

16 June 2006

**Product Category Rules (PCR)  
for  
Uncompounded Polymer Resins,  
or Reactive Polymer Precursors**

Prepared for:

**Plastics*Europe***

Prepared by:

**Five Winds International**



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# 1 GENERAL INFORMATION

## 1.1 Purpose of the PCR Document

This document establishes the rules for developing the data and indicators underlying a Type III Environmental Declaration (ED) for the product category of “Uncompounded polymer resins, including reactive polymer precursors”. These rules are compiled for the Type III environmental declarations programme of *PlasticsEurope*. They follow the requirements of ISO DIS 14025, "Environmental labelling and declarations – Type III environmental declarations – Principles and procedures" and the provisions in ISO 14040 series of standards, "Environmental management — Life Cycle Assessment". The PCR builds on the Eco-Profile methodology of *PlasticsEurope*.

The document includes the rules for developing the Life Cycle Assessment (LCA) derived data as well as for communicating additional data relevant to the environmental performance of products within the range of this product category. The document also specifies the LC-indicators and other indicators to be declared in the ED.

This PCR document was developed in the course of an international bottom up process with stakeholder participation and independent third party review and went through the following stages of discussion:

- Agreement on key methodological features within *PlasticsEurope*
- Stakeholder workshop (after a broad and open invitation) in Brussels on 1 June 2005, venue *PlasticsEurope*
- Distribution of meeting minutes to participants and other interested parties
- Development of the PCR
- Third-party review
- Continued stakeholder consultation

After the publication of the PCR the programme operator will ensure ongoing monitoring of the applicability and appropriateness of the PCR supported by practical experience.

The PCR document is a living document. If relevant changes in LCA methodology or in production technology for the product category occur, the document will be revised and the



changes will be published on the Internet website of *PlasticsEurope* and applicable international fora, such as GEDnet and the Swedish EPD<sup>®</sup> network. In any case, the validity of the document will be reviewed, at the latest, after three years from the date of issue and will be revised as necessary.

## **1.2 Use of the PCR Document**

This PCR document is intended for the development of EDs describing the environmental performance of different uncompounded polymer resins, or reactive polymer precursors, based on data that are representative of resin production. This PCR document also provides the rules for the development of EDs describing the environmental performance of specific products in the same product category. The target audience for the ED is primarily polymer users, such as compounders, processors and original equipment manufacturers, as well as other involved interested parties. The goal is to develop EDs so as to communicate the key environmental aspects of polymers.

## **1.3 Programme Operator**

*PlasticsEurope* is the programme operator:

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## **2 PRODUCT CATEGORY AND DECLARED UNIT**

### **2.1 Product Category**

The product category is defined as uncompounded polymer resins, or reactive polymer precursors.

### **2.2 Declared Unit**

The declared unit of this modular information is 1 kg of resin representative of the European production base of the declaring base resin or reactive polymer precursor producer(s) before any compounding step, unless specified otherwise.



## **3 PRODUCT AND PRODUCER DESCRIPTION**

### **3.1 Product Description**

The product to be declared shall be clearly indicated by the ISO code for polymers, IUPAC name and CAS number, if applicable. The main production steps shall be visualized in a flow diagram. The product's main applications shall be described. When relevant, product standards shall be given.

### **3.2 Producer Description**

The ED shall give the name, address and web-link of the organization, individual company or consortium of companies producing the declared product and providing the ED, as well as the name and address of the contact person who can provide further information about the ED.



## 4 SYSTEM BOUNDARIES

### 4.1 General

As a general rule the selection of system boundaries shall reflect the goal of the production process. The ED is based on a cradle to gate information module.

The production stage covers all life cycle processes from extraction of natural resources, up to the point where the product is ready for transportation to the customer. Packaging of the material is not included.

The use stage and end of life stage are not included in this information module.

Environmentally relevant information pertaining to the use stage and to end of life management is optional and can be given under additional information.

### 4.2 System Boundaries for Production

The following processes shall be included in the system boundaries:

- Extraction of natural resources (e.g. operation of oil platforms and pipelines)
- Refining of extracted resources or bio-based raw materials for production
- Recycling of waste or secondary materials for use in production
- Production processes
- Refining of natural resources into energyware<sup>1</sup>
- Processes providing bio-derived feedstock or resources for energy production
- All relevant transportation
- Management of relevant wastes generated as outputs from all the processes included within the system boundaries.

Further processes can be included as appropriate. The system boundaries and included processes shall be transparently documented, for example, as displayed in the following sample charts.

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<sup>1</sup> Energyware: Tradable commodity used mainly to produce mechanical work or heat, or to operate chemical or physical processes, and which is listed in Annex A of ISO 13600:1999.

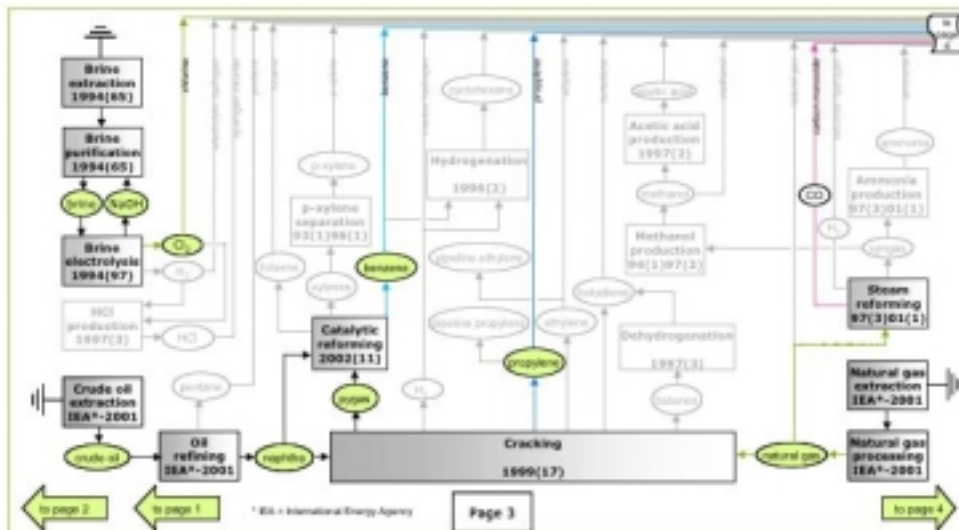
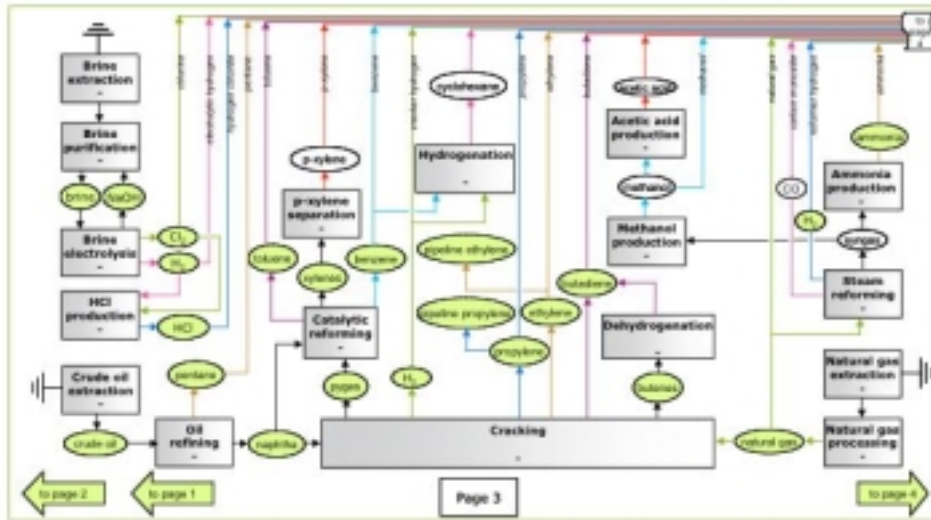


Figure 1: Sample illustration of system boundaries



## **4.3 Technical Boundaries**

### **4.3.1 Available Technology**

The technology used in the geographic region where the product is produced, or for the specific production chain that is assessed, shall be the basis for calculations.

### **4.3.2 Boundaries towards other Technical (Product) Systems**

The ED shall differentiate data from own processes, which are processes under operational control (foreground processes), and third party processes where only indirect management control or no control exists (background process).

Boundaries towards other technical systems will be treated according to the general principles mentioned under this chapter 4 and:

- If it is a process aimed at resin production, then it is included as a whole.
- If it is a service that includes production of resins as by-product, all activities that are connected to resin production shall be included and the system boundaries shall allow for appropriate allocation (cf. 6.).

## **4.4 Temporal Boundaries**

The time for which the LCA data is valid shall be stated. The ED shall state the reference year.

## **4.5 Boundaries of Geographic Scope**

The geographic location of the production sites included in the calculation of representative data shall be documented.



## **5. CUT-OFF RULES**

Any processes or activities that altogether do not contribute to more than 2% of the total mass and 1% of the total energy use may be omitted from the inventory analysis, but omissions of any material flows that may have a relevant contribution to the selected impact categories of the system underlying the ED shall be justified, if applicable, by a sensitivity analysis.



## 6. ALLOCATION RULES

In principle allocation rules should reflect the goal of the production process. Allocation for EDs prepared under this PCR is relevant mainly in multi-output processes.

### 6.1 Multi-output

The aim of allocation is to find a suitable partitioning parameter so that the inputs and outputs from the overall system can be assigned to the single product sub-systems. The precise method of partitioning may vary, but the choice of partitioning parameter is not arbitrary and should reflect as closely as possible the physical behaviour of the system (as shown by mass, energy, or molecular flows).

Mass allocation shall be used as the default option. Stoichiometric allocation and methods based on economic reality should be considered in order to avoid inappropriate results where these are an upshot of mass allocation. In case of substantial deviation, i.e. more than 20%, between the resulting impact category indicator from mass allocation and an alternative method, the influence of the choice of allocation method shall be addressed by a sensitivity analysis.

The chosen allocation method, its rationale, and sufficient detail should be provided by the user of the PCR to the reviewer of the ED.

### 6.2 End of Life Recovery

The end of life stage is outside the scope of this PCR. Methodological guidance and recommendations for recovery can be addressed as additional information. They are not part of the resin-related Life Cycle information module.

In the case of bio-based materials, the modelling of end-of life processes may be very relevant and should be considered for product and total life cycle calculations.

Inputs of secondary materials (recyclate) and outputs of wastes for recovery or disposal shall be noted as crossing the system boundaries (cf. 4). Whether these are analysed further by



system expansion or by credits, the chosen method, its rationale, and sufficient detail shall be provided by the user of the PCR to the reviewer of the ED.

## **7. UNITS**

SI units are used throughout the ED and the report to the verifier.



## 8. CALCULATION RULES AND DATA QUALITY REQUIREMENTS

For the sake of comparability common rules about data quality need to be followed. Any deviations from calculation rules and data quality requirements shall be reported and justified in the report of the LCA underlying the ED.

**Temporal:** All data should be taken as 12 months averages; exceptions shall be justified.

**Geographical:** Data describing the direct inputs and outputs of the foreground processes (resin production) shall be representative of the defined production region.

**Technological:** Data should represent technology in use. The data for resin production processes shall be representative of the available data for the defined production region. The coverage (production volume) must be stated.

**Data Sources and Modelling:** Individual plants at each step of the production chain may be sourced with varying feedstocks, depending on production circumstances, geography, etc. Consequently, outputs are often not traceable to single inputs, and material specification typically occurs in general terms and is not supplier specific.

EDs developed by PlasticsEurope shall use average data representative of resin production. In particular, they will be based on LCI data from the PlasticsEurope Eco-profile programme, where member companies of PlasticsEurope supply site specific information on the foreground processes (e.g., processing of hydrocarbons and intermediates) under their operational control.

The LCI and ED must be representative for the declaring producer(s), both in terms of technology and market share.

ED developed by individual companies or a consortium shall use site-specific data (for processes under operational control) and may include generic data for background processes.

All procedures, methods and assumptions shall comply with the requirements set forth in ISO 14040 ff. In addition, all underlying LCI efforts of the ED shall be subject to a third party Critical Review specified in the PlasticsEurope ED programme.

When modelling cases where different production routes for the declared product are used, the results of the LCA shall be presented as vertical averages. Vertical averaging means that data are first calculated separately for each production chain, and only then an average is calculated weighted by the production tonnage of each chain. These averages shall be



calculated, taking into account a sufficient number of representative site-specific production routes. More information on this procedure can be found in *PlasticsEurope's* Eco-profile methodology report (2004).

The energy supply shall be modelled on a site specific basis. If direct energy supply is derived from one source, then this should be used, and where energy is taken from a national or regional grid, then this shall be modelled specifically for the specified geographic region. Generic data for energy shall be taken from the database of the International Energy Agency IEA<sup>2</sup>, and data for ancillary polymer production materials should be taken from the *PlasticsEurope* eco-profile database or equivalent data. Care shall be taken to ensure consistency of any other data used for EDs in the ED-programme of *PlasticsEurope*.

Any data taken from a database, as opposed to measured data provided by the user of the PCR, shall, where that data contributes to the impact categories by more than 1%, be identified and the data source stated.

Where an individual company is utilizing average data to develop a company specific ED for the communication of life cycle information within its specific value chains, the data source and original authorship shall be transparently documented.

In the case where an individual company desires to provide company or site-specific data, a justification shall be provided, that such data is sufficiently representative for the European production base of the data provider(s).

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<sup>2</sup> IEA Website: [www.iea.org](http://www.iea.org) (energy information centre).



## **9. PARAMETERS TO BE DECLARED IN THE ED**

LCA results are reported in the ED as a minimum set of inventory and impact category parameters. A minimum set of parameters other than environmental information derived from LCA is also to be reported.

### **9.1. Minimum Set of Parameters from the LCA Study**

#### **9.1.1 Input Parameters: Material Resources**

- Non-renewable materials, such as minerals, fossil fuels;
- Renewable materials, such as bio-based materials;
- Water use<sup>3</sup>.

In this category the consumption of resources is reported. Resources must be reported to the verifier as un-aggregated inventory data and are specified in grams.

For both bio-based materials and bio-based fuels, the related sinks of carbon should be modelled and reported as carbon uptake.

#### **9.1.2 Input Parameters: Energy Resources**

- Non-renewable energy resources, differentiated into resources for energy and feedstock,
- Renewable energy resources, differentiated into resources for energy and feedstock,

Energy resources shall be reported in MJ utilizing the upper heating value as calculation reference.

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<sup>3</sup> This indicator models the use of process water only. Cooling water is not included.



*Caution! The material (feedstock) and energy data must not be added together.*

Since it is common practise to use the lower heating value in many LCA studies, the energy resource use shall also be reported in lower heating values.

### **9.1.3 Output Parameters: Impact Categories**

All Life Cycle Inventory emission data necessary to support the declared impact categories shall be reported to the ED verifier, but not declared in the ED. However, the more complete LCI profile of the European average production will remain available under the PlasticsEurope Eco-Profiles programme.

The minimum set of environmental impact categories to be supported by emission data and to be treated in the ED is as follows:

- Greenhouse gas contributions as Greenhouse Warming Potential (GWP) in kg CO<sub>2</sub>-equivalents,
- Ozone depleting contributions as Ozone Depletion Potential (ODP) in g CFC 11-equivalents,
- Acidification contributions as Acidification Potential (AP) in g SO<sub>2</sub>-equivalents,
- Summer smog contributions as Photo-Oxidant Creation Potential (POCP) in g ethane-equivalents,
- Nutrifying and eutrophication contributions as Nutrifcation Potential (NP) in g PO<sub>4</sub><sup>3-</sup>, and
- Dust and particulate matter in g<sup>4</sup>.

The characterisation factors for calculating environmental impacts shall be taken from CML 2002 LCA Guide.

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<sup>4</sup> If PM-specified data are available, this indicator should be reported in g PM<sub>10</sub>. An explanatory statement may designate the origins, e. g. mining and furnaces.



#### **9.1.4 Output Parameter: Waste**

Waste is reported as inventory data specified in weight units (SI) and differentiated as mineral, non-hazardous and hazardous waste. The distinction of the wastes shall be made in accordance with the requirements of the EU landfill directive and the EU Waste List.

While some waste management operations are within the system boundaries (cf. 4.2), there may still be waste streams leaving the system boundaries, e.g. pre-treated waste for final disposal. Hence waste is included as an output parameter.

#### **9.2 Additional Environmental and Health Information**

There is scientific consensus, that environmental and health related risk can not be properly assessed in the Life Cycle Impact Assessment phase. However, if the related life cycle inventory data provides relevant information about the environmental performance of the product system under study it may be considered. According to ISO CD 14025 such information may be included in an ED under “additional information”. Any other, non- LCA related information about the environmental performance of the product system is to be covered under this heading.

Any other additional information related to environment and health issues other than LCI/LCA derived information can be provided here. It shall comply with Section 7.2.3. and 7.2.4. of ISO 14025.

Material Safety Data Sheet information may be used as a basis for risk communication.

Any assessment of accident risks is not part of the LCI of the system under study.

Toxicity-related life cycle impact categories have been excluded from the ED, due to the recognised lack of scientific consensus for the existing models. In order to allow interested parties to comprehend the fuller set of life cycle inventory data, the established Eco-Profiles of PlasticsEurope will continue to meet such information and detail requests.



Land use shall be assessed and reported in the case of bio-based materials and, if relevant, for bio-based fuels.<sup>5</sup>

### **9.3 Additional Technical Information**

The inclusion in the ED of additional technical information, such as specifications or technical properties of the polymer resin that are potentially relevant for environmental performance during its use phase, is optional. Such information can be important to the supply chain in that it addresses success factors of the applications.

The following are examples of applications and their success factors:

- Thermal conductivity for building applications and window frames,
- acoustic performance for building applications,
- light weight design options for vehicles, transport or packaging applications,
- gas barrier properties for building or packaging applications.

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<sup>5</sup> This indicator should either be given as sealed land (as defined by EMPA) or as an explanatory qualitative statement stating that land use is close to nil.



## 10. REFERENCES

- PlasticsEurope Eco-Profile LCI methodology. Brussels. 2004
- EU landfill directive - Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste – Official Journal L 182, 16/07/1999 pp. 0001–0019
- EU Waste list – 2000/532/EC: Commission Decision of 3 May 2000 replacing Decision 94/3/EC establishing a list of wastes pursuant to Article 1(a) of Council Directive 75/442/EEC on waste and Council Decision 94/904/EC establishing a list of hazardous waste pursuant to Article 1(4) of Council Directive 91/689/EEC on hazardous waste (notified under document number C(2000) 1147) – Official Journal L 226, 06/09/2000 pp. 0003–0024
- ISO 13600.1997: Technical energy systems – Basic concepts. ISO, Geneva, 1997.
- ISO 14025: Environmental labels and declarations – Type III environmental declarations. ISO, Geneva, 2006 (in publ.).
- ISO 14040 – 14043: Life Cycle Assessment. ISO, Geneva, 1997 – 2003 (Note: publication of the revised ISO 14040 and of ISO 14044 is expected by the end of 2006)
- ISO 15686: Buildings and constructed assets – Service life planning. ISO, Geneva, 2001
- ISO 11469: Plastics – Generic identification and marking of plastics products.
- ISO 1043-1: Plastics – Symbols and abbreviated terms – Part 1: Basic polymers and their special characteristics.
- IUPAC name code: INTERNATIONAL UNION OF PURE AND APPLIED CHEMISTRY - Nomenclature of Organic Chemistry, Sections A, B, C, D, E, F, and H, Pergamon Press, 1979. Edited by J Rigaudy and S P Klesney.
- CML Guide: Guinée, Jeroen B. (Ed.): Handbook on Life Cycle Assessment – Operational Guide to the ISO Standards. Springer, 2002



## **11. ANNEX: REVIEW OF THIS PCR**

This Product Category Rules (PCR) document for “Uncompounded Polymer Resins or Reactive Polymer Precursors” was subject to a critical review according to ISO 14025. The critical review process was performed in two steps: first, the reviewers’ attendance at the stakeholder meeting in June 2005 and the subsequent review of the draft PCR document; second, the review of the final Product Category Rules for “Uncompounded Polymer Resins or Reactive Polymer Precursors” as of 8 September 2005.

The summary report by the reviewers is provided in the annexed document as of April 2006. Since then, *PlasticsEurope* has taken the reviewers’ comments into careful consideration when amending the PCR. All of the specific comments have been incorporated (as editorial changes or additional explanations, as appropriate) into this revised version of the PCR as of 16 June 2006.

# Critical Review

on the

Product Category Rules (PCR)  
for Uncompounded Polymer Resins, or  
Reactive Polymer Precursors

prepared by

**PlasticsEurope**

**Reviewers:**

**Johannes Kreißig**

**Birgit Bodlund**

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**April 2006**

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## 1 Summary of the Critical Review

PlasticsEurope authorised three reviewers to perform a critical review according to ISO 14025 on Product Category Rules (PCR) for “Uncompounded Polymer Resins or Reactive Polymer Precursors”. The Product Category Rules are developed by PlasticsEurope with support of FiveWinds International.

The critical review process was performed in two steps; the first step was the attendance at the stakeholder meeting on July 6<sup>th</sup> and subsequent reviewing draft PCR document, the second step the review of the final Product Category Rules.

Basis for the review are the final Product Category Rules for “Uncompounded Polymer Resins or Reactive Polymer Precursors” dated September 8<sup>th</sup> 2005.

In summary the critical review of the study concludes the following:

- The methods employed for the development of the PCR document are consistent with the international standard ISO 14025.
- In general the PCR document is defined in compliance with the recommendations of the ISO 14040ff standards. All requirements relevant for a PCR, which are given in the ISO standards, are included. Basis for the Environmental Declarations (EDs) based on the reviewed PCR are life cycle data from a study according to ISO 14040.
- The methods considered for the development of the PCR are conclusive and scientifically valid and reflect the international state of the art for LCA.
- The PCR document is considered to have a very good transparency and consistency.

Several points have been described more precisely during the review process, e. g. the handling of toxicity impact categories or land use, the definition of the parameters to be declared in the ED and the references are stated.

The following aspects require some attention when developing the ED according to the PCR:

- The production process shall be visualized in a flow diagram. It would be useful information, if the production steps are not only shown in a diagram, but also described in words with a reference in order to get more information.
- A high transparency regarding the use of generic data in a specific ED and the representativity of the underlying data in a generic ED should be aimed at.
- Additional information shall be related to the declared unit, e.g. the thermal conductivity of PVC resin itself could be stated, but not the thermal conductivity of a window frame made out of PVC compound.

Overall the critical review concludes that the Product Category Rules are entirely in line with the requirements of the international standards ISO 14025.

April 2006

Johannes Kreißig, Birgit Bodlund, Konrad Hungerbühler

## 2 Additional detailed comments

### Chapter 4:

- 4.1: Does the definition “point where the product is ready for transportation to the customer” include packaging of the material or not, please specify explicitly.
- Is the list of processes an exclusive list? If yes, are you sure that it is complete? If not, please mark the list as an example-list.
- 4.3.2: it might be not appropriate to allocate only those activities to the resin production, which are solely connected to the resin production.

### Chapter 6:

- 6.1: This criterion does not lead to a consistent approach. The principle you state under chapter 6 is mainly economically (goal of the production), the specification does focus on mass and stoichiometry. It is not clear for the user what to do, is there a hierarchy? We recommend to take the decision or some of the decisions explicitly and to include them in the PCR. Otherwise you cannot ensure consistent EDs.  
When you take a look at the PlasticsEurope Ecoprofiles you see a “philosophy” in allocation, you have the possibility to enunciate that in the PCR.  
Why not presenting the most important allocations as examples in the PCR?
- 6.2: this is o.k., but you have to give guidance how to handle EOL allocation anyway, there might be situation that a producer is using input from another “life cycle”, he has to know what to do.

### Chapter 8:

- It seems to be unrealistic to state any data taken from a database, we recommend including a criteria addressing relevance (e.g. 1% in any impact category used in chapter 9).

### Chapter 9:

- 9.1.3: Since the ED is addressing “only” cradle to gate, we recommend naming the Category just “Impact Categories”.
- 9.1.4: chapter 4.2 defines that “management of waste” shall be included in the system boundaries, this is inconsistent to 9.1.4.
- 9.3: please make clear, that the technical information has to be declared only for the product category (uncompounded polymer resins or reactive polymer precursors) and not for its applications. Therefore you can declare a thermal conductivity for the resin, but not “for building applications and window frames” or may be an acoustic performance, but not “for building applications” or gas barrier properties, but not “for building or packaging applications”.
- “Light weight design for vehicles, transport or packaging applications” is no technical specification of a polymer resin; it could be the density of the resin.