900 emissions factors from the five database sources from the different regions used in the embedded GHG emissions database. They are shown in Table 1 below.

Table 1. Five sources of database used in the embedded GHG emissions database and their corresponding descriptions and regions

	Database	Description	Region
1	Ecoinvent 2.2	Ecoinvent 2.2	Europe
2	JEMAI	Japan Environmental Management Association for Industry	Japan
3	Korean LCI	Korea Life Cycle Inventory(LCI) Database	Korea
4	Taiwan EPA	Taiwan's Environmental Protection Administration	Taiwan
5	PolyU GME Research Group	PolyU ISE Eco-Design and Green Manufacturing Research Group	Hong Kong

We have chosen the emission factors from the above four databases available in the market according to their relevancy, accuracy and suitability to be used for the SMEs in the electrical and electronics industry.

Apart from the above four databases available in the market, the Green Manufacturing and Eco-Design Research Group has computed more than 60 items of our own customized emission factors which are not available in the other four databases in order to enhance the user-friendliness of the G-BOM analyzer. This means that the users do not need to compute their own emission factors but just choose our computed emission factors.

For example, in the “use stage”, for the emissions factors of electricity used in Hong Kong, the original four databases available in the market do not include this data, so our group has computed the emission factor “Electricity (Hong Kong)” based on the emission factors from the other four databases and the relevant data specific to Hong Kong. This emission factor can be found under the category “Electricity” and sub-category “China” in the “use stage”. Thus, the users can just choose the emission factor “Electricity (Hong Kong)” that can be found in the “use stage” in the G-BOM analyzer during the process of estimating their product carbon footprint.

Another example for the “use stage” is grid power used in the Northern part of China. Our group has also computed the emission factor “Grid power (North)” based on the emission factors from the other four databases and the relevant data specific to Northern China. This emission factor can be also found under the category “Electricity” and the sub-category “China” in the “use stage”.

4. Procedures to do before using G-BOM analyzer

4.1 Getting an user ID

Your login ID and password should be registered before use. Send an email to mfeco@polyu.edu.hk to request your preferred login ID and password. Company name and nature, contact person and number should be included in the email. An example email is shown below.



4.2 Go to G-BOM analyzer webpage

Go to G-BOM webpage
(link: http://www.pctech.ise.polyu.edu.hk/ecodesign/gbom_analyzer.html), (1) click “English” or “中文” in the upper right hand corner of the website to use English or Chinese version and (2) click “LOGIN”.



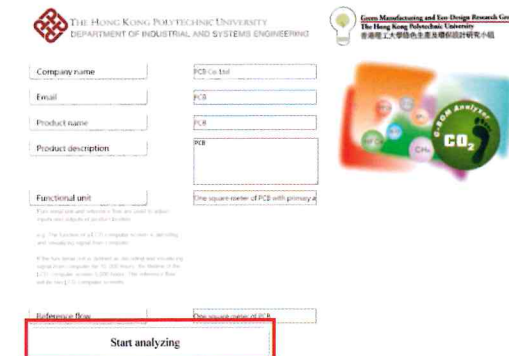
4.3 Login to G-BOM analyzer

Enter the registered login ID and password and click “Login”.



4.4 Enter your company name and information before using G-BOM analyzer

An example is shown below. Click “Start analyzing” after filling in the information.



Procedures for using an embedded Greenhouse Gas (GHG) emissions database and G-BOM analyzer for two end product showcases (i.e. electronic scale and induction cooker) and two component showcases (i.e. LCD panel and printed circuit board (PCB)) throughout the whole product life cycle are shown in the next four sections (sections 5 to 8).

5. Electronic scale

5.1 Raw material stage

The interface of “raw material stage” is shown below.

The screenshot shows the 'Raw Material Stage' interface. It includes a header with 'Raw Material Stage' and a list of materials. Below the header, there are several sections:

- Section for choosing “Component name”, searching “Material” emission factor and entering “Quantity”**: This section includes a dropdown menu for 'Component', a search bar for 'Material', and input fields for 'Quantity' and 'Unit'. A 'Save' button is located to the right.
- Section for entering “Assumption”**: This section includes a text area for entering assumptions.
- Section for entering “Component name”**: This section includes a dropdown menu for 'Component' and an input field for 'Input the Component name'. A 'Save' button is located to the right.
- Section for entering a list of “Component name” from Excel**: This section includes a text area for entering a list of component names from an Excel file. A 'Save' button is located to the right.

5.1.1 Input the name of component

There are two methods to input the item names.

Method 1

A user can enter each component name one by one. Input the component name in the box “Input the Component here” and then click “Save”. For the example below, “upper cover” is the input to the “Component name”.

The screenshot shows the 'Input the Component here' section. It includes a dropdown menu for 'Component' and an input field for 'Input the Component here'. The input field contains the text 'Upper cover'. A 'Save' button is located to the right of the input field.

Then the component name will appear under the “Component” category.

The screenshot shows a table with the following columns: Component, Material, Quantity, and Unit. The 'Component' column contains the text 'Upper cover'. A 'Save' button is located to the right of the table.

Then enter the next component and click “Save”.

The screenshot shows the 'Input the Component here' section. The input field contains the text 'Bottom cover'. A 'Save' button is located to the right of the input field.

The next component name will appear under the category of “Component” and then click to choose it.

The screenshot shows a table with the following columns: Component, Material, Quantity, and Unit. The 'Component' column contains the text 'Upper cover' and 'Bottom cover'. A 'Save' button is located to the right of the table.

Method 2

Import an excel file (xls format) directly for a large number of components. Click “Choose File” to import an excel file and click “Import” as below.

The screenshot shows the 'Import' section. It includes a text area for 'Component XLS File:', a 'Choose File' button, and an 'Import' button. The text area contains the text 'example.xls'. A 'Download Excel Sample' link is located below the text area.

Example of an excel file is shown below.

	A	B
1	Upper cover	
2	Bottom cover	
3	Screen printing glass plate	
4	LCD panel	
5	Display stand	
6		

After importing the excel file, the list of components will appear under “Component” category.

Component	Material	Quantity	Unit
Upper cover			
Upper cover			
Bottom cover			
Screen printing glass plate			
LCD panel			
Display stand			

Back Next Save

5.1.2 Use the GHG emissions database/ Enter carbon footprint emission factor

Click 'Search' to enter the GHG emissions database.

Component	Material	Quantity	Unit

Back Next Save

After clicking “Search”, the interface of the GHG emissions database will appear as shown below.

GHG emission database

Keyword search: Search Clear Search

Find the cursor on stages to select data, or check stage boxes and click search for specific data.

Material stage
Manufacturing stage
Transportation stage
Use stage
End of life stage

Self Define
Enter the emission factor if better quality data is available

Name:
Unit:
Carbon footprint emission factor (kg CO₂-e):

Submit

Method 2 (keyword search)

Method 1 & 2 (use embedded GHG emissions database)

Method 3 (self-define)

There are 3 methods to select the emission factor of the components.

Method 1

Select the material emission factor in the embedded GHG emissions database according to its stage and category.

Example: High impact polystyrene (HIPS)

1. Point the cursor and select “Material stage”
2. Select “Plastic-related products”, as HIPS belongs to this category
3. Select “Plastic polymers”, as HIPS belongs to this sub-category
4. You can then find “polystyrene, high impact, HIPS, at plant [RER]” in the GHG emissions database under the “Ecoinvent 2.2” database

Raw material stage: Agriculture and livestock-related products, Manufacturing stage: Chemicals and related products, Transportation stage: Electronic and electrical related products, Use stage: Energy-related products, End of life stage: Food and beverage related products, Self Define: Machinery and equipment related products, Enter the emission factor if better quality data is available.

Name:

Unit:

Carbon footprint emission CO2-e:

Submit

polystyrene, high impact, HIPS, at plant [RER] Ecoinvent 2.2

High-performance resin, Other synthetic resin, Plastic footwear, Plastic nonwovens, Plastic polymers, Plastic products, Plastics

5. After clicking the “polystyrene, high impact, HIPS, at plant [RER]” in the interface of GHG emissions database, it will appear under the “Material” category in the interface of “raw material stage”.

Component	Material	Quantity	Unit	
Upper cover	polystyrene, high impact, HIPS, at plant [RER]	<input type="text"/>	kg	<input type="button" value="Save"/>

Method 2 (keyword search)

It is a faster method to find the materials in the GHG database and is suitable for users who may not know which category the material belongs to.

(1) Enter a keyword in the search engine and (2) click “Search”. All related items will be shown when you click into different stages. (3) Click the material you choose. Below “HIPS” is an example.

GHG emission database

Keyword search:

Point the cursor on stages to select data, or check stage boxes and click search for specific data.

Material stage: Plastic-related products, Manufacturing stage: Plastic polymers, Transportation stage: Plastics, Use stage: polystyrene, high impact, HIPS, at plant [RER] Ecoinvent 2.2, End of life stage: Other synthetic resin, Plastic footwear, Plastic nonwovens, Plastic polymers, Plastic products, Plastics

After clicking the “polystyrene, high impact, HIPS, at plant [RER]” in the interface of GHG emissions database, it will appear under the “Material” category in the interface of the “raw material stage”.

Component	Material	Quantity	Unit	
Upper cover	polystyrene, high impact, HIPS, at plant [RER]	<input type="text"/>	kg	<input type="button" value="Save"/>

Method 3 (self-define)

Enter the emission factors for the materials that are not included in the GHG database.

Example: Black pigments from ABC company

Enter its name, unit and carbon footprint emission factor as below if you can find its emission factor from other databases. An example is shown on the next page. Click “Submit” after entering the information.

Self Define

Enter the emission factor if better quality data is available

Name:

Unit:

Carbon footprint emission factor (kg CO2-e):

After clicking “Submit”, it will appear under the “Material” category, just like the example below.

Component	Material	Quantity	Unit
Coating	Black pigments (ABC company)		kg

← Back Next →

5.1.3 Enter the quantity used in the component

Enter the quantity used in the component, just like the example below and then click “Save”.

Component	Material	Quantity	Unit
Upper cover	polystyrene, high impact, HIPS, at plant [R]	0.14	kg

← Back Next → Save

5.1.4 Proceed to the “manufacturing stage”

After repeating the procedures in 5.1.1 to 5.1.3 to add new components and entering all the information of the components (component name, material emission factor, quantity and unit) in the raw material stage, just like the example below, click “Next” to proceed to the manufacturing stage. The example below only shows part of the components.



Component	Material	Quantity	Unit	Save	Delete
Upper cover	polystyrene, high impact, HIPS, at plant [R]	0.14	kg	Save	Delete
Bottom cover	polystyrene, high impact, HIPS, at plant [R]	0.15	kg	Save	Delete
Screen printing glass plate	flat glass, uncoated, at plant [RER]	1.61	kg	Save	Delete
LCD	LCD module, at plant [OLO]	0.026	kg	Save	Delete
Display stand	polystyrene, high impact, HIPS, at plant [R]	0.011	kg	Save	Delete

← Back Next →

Remarks:

1. All components and product packaging materials should be included in the actual situation.
2. All packaging of both components and product packaging materials should be included in the actual situation.
3. All transportations of both components and product packaging materials should be included in the actual situation.
4. Assumptions should be stated clearly in the actual situation.
5. If the direct emission factors of the component and the packaging material cannot be found in the embedded GHG emissions database, please try to find out the emission factors of its corresponding raw material and manufacturing process from raw material to the component.

5.2 Manufacturing stage

The interface of “manufacturing stage” is shown below.

The screenshot shows the 'Manufacturing Stage' interface. It includes a header with a factory image and the title 'Manufacturing Stage'. Below the header is a table with columns: Name of process, Process, Quantity, and Unit. A 'Search' button is located next to the 'Process' column. A 'Save' button is at the bottom right. A 'Back' button is at the bottom left. A 'Next' button is at the bottom right. A 'Section for choosing “Name of the process”, searching “Process” emission factor and entering “Quantity”' points to the 'Process' column and the 'Search' button. A 'Section for entering “Assumption”' points to the 'Assumption' section. A 'Section for entering “Name of the process”' points to the 'Name of process' column. A 'Section for entering a list of “Name of the process” from Excel' points to the 'Component XLS File' section, which includes a 'Choose File' button, a 'Download Excel Sample' link, and an 'Import' button.

5.2.1 Input the name of process

Similar to the “raw material stage”, there are two methods to input the name of the process.

Method 1

A user can enter each of the names of the process one by one and then click “Save”.

The screenshot shows the input form for Method 1. It includes a dropdown menu labeled '---Select the Name of the process'. Below it is a text input field labeled 'Input the Name of the process here'. At the bottom are 'Save' and 'Clear all' buttons.

Method 2

Import an excel file (xls format) directly for large number of processes.

Click “Choose File” to import an excel file and click “Import” as below.

The screenshot shows the 'Component XLS File' section. It includes a 'Choose File' button, a text input field containing 'example.xls', a 'Download Excel Sample' link, and an 'Import' button.

5.2.2 Use the GHG emissions database/ Enter carbon footprint emission factor

Click 'Search' to enter the GHG emissions database.

The screenshot shows the GHG emissions database interface. It includes a table with columns: Name of process, Process, Quantity, and Unit. A 'Search' button is located next to the 'Process' column. A 'Save' button is at the bottom right. A 'Back' button is at the bottom left. A 'Next' button is at the bottom right.

After clicking “Search”, the interface of GHG emissions database will appear as shown below.

The screenshot shows the GHG emissions database interface with three methods highlighted. Method 2 (keyword search) points to the 'Keyword search' section. Method 1 & 2 (use embedded GHG emissions database) points to the 'Material stage', 'Manufacturing stage', 'Transportation stage', 'Use stage', and 'End of life stage' sections. Method 3 (self-define) points to the 'Self Define' section, which includes a 'Name' input field, a 'Unit' input field, and a 'Carbon footprint emission factor (kg CO2-e)' input field.

Similar to the “raw material stage”, there are 3 methods to select the emission factor of the process.

Method 1

Select the emission factor of the process according to its stage and category.

GHG emission database

Keyword search

Point the cursor on stages to select data, or check stage boxes and click search for specific data.

Material stage	
Manufacturing stage	(Excluding furniture and equipment) lumber and wood
Transportation stage	
Use stage	Chemical reaction
End of life stage	Combustion
	Electricity Others Public electricity JEMAI
	From textile

Method 2 (keyword search)

(1) Enter a keyword in the search engine and (2) click “Search”. All related items will be shown when you click into different stages. (3) Click the name of the process you have chosen.

GHG emission database

Keyword search

Point the cursor on stages to select data, or check stage boxes and click search for specific data.

Material stage	
Manufacturing stage	Electricity Others Public electricity JEMAI
Transportation stage	
Use stage	
End of life stage	

Method 3 (self-define)

Enter the emission factor for the process name that is not included in the GHG database.

Enter its name, unit and carbon footprint emission factor as below if you can find its emission factor from other databases.

Self Define
Specify the emission factor if better quality data is available

Name

Unit

Carbon footprint emission factor (kg CO₂-e)

5.2.3 Enter the quantity used in the process

Enter the quantity used in the process per electronic scale, as below, and then click “Save”.

Name of process	Process	Quantity	Unit	
Electricity consumption from	Electricity consumption from NDRC	2.32	kWh	<input type="button" value="Save"/> <input type="button" value="Delete"/>

5.2.4 Proceed to the “distribution stage”

A user can click “Next” to proceed to the distribution stage after finishing the data entry in the manufacturing stage

Manufacturing Stage

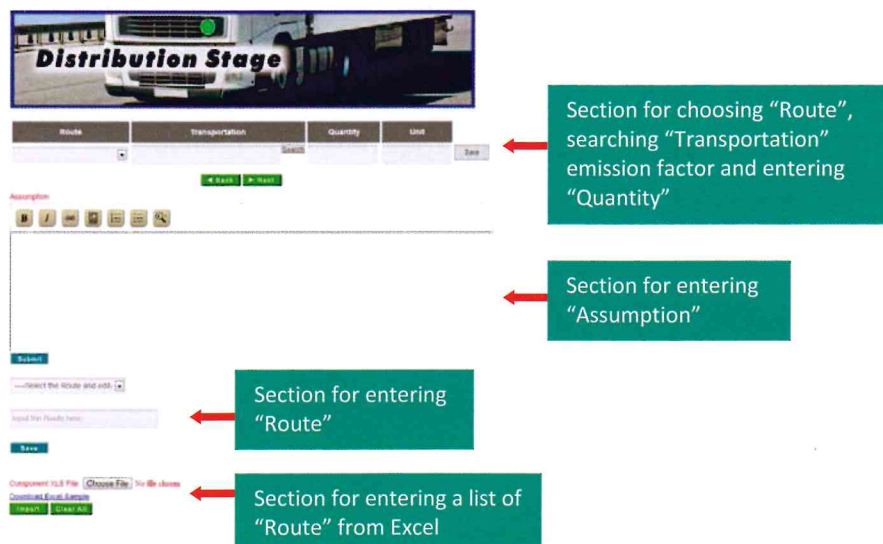
Name of process	Process	Quantity	Unit	
Electricity consumption from	Electricity consumption from NDRC	2.32	kWh	<input type="button" value="Save"/> <input type="button" value="Delete"/>
Ethanol	ethanol from ethylene, at plant (NRC)	0.0076	kg	<input type="button" value="Save"/> <input type="button" value="Delete"/>

Remarks:

1. Electricity consumption per unit of electronic scale should be included in this stage.
2. All consumables, packaging of consumables and transportation of consumables per unit of electronic scale should be included in this stage.
3. All waste management per unit of electronic scale, e.g. solid waste and wastewater from manufacturing processes should be included in this stage.
4. Assumptions should be stated clearly in the actual situation.
5. If the direct emission factors of the consumable and the packaging material of consumable cannot be found in the embedded GHG emissions database, please try to find out the emission factors of its corresponding raw material and manufacturing process from raw material to the component.

5.3 Distribution stage

The interface of “distribution stage” is shown below.

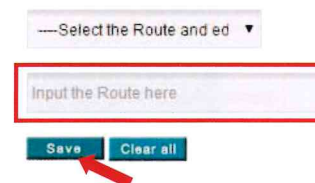


5.3.1 Input the name of route

Similar to the previous “manufacturing stage”, there are two methods to input the name of the route.

Method 1

A user can enter each of the names of the route one by one and then click “Save”.



Method 2

Import an excel file (xls format) directly for a large number of routes. Click “Choose File” to import an excel file and click “Import” as below.



5.3.2 Use the GHG emissions database/ Enter carbon footprint emission factor

Click 'Search' to enter the GHG emissions database and select the transportation activities.

Route	Transportation	Quantity	Unit
	<input type="text" value="Search"/>		

Back Next

After clicking “Search”, the interface of the GHG emissions database will appear as shown below.

GHG emission database

Keyword search:

Point the cursor on stages to select data, or check stage boxes and click search for specific data.

Material stage

Manufacturing stage

Transportation stage

Use stage

End of life stage

Self Define

Enter the emission factor if better quality data is available

Name:

Unit:

Carbon footprint emission factor (kg CO₂-e):

Method 2
(keyword search)

Method 1 & 2 (use
embedded GHG
emissions
database)

Method 3 (self-
define)

Similar to “manufacturing stage”, there are 3 methods to select the emission factor of route.

Method 1

Select the emission factor of the transportation activity from embedded GHG emissions database according to its stage and category.

Material stage

Manufacturing stage

Transportation stage

Use stage

End of life stage

Road

Freight

Train

Passenger

Transportation tools

[RER] Ecoinvent 2.2

Transport, lorry 16-32t, EURO4

[RER] Ecoinvent 2.2

Transport, lorry 16-32t, EURO5

Self Define

Method 2 (keyword search)

(1) Enter a keyword in the search engine and (2) click “Search”. All related items will be shown when you click into different stages. (3) Click the transportation activity you choose.

1

GHG emission database

Keyword search:

Point the cursor on stages to select data, or check stage boxes and click search for specific data.

Material stage

Manufacturing stage

Transportation stage

Use stage

End of life stage

Road

Freight

Train

Passenger

Transportation tools

[RER] Ecoinvent 2.2

Transport, lorry 16-32t, EURO4

[RER] Ecoinvent 2.2

Transport, lorry 16-32t, EURO5

Self Define

2

3

Method 3 (self-define)

Enter the emission factor for a transportation activity that is not included in the GHG database.

Enter its name, unit and carbon footprint emission factor, as below, if you can find its emission factor from other databases.

Self Define

Enter the emission factor if better quality data is available

Name:

Unit:

Carbon footprint emission factor (kg CO₂-e):

5.3.3 Enter the quantity used in the transportation activity

Enter the quantity used in the transportation activity per unit of electronic scale, as below, and then click “Save”.

Please note that the formula of tkm calculation is as follows:

$$\text{Distance of transportation activity (km)} \times \text{Weight of finished product (g)} / 1,000,000 = \text{tkm}$$

For example, distance of route 1 = 100 km

Weight of finished product = 3,500 g

Then the quantity used in the transportation activity of route 1 = $100 \text{ (km)} \times 3,500 \text{ (g)} / 1,000,000 = 0.35 \text{ tkm}$

5.3.4 Proceed to the “use stage”

A user can click “Next” to proceed to the “use stage” after finishing the data entry in the distribution stage. Only part of all the routes is shown in below example.



Remarks:

1. Distances for routes can be obtained from Google Map.
2. Assumptions should be stated clearly in the actual situation.

5.4 Use stage

The interface of the “use stage” is shown below.

5.4.1 Input the name of “use/maintenance”

Similar to the previous “distribution stage”, there are two methods to input the name of “use/maintenance”.

Method 1

A user can enter each of the names of “use/maintenance” one by one and then click “Save”.

Method 2

Import an excel file (xls format) directly for a large number of use/maintenance activities. Click “Choose File” to import an excel file and click “Import” as below.

5.4.2 Use the GHG emissions database/ Enter carbon footprint emission factor

Click 'Search' to enter the GHG emissions database.

After clicking “Search”, the interface of the GHG emissions database will appear as shown on the next page.

Similar to the “distribution stage”, there are 3 methods to select the emission factor of the energy/ material used.

Method 1

Select the emission factor of the energy/ material used according to its stage and category.

Method 2 (keyword search)

(1) Enter a keyword in the search engine and (2) click “Search”. All related items will be shown when you click into different stages. (3) Click the energy/ material you choose.

GHG emission database

Keyword search:

Point the cursor on stages to expand data, to check stage notes and then search for specific data

Material stage
 Manufacturing stage
 Transportation stage
 Use stage: Electricity Foreign France JEMAJ
 End of life stage

Method 3 (self-define)

Enter the emission factor for the energy/ material used that is not included in the GHG database.

Enter its name, unit and carbon footprint emission factor as below if you can find its emission factor from other databases.

Self Define

Name:

Unit:

Carbon footprint emission factor (kg CO2e):

5.4.3 Enter the quantity used in the energy/ material used

Enter the quantity used in the energy/ material used per unit of electronic scale, as below, and then click “Save”.

Use/Maintenance: Energy/material used: Quantity: Unit:

5.4.4 Proceed to the “end-of-life stage”

A user can click “Next” to proceed to the “end-of-life stage” after finishing the data entry in the distribution stage.

Use Stage

Use/Maintenance: Energy/material used: Quantity: Unit:

Remarks:

1. All components and activities of use/maintenance should be included in the actual situation.
2. Assumptions should be stated clearly in the actual situation.
3. If the direct emission factors of the component of use/maintenance cannot be found in the embedded GHG emissions database, please try to find out the emission factors of its corresponding raw material and manufacturing process from raw material to the component.

5.5 End-of-life stage

The interface of the “end-of-life stage” is shown below.

End-of-life Stage

Activity: Quantity: Unit:

Assumption:

5.5.1 Input the name of activity

Similar to the previous “use stage”, there are two methods to input the name of the “activity”.

Method 1

A user can enter each of the names of “activity” one by one and then click “Save”.

Method 2

Import an excel file (xls format) directly for a large number of activities. Click “Choose File” to import an excel file and click “Import” as below.

5.5.2 Use the GHG emissions database/ Enter carbon footprint emission factor

Click 'Search' to enter the GHG emissions database.

After clicking “Search”, the interface of the GHG emissions database will appear as shown on the next page.

Similar to the “use stage”, there are 3 methods to select the emission factor of the “activity”.

Method 1

Select the emission factor of the “activity” according to its stage and category.

Method 2 (keyword search)

(1) Enter a keyword in the search engine and (2) click “Search”. All related items will be shown when you click on different stages.

(3) Click the “activity” you choose.

GHG emission database

Keyword search: WEEE [Search] [Clear Search]

Point the cursor on stages to select data, or check stage boxes and click search for specific data.

Material stage
Manufacturing stage
Transportation stage
Use stage
End of life stage: Recycling, Electronic products recycling, Other product recycling, Disposal, industrial devices, to WEEE treatment [CH] Ecoinvent 2.2

Method 3 (self-define)

Enter the emission factor for an “activity” that is not included in the GHG database.

Enter its name, unit and carbon footprint emission factor as below if you can find its emission factor from other databases.

Self Define
Enter the emission factor if better quality data is available

Name
Unit
Carbon footprint emission factor (kg CO₂-e)

[Submit]

5.5.3 Enter the quantity used in the activity

Enter the quantity used in the “activity” per unit of electronic scale, just like next page, and then click “Save”.

Activity	Activity	Quantity	Unit	Save	Delete
WEEE to recycling factory	Transport, lorry 16-32t, EURO4 (RER)	0.132	Item	[Save]	[Delete]

5.5.4 Proceed to the next stage

A user can click “Next” to proceed to the next stage after finishing the data entry in the end-of-life stage.



Activity	Activity	Quantity	Unit	Save	Delete
WEEE to recycling factory	Transport, lorry 16-32t, EURO4 (RER)	0.132	Item	[Save]	[Delete]
WEEE recycling factory to	Transport, lorry 16-32t, EURO4 (RER)	0.253	Item	[Save]	[Delete]

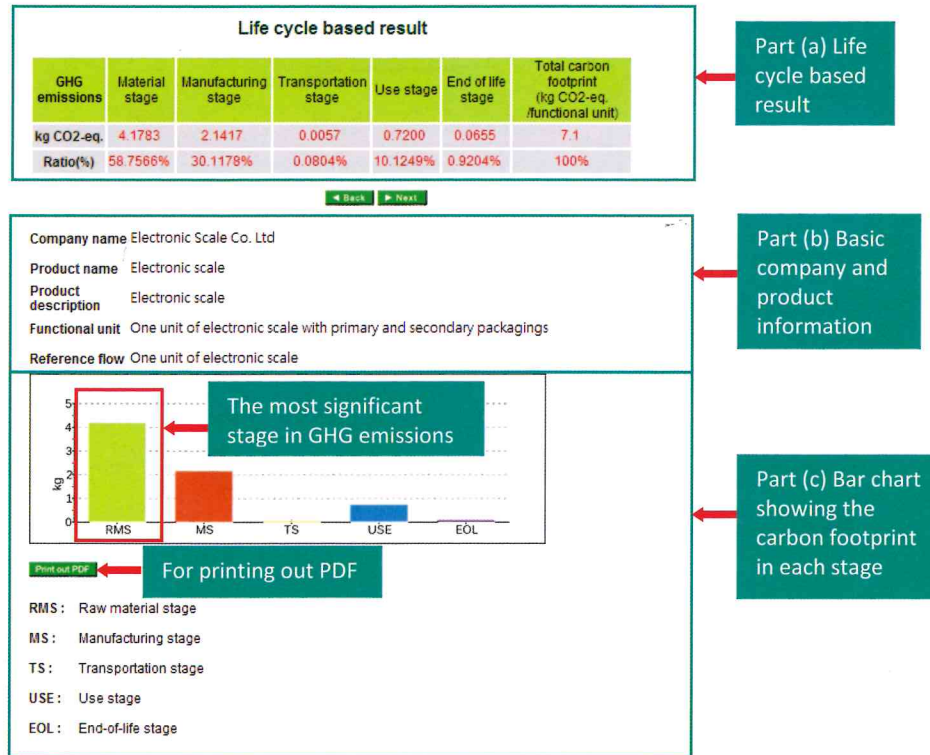
[Back] [Next]

Remarks:

1. All components and activities of end-of-life stage should be included in the actual situation.
2. Assumptions should be stated clearly in the actual situation.
3. If the direct emission factor of the component of disposal/recycling stage cannot be found in the embedded GHG emissions database, please try to find out the emission factors of its corresponding raw material and manufacturing process from raw material to the component.

5.6 Life cycle based result

After clicking “next” on the previous page, a page of “Life cycle based result” page will appear. An example is shown below.



In part (a), the GHG emissions and their corresponding ratios in each stage will be shown. The total carbon footprint of this product will also be shown.

In part (b), the basic information including company name, product name, product description, functional unit and reference flow that were entered at the beginning will be shown.

In part (c), a bar chart showing the carbon footprint in each stage will be shown. The bar chart can show which stage is the most significant life cycle stage in the GHG emissions. In this case, the “raw material stage” has contributed the highest amount of GHG emissions in the whole life cycle. As a result, G-BOM analyzer users can recognize the most significant life cycle stage in GHG emissions of their product and the GHG emissions in other stages, especially focus on the most significant life cycle stage to adopt suitable improvements in reducing their product carbon footprint.

In this stage of the life cycle based result, a user can print out the result of this stage in PDF format by clicking “Print out PDF”. The assumptions written in each stage of the G-BOM analyzer will also be printed on the resulting page.

A user can proceed to the next page by clicking “next”.

5.7 Components and activities based result

After clicking “next” on the previous page, a “Components and activities based result” page will appear. An example is shown below.

Components and activities based result

GHG emissions	Material stage	Manufacturing stage	Transportation stage	Use stage	End of life stage	Ratio
Screen printing glass plate	1.5778	0	0	0	0	22.19%
LCD panel	1.547	0	0	0	0	21.75%
Bottom cover	0.525	0	0	0	0	7.38%
Upper cover	0.49	0	0	0	0	6.89%
Display stand	0.0385	0	0	0	0	0.54%
Electricity consumption from HIBER	0	2.1397	0	0	0	30.09%
Ethanol	0	0.002	0	0	0	0.03%
Factory to Yantian port	0	0	0.0057	0	0	0.08%
AAA battery	0	0	0	0.72	0	10.12%
WEEE recycling factory to plastic factory	0	0	0	0	0.043	0.6%
WEEE to recycling factory	0	0	0	0	0.0224	0.32%

[Back](#)

Company name: Electronic Scale Co., Ltd.
 Product name: Electronic scale
 Product description: Electronic scale
 Functional unit: One unit of electronic scale with primary and secondary packagings
 Reference flow: One unit of electronic scale

[Print out PDF](#) For printing out PDF

The most significant activity in GHG emissions

On this page, the GHG emission and ratio of carbon footprint for each component and each activity will be shown in the corresponding stage accordingly. This table can show which component/component in which stage is the most significant component in GHG emissions. In this case, the electricity consumption in the “manufacturing stage” has contributed the highest amount of GHG emissions in the whole life cycle. As a result, G-BOM analyzer users can recognize the most significant component/activity in GHG emissions of their product and focus here on adopting suitable improvement in reducing their product carbon footprint.

A user can print out the result of this stage in PDF format by clicking “Print out PDF”. The assumptions written in each stage of the G-BOM analyzer will also be printed in the resulting page.

6. Induction cooker

6.1 Raw material stage

The interface of the “raw material stage” is shown below.

The screenshot shows the 'Raw Material Stage' interface. Annotations point to the following sections:

- Section for choosing “Component name”, searching “Material” emission factor and entering “Quantity”**: Points to the top section with a table of components and a search bar.
- Section for entering “Assumption”**: Points to the middle section with a text area for assumptions.
- Section for entering “Component name”**: Points to the bottom section with a dropdown menu and a text input field.
- Section for entering a list of “Component name” from Excel**: Points to the bottom right section with a file upload button.

6.1.1 Input the name of component

There are two methods to input the item names.

Method 1

A user can enter the name of each component one by one. Input the component name in the box “Input the Component here” and then click “Save”. For the example below, “aluminium plate” is input as the “Component name”.

The screenshot shows the component input form. A red box highlights the 'Save' button, and a red arrow points to the text input field containing 'Aluminium plate'.

Then the component name will appear under the “Component” category.

Then enter the next component and click “Save”.

The next component name will appear under the category of “Component”, then click to choose it.

Method 2

Import an excel file (xls format) directly for a large number of components. Click “Choose File” to import an excel file and click “Import” as below.

Component XLS File: example.xls
[Download Excel Sample](#)

Example of an excel file is shown on the next page.

	A	B	C
1	Aluminium plate		
2	Heat sink		
3	Solder		
4	Integrated circuit		
5	Ring core chokecoil inductor		

After importing the excel file, a list of components will appear under “Component” category.

6.1.2 Use the GHG emissions database/ Enter carbon footprint emission factor

Click 'Search' to enter the GHG emissions database and select the materials of the components.

After clicking “Search”, the interface of the GHG emissions database will appear as shown below.

GHG emission database

Keyword search

Point the cursor on stages to select data, or check stage boxes and click search for specific data.

Material stage
☐ Manufacturing stage
☐ Transportation stage
☐ Use stage
☐ End of life stage

Self Define
 Enter the emission factor if better quality data is available.
 Name
 Unit
 Carbon footprint emission factor (kg CO₂-e)

Method 2 (keyword search)

Method 1 & 2 (use embedded GHG emissions database)

Method 3 (self-define)

There are 3 methods to select the emission factor of the component.

Method 1

Select the material according to its stage and category.

Example: integrated circuit

1. Point the cursor and select “Material stage”
2. Select “Electronic and electrical related products” as an integrated circuit belongs to this category
3. Select “Electronic components” as an integrated circuit belongs to this sub-category
4. You can then find “integrated circuit, IC, logic type, at plant [GLO]” in the GHG emissions database under “Ecoinvent 2.2” database

Material stage
☒ Manufacturing stage
☐ Transportation stage
☐ Use stage
☐ End of life stage

Agriculture and livestock-related products
 Chemicals and related products
 Electronic and electrical related products
 Energy-related products

Electronic components
 Electronic modules

[GLO] Ecoinvent 2.2
 integrated circuit, IC, logic type, at plant [GLO] Ecoinvent 2.2
 integrated circuit, IC, memory type, at plant [GLO] Ecoinvent 2.2

5. After clicking on the material, it will appear under the “Material” category.

Component	Material	Quantity	Unit	
Integrated circuit	integrated circuit, IC, logic type, at plant [GLO] Ecoinvent 2.2		kg	<input type="button" value="Save"/>

Method 2

It is a faster method to find the materials in the GHG database and is suitable for those who may not know which category the material belongs to.

- (1) Enter a keyword in the search engine and (2) click “Search”. All related items will be shown when you click into different stages. (3) Click the material you choose. An example is shown below.

GHG emission database

Keyword search

Point the cursor on stages to select data, or check stage boxes and click search for specific data.

Material stage
☐ Manufacturing stage
☐ Transportation stage
☐ Use stage
☐ End of life stage

Electronic and electrical related products
 Electronic components
 integrated circuit, IC, logic type, at plant [GLO] Ecoinvent 2.2
 integrated circuit, IC, memory type, at plant [GLO] Ecoinvent 2.2
 water, fabricated for integrated circuit, at plant [GLO] Ecoinvent 2.2

After clicking on the material, it will appear under the “Material” category.

Component	Material	Quantity	Unit	
Integrated circuit	integrated circuit, IC, logic type, at plant [GLO] Ecoinvent 2.2		kg	<input type="button" value="Save"/>

Method 3

Enter the emission factor for materials not included in the GHG database.

Example: thermal fuse

Enter its **name**, **unit** and **carbon footprint emission factor** as below if you can find its emission factor from other databases. An example is shown below. Click “Submit” after entering the information.

Self Define

Enter the component name, material, quantity, unit, and carbon footprint emission factor.

Name	Thermal fuse
Unit	kg
Carbon footprint emission factor (kg CO ₂ e)	30.23

Submit

After clicking “Submit”, it will appear under the “Material” category, just like example below.

Component	Material	Quantity	Unit	
Thermal fuse	Thermal fuse	Search	kg	Save

◀ Back ▶ Next

6.1.3 Enter the quantity used in the component

Enter the quantity used in the component just like the example below and then click “Save”.

Component	Material	Quantity	Unit	
Thermal fuse	Thermal fuse	0.001	kg	Save

◀ Back ▶ Next

6.1.4 Proceed to the “manufacturing stage”

After repeating the procedures in 6.1.1 to 6.1.3 to add new components and entering all the information of the components (component name, material, quantity and unit) in the raw material stage, just like example on next page as part of the raw material list, click “Next” to proceed to the manufacturing stage.

Raw Material Stage

Component	Material	Quantity	Unit	
Aluminium plate	aluminium, primary, at plant [RER]	0.0524	kg	Save Delete
Heat sink	aluminium, primary, at plant [RER]	0.100	kg	Save Delete
Solder	solder, bar, Sn62Pb37, for electronics indu	0.0240	kg	Save Delete
Integrated circuit	integrated circuit, IC, logic type, at plant [G	0.00414	kg	Save Delete
Ring core chokecoil inductor	inductor, ring core choke type, at plant [GL	0.048	kg	Save Delete

◀ Back ▶ Next

Remarks:

1. All raw materials and product packaging materials should be included in the actual situation.
2. All packaging of both raw materials and product packaging materials should be included in the actual situation.
3. All transportation of both raw materials and product packaging materials should be included in the actual situation.
4. Assumption should be stated clearly in the actual situation.
5. If the direct emission factors of the component and the packaging material cannot be found in the embedded GHG emissions database, please try to find out the emission factors of its corresponding raw material and manufacturing process from raw material to the component.

6.2 Manufacturing stage

The interface of “manufacturing stage” is shown below.

The screenshot shows the 'Manufacturing Stage' interface. It includes a header with a factory image and the title 'Manufacturing Stage'. Below the header is a table with columns: Name of process, Process, Quantity, and Unit. A 'Search' button is next to the 'Process' column. A 'Save' button is at the bottom right. A 'Back' button is at the bottom left. A 'Next' button is at the bottom right. A 'Submit' button is at the bottom left. A 'Save' button is at the bottom right. A 'Component XLS File' section is at the bottom left, with a 'Choose File' button, a 'Download Excel Sample' link, and an 'Import' button. A 'Clear All' button is at the bottom right. A 'Section for choosing "Name of the process", searching "Process" emission factor and entering "Quantity"' points to the table. A 'Section for entering "Assumption"' points to the 'Assumption' section. A 'Section for entering "Name of the process"' points to the 'Name of the process' input field. A 'Section for entering a list of "Name of the process" from Excel' points to the 'Component XLS File' section.

6.2.1 Input the name of process

Similar to the “raw material stage”, there are two methods to input the name of the process.

Method 1

A user can enter each of the names of the process one by one and then click “Save”.

The screenshot shows the input form for Method 1. It includes a dropdown menu labeled '---Select the Name of the pro...' and a text input field labeled 'Input the Name of the process here'. Below the input field are 'Save' and 'Clear all' buttons.

Method 2

Import an excel file (xls format) directly for a large number of processes. Click “Choose File” to import an excel file and click “Import” as below.

The screenshot shows the input form for Method 2. It includes a 'Component XLS File:' label, a 'Choose File' button, and a text input field containing 'example.xls'. Below the input field are links for 'Download Excel Sample' and an 'Import' button.

6.2.2 Use the GHG emissions database/ Enter carbon footprint emission factor

Click 'Search' to enter the GHG emissions database.

The screenshot shows the GHG emissions database interface. It includes a table with columns: Name of process, Process, Quantity, and Unit. A 'Search' button is next to the 'Process' column. A 'Save' button is at the bottom right. A 'Back' button is at the bottom left. A 'Next' button is at the bottom right.

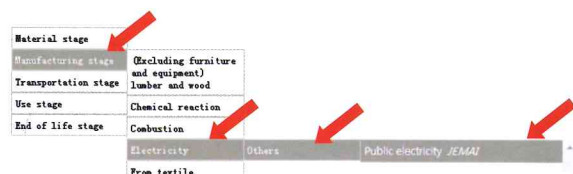
After clicking “Search”, the interface of the GHG emissions database will appear as shown below.

The screenshot shows the GHG emissions database interface with three methods highlighted. Method 2 (keyword search) is highlighted with a red box and a callout. Method 1 & 2 (use embedded GHG emissions database) is highlighted with a red box and a callout. Method 3 (self-define) is highlighted with a red box and a callout. The interface includes a 'Keyword search' section, a 'GHG emission database' section, and a 'Self Define' section. The 'Self Define' section includes fields for 'Name', 'Unit', and 'Carbon footprint emission factor (kg CO2-e)'. A 'Submit' button is at the bottom.

Similar to the “raw material stage”, there are 3 methods to use the GHG emissions database in order to select the emission factor of the process.

Method 1

Select the emission factor of the process according to its stage and category.



Method 2

(1) Enter a keyword in the search engine and (2) click “Search”. All related items will be shown when you click into different stages. (3) Click the name of the process you choose.



Method 3

Enter the emission factor for a process name that is not included in the GHG database.

Enter its name, unit and carbon footprint emission factor as below if you can find its emission factor from other databases.

Self Define

Name

Unit

Carbon footprint emission factor (kg CO₂e)

6.2.3 Enter the quantity used in the process

Enter the quantity used in the process per induction cooker, just like below, and then click “Save”.

Name of process	Process	Quantity	Unit	Save	Delete
Electricity consumption from	Electricity consumption from NDRC	2.32	kWh	<input type="button" value="Save"/>	<input type="button" value="Delete"/>

6.2.4 Proceed to the “distribution stage”

A user can click “Next” to proceed to the distribution stage after finishing the data entry in the manufacturing stage



Remarks:

1. Electricity consumption per unit of induction cooker should be included in this stage.

2. All consumables, packaging of consumables and transportation of consumables per unit of induction cooker should be included in this stage.
3. All waste management per unit of induction cooker, e.g. transportation of waste metal cutoffs and waste plastic materials should be included in this stage.
4. Assumptions should be stated clearly in the actual situation.
5. If the direct emission factors of the consumable and the packaging material of consumable cannot be found in the embedded GHG emissions database, please try to find out the emission factors of its corresponding raw material and manufacturing process from raw material to the component.

6.3 Distribution stage

The interface of the “distribution stage” is shown below.

The screenshot shows the 'Distribution Stage' interface. At the top, there is a header image of a truck with the text 'Distribution Stage'. Below this is a table with columns: Route, Transportation, Quantity, and Unit. There is a 'Save' button next to the table. Below the table is a 'Back' button and a 'Next' button. Below the table is a section for entering 'Assumption' with a 'Search' button. Below the 'Assumption' section is a section for entering 'Route' with a 'Save' button. Below the 'Route' section is a section for entering a list of 'Route' from Excel with a 'Choose File' button, an 'Import' button, and a 'Clear All' button. Red arrows point from text boxes to these sections: 'Section for choosing "Route", searching "Transportation" emission factor and entering "Quantity"' points to the table; 'Section for entering "Assumption"' points to the 'Assumption' section; 'Section for entering "Route"' points to the 'Route' section; and 'Section for entering a list of "Route" from Excel' points to the 'Choose File' button.

Please note that this stage is for reference only because there is a huge variation in users' usage patterns for induction cookers in terms of different temperature selection and cooking methods, and in geographical differences regarding electricity production in different regions. Therefore, the system boundary of this case is confined to the “Cradle to Gate” product life cycle stages. The distribution stage is for reference only. The overall product carbon footprint excludes the carbon footprint generated in the distribution stage.

6.3.1 Input the name of route

Similar to the previous “manufacturing stage”, there are two methods to input the name of the route.

Method 1

A user can enter each of the names of the route one by one and then click “Save”.

The screenshot shows the 'Input the name of route' interface. At the top, there is a dropdown menu labeled '---Select the Route and edit'. Below this is a text input field labeled 'Input the Route here'. Below the input field are two buttons: 'Save' and 'Clear all'. A red arrow points to the 'Save' button.

Method 2

Import an excel file (xls format) directly for a large number of routes. Click “Choose File” to import an excel file and click “Import” as shown on next page.

Component XLS File: example.xls
[Download Excel Sample](#)

6.3.2 Use the GHG emissions database/ Enter carbon footprint emission factor

Click 'Search' to enter the GHG emissions database and select the transportation activities.

The screenshot shows a form with fields for 'Route', 'Transportation', 'Quantity', and 'Unit'. A 'Search' button is highlighted with a red box and an arrow. Below the form are 'Back' and 'Next' buttons.

After clicking “Search”, the interface of the GHG emissions database will appear as shown below.

The three screenshots illustrate different methods to select an emission factor:

- Method 2 (keyword search):** The first screenshot shows the 'Keyword search' field with a red box around it.
- Method 1 & 2 (use embedded GHG emissions database):** The second screenshot shows the 'Material stage', 'Manufacturing stage', 'Transportation stage', 'Use stage', and 'End of life stage' dropdown menus with red boxes around them.
- Method 3 (self-define):** The third screenshot shows the 'Self Define' section with fields for 'Name', 'Unit', and 'Carbon footprint emission factor (kg CO₂-e)' with a red box around it.

Similar to the “manufacturing stage”, there are 3 methods to select the emission factor of route.

Method 1

Select the emission factor of the transportation activity according to its stage and category.

The screenshot shows the 'GHG emission database' interface. The 'Transportation stage' dropdown menu is selected, showing options like 'Air', 'General', 'Marine', 'Road', 'Freight', 'Passenger', and 'Transportation tools'. A red box and arrow highlight the 'Transportation stage' dropdown.

Method 2

(1) Enter a keyword in the search engine and (2) click “Search”. All related items will be shown when you click into different stages. (3) Click the transportation activity you choose.

The screenshot shows the 'GHG emission database' interface with numbered steps:

1. Enter a keyword in the search engine (e.g., 'lorry 16-32t').
2. Click the 'Search' button.
3. Click the transportation activity you choose (e.g., 'Transport, lorry 16-32t, EURO4').

Method 3

Enter the emission factor for a transportation activity that is not included in the GHG database.

Enter the name, unit and carbon footprint emission factor as below if you can find its emission factor from other databases.

Self Define

Enter the emission factor from other databases if the quantity of data is small.

Name	
Unit	
Carbon footprint emission factor (kg CO ₂ -e)	

Submit

6.3.3 Enter the quantity used in the transportation activity

Enter the quantity used in the transportation activity per unit of induction cooker, just like below, then click “Save”.

Route	Transportation	Quantity	Unit
Factory to Tienkuo port	Transport, heavy 7.5-10t, EURO4 (2017)	0.028	tkm

Save

◀ Back ▶ Next

Please note that the formula of tkm calculation is as follows:

Distance of transportation activity (km) x Weight of finished product (g) / 1,000,000 = _____ tkm

For example, distance of route 1 = 100 km

Weight of finished product = 3,000 g

Then the quantity used in the transportation activity of route 1 = 100 (km) x 3,000 (g) / 1,000,000 = 0.3 tkm

6.3.4 Proceed to the “use stage”

A user can click “Next” to proceed to the “use stage” after finishing the data entry in the distribution stage.

Distribution Stage

Route	Transportation	Quantity	Unit
Factory to Tienkuo port	Transport, heavy 7.5-10t, EURO4 (2017)	0.028	tkm

◀ Back ▶ Next

Remarks:

1. Distances of routes can be obtained from Google Map.
2. Assumptions should be stated clearly in the actual situation.

6.4 Use stage

Please note that “use stage” is not included in the induction cooker case because the system boundary of this case is confined to the “Cradle to Gate” product life cycle stages. The reasons are described in the previous section 6.3. The overall product carbon footprint excludes the carbon footprint generated in the use stage. Therefore, simply leave this stage blank and click “Next” to proceed to the end-of-life stage as below.

Use Stage

Use/End-of-life	Energy material used	Quantity	Unit

◀ Back ▶ Next

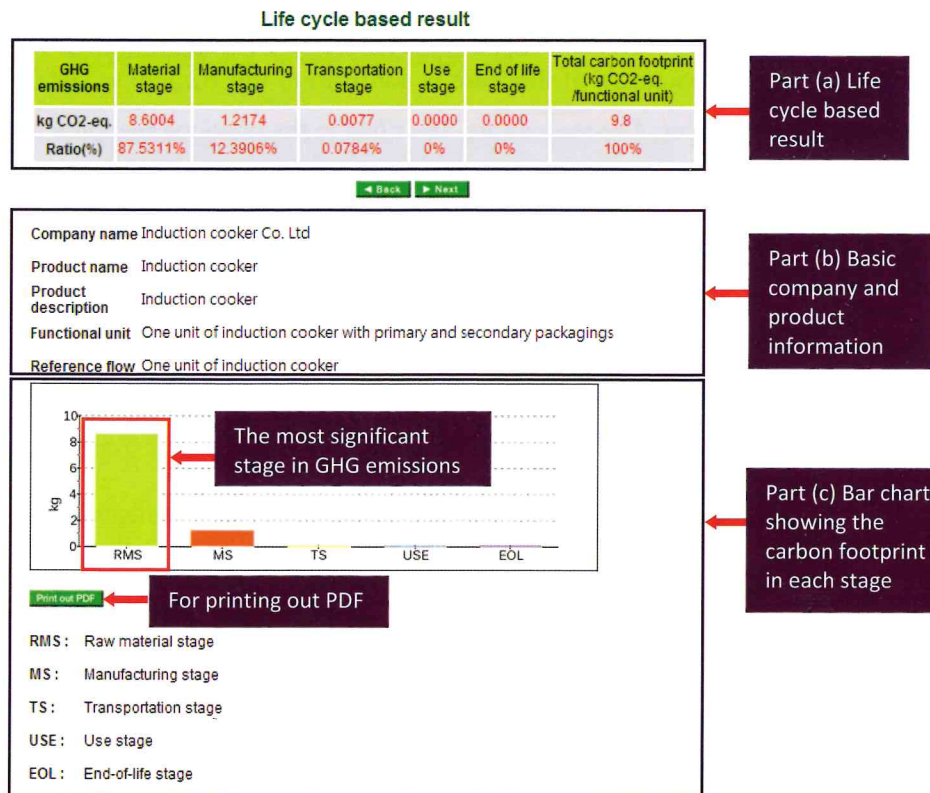
6.5 End-of-life stage

Similar to the reasons in the “use stage”, please note that the “end-of-life” stage is also not included in this case because the system boundary of this case is confined to the “Cradle to Gate” product life cycle stages. Therefore, simply leave this stage blank and click “Next” to proceed to the next page as below.



6.6 Life cycle based result

After clicking “next” on the previous page, a “Life cycle based result” page will appear. An example is given below.



In part (a), the GHG emissions and their corresponding ratios in each stage are shown. The total carbon footprint of this product is also shown. As the induction cooker only covers the “Cradle to Gate” stages of the product life cycle, the “use” stage and the “end-of-life” stage are not calculated from the total carbon footprint. The carbon footprint in the “transportation” stage is also for reference only.

In part (b), the basic information, including company name, product name, product description, functional unit and reference flow that are entered at the beginning, will be shown.

In part (c), a bar chart showing the carbon footprint in each stage will be shown. The bar chart can show which stage is the most significant life cycle stage in regard to GHG emissions. In this case, the “raw material stage” has contributed the highest amount of GHG emissions in the whole life cycle. As a result, G-BOM analyzer users can recognize the most significant life cycle stage in GHG emissions of their product and focus on adopting suitable improvements so as to reduce their product carbon footprint.

In this stage of the life cycle based result, a user can print out the result of this stage in PDF format by clicking “Print out PDF”. The assumptions written in each stage of the G-BOM analyzer will also be printed on the resulting page.

A user can proceed to the next page by clicking “next”.

6.7 Components and activities based result

After clicking “next” on the previous page, a “Components and activities based result” page will appear. An example is shown below.

Components and activities based result

GHG emissions	Material stage	Manufacturing stage	Transportation stage	Use stage	End of life stage	Ratio
Integrated circuit	4.1814	0	0	0	0	42.56%
Ring core chokecoil inductor	2.0208	0	0	0	0	20.57%
Heat sink	1.3392	0	0	0	0	13.63%
Aluminium plate	0.7738	0	0	0	0	7.88%
Solder	0.2852	0	0	0	0	2.9%
Electricity consumption	0	1.2174	0	0	0	12.39%
Factory to Foshan City	0	0	0.0077	0	0	0.06%

The most significant component in GHG emissions

Company name Induction cooker Co. Ltd
 Product name Induction cooker
 Product description Induction cooker
 Functional unit One unit of induction cooker with primary and secondary packagings
 Reference flow One unit of induction cooker

Print out PDF

In this page, the GHG emission and ratio of carbon footprint for each component and each activity will be shown in the corresponding stage accordingly. This table can show which component in which stage is the most significant component in GHG emissions. In this case, the integrated circuit in the “raw materials stage” has contributed the highest amount of GHG emissions in the whole life cycle. As a result, G-BOM analyzer users can recognize the most significant component/activity in GHG emissions of their product and focus on adopting suitable improvement in reducing their product carbon footprint.

A user can print out the result of this stage in PDF format by clicking “Print out PDF”. The assumptions written in each stage of the G-BOM analyzer will also be printed on the resulting page.

7. LCD panel

7.1 Raw material stage

The interface of the “raw material stage” is shown below.

Section for choosing “Component name”, searching “Material” emission factor and entering “Quantity”

Section for entering “Assumption”

Section for entering “Component name”

Section for entering a list of “Component name” from Excel

7.1.1 Input the name of component

There are two methods to input the item names.

Method 1

A user can enter each component name one by one. Input the component name in “Input the Component here” box and then click “Save”. For the example below, “ITO glass” is input as the “Component name”.

-----Select the Component and-----

ITO glass

Save Clear all

Then the component name will appear under the “Component” category.

Component	Material	Quantity	Unit
ITO glass			

Search Save

Then enter the next component and click “Save”.

---Select the Component and---

Epoxy resin

Save Clear all

The name of the next component will appear under the category of “Component”, and then click to choose it.

Component	Material	Quantity	Unit
ITO glass			
ITO glass			
Epoxy resin			

Search Back Next Save

Method 2

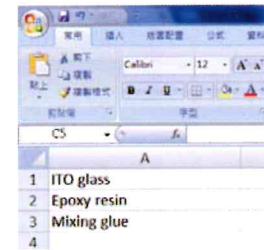
Or import an excel file (xls format) directly for a large number of components. Click “Choose File” to import an excel file and click “Import” as below.

Component XLS File: Choose File example.xls

[Download Excel Sample](#)

Import

An example of an excel file is shown on the next page.



After importing the excel file, the list of components will appear under the “Component” category.

Component	Material	Quantity	Unit
ITO glass			
ITO glass			
Epoxy resin			
Mixing glue			

Search Back Next Save

7.1.2 Use the GHG emissions database/ Enter carbon footprint emission factor

Click 'Search' to enter the GHG emissions database and select the materials of the components

Component	Material	Quantity	Unit

Search Back Next Save

After clicking “Search”, the interface of the GHG emissions database will appear as shown below.

GHG emission database

Keyword search

Point the cursor on stages to select data, or check stage boxes and click search for specific data.

Material stage
Manufacturing stage
Transportation stage
Use stage
End of life stage

Method 2 (keyword search)

Method 1 & 2 (use embedded GHG emissions database)

Method 3 (self-define)

Self Define
Enter the emission factor if better quality data is available.

Name

Unit

Carbon footprint emission factor (kg CO₂-e)

There are 3 methods to use the GHG emissions database.

Method 1

Select the material according to its stage and category.

Example: LCD glass

1. Point the cursor and select "Material stage"
2. Select "Electronic and electrical related products" as LCD glass belongs to this category
3. Select "Electronic components" as LCD glass belongs to this sub-category
4. You can then find "LCD glass, at plant [RER]" in the GHG emissions database under the "Ecoinvent 2.2" database

Material stage	Agriculture and livestock-related products		
Manufacturing stage			
Transportation stage	Chemicals and related products		
Use stage			
End of life stage	Electronic and electrical related products	Electronic components	LCD glass, at plant [GLO] Ecoinvent 2.2
		Electronic modules	Light emitting diode, LED, at plant [GLO] Ecoinvent 2.2
	Energy-related products		
	Food and beverage		

5. After clicking on the material, it will appear under the "Material" category.

Component	Material	Quantity	Unit	
ITO glass	LCD glass, at plant [GLO]	<input type="text"/>	kg	<input type="button" value="Save"/>

Method 2 (keyword search)

It is a faster method to find the materials in the GHG database and is suitable for those who may not know which category the material belongs to.

(1) Enter a keyword in the search engine and (2) click "Search". All related items will be shown when you click into different stages. (3) Click the material you choose. "LCD glass" is an example given below.

GHG emission database

Keyword search

Point the cursor on stages to select data, or check stage boxes and click search for specific data.

Material stage
Manufacturing stage
Transportation stage
Use stage
End of life stage

Electronic and electrical related products

Electronic components

LCD glass, at plant [GLO] Ecoinvent 2.2

After clicking on the material, it will appear under the "Material" category.

Component	Material	Quantity	Unit	
ITO glass	LCD glass, at plant [GLO]		kg	Save

◀ Back ▶ Next

Method 3 (self-define)

Enter the emission factors for materials that are not included in the GHG database.

Example: cellulose triacetate membrane

Enter its **name**, **unit** and **carbon footprint emission factor** as below if you can find its emission factor from other databases. An example is shown below. Click “Submit” after entering the information.

Self Define

Enter the emission factor if better quality data is available

Name	Cellulose triacetate membrane
Unit	kg
Carbon footprint emission factor (kg CO ₂ -e)	3.5

Submit

After clicking “Submit”, it will appear under the “Material” category, just like the example below.

Component	Material	Quantity	Unit	
Polarizer	Cellulose triacetate membrane		kg	Save

◀ Back ▶ Next

7.1.3 Enter the quantity used in the component

Enter the quantity used in the component just like the example below and then click “Save”.

Component	Material	Quantity	Unit	
Polarizer	Cellulose triacetate membrane	0.015	kg	Save

◀ Back ▶ Next

7.1.4 Proceed to the “manufacturing stage”

After repeating the procedures in 7.1.1 to 7.1.3 to add new components and entering all the information of the components (component name, material, quantity and unit) in the raw material stage, just like example on the next page as part of the raw material list, click “Next” to proceed to the manufacturing stage.

Raw Material Stage

Component	Material	Quantity	Unit	
ITO glass	LCD glass, at plant [GLO]	0.004	kg	Save
Epoxy resin	epoxy resin, liquid, at plant [Rf]	4.59e-06	kg	Save
Mixing glue	Adhesive	5e-06	kg	Save
	Adhesive		kg	Save

◀ Back ▶ Next

Remarks:

1. All raw materials and product packaging materials should be included in the actual situation.
2. All packaging of both raw materials and product packaging materials should be included in the actual situation.
3. All transportation of both raw materials and product packaging materials should be included in the actual situation.
4. Assumption should be stated clearly in the actual situation.
5. If the direct emission factors of the component and the packaging material cannot be found in the embedded GHG emissions database, please try to find out the emission factors of its corresponding raw material and manufacturing process from raw material to the component.

7.2 Manufacturing stage

The interface of “manufacturing stage” is shown below.

The screenshot shows the 'Manufacturing Stage' interface. It includes a header with the university logo and name. Below the header is a table with columns: Name of process, Process, Quantity, and Unit. There are buttons for 'Back' and 'Next'. Annotations with red arrows point to specific sections:

- Section for choosing “Name of the process”, searching “Process” emission factor and entering “Quantity”**: Points to the table header.
- Section for entering “Assumption”**: Points to a text area below the table.
- Section for entering “Name of the process”**: Points to a dropdown menu labeled 'Select the Name of the process'.
- Section for entering a list of “Name of the process” from Excel**: Points to a section with 'Component XLS File' and 'Choose File' buttons.

7.2.1 Input the name of process

Similar to the “raw material stage”, there are two methods to input the name of the process.

Method 1

A user can enter each of the names of the process one by one and then click “Save”.

The screenshot shows the input interface for Method 1. It includes a dropdown menu labeled '---Select the Name of the process'. Below it is a text input field with the placeholder 'Input the Name of the process here'. At the bottom are 'Save' and 'Clear all' buttons.

Method 2

Import an excel file (xls format) directly for a large number of processes. Click “Choose File” to import an excel file and click “Import”, as below.

The screenshot shows the import interface for Method 2. It includes a label 'Component XLS File:' followed by a 'Choose File' button and the text 'example.xls'. Below this is a link 'Download Excel Sample' and an 'Import' button. Red arrows point to the 'Choose File' and 'Import' buttons.

7.2.2 Use the GHG emissions database/ Enter carbon footprint emission factor

Click 'Search' to enter the GHG emissions database.

The screenshot shows the GHG emissions database search interface. It includes a table with columns: Name of process, Process, Quantity, and Unit. There is a 'Search' button in the 'Process' column. Below the table are 'Back' and 'Next' buttons. A red arrow points to the 'Search' button.

After clicking “Search”, the interface of GHG emissions database will appear as shown below.

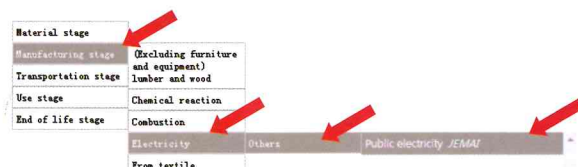
The screenshot shows the GHG emissions database results interface. It includes a 'GHG emission database' header and a 'Keyword search' input field. Below this is a list of stages: Material mixer, Manufacturing stage, Transportation stage, Use stage, and End of life stage. At the bottom is a 'Self Define' section with fields for Name, Unit, and Carbon footprint emission factor (kg CO2/t). Annotations with red arrows point to specific sections:

- Method 2 (keyword search)**: Points to the 'Keyword search' input field.
- Method 1 & 2 (use embedded GHG emissions database)**: Points to the list of stages.
- Method 3 (self-define)**: Points to the 'Self Define' section.

Similar to the “raw material stage”, there are 3 methods to select the emission factor of the process.

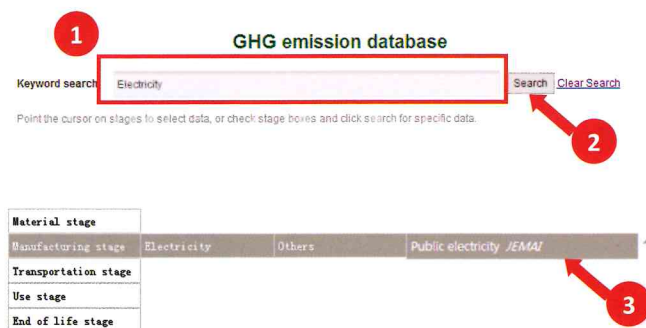
Method 1

Select the emission factor of the process according to its stage and category.



Method 2 (keyword search)

(1) Enter a keyword in the search engine and (2) click “Search”. All related items will be shown when you click into different stages. (3) Click the name of the process you choose.



Method 3 (self-define)

Enter the emission factor for a process name that is not included in the GHG database.

Enter its name, unit and carbon footprint emission factor as below if you can find its emission factor from other databases.

Self Define

Enter the process name, unit and carbon footprint emission factor (kg CO₂e)

Name:

Unit:

Carbon footprint emission factor (kg CO₂e):

Submit

7.2.3 Enter the quantity used in the process

Enter the quantity used in the process per unit of LCD panel, just like below, then click “Save”.

Name of process	Process	Quantity	Unit	Save	Delete
Electricity consumption from	Electricity consumption from NDRC	0.14	kWh	Save	Delete

7.2.4 Proceed to the “distribution stage”

A user can click “Next” to proceed to the distribution stage after finishing the data entry in the manufacturing stage.



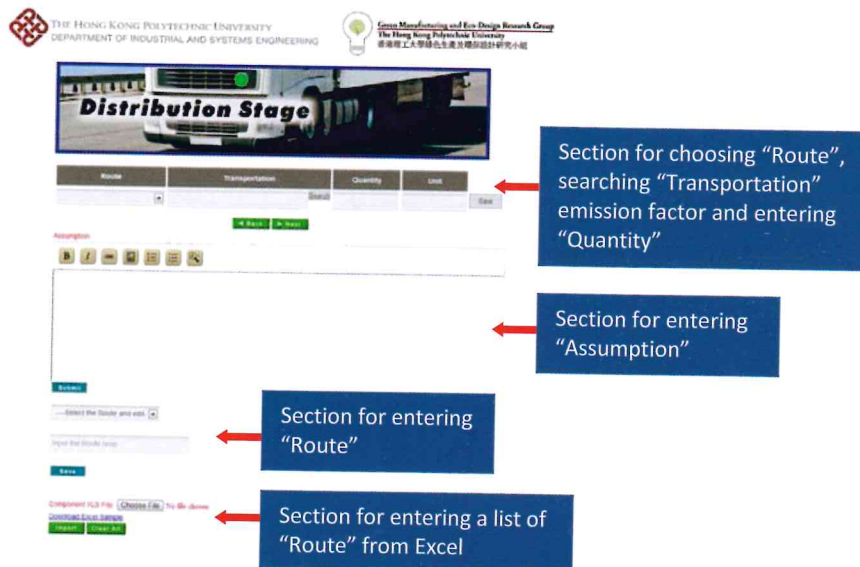
Remarks:

1. Electricity consumption per unit of LCD panel should be included in this stage.

2. All consumables, packaging of consumables and transportation of consumables per unit of LCD panel should be included in this stage.
3. All solid wastes and wastewater emissions in the manufacturing processes should be included in this stage.
4. Assumptions should be stated clearly in the actual situation.
5. If the direct emission factors of the consumable and the packaging material of consumable cannot be found in the embedded GHG emissions database, please try to find out the emission factors of its corresponding raw material and manufacturing process from raw material to the component.

7.3 Distribution stage

The interface of the “distribution stage” is shown below.



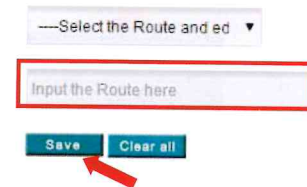
Please note that this stage is for reference only because the LCD module is a component used in the end product, which covers only the “Cradle to Gate” stages of the product life cycle. The overall product carbon footprint excludes the carbon footprint generated in the distribution stage.

7.3.1 Input the name of route

Similar to the previous “manufacturing stage”, there are two methods to input the name of the route.

Method 1

A user can enter each of the names of the route one by one and then click “Save”.



Method 2

Import an excel file (xls format) directly for a large number of routes. Click “Choose File” to import an excel file and click “Import”, as shown on the next page.



7.3.2 Use the GHG emissions database/ Enter carbon footprint emission factor

Click 'Search' to enter the GHG emissions database and select the transportation activities.

The screenshot shows a form with fields for 'Route', 'Transportation', 'Quantity', and 'Unit'. Below these fields is a 'Search' button, which is highlighted with a red box and a red arrow pointing to it. There are also 'Back' and 'Next' buttons at the bottom.

After clicking “Search”, the interface of the GHG emissions database will appear as shown below.

The screenshot shows the 'GHG emission database' interface with three methods to select data:

- Method 2 (keyword search):** A search bar with 'Keyword search' and a 'Search' button.
- Method 1 & 2 (use embedded GHG emissions database):** A list of stages: Material stage, Manufacturing stage, Transportation stage, Use stage, and End of life stage.
- Method 3 (self-define):** A form with fields for 'Name', 'Unit', and 'Carbon footprint emission factor (kg CO₂e)', with a 'Submit' button.

Similar to the “manufacturing stage”, there are 3 methods to select the emission factor of route.

Method 1

Select the emission factor of the transportation activity according to its stage and category.

The screenshot shows the 'GHG emission database' interface with the 'Transportation stage' selected. A red arrow points to the 'Search' button. The interface also shows a table of transportation activities with columns for 'Material stage', 'Manufacturing stage', 'Transportation stage', 'Use stage', and 'End of life stage'. The 'Transportation stage' is highlighted, and a red arrow points to the 'Search' button.

Method 2

(1) Enter a keyword in the search engine and (2) click “Search”. All related items will be shown when you click into different stages. (3) Click the transportation activity you choose.

The screenshot shows the 'GHG emission database' interface with the search process:

- Enter a keyword in the search engine (e.g., 'lorry 16-32t').
- Click the 'Search' button.
- Click the transportation activity you choose (e.g., 'Transport, lorry 16-32t, EURO4').

Method 3

Enter the emission factor for a transportation activity that is not included in the GHG database.

Enter its name, unit and carbon footprint emission factor, as below, if you can find its emission factor from other databases.

Self Define
Enter the emission factor for the product data in this stage

Name	
Unit	
Carbon footprint emission factor (kg CO ₂ -e)	

Submit

7.3.3 Enter the quantity used in the transportation activity

Enter the quantity used in the transportation activity per unit of LCD panel, just like below, and then click “Save”.

Route	Transportation	Quantity	Unit
Factory to Varanasi port	Transport, lorry 7.5-18t, EURO4 (PER)	0.026	km

Back Next Save

Please note that the formula of tkm calculation is as follows:

$$\text{Distance of transportation activity (km)} \times \text{Weight of finished product (g)} / 1,000,000 = \text{tkm}$$

For example, distance of route 1 = 100 km

Weight of per unit of LCD panel = 6.5 g

Then the quantity used in the transportation activity of route 1 =
 $100 \text{ (km)} \times 6.5 \text{ (g)} / 1,000,000 = 0.00065 \text{ tkm}$

7.3.4 Proceed to the “use stage”

A user can click “Next” to proceed to the “use stage” after finishing the data entry in the distribution stage.

Distribution Stage

Route	Transportation	Quantity	Unit
Factory to Varanasi port	Transport, lorry 7.5-18t, EURO4 (PER)	0.026	km

Back Next Save

Remarks:

1. Distances of routes can be obtained from Google Map.
2. Assumptions should be stated clearly in the actual situation.

7.4 Use stage

Please note that “use stage” should not be included in the LCD panel case because the LCD panel only covers the “Cradle to Gate” stages of the product life cycle, as the LCD panel is a component used in the end product. Therefore, simply leave this stage blank and click “Next” to proceed to the next stage, as below.

Use Stage

Use/Maintenance	Energy material used	Quantity	Unit

Back Next Save

7.5 End-of-life stage

Please note that “end-of-life” stage should not be included in LCD module case because LCD module only covers the “Cradle to Gate” stages of the product life cycle, as the LCD panel is a component used in the end product.

Therefore, simply leave this stage blank and click “Next” to proceed to the next page, as below.



7.6 Life cycle based result

After clicking “next” on the previous page, a “Life cycle based result” page will appear. An example is given below.

Life cycle based result

GHG emissions	Material stage	Manufacturing stage	Transportation stage	Use stage	End of life stage	Total carbon footprint (kg CO ₂ -eq./functional unit)
kg CO ₂ -eq.	0.0175	0.1296	0.0008	0.0000	0.0000	0.1
Ratio(%)	11.8218%	87.6572%	0.521%	0%	0%	100%

Part (a) Life cycle based result

Life cycle based result

Company name LCD Co. Ltd

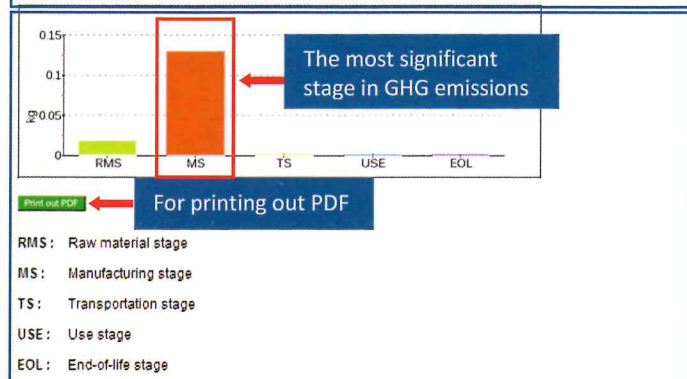
Product name LCD panel

Product description LCD panel

Functional unit One unit of LCD panel with primary and secondary packagings

Reference flow One unit of LCD panel

Part (b) Basic company and product information



Part (c) Bar chart showing the carbon footprint in each stage

In part (a), the GHG emissions and their corresponding ratios in each stage will be shown. The total carbon footprint of this product will also be shown. As LCD only covers the “Cradle to Gate” stages of the product life cycle, the “use” stage and the “end-of-life” stage are not calculated in the total carbon footprint. The carbon footprint in the “transportation” stage is also for reference only.

In part (b), the basic information including company name, product name, product description, functional unit and reference flow that are entered at the beginning will be shown.

In part (c), a bar chart showing the carbon footprint in each stage will be shown. The bar chart can show which stage is the most significant life cycle stage in GHG emissions. In this case, the “raw material stage” has contributed the highest amount of GHG emissions in the whole life cycle. As a result, the G-BOM analyzer users can recognize the most significant life cycle stage in GHG emissions of their product and focus on adopting suitable improvements in reducing their product carbon footprint.

In this stage of the life cycle based result, a user can print out the result of this stage in PDF format by clicking “Print out PDF”. The assumptions written in each stage of the G-BOM analyzer will also be printed in the resulting page.

A user can proceed to the next page by clicking “next”.

7.7 Components and activities based result

After clicking “next” on the previous page, a “Components and activities based result” page will appear. An example is shown below.

Components and activities based result

GHG emissions	Material stage	Manufacturing stage	Transportation stage	Use stage	End of life stage	Ratio
ITO glass	0.0174	0	0	0	0	11.8%
Epoxy resin	0	0	0	0	0	0.02%
Mixing glue	0	0	0	0	0	0%
Electricity consumption	0	0.1291	0	0	0	87.36%
Sodium hydroxide	0	0.0004	0	0	0	0.25%
Acetone	0	0.0001	0	0	0	0.05%
Factory to Kiwon Tong	0	0	0.0008	0	0	0.52%

[Back](#)

Company name LCD Co. Ltd
 Product name LCD panel
 Product description LCD panel
 Functional unit One unit of LCD panel with primary and secondary packagings
 Reference flow One unit of LCD panel

[Print out PDF](#) For printing out PDF

The most significant activity in GHG emissions

In this page, the GHG emission and ratio of carbon footprint for each component and each activity will be shown at the corresponding stage accordingly. This table can show which component/ activity in which stage is the most significant component in GHG emissions. In this case, the electricity consumption in the “manufacturing stage” has contributed the highest amount of GHG emissions in the whole life cycle. As a result, G-BOM analyzer users can recognize the most significant component/activity in GHG emissions of their product and focus on adopting suitable improvements in reducing their product carbon footprint.

A user can print out the results of this stage in PDF format by clicking “Print out PDF”. The assumptions in each stage of the G-BOM analyzer will also be printed on the resulting page.

8. Printed Circuit Board

8.1 Raw material stage

The interface of the “raw material stage” is shown below.

The screenshot shows the 'Raw Material Stage' interface. Annotations point to the following sections:

- Section for choosing “Component name”, searching “Material” emission factor and entering “Quantity”**: Points to the top section with a search bar and a table with columns: Component, Material, Quantity, Cost.
- Section for entering “Assumption”**: Points to the 'Assumption' text area.
- Section for entering “Component name”**: Points to the 'Select the Component' dropdown menu.
- Section for entering a list of “Component name” from Excel**: Points to the 'Component ALD File' and 'Upload Excel' buttons.

8.1.1 Input the name of component

There are two methods to input the item names.

Method 1

A user can enter each component name one by one. Input the component name in the “Input the Component here” box and then click “Save”. For the example below, “Laminate – woven glass” is input as the “Component name”.

—Select the Component and—

Laminate – woven glass

Save Clear all

The component name will then appear under the “Component” category.

Then enter the next component and click “Save”.

The next component name will appear under the category of “Component”, and then click to choose it.

Method 2

Import an excel file (xls format) directly for a large number of components. Click “Choose File” to import an excel file and click “Import” as below.

Example of an excel file is shown on the next page.

After importing the excel file, a list of components will appear under “Component” category.

8.1.2 Use the GHG emissions database/ Enter carbon footprint emission factor

Click 'Search' to enter the GHG emissions database and select the materials of the components

After clicking “Search”, the interface of the GHG emissions database will appear as shown below.

GHG emission database

Keyword search: Search Clear/Select

Point the cursor on stages to select data, or check stage boxes, and click search for specific data.

Material stage: ☐ Manufacturing stage: ☐ Transportation stage: ☐ Use stage: ☐ End of life stage: ☐

Self Define: Enter the emission factor if better quality data is available.

Name:

Unit:

Carbon footprint emission factor (kg CO₂-e):

Submit

Method 2 (keyword search)

Method 1 & 2 (use embedded GHG emissions database)

Method 3 (self-define)

There are 3 methods to select the emission factor of the component.

Method 1

Select the material according to its stage and category.

Example: glass fibre

1. Point the cursor and select “Material stage”
2. Select “Other product categories” as glass fibre belongs to this category
3. Select “Glass manufacturing” as glass fibre belongs to this sub-category
4. You can then find “glass fibre, at plant [RER]” in the GHG emissions database under the “Ecoinvent 2.2” database

Material stage: ☐ Agriculture and livestock-related products

Manufacturing stage: ☐ Chemicals and related products

Transportation stage: ☐ Electronic and electrical related products

Use stage: ☐ Energy-related products

End of life stage: ☐ Food and beverage related products

Self Define: Enter the emission factor if better quality data is available.

Name:

Unit:

Carbon footprint emission factor (kg CO₂-e):

Submit

Other product categories: ☐ Building materials

Other product categories: ☐ Cosmetics & dental products

Other product categories: ☐ Glass fibre and its products

Other product categories: ☐ Textiles and apparel related products

Other product categories: ☐ Wood and paper-related materials

Other product categories: ☐ Glass manufacturing

Other product categories: ☐ Flat glass, coated, at plant [RER] Ecoinvent 2.2

Other product categories: ☐ Flat glass, uncoated, at plant [RER] Ecoinvent 2.2

Other product categories: ☐ Glass fibre, at plant [RER] Ecoinvent 2.2

Other product categories: ☐ Photographic sensitive

5. After clicking on the material, it will appear under the “Material” category.

Component	Material	Quantity	Unit
Laminate - woven glass	glass fibre, at plant [RER]		kg

Back Next

Method 2 (keyword search)

It is a faster method to find the materials in the GHG database and is suitable for those who may not know which category the material belongs to.

- (1) Enter a keyword in the search engine and (2) click “Search”. All related items will be shown when you click into different stages. (3) Click the material you choose. A “glass fibre” example is shown below.

1 **GHG emission database**

Keyword search: glass fibre **2** Search Clear Search

Point the cursor on stages to select data, or check stage boxes and click search for specific data.

3

Material stage	Other product categories	Glass manufacturing	glass fibre, at plant [RER]	Component 2.2
Manufacturing stage	Plastic-related products			
Transportation stage				
Use stage				
End of life stage				

After clicking on the material, it will appear under the “Material” category.

Component	Material	Quantity	Unit	
Laminate - woven glass	glass fibre, at plant [RER]		kg	Save

Back **Next**

Method 3 (self-define)

Enter the emission factor for materials that are not included in the GHG database.

Example: nickel (II) sulphate

Enter its **name**, **unit** and **carbon footprint emission factor** as below if you can find its emission factor from other databases. An example is shown below. Click “Submit” after entering the information.

Self Define

Enter the emission factor if neither system data is available

Name	nickel (II) sulphate
Unit	kg
Carbon footprint emission factor (kg CO ₂ e)	2.5

Submit

After clicking “Submit”, it will appear under the “Material” category, just like the example below.

Component	Material	Quantity	Unit	
Electroless nickel	nickel (II) sulphate		kg	Save

Back **Next**

8.1.3 Enter the quantity used in the component

Enter the quantity used in the component, just like the example below and then click “Save”.

Component	Material	Quantity	Unit	
Electroless nickel	nickel (II) sulphate	0.15	kg	Save

Back **Next**

8.1.4 Proceed to the “manufacturing stage”

After repeating the procedures in 8.1.1 to 8.1.3 to add new components and entering all the information on the components (component name, material, quantity and unit) in the raw material stage, just like example on the next page as part of the raw material list, click “Next” to proceed to the manufacturing stage.

Raw Material Stage

Component	Material	Quantity	Unit	
Laminate - woven glass	glass fibre, at plant [RER]	1.21	kg	Save Delete
Laminate - epoxy resin	epoxy resin, liquid, at plant [RER]	1.36	kg	Save Delete
Laminate - copper foil	copper, primary, at refinery [GLO]	0.45	kg	Save Delete
Electroless nickel	nickel (II) sulphate	0.15	kg	Save

Back **Next**

Remarks:

1. All raw materials and product packaging materials should be included in the actual situation.
2. All packaging of both raw materials and product packaging materials should be included in the actual situation.
3. All transportation of both raw materials and product packaging materials should be included in the actual situation.
4. Assumptions should be stated clearly in the actual situation.
5. If the direct emission factors of the component and the packaging material cannot be found in the embedded GHG emissions database, please try to find out the emission factors of its corresponding raw material and manufacturing process from raw material to the component.

8.2 Manufacturing stage

The interface of the “manufacturing stage” is shown below.

The screenshot shows the 'Manufacturing Stage' interface. At the top, there is a header with the logo of The Hong Kong Polytechnic University and the Department of Industrial and Systems Engineering. Below the header, there is a banner image with the text 'Manufacturing Stage'. Underneath the banner, there is a table with columns: 'Name of process', 'Process', 'Quantity', and 'Link'. To the right of the table, there is a red box with an arrow pointing to the 'Name of process' column, containing the text: 'Section for choosing “Name of the process”, searching “Process” emission factor and entering “Quantity”'. Below the table, there is a section for entering assumptions. To the right of this section, there is a red box with an arrow pointing to it, containing the text: 'Section for entering “Assumption”'. Below the assumptions section, there is a section for entering the name of the process. To the right of this section, there is a red box with an arrow pointing to it, containing the text: 'Section for entering “Name of the process”'. Below this section, there is a section for entering a list of 'Name of the process' from Excel. To the right of this section, there is a red box with an arrow pointing to it, containing the text: 'Section for entering a list of “Name of the process” from Excel'.

8.2.1 Input the name of process

Similar to the “raw material stage”, there are two methods to input the name of the process.

Method 1

A user can enter each of the names of the processes one by one and then click “Save”.

The screenshot shows the 'Input the name of process' form. At the top, there is a dropdown menu with the text '-----Select the Name of the pro'. Below the dropdown menu, there is a text input field with the placeholder text 'Input the Name of the process here'. Below the input field, there are two buttons: 'Save' and 'Clear all'.

Method 2

Import an excel file (xls format) directly for a large number of processes.
Click “Choose File” to import an excel file and click “Import” as below.



8.2.2 Use the GHG emissions database/ Enter carbon footprint emission factor

Click 'Search' to enter the GHG emissions database.



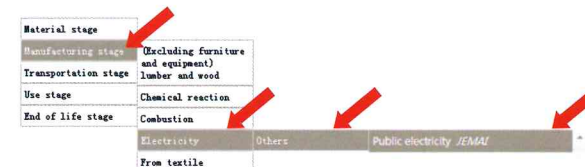
After clicking “Search”, the interface of GHG emissions database will appear as shown below.



Similar to the “raw material stage”, there are 3 methods to use the GHG emissions database in order to select the emission factor of the process.

Method 1

Select the emission factor of the process according to its stage and category.



Method 2 (keyword search)

(1) Enter a keyword in the search engine and (2) click “Search”. All related items will be shown when you click into different stages. (3) Click the name of the process you choose.



Method 3 (self-define)

Enter the emission factor for a process name that is not included in the GHG database.

Enter its name, unit and carbon footprint emission factor, as below, if you can find its emission factor from other databases.

Self Define
Self-define emission factor of carbon footprint data to input table

Name	
Unit	
Carbon footprint emission factor (kg CO ₂ e)	

Submit

8.2.3 Enter the quantity used in the process

Enter the quantity used in the process per square meter of PCB, just like below, and then click “Save”.

Name of process	Process	Quantity	Unit
Electricity consumption	Electricity consumption from NERC	70.86	kWh

8.2.4 Proceed to the “distribution stage”

A user can click “Next” to proceed to the distribution stage after finishing the data entry in the manufacturing stage.



Name of process	Process	Quantity	Unit	
Electricity consumption	Electricity consumption (China)	0.14	kWh	Save Delete
Sodium hydroxide	sodium hydroxide, 50% in H ₂ O, producer	0.00034	kg	Save Delete
Acetone	acetone, liquid, at plant [RER]	3e-05	kg	Save Delete
	acetone, liquid, at plant [RER]		kg	Save

◀ Back ▶ Next

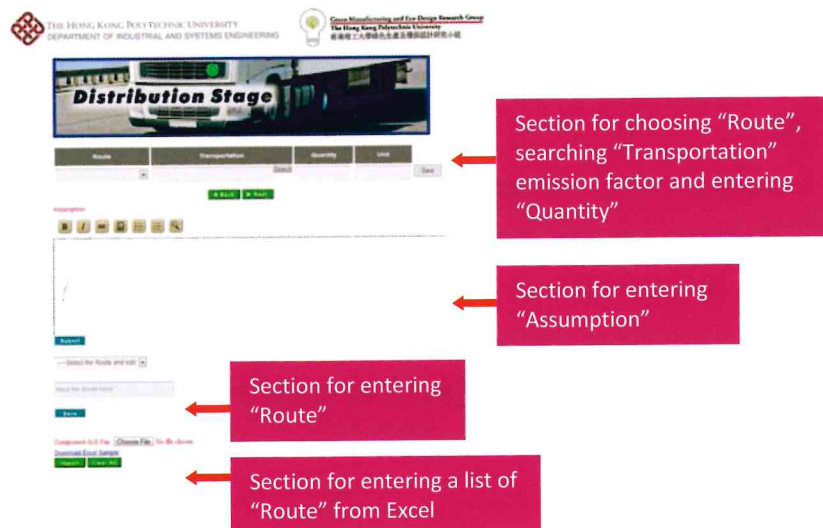
Remarks:

1. Electricity consumption per m² of PCB production should be included in this stage.

2. All consumables, packaging of consumables and transportation of consumables per m² of production should be included in this stage.
3. All waste management per m² of production including liquid/solid waste from manufacturing processes, sludge from wastewater treatment, discharged water effluent and hazardous liquid should be included in this stage.
4. Assumptions should be stated clearly in the actual situation.
5. If the direct emission factors of the consumable and the packaging material of consumable cannot be found in the embedded GHG emissions database, please try to find out the emission factors of its corresponding raw material and manufacturing process from raw material to the component.

8.3 Distribution stage

The interface of “distribution stage” is shown below.



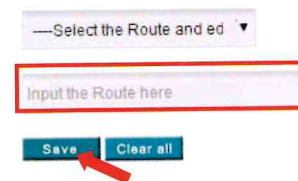
Please note that this stage is for reference only because a PCB is a component used in the end product which covers only the “Cradle to Gate” stages of the product life cycle. The overall product carbon footprint excludes the carbon footprint generated in the distribution stage.

8.3.1 Input the name of route

Similar to the previous “manufacturing stage”, there are two methods to input the name of the route.

Method 1

A user can enter each of the names of the route one by one and then click “Save”.



Method 2

Import an excel file (xls format) directly for a large number of routes. Click “Choose File” to import an excel file and click “Import”, as shown on the next page.



8.3.2 Use the GHG emissions database/ Enter carbon footprint emission factor

Click 'Search' to enter the GHG emissions database and select the transportation activities.



After clicking “Search”, the interface of GHG emissions database will appear as shown below.

GHG emission database

Keyword search: Search [Clear Search](#)

Point the cursor on stages to select data, or check stage boxes and click search for specific data.

Material stage
Manufacturing stage
Transportation stage
Use stage
End of life stage

Method 2 (keyword search)

Method 1 & 2 (use embedded GHG emissions database)

Method 3 (self-define)

Self Define
Enter the emission factor (or better quality data is available)

Name:

Unit:

Carbon footprint emission factor (kg CO₂-e):

[Submit](#)

Similar to the “manufacturing stage”, there are 3 methods to select the emission factor of route.

Method 1

Select the emission factor of the transportation activity according to its stage and category.

Material stage
Manufacturing stage
Transportation stage: Air
Use stage: General
End of life stage: Marine

Self Define

Road	Freight	[RER] Ecoinvent 2.2
Train	Passenger	Transport, lorry 16-32t, EURO4
Transportation tools		[RER] Ecoinvent 2.2
		Transport, lorry 16-32t, EURO5

Method 2

(1) Enter a keyword in the search engine and (2) click “Search”. All related items will be shown when you click into different stages. (3) Click the transportation activity you choose.

GHG emission database

Keyword search: lorry 16-32t Search [Clear Search](#)

Point the cursor on stages to select data, or check stage boxes and click search for specific data.

Material stage
Manufacturing stage
Transportation stage: Air
Use stage: General
End of life stage: Marine

Self Define

Road	Freight	[RER] Ecoinvent 2.2
Train	Passenger	Transport, lorry 16-32t, EURO4
Transportation tools		[RER] Ecoinvent 2.2
		Transport, lorry 16-32t, EURO5

Method 3

Enter the emission factor for a transportation activity that is not included in the GHG database.

Enter its name, unit and carbon footprint emission factor as below if you can find its emission factor from other databases.

Self Define
Enter the emission factor (or better quality data is available)

Name:

Unit:

Carbon footprint emission factor (kg CO₂-e):

[Submit](#)

8.3.3 Enter the quantity used in the transportation activity

Enter the quantity used in the transportation activity per m² of PCB, just like below, and then click “Save”.

Route	Transportation	Quantity	Unit
		<input type="text"/>	

[Back](#) [Next](#) [Save](#)

Please note that the formula of tkm calculation is as follows:

Distance of transportation activity (km) x Weight of finished product (kg) / 1,000 = _____tkm

For example, distance of route 1 = 100 km

Weight of PCB per m² = 4.52 kg

Then the quantity used in the transportation activity of route 1 = 100 (km) x 4.52 (kg) / 1,000 = 0.452 tkm

8.3.4 Proceed to the “use stage”

A user can click “Next” to proceed to the “use stage” after finishing the data entry in distribution stage.



Route	Transportation	Quantity	Unit	
Factory to Huanggang	Transport, van <3.5t (RECR)	0.19	tkm	Save Delete
Huanggang to HK International	Transport, van <3.5t (RECR)	0.18	tkm	Save



Remarks:

1. Distances of routes can be obtained from Google Map.
2. Assumptions should be stated clearly in the actual situation.

8.4 Use stage

Please note that the “use stage” should not be included in the PCB case because PCB covers only the “Cradle to Gate” stages of the product life cycle as a PCB is a component used in the end product. Therefore, simply leave this stage blank and click “Next” to proceed to the next stage, as below.



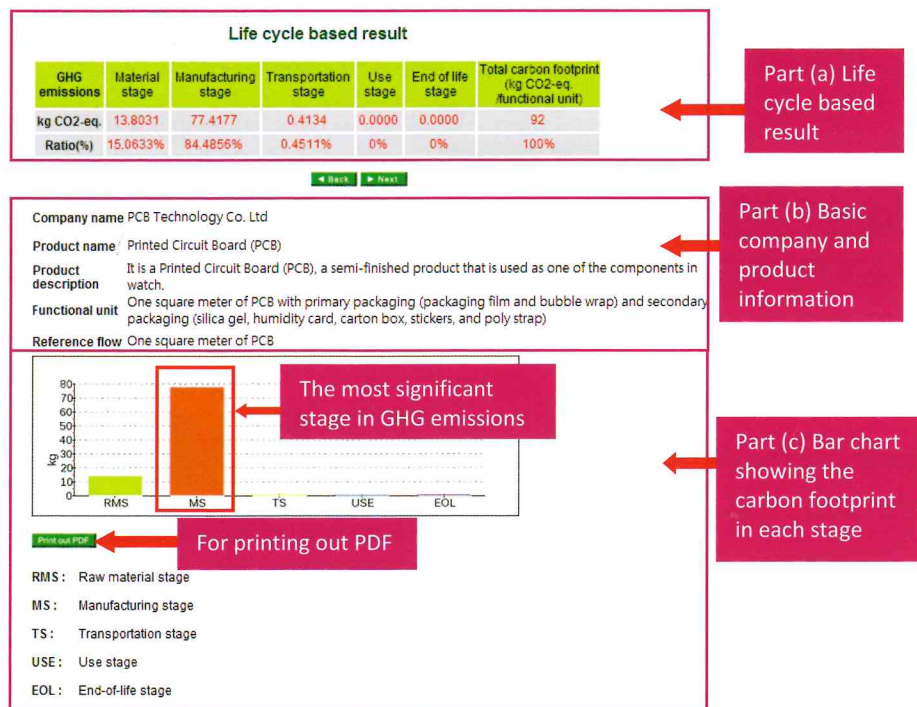
8.5 End-of-life stage

Please note that the “end-of-life” stage should not be included in PCB because PCB covers only the “Cradle to Gate” stages of the product life cycle as PCB is a component used in the end product. Therefore, simply leave this stage blank and click “Next” to proceed to the next page.



8.6 Life cycle based result

After clicking “next” on the previous page, a “Life cycle based result” page will appear. An example is shown below.



In part (a), the GHG emissions and their corresponding ratios in each stage will be shown. The total carbon footprint of this product will also be shown. As PCB covers only the “Cradle to Gate” stages of the product life cycle, the “use” stage and the “end-of-life” stage are not calculated for the total carbon footprint. The carbon footprint in the “transportation” stage is also for reference only.

In part (b), the basic information including company name, product name, product description, functional unit and reference flow that were entered at the beginning, will be shown.

In part (c), a bar chart showing the carbon footprint in each stage will be shown. The bar chart can show which stage is the most significant life cycle stage in GHG emissions. In this case, the “manufacturing stage” has contributed the highest amount of GHG emissions in the whole life cycle. As a result, G-BOM analyzer users can recognize the most significant life cycle stage in GHG emissions of their product and focus on adopting suitable improvements in reducing their product carbon footprint.

In this stage of the life cycle based result, a user can print out the results of this stage in PDF format by clicking “Print out PDF”. The assumptions in each stage of the G-BOM analyzer will also be printed in the resulting page.

8.7 Components and activities based result

After clicking “next” on the previous page, a “Components and activities based result” page will appear. An example is shown below.

Components and activities based result

GHG emissions	Material stage	Manufacturing stage	Transportation stage	Use stage	End of life stage	Ratio
Laminate - epoxy resin	9.1703	0	0	0	0	10.01%
Laminate - woven glass	3.1979	0	0	0	0	3.48%
Laminate - copper foil	1.4353	0	0	0	0	1.67%
Electricity consumption	0	77.3441	0	0	0	84.41%
Sodium carbonate	0	0.0573	0	0	0	0.06%
Sulphuric acid	0	0.0189	0	0	0	0.02%
Material cutter - steel alloy	0	0.0004	0	0	0	0%
PCB factory to Huanggang Port	0	0	0.2089	0	0	0.23%
Huanggang Port to HK International Airport	0	0	0.2045	0	0	0.22%

Company name: PCB Technology Co., Ltd.
 Product name: Printed Circuit Board (PCB)
 Product description: It is a Printed Circuit Board (PCB), a semi-finished product that is used as one of the components in watch.
 Functional unit: One square meter of PCB with primary packaging (packaging film and bubble wrap) and secondary packaging (silica gel, humidity card, carton box, stickers, and poly strap)
 Reference flow: One square meter of PCB

[Print out PDF](#)

The most significant activity in GHG emissions

For printing out PDF

On this page, the GHG emission and ratio of carbon footprint for each component and each activity will be shown in the corresponding stage accordingly. This table can show which component/ activity in which stage is the most significant component in GHG emissions. For example, the electricity consumption in the “manufacturing stage” has contributed the highest amount of GHG emissions in the whole life cycle. As a result, G-BOM analyzer users can recognize the most significant component/ activity in GHG emissions of their product in each stage and focus on adopting suitable improvements in reducing their product carbon footprint.

A user can print out the result of this stage in PDF format by clicking “Print out PDF”. The assumptions in each stage of the G-BOM analyzer will also be printed on the resulting page.

9. Conclusion

This “application guideline for embedded GHG emissions database and G-BOM analyzer”, through detailed procedures of how to use G-BOM analyzer and embedded GHG emissions database, is applied in two showcases of “downstream” end-products (electronic scale and induction cooker) and two “upstream” components corresponding to the previous two end products. SMEs in the electrical and electronics industries in Hong Kong can have the following three benefits by using this G-BOM analyzer with the embedded GHG emissions database:

- (1) To estimate their product carbon footprints in a simple and cost effective way;
- (2) To identify key items and key stages for effective GHG reduction;
- (3) To adopt low carbon supply chain management during the design and development stage in order to increase the competitiveness of their products.