Product-Category Rules (PCR)

for Preparing an Environmental Product Declaration (EPD) for

Femto Cells

PCR 2011:1.0

SerComm Corporation

Version 1.0
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1. General Information

This document is to be used as the product category rules (PCR) for the global production and manufacturing of femto cells. The requirements specified in this PCR are intended to be used for EPDs certified in accordance with ISO 14025 standard. This document shall be valid until December 31, 2013.

This PCR was prepared by SerComm Corporation. Representatives from major Taiwanese manufacturers of similar products and stakeholders were invited by the Taiwan Electrical and Electronic Manufacturers Association (TEEMA) to the open consultation meeting on December 20 2011, to participate in the discussion and review of this PCR. Environment and Development Foundation (EDF) then reviewed and approved this PCR.

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2. Company and product description

The EPD shall include information about the manufacturing company/organization. The information may include manufacturing process related information, and environmental related information, such as the environmental management system information. The information may also include special issues which the company/organization would like to emphasize, such as the products meeting certain environmental criteria, or environmental safety and health related information.

This PCR is applicable to both business to consumer/customer (B2C) and business to business (B2B) communications. While conducting certification of product related environmental impacts, the inventory shall also include product accessories and packaging.

2.1 Product group function

The femtocell (or femto cell) is a small cellular base station installed in a fixed location (home or office setting) to perform its specific functions, including connecting 3G/4G (LTE or WiMAX) mobile phones and implementing functions such as data transfer or dispersion of bandwidth.

A femtocell may exist independently, or it can be connected to the Internet through its external (wired or wireless) local area network (LAN or WLAN) function and connected to a router or gateway, in order to transfer data. The router or gateway can also be integrated with the femtocell into a single device to achieve the above functions.

Thus this PCR defined the following types of femtocells:

1. **Femto cell (micro base station)**

Feature one or more 3G/4G function and connection function through wired or wireless local area network (LAN or WLAN).

2. **Femtocell with integrated router function**

Feature one or more 3G/4G functionality, connection function through wired or wireless local area network (LAN or WLAN), and router function.

3. Femtocell with integrated gateway function

Feature one or more 3G/4G functionality, connection function through wired or wireless local area network (LAN or WLAN), and gateway function (including various WAN interfaces, e.g., ADSL, ADSL2, ADSL2+, VDSL, Cable, Fiber, etc.).

2.2 Product components

The femto cell's main components include the following:

1. Main board;
2. Electronic components: e.g., CPU, memory, control chips;
3. Communication components: e.g., communication chip, built-in antenna module;
4. Mechanical components;
5. Input/output device interface;
6. External case;
7. Packaging; and
8. External power supply.

The femto cell may also include the following components:

1. External wireless antenna;
2. Connector cables; and
3. Other components: e.g., CD, user manual.

The data quality requirements for the main components are described in Section 9 on calculation rules and data quality requirements. The EPD shall also include the other components of the product, but their data quality requirements are different from those of the main components.

2.3 Product technical description

The product technical description part of the EPD may include but not limited to the following information:

1. Product name & model number;
2. Total weight and dimension;
3. Connecting devices;
4. CPU or major chips;
5. Memory capacity;
6. Power consumption;
7. 3G/4G network interface;
8. WAN interface;
9. LAN or WLAN interface;
10. Count of interfaces and speed; and
11. Product service lifetime.

3. List of materials and chemical substances

The contents of the following materials and substances in the product shall be declared:

- All materials of the product with weight ratio (material weight/product weight) ≥ 1%;
- All materials/substances in the product (including packaging) regulated by legal, customer and environmental requirements;
- The following materials in the product components: flame retardants, lead content in solder, lead and flame retardant content in solder masking agent, and substances regulated by EU's RoHS Directive (the latest version).

The declaration of halogen-free flame retardants, lead-free solders and no RoHS-regulated substances may only be made when appropriate evidences are available (for example, test reports from accredited laboratories/testing facilities). The following organizations may provide accreditation for testing facilities: Taiwan Accreditation Foundation (TAF), (Asia Pacific Laboratory Accreditation Cooperation (APLAC), International Laboratory Accreditation Cooperation (ILAC) or ILAC Mutual Recognition Arrangement (ILAC MRA). For definitions of testing methodology and confirmations of regulated hazardous substances based on the accredited laboratories' product testing methods, please refer to IEC 62321 Standard.

4. Declared unit

The declared unit is one unit of femto cell. This unit is chosen because the femto cell products are marketed and sold in such a unit. The power rating of the product shall also be declared.

5. System boundaries

The main system boundaries for the declared product system are presented as follows:

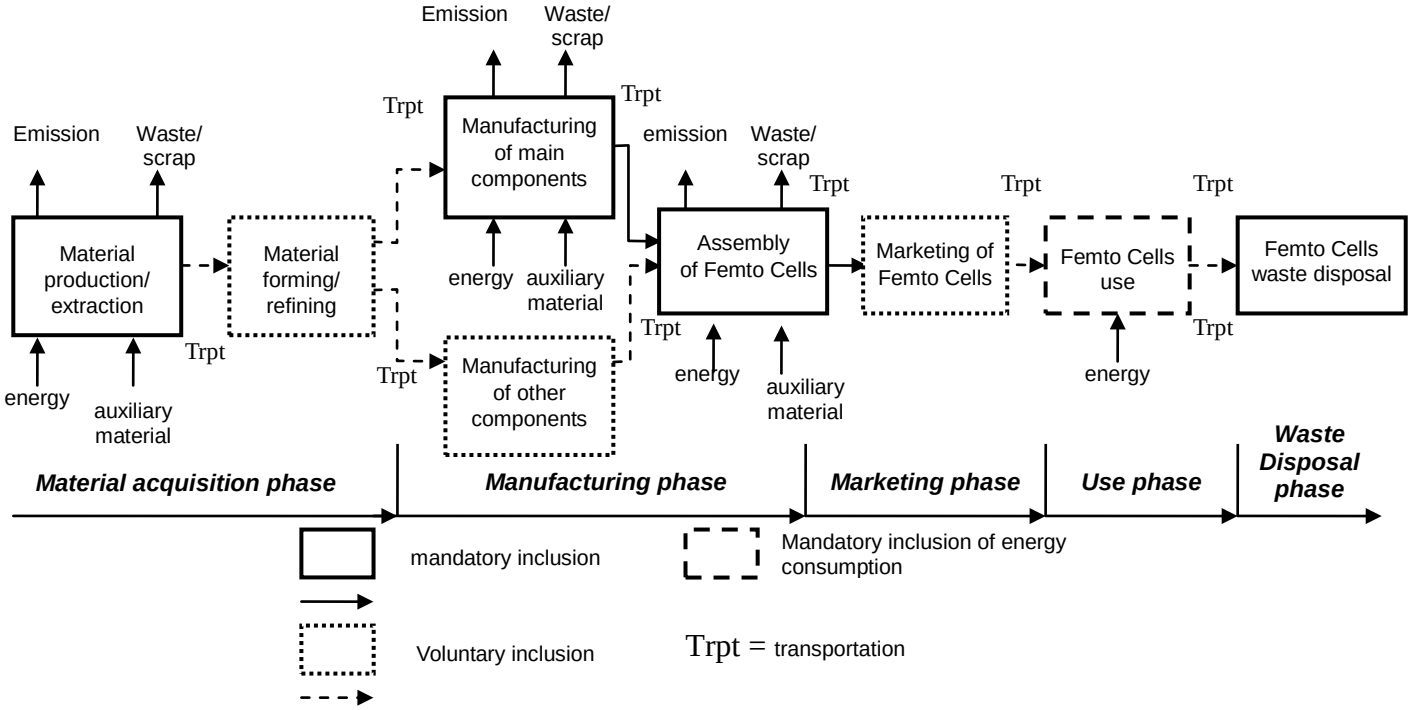

Figure 1 System boundary of the product system

As noted in Figure 1 above, the life cycle of a femto cell covers five life cycle stages: raw material acquisition, product manufacturing, distribution, product use and waste disposal. The data quality requirements for the main components and other components are described in Section 9 on calculation rules and data quality requirements.

Raw Materials Acquisition Stage

The LCA shall include information for the following unit processes:

— Material extraction and manufacturing of main components and other components;

— Production/generation of energy used for raw material manufacturing.

The inclusion in the LCA the information on the forming and refining of raw materials and transportation of raw materials is optional (voluntary).

Manufacturing Stage

The LCA shall include information for the following unit processes:

— Manufacturing of main components and generation of associated process waste;

— Assembly of products and generation of associated process waste;

— Transportation of main components to product assembly plant.

The inclusion in the LCA the information on the input/output of packaging material during main components manufacturing process and the manufacturing of minor/secondary components/parts is optional (voluntary).

Distribution and Marketing Stage

The LCA shall include information for the following unit processes:

- Transportation of products to the distribution sites or customer designated locations;
- Inventory and reporting of energy/resource input and waste generation during the marketing process is optional (voluntary);
- Inventory and reporting of transportation from sales/distribution sites to users is optional (voluntary).

Use Stage

Product manufacturer shall provide the energy consumption information for this stage based on the highest (most energy consuming) product technical configuration/specifications, and conduct environmental impact assessment based on this information; while brand-name manufacturer shall conduct environmental impact assessment based on the product's technical specifications as shipped. The definitions of energy consumption, test standard and product usage scenario are described as follows.

Product shall declare its power consumption during each of its power consumption mode. A femto cell's power consumption modes can be defined as idle mode, connection working mode and basic working mode. Each mode is defined as follows:

Idle Mode: The power state in which the product's operating system and other software have completed loading, a user profile has been created, and activity is limited to those basic applications. It is assumed that the product is in idle mode 10 hours a day, each year the total time in idle mode is 3,650 hours.

Connect Working Mode: The power state in which the product is connected to the 3G/4G mobile phones or devices, and the power consumption of the product varies with the distance between the product and the mobile phones/devices. The farther the mobile phone/device is away from the femto cell, the greater the power output (thus power consumption) of the femto cell and vice versa. Therefore, the power consumption of the femto cell during this mode can be divided into high, middle and low power output.

Assume each day, the femto cell is connected to the 3G/4G mobile devices 6 hours for data transmission everyday, with two hours each at the high, medium and low output power state respectively. Thus, every year the product will be under each of the three power output states for 730 hours.

Basic Working Mode: The power state in which the product is not connected to the 3G/4G mobile phones or devices. Instead, the product is communicated with the Internet through the wired or wireless local area network (LAN or WLAN). It is assumed that the product is under the basic working mode for 8 hours a day and 2,920 hours a year.

If there are other energy consumption assumptions or usage scenarios, they should be described with reference to applicable international, national or industrial standards.

The estimated annual time (hours) the product spent in each power consumption mode is listed as follows:

Usage Mode		Normal Time (hours)	Ratio (%)
Idle mode		3,650	41.67
Connect working mode	High output power	730	8.33
	Medium output power	730	8.33
	Low output power	730	8.33
Basic working mode		2,920	33.33

The power consumption for each state can be denoted as follows:

- PI: Power consumption during idle mode power consumption
- PCH: Power consumption during connect working mode with high output power
- PCM: Power consumption during connect working mode with medium output power
- PCL: Power consumption during connect working mode with low output power
- PB: Power consumption during basic working mode

The product's total power consumption (MJ) during the use stage can be calculated using the follow equation:

$$E_{TEC} = [((8760/1000) \times (PI \times 0.4167 + PCH \times 0.0833 + PCM \times 0.0833 + PCL \times 0.0833 + PB \times 0.3333)) / 3.6] \times \text{service life}$$

A service lifetime of three years is assumed for the product. The reporting of maintenance during the use stage and the transportation of end-of-life product to waste disposal facility is optional (voluntary).

(Note: Assume a product lifespan of three years).

Recycling/end-of-life Stage

Reporting of recycling information (such as recycling and dis-assembly report or information on recycling channels) is mandatory in the EPD.

5.1 Specification of different boundary settings

Boundary in time

The validity period for the LCA results presented in the LCA report shall be defined.

Boundary towards nature

If the manufacturing processes are located within Taiwan, the solid waste categories as defined in Taiwan's Waste Disposal Act shall be adopted. If the processes are located in other countries,

equivalent legal requirements shall be considered.

The natural boundary of the system shall describe the boundary where the materials and energy resources flow from nature into the system, and where the water and air emissions and waste are released out of the system.

Only the waste which is required to be disposed of needs to be considered; land filling process does not need to be included. If the waste is generated through wastewater treatment or incineration process, such waste should be included into the wastewater treatment or incineration process.

Boundaries in the life cycle
The boundaries in the product life cycle are described in Figure 1. The construction of the site and infrastructure, as well as the production of manufacturing equipment and activities of the workers, does not need to be included.

Boundaries towards other technical systems

Boundaries towards other technical systems describe the inputs of material and other components towards other systems, as well as outputs of materials towards other systems. For the inputs of recycled materials and energy towards the product manufacturing stage, the transportation between the recycling process and use of recycled materials shall be included in the data set. For the production of recyclable products during the manufacturing stage, the transportation towards the recycling process shall be included.

(Note: Further explanations are provided in Section 7 on open-loop recycling)

Boundaries regarding geographical coverage

The manufacturing stage may cover manufacturing processes located on any sites around the world. For processes located in a specific region, the data used should be representative of the region. The data for the main components shall be the specific regional data for the region where the process takes place (see Section 9). For ease of comparison, no matter where the emissions are generated, the same environmental impact parameters should be used for life cycle impact assessment (see Section 10).

6. Cut-off rules

For any impact category, if the sum of various impacts from a specific process/activity is less than 1% of the impact equivalent in that category, such a process/activity may be neglected during the inventory analysis. Nonetheless, the accumulated impact of neglected process/activity may not exceed 5%. Components and materials omitted from the LCA shall be documented.

(Note: This judgment for this “1% Rule” is based on the environment relevance assessment of material input to the system, and does not consider special and exceptional environmental impacts.)

7. Allocation rules

The main allocation rules shall be valid for the entire product system. For other secondary processes, other allocation rules may be defined; however, the use of these rules should be justified.

Product-specific information should be preferentially collected in order to avoid the need for allocation. While selecting allocation rules, the following principles are recommended.

- Multi-output: The allocations are based on the changes in the resource consumption and pollutant emissions (for example, adopted quantity allocation for some main component, or surface allocation for some components), following the changes in the studied system's output product or function or economical relationship.
- Multi-input: The allocation is based on actual relationship. For example, the manufacturing process's emissions may be affected by the change in waste flow input.
- Open loop recycling: For the input of recycled materials or energy during the manufacturing stage of the product system, the transportation between the recycling process and the recycling to material use shall be included in the dataset. For the product which shall be recycled during the manufacturing stage, the transportation towards the recycling process shall be included.

Notes:

- *Allocation may be avoided through avoidance of dividing processes, for example as described in Section 6.3 of ISO/TR 14049; or through expansion of system boundary (for example as described in Section 6.4), so that the amended system shares the same product exchanges as the original system.*

8. Units

The base units and derived units of the International System of Units (SI, Système International d'unités) shall be used preferentially.

Power & energy units:
- power unit: W
- energy unit: J

Specification units:
- length unit: m
- capacity unit: m^3
- area unit: m^2
- weight unit: kg

If necessary, prefixes may be used before the SI units.
10^9 = giga, symbol "G"
10^6 = mega, symbol "M"
10^3 = kilo, symbol "k"
10^{-2} = centi, symbol "c"
10^{-3} = milli, symbol "m"
10^{-6} = micro, symbol "μ"
10^{-9} = nano, symbol "n"

9. Calculation rules and data quality requirements

Date quality requirements for the raw material acquisition stage

- Generic data may be used for the acquisition, production, forming and refining of raw materials used for the components of the femto cell products. Please refer to Appendix I for the common sources of generic data.

Date quality requirements for the manufacturing stage

- Site specific data (for example, specific data for manufacturing plant or transportation) shall be used for the manufacturing of major components and assembly of the femto cell products. If other types of information are used, description of the information and rationale for using the information shall be provided. For site specific data of main component manufacturing plants, specific data from a plant representative of such a site may be used.
- Generic data may be used for the manufacturing of other components for the femto cell products, and based the calculation on actual consumption. Please refer to Appendix I for the common sources of generic data.
- When generic data are used, the equivalence between the chemical and/or physical process of referred systems shall be considered. Moreover, it is also recommended to consider the date or geographic aspects of the data quality when feasible.
- Generic data may also be used when suppliers refuse to provide specific data, or when even if generic data are used in place of specific data, there is only minor impact to the results. The general rule is that if generic data are used in place of specific data, their combined contribution for all life cycle stages shall not be greater than 20% of total impacts for each impact category. But there may be certain exception to specific products, and such exceptions shall be explained.
- The data shall be representative for the average of a specific year. If the average data for a specific time period of less than one year is used, the reason for using such data shall be provided.
- The electricity mix for the manufacturing stage should be site specific data. If site specific data cannot be obtained, the official electricity mix for the country where the site is located may be used as approximate value. The electricity mix should be documented.
- For the definition of hazardous waste, the definition as defined in Taiwan's Waste Disposal Act shall be used for sites located in Taiwan. For sites located outside Taiwan, legal requirements for the host country shall be observed.
- For the transportation of main components to the manufacturing plant, the actual transportation modes used and distance traveled shall be considered.

Date quality requirements for the distribution and marketing stage

- For the transportation of products to the distribution sites or retailer sites, the actual mode of transportation and distance traveled shall be considered.

Date quality requirements for the use stage

- The energy consumption of the product shall be determined based on testing methodology stipulated in applicable international, national or industrial standards of the countries/regions the product is marketed.
- For the electricity mix for the use stage, the official electricity mix for the country where the product is exported may be used as approximate value. Please refer to Appendix I for the common sources of generic data.

Date quality requirements for the recycling/end-of-life stage

- For transportation of end-of-life femto cells as post-consumer waste for delivery to processors or recyclers, the data from national or industry sources or consumer behavior surveys can be used. When such data cannot be obtained, evaluation based on assumed scenario can be made, and the assumptions for such a scenario shall be reported in the EPD.

- Generic data may be used during the recycling/end-of-life stage, if for specific reason the site specific data for the recycling/waste disposal system can not be obtained. Then generic data and recycling rate may be used to calculate environmental impact. Please refer to Appendix I for the common sources of generic data.

10. Parameters to be declared in the EPD

The following parameters shall be declared in the EPD:

Energy use

- The energy consumption during each product life cycle stage shall be declared. If the product is intended for end-users, the power consumption during the use stage shall also be declared.
- The following units shall be used preferentially:

  kW or W for power; J or MJ for energy.

Resource use

The information on resource input during the product life cycle stages shall be declared.

Impact equivalents expressed as potential environmental impacts

-Global warming	kg CO_2 equivalent
-Acidification	kg SO_2 equivalent
-Photochemical oxidant formation	kg C_2H_4 equivalent
-Eutrophication	kg PO_4^{3-} equivalent
-Ozone depletion	kg CFC-11 equivalent

Note: For characterization factors of each impact category, please refer to *EPD Supporting Annexes*, Version 1.0 (2008-02-29), The International EPD Cooperation, downloadable from www.environdec.com.

Additional information

- Recyclable materials (optional)
- Information on secondary materials (optional)
- Waste (classification):
  - Hazardous waste as defined in Taiwan's Waste Disposal Act. Follow host countries' laws for sites outside Taiwan.
  - Other waste.

- Plastic parts marking: Where technologically possible, plastic parts of the femto cell weighing $\geqq$ 25 g shall be marked in accordance with the ISO 11469 and ISO 1043 Part 1/2/3/4, SPI or other

international standard label to facilitate their identification and recovery at the end of life.

- Plastic packaging materials marking: The Plastic packaging materials shall be labeled on the parts with SPI or other international standards for ease of sorting.

11. Recycling information

The recycling information shall include information such as dis-assembly instructions, which parts/components are suitable for recycling (such as metal cases) or not suitable for recycling. The information which the EU WEEE Directive requires the end product manufacturer to provide may also be included in the product declaration information for femto cell products.

If practical, information for the parts which can not be recycled and therefore should be disposed of properly during the end-of-life stage may also be included.

12. Other environmental information (Optional)

The EPD may cover information including technology adopted, site of product manufacturing and assembly, as well as information on other working environment, health and risk-related aspects.

If this PCR is to be used for product carbon footprint declaration purpose, in the declaration, information regarding commitment on GHG reduction should be included and shall ensure that the commitment is measurable, reportable and verifiable. The organization may also list environmental and energy management related information, such as awards, commendations and system certifications (e.g., ISO 14001, ISO 14064-1, IECQ HSPM) etc.

13. Information about the certification

The information on PCR review, EPD verification and verification organization shall be included.

EPD Certification is valid until 20XX-__-__ According to the Requirements for the international EPD system. General Programme Instructions, Version 1 (2008) – www.environdec.com The PCR review for _____ (PCR 201X:) was administered by the Environment and Development Foundation and carried out by an LCA expert panel chaired by Dr. Ning Yu (ningyu@edf.org.tw). Independent verification of the declaration, according to ISO 14025:2006 □ Internal ■ External
Third party verifier: Environment and Development Foundation in Taiwan. Accredited by : Name: Title: Organization: Signature:_____ Name: Title: Organization: Signature:_____ Name: Title: Organization: Signature:_____
Environmental declarations from different programmes may not be comparable.

14. References

Energy Star Computer Specification -Version 5.2

The EPD shall make reference to the following documents:

- EPD General Program Instructions, Version 1.0 (2008-02-29), The International EPD Cooperation, downloadable from http://www.environdec.com/;
- Relevant PCR documents;
- The underlying LCA report.

When available, the following documents shall also be referenced:

- Other documents and recycling instructions which verify and complement the EPD.

Appendix I – Generic Data Sources to Refer to

For processes located within Taiwan, Taiwan generic data or the data published by the commercial, industrial and energy competent authorities of the Republic of China (ROC) government, may be used. However, for other regions (such as EU), if there are more relevant generic data available, these data should be used instead. The following generic databases are recommended for use.

Material	Database
Packing materials, transport, Waste treatments	BUWAL 250
Steel, Primary copper, Copper products, Electricity, Fuels, Aluminum, Chemicals, Transports, Waste management	ELCD version
	EIME (Environmental Information and Management Explorer) EcoBilan
Plastics	PE Plastics Europe (Association of Plastics Manufacturers in Europe)
	ELCD
	EIME (Environmental Information and Management Explorer) EcoBilan
Electronic components	ELCD
	EIME (Environmental Information and Management Explorer) EcoBilan
General Database	Ecoinvent
	The Boustead Model
	PE-GaBi
	DoITPro(Taiwan)

Appendix II – Reporting Format for the EPD

This appendix provides guidance information for the titles of sections, types of data and required information to be reported in the mandatory reporting part of the EPD. As a generic reporting template, the following titles and sub-titles are recommended:

(Refer to the PCR manual for the section numbering, the information in Italics are the recommended data/information for inclusion)

Introductory part

Each EPD should have an introduction part on the top part of the EPD which includes the following information:

- *Company/organization name*
- *Product name*
- *EPD registration number*

Description of the company/organization and product/service

Company/Organization

- *Description of company/organization*
- *Description of overall working environment, existing quality system and environmental management system*

Product and services (see Section 2)

- *Product's main applications*
- *Description of product specification, manufacturing process, manufacturing sites (if there are several sites)*
- *For product's environmental performance aspects, characteristics which may improve the usefulness of product*
- *Other types of relevant information, for example, special manufacturing processes with special advantages to the environment*

List of materials and chemical substances

- *Content declaration (see Section 3)*

Presentation of the environmental performance

- *Outline of the LCA methodology, for example, period of LCA, declared units, system boundaries (graphical presentation), cut-off and allocation rules, and data sources.*

Manufacturing stage *(see Section 10)*

Use stage *(see Section 10)*

-*Geographical region for product delivery*
-*Transportation data*
-*End-of-life information*

Information about Company and Certification Organization

Recycling information *(see Section 11)*

Other environmental information *(see Section 12)*

Information regarding certification

- *Names of certification and verification organizations*

- *Validity of certification certificates*
- *Compliance with legal and relevant requirements*

References *(see Section 14)*

- *relevant PCR documents*
- *EPD General Program Instructions, Version 1.0 (2008-02-29)*
- *underlying LCA study*
- *other supporting documents for LCA information*
- *other relevant documents regarding company/organization's environmental activities*

Appendix III Abbreviations

Acronym	Common Name
ACPI	Advanced Configuration & Power Interface
APLAC	Asia Laboratory Accreditation Cooperation
CFP	Carbon Footprint of Product
EPD	Environmental Product Declaration
ErP	Energy Related Product
ILAC	International Laboratory Accreditation Cooperation
ILAC MAR	International Laboratory Accreditation Cooperation Mutual Recognition Arrangement
ISO	International Organization for Standardization
LCA	Life Cycle Assessment
PCR	Product Category Rule
RoHS	The Restriction of the use of certain Hazardous Substances in electrical and electronic equipment
SPI	Society of the Plastics Industry
TAF	Taiwan Accreditation Foundation
TEC	Typical Energy Consumption
Trpt	Transportation
WEEE	The Waste Electrical and Electronic Equipment Directive