Appendix to the Guidelines for LCA: Electronic Component

LCI Data Calculation Manual

It is recommended in the guidelines that data allocation be used as the technique for collecting data for use in life cycle inventory analysis (LCI analysis), which is the second phase of an LCA.

Conduct data allocation in accordance with ISO 14044, 4.3.4 using a parameter that is interrelated to the environmental impacts of the product, such as the product volume, weight, price, and the like, to arrive at data for one unit of product.

A basic concept and an example of working procedure follow.

1. Concept

1-1. Concept of data allocation and calculation methods

The table below shows the concept of data allocation and sample calculation methods for unit product data.

Note that the calculation methods are not limited to those listed in the table.

Table - Concept of data allocation and sample calculation methods

No.	Name	Description	Concept
Calculation method 1	Proportion by product volume	Calculate using ratio by volume of product.	LCI data is proportional to volume.
Calculation method 2	Proportion by product weight	Calculate using ratio by weight of product.	LCI data is proportional to weight.
Calculation method 3	Proportion by sales	Calculate using ratio of monetary amounts of sales.	LCI data is proportional to the monetary amount of sales.
Calculation method 4	Proportion by cost	Calculate using ratio of costs.	LCI data is proportional to cost.
Calculation method 5	Proportion by raw material cost	Calculate using ratio of raw material costs.	LCI data is proportional to cost of raw materials.
Calculation method 6	Proportion by process area	Calculate using ratio of process floor areas.	LCI data is proportional to the area of the manufacturing process
Calculation method 7	Proportion by energy	Calculate other items using proportion by energy.	LCI data on water, ancillary materials, wastewater, and wastes are reset to be in the same proportion as that of energy.

1-2 Allocation, aggregation, and calculation of ratios

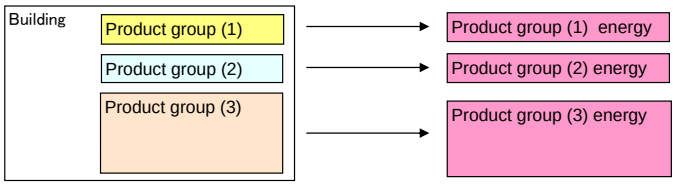
In allocating data, it may be required first to allocate plant data by the product group or to aggregate individual-product data into product-group data, as an intermediate step.

In calculating LCI data, use the ratios of a desired parameter to convert plant data into data for one unit of product.

Given below is a sample of allocation to product groups, aggregation into a product group, and calculation by the proportion, which are required in the process of allocation.

(1) Allocating plant data by, for example, sales for each product group

Allocate plant data by, for example, sales for each product group



(For example)

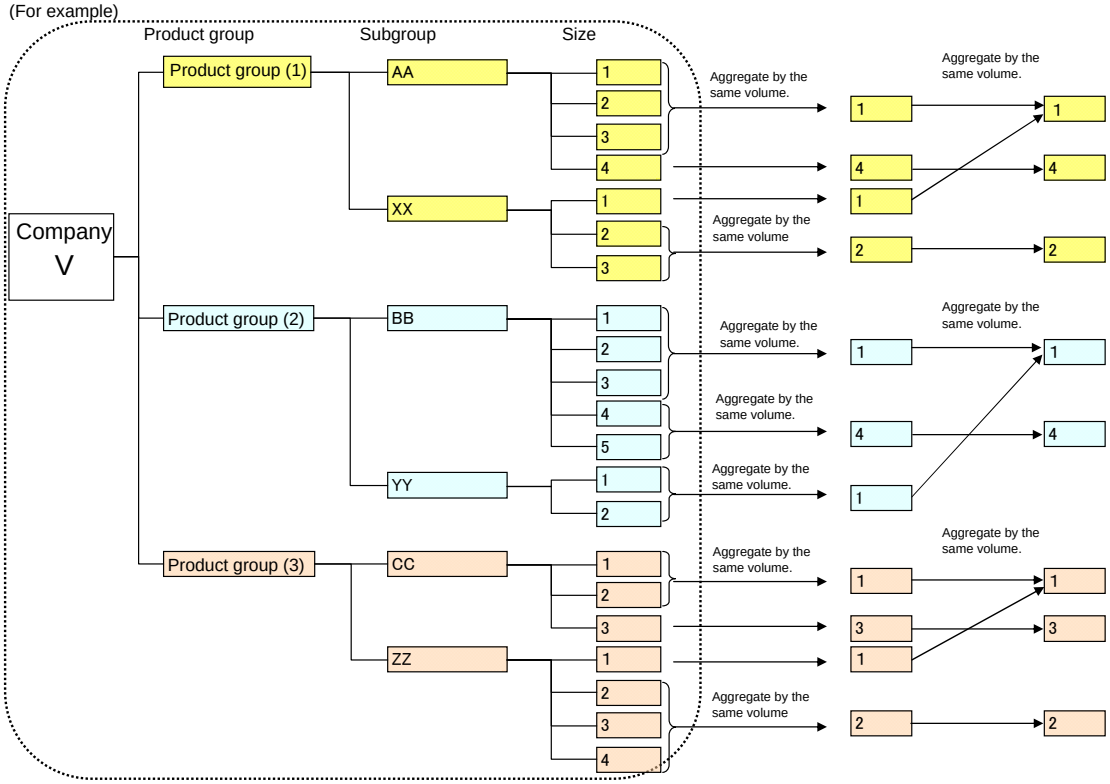
$$\text{Product group (1) energy} = \frac{\text{Product group (1) sales}}{\text{Plant sales}} \times \text{Energy used by entire plant}$$

(2) Aggregating data by the product

To conduct LCI efficiently, select, out of volume, weight, price, etc. of product, a parameter that is interrelated to the environmental impact of product.

Using the selected element as the standard, aggregate data by the product group to facilitate calculation.

(For example)



(3) Calculating by the proportion

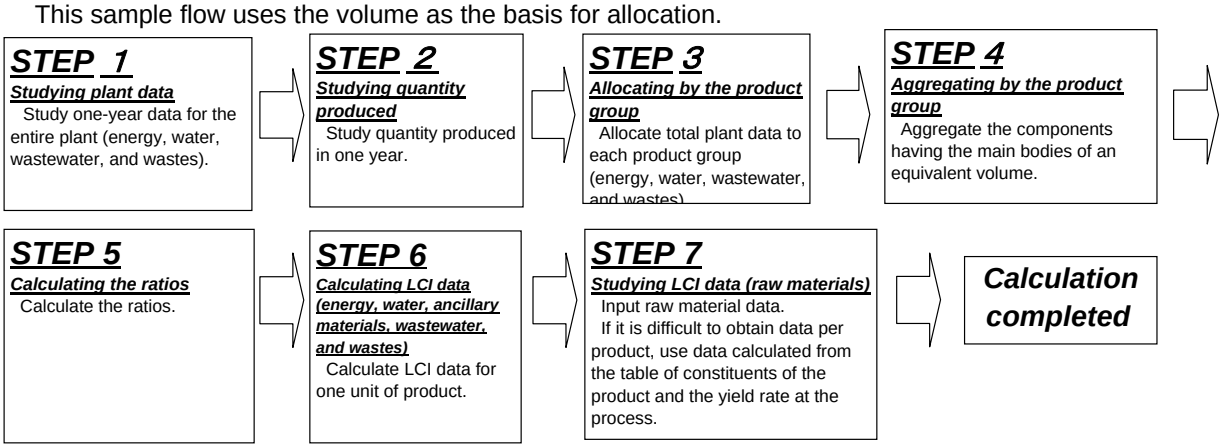
Obtain LCI data for one unit of product from the ratio of annually-produced quantity to the volume of product, etc

(For example)

$$\text{Energy for one unit} = \frac{\text{Volume of one unit of product}}{\text{Total volume of the quantity produced in one year.}} \times \text{Energy used by the product group}$$

2. About the flow of calculation

The diagram below shows a sample calculation flow for data for one unit of product under these guidelines
This sample flow uses the volume as the basis for allocation.



3. Calculation method in detail

A specific procedure based on the foregoing calculation flow is illustrated below
This sample flow uses the volume as the basis for allocation.

STEP 1. Studying plant data

Obtain the energy, water, ancillary materials, wastewater and wastes for the entire plant.

INPUT

Energy	Unit	
Electric power	kWh	20,000,000
Kerosene	L	200
Fuel oil	L	100,000
LPG	kg	50,000
LNG	kg	0
City gas	Nm^3	2,000
Water	m^3	50,000

Raw materials	Unit	
Ceramic raw materials	kg	
Ni	kg	
Cu	kg	
Sn	kg	
Solvents	kg	400,000
Binder resins	kg	8,000,000
Carrier film	kg	900,000

Plant Z

OUTPUT

Wastewater	Unit	Discharge
Wastewater	m^3	50,000

Wastes	Unit	Discharge
Industrial waste discharges	kg	100,000

STEP 2. Studying the quantity produced

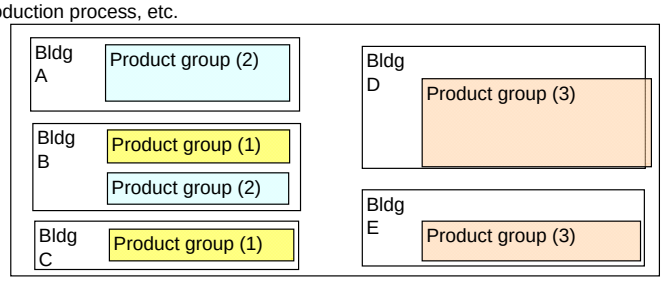
Study the quantity produced in a one year.

Product group	Subgroup	Item name	Quantity produced (1000, 000 pcs)
Product group (1)	AA	AA-1	10
Product group (1)	AA	AA-2	20
Product group (1)	AA	AA-3	30
Product group (1)	AA	AA-4	40
Product group (1)	XX	XX-1	20
Product group (1)	XX	XX-2	40
Product group (1)	XX	XX-3	60
Product group (2)	BB	BB-1	20
Product group (2)	BB	BB-2	30
Product group (2)	BB	BB-3	40
Product group (2)	BB	BB-4	100
Product group (2)	BB	BB-5	100
Product group (2)	YY	YY-1	200
Product group (2)	YY	YY-2	150
Product group (3)	CC	CC-1	330
Product group (3)	CC	CC-2	20
Product group (3)	CC	CC-3	220
Product group (3)	ZZ	ZZ-1	300
Product group (3)	ZZ	ZZ-2	200
Product group (3)	ZZ	ZZ-3	100
Product group (3)	ZZ	ZZ-4	100

STEP 3. Allocating by the product group

Study the product groups and the layout of production process to determine whether independent data for each produc group can be extracted or not.

If no independent data can be extracted, accomplish allocation by using sales amounts, costs, raw materials, area of the production process, etc.



(For example)
Calculation method for product groups group (1):
Calculate Bldg. B by allocation, and add to Bldg. C.

Calculation method for product group (2):
Calculate Bldg. B by allocation, and add to Bldg. A.

Calculation method for product group (3):
Add Bldg. D and Bldg. E.

		Unit	Product group (1)	Product group (2)	Product group (3)	Total
Energy	Electric power	kWh	10,000,000	6,000,000	4,000,000	20,000,000
	Kerosene	L	100	60	40	200
	Fuel oil	L	50,000	30,000	20,000	100,000
	LPG	kg	25,000	15,000	10,000	50,000
	LNG	kg	0	0	0	0
	City gas	Nm^3	1,000	600	400	2,000
Water	Water	m^3	25,000	15,000	10,000	50,000
Ancillary materials	Solvents	kg	200,000	120,000	80,000	400,000
	Binder resins	kg	4,000,000	2,400,000	1,600,000	8,000,000
	Carrier film	kg	450,000	270,000	180,000	900,000
Wastewater	Wastewater	m^3	25,000	15,000	10,000	50,000
Industrial wastes	Industrial waste discharge	kg	50,000	30,000	20,000	100,000

STEP 4. Aggregating by the product group

Aggregate those items into a product group, out of the items studied in Step 2, whose main component volumes are equivalent to one another.

Product group	Category	Item name	Quantity produced (1,000,000 pcs)	Reason for aggrega-tion
Product group (1)	AA	AA-1	10	–
Product group (1)	AA	AA-2	20	Same as AA-1
Product group (1)	AA	AA-3	30	Same as AA-1
Product group (1)	AA	AA-4	40	–
Product group (1)	XX	XX-1	20	Same as AA-1
Product group (1)	XX	XX-2	40	–
Product group (1)	XX	XX-3	60	Same as XX-2
Product group (2)	BB	BB-1	20	–
Product group (2)	BB	BB-2	30	Same as BB-1
Product group (2)	BB	BB-3	40	Same as BB-1
Product group (2)	BB	BB-4	100	–
Product group (2)	BB	BB-5	100	Same as BB-4
Product group (2)	YY	YY-1	200	
Product group (2)	YY	YY-2	150	
Product group (3)	CC	CC-1	330	–
Product group (3)	CC	CC-2	20	Same as CC-1
Product group (3)	CC	CC-3	220	
Product group (3)	ZZ	ZZ-1	300	
Product group (3)	ZZ	ZZ-2	200	
Product group (3)	ZZ	ZZ-3	100	
Product group (3)	ZZ	ZZ-4	100	

Product group	Aggrega-tion group name	Quantity produced (1,000,000 pcs)
Product group (1)	(1)-1	80
Product group (2)	(1)-2	40
Product group (3)	(1)-3	100
Product group (2)	(2)-1	440
Product group (2)	(2)-2	200
Product group (3)	(3)-1	650
Product group (3)	(3)-2	220
Product group (3)	(3)-3	400

Before aggregation: 21 items

After aggregation: 8 items

STEP 5. Calculating the proportions

Calculate the proportion of the product to the entire product group.

$$\text{AA-1 Proportion (one unit)} = \frac{\text{AA-1 Volume (one unit)}}{\text{(1)-1 Quantity produced} \times \text{Volume} + \text{(1)-2 Quantity produced} \times \text{Volume} + \text{(1)-3 Quantity produced} \times \text{Volume}}$$

Product group	Group	Quantity produced (1,000,000 pcs)	Volume (mm^3/piece)	Total volume (mm^3)	Proportion of one unit
Product group (1)	(1)-1	80	2.2	1.76E+08	3.79E-09
Product group (1)	(1)-2	40	2.6	1.04E+08	4.48E-09
Product group (1)	(1)-3	100	3.0	3.00E+08	5.17E-09
				5.80E+08	
Product group (2)	(2)-1	440	8	3.52E+09	1.16E-09
Product group (2)	(2)-2	200	17	3.40E+09	2.46E-09
				6.92E+09	
Product group (3)	(3)-1	650	12	7.80E+09	6.28E-10
Product group (3)	(3)-2	220	15	3.30E+09	7.85E-10
Product group (3)	(3)-3	400	20	8.00E+09	1.05E-09
				1.91E+10	

STEP6 . Calculating LCI data (Energy, water, ancillary materials, wastewater, wastes

Calculate LCI data (energy) for one unit of product.using data of a product group obtained in Step 3 and the proportion obtained in Step 6,
(For example)

Electric power consumption for one unit of AA-1:

= Electric power consumption for the product group × Proportion for AA-1 one unit
= 10,000,000 × 3.79E-09
= 3.79E-02

		Unit	
Energy	Electric powe	kWh	3.79E-02
	Kerosene	L	3.79E-07
	Fuel oil	L	1.90E-04
	LPG	kg	9.48E-05
	LNG	kg	0.00E+00
	City gas	Nm3	3.79E-06
Water	Water	m3	9.48E-05
Ancillary materia	Solvents	kg	7.59E-04
	Binder resins	kg	1.52E-02
	Carrier film	kg	1.71E-03
Wastewater	Wastewater	m3	9.48E-05
Industrial wastes	Industrial waste discharge	kg	1.90E-04

STEP 7. Studying LCI data (raw materials)

The raw materials are specific to each product group. Raw material data is not suitable for allocation out of the entire plant data. Acquire raw material data independently of all other items.

Use one of the following methods to enter the raw material consumption for one unit of product:

Method 1: Obtain a standard consumption rate for one unit of product from cost from cost accounting records,

Method 2: Use the method in Step 6 to allocate the raw materials consumed by the product group to obtain the consumption for one unit of product.

Method 3: If the consumption cannot be obtained in either of the foregoing methods, use the amounts of the constituent components as the amounts of raw materials consumed.

Raw material	Unit	
Ceramic raw material	kg	1.80E-04
Ni	kg	2.30E-03
Cu	kg	1.50E-04
Sn	kg	1.40E-04

Completing the final data

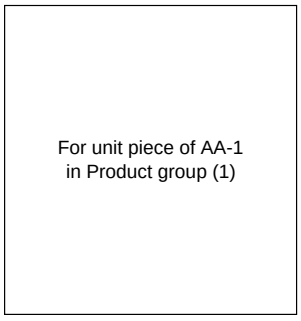
Combine data from Step 6 and Step 7 to complete the data.

(For Example) Completed final data for Product AA-1

INPUT

Energy	Unit	
Electric power	kWh	3.79E-02
Kerosene	L	3.79E-07
Fuel oil	L	1.90E-04
LPG	kg	9.48E-05
LNG	kg	0.00E+00
City gas	Nm3	3.79E-06
Water	m3	9.48E-05

Raw material	Unit	
Ceramic raw material	kg	1.80E-04
Ni	kg	2.30E-03
Cu	kg	1.50E-04
Sn	kg	1.40E-04
Solvents	kg	7.59E-04
Binder resins	kg	1.52E-02
Carrier film	kg	1.71E-03



OUTPUT

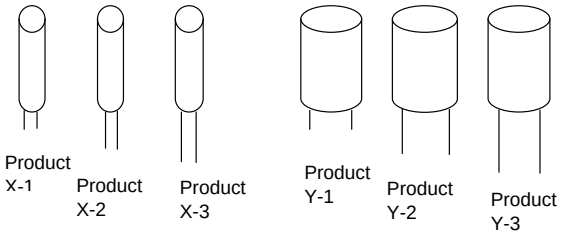
Wastewater	Unit	Discharge
Wastewater	m3	9.48E-05

Wastes	Unit	Discharge
Industrial waste discharge	kg	1.90E-04

(Reference Material 1) Calculation method proportion by volume when the components vary in shapes

(1) Lead wire

If the lead-wire length is the only item that varies, use only the main-body volume to calculate the proportion by volume.



Product X-1 Product X-2 Product X-3 Product Y-1 Product Y-2 Product Y-3

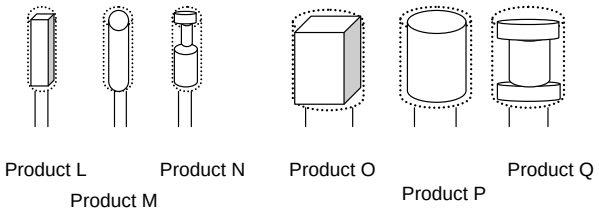
	Quantity produced (1,000,000 pcs/year)
Product X-1	10
Product X-2	40
Product X-3	100
Product Y-1	10
Product Y-2	30
Product Y-3	60

Aggregate

	Quantity produced (1,000,000 pcs/year)
Product X	150
Product Y	100

(2) Shape of main body

If the shape of main body varies, decide on, and use an apparent volume to calculate the proportion by volume.



Product L Product N Product O Product Q

Product M Product P

	Quantity produced (1,000,000 pcs/year)
Product L	20
Product M	50
Product N	60
Product O	10
Product P	30
Product Q	60

Aggregate

	Quantity produced (1,000,000 pcs/year)
Product X	130
Product Y	100

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