

Earthsure® Environmental Product Declarations General Program Instructions

The Earthsure program is a Type III Environmental Product Declaration program organized in conformance with ISO 14025:2006. It was initially developed in 2000, and was applicable only to food and agricultural product systems, but due to requests from other sectors, it has been expanded to cover the full range of products and services. This document describes the management system as it relates to Product Category Rules (PCRs) and Environmental Product Declarations (EPDs).

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1 Definitions

ACLCA: American Center for Life Cycle Assessment, the professional society for LCA in the U.S.

Background Data: data other than foreground data.

CAS Number: chemical registration numbers provided by the Chemical Abstracts Service.

Conflict of interest: a conflict of interest is a situation in which individual(s) in positions of trust have divided loyalties.

Consequential Analysis: a form of LCA that calculates the difference between a current and an alternative (hypothesized) industrial system.

Ecolabel, Environmental Declaration: a claim which indicates the environmental aspects of a product or service

NOTE An ecolabel or declaration may take the form of a statement, symbol or graphic on a product or package label, in product literature, in technical bulletins, in advertising or in publicity, amongst other things.

Ecosphere flow: flows directly to and from nature.

EPD: Type III Environmental Product Declaration as defined by ISO 14025.

EPD Owner: organization developing an EPD in accordance with a published PCR. Usually the business providing the product.

EPD program operator: an organization that conducts a Type III environmental product declaration program in accordance with ISO 14025. This may or may not be the organization developing the PCR.

Foreground data: data directly under the operational control of and measured by the owner of the EPD. This may include technosphere flows in the manufacturing phase, transport to and from the manufacturing location, and measured emissions from the facilities under operational control of the EPD owner.

IERE: The Institute for Environmental Research and Education

Immediate family member: a parent, sibling, spouse, child or step-child, or life partner.

Independent manufacturing representatives: individuals representing a company whose goods are covered in the PCR in whole or in part. They shall be independent of each other, which means that they are neither substantial direct customers or vendors (greater than 5 % of purchase or sales) nor partners of any other manufacturing company being represented.

Industry expert: an individual with a higher degree in the field (Master or Ph.D), or five years of experience working in the industry in question.

LCA: Life Cycle Assessment

LCACP: Life Cycle Assessment Certified Professional: an individual in good standing under the American Center for Life Cycle Assessment certification program, or other comparable program developed for LCA professionals under the ISO 17024 standard.

LCIA: Life Cycle Impact Assessment.

Module: a portion of a product life cycle.

PCR committee: group organized under a PCR program operator to develop one or more PCRs in accordance with the PCR Operator's management system.

PCR program operator: an organization that develops or shepherds the development of one or more PCRs. PCR program operators may also be EPD program operators.

PCR: Product Category Rule, the detailed description of how a life cycle assessment should be performed for a particular functional unit, in order to obtain an environmental product declaration. A PCR also includes explicit instructions for the label itself.

Primary Data: data measured by the owner of the EPD or data gathered directly from other entities in the value chain.

Product: any goods or service [from ISO 14040].

Secondary Data: data from non-primary sources, such as publications in the peer reviewed literature or grey literature such as government publications.

Substantial interest: Earning at least five percent of one's annual income from a commercial interest that manufacturers or otherwise produces a product covered by a particular PCR or owning at least \$100,000 in stocks or bonds of such a commercial interest. Such ownership as a part of a mutual fund does not constitute substantial interest.

Substantive compliance: compliance to all applicable emissions rules and regulations. Errors in documentation are not substantive.

System Function: the social benefit provided by a product or service.

Technosphere flow: flows related to economic activity.

Tertiary Data: data derived from meta-analyses such as life cycle databases, economic input-output data, and meta-analyses in the peer reviewed literature.

UNSPSC Code: the United Nations Standard Products and Services Code (UNSPSC) an open, global multi-sector standard for efficient, accurate classification of products and services.

1.1 Standards Incorporated by Reference

ISO 14020^j, ISO 14021ⁱⁱ, ISO 14025ⁱⁱⁱ, ISO 14040^{iv}, ISO 14044^v, ISO 14050^{vi}, ISO 17024^{vii}, ISO 21930^{viii} as revised.

In addition, in developing this guidance, IERE benefited from review of PAS 2050^x, the draft ISO 14067 (Product Carbon Footprints), the draft International EPD General Program Instructions, the PCR Guidance from the Product Category Rule Guidance Development Initiative^x and the AFNOR standard BP X30-323^{xi}.

2 Program Operator

The Institute for Environmental Research and Education (IERE) is a not-for-profit organization with a mission to undertake and disseminate comprehensive, fact-based research for use in the development of responsible environmental policy, programs and decisions. IERE supports the use of Life Cycle Assessment as the best way to get most of the environmental facts together in one place. IERE was founded in 1997, and it is headquartered in Washington State, USA.

3 Purpose of the Program

The purpose of the Earthsure program is to provide comprehensive environmental data about all products to purchasers (business and individuals) so that the power of the market can move the economy towards overall environmental improvement. For each step along the value chain there is potential for an EPD, but the Earthsure program has focused on only a few points along the value chain, because only a few points represent an opportunity to leverage substantially improved overall environmental and economic performance.

3.1 Philosophical Approach

The intent of the program is to calculate and disclose the environmental impacts of a product as much as possible to conform to the understanding of the ordinary user. For example, the EPD for a cup should as much as possible refer to the cup in hand, not some hypothetical cup. Offsets and consequential analysis have no place in this approach. The EPD should also support the decisions actually made. Thus for example, in a manufacturing facility the only decisions to be made about waste and recycling are whether to use recycled material as a raw material and whether to recycle the wastes being produced. In contrast, raw material manufacturers rarely have any control on the end of life disposition of their products. This approach to LCA calculation is called strict sustainability accounting.

To the greatest extent possible IERE seeks to democratize EPDs. This means that EPDs should be automated and inexpensive to produce, permitting many EPDs to be made in real time. An automated EPD system does not require verification of each and every EPD individually: only outliers are audited.

IERE supports the harmonization of EPD programs, with a goal of cross-recognition of EPDs from different program operators.

3.2 Data Confidentiality and Management

IERE supports the use of the US Federal LCA Digital Commons, and intends that the Earthsure EPD data it collects or manages are eventually incorporated into this public, free repository of life cycle data. However, it is essential that the confidentiality of data provided for the EPD be maintained. To support both these goals, IERE may execute confidentiality agreements about business-specific data but it also requires release of data in an aggregated format as long as at least three examples of a unit process are aggregated.

4 Scope

The Earthsure program covers the entire economy. As required, sector by sector guidance is developed. Examples of this kind of guidance for food packaging and for apparel can be seen on the Earthsure website. To assure clarity and non-overlapping of the different PCRs, Earthsure uses the UNSPSC codes^{xii}, which are an international e-commerce product coding system that covers the entire economy. IERE is a member of UNSPSC, and will provide new codes to the organization in the event that the need is discovered during its work.

EPDs can cover a portion of a life cycle (called a module) or an entire life cycle. Only in the case where the entire life cycle is covered can one understand the full environmental performance of a product. For products that are components, a cradle to gate assessment is appropriate. Only in the case where the product itself provides the desired end function can a full comparison be made between products. For example, a chair provides the function of seating, and though one may have different seating functions, it is not necessary to have more than the chair itself to provide the function. In this case, the chair LCA can be performed without resorting to sophisticated models of its use and end of life phases.

The table below shows the sectors covered by the UNSPSC codes, and whether that sector contains products that are only modules (module), products that provide the full life cycle function (LCA), or both.

Type	Code	Title
Both	10000000	Live Plant and Animal Material and Accessories and Supplies
Module	11000000	Mineral and Textile and Inedible Plant and Animal Materials
Module	12000000	Chemicals including Bio Chemicals and Gas Materials
Module	13000000	Resin and Rosin and Rubber and Foam and Film and Elastomeric Materials
Both	14000000	Paper Materials and Products
Module	15000000	Fuels and Fuel Additives and Lubricants and Anti corrosive Materials
Module	20000000	Mining and Well Drilling Machinery and Accessories
Module	21000000	Farming and Fishing and Forestry and Wildlife Machinery and Accessories
Module	22000000	Building and Construction Machinery and Accessories
Module	23000000	Industrial Manufacturing and Processing Machinery and Accessories
Module	24000000	Material Handling and Conditioning and Storage Machinery and their Accessories and Supplies
Module	25000000	Commercial and Military and Private Vehicles and their Accessories and Components
Module	26000000	Power Generation and Distribution Machinery and Accessories
Module	27000000	Tools and General Machinery

Type	Code	Title
Both	30000000	Structures and Building and Construction and Manufacturing Components and Supplies
Module	31000000	Manufacturing Components and Supplies
Module	32000000	Electronic Components and Supplies
Module	39000000	Electrical Systems and Lighting and Components and Accessories and Supplies
Module	40000000	Distribution and Conditioning Systems and Equipment and Components
Both	41000000	Laboratory and Measuring and Observing and Testing Equipment
Module	42000000	Medical Equipment and Accessories and Supplies
Both	43000000	Information Technology Broadcasting and Telecommunications
Both	44000000	Office Equipment and Accessories and Supplies
Module	45000000	Printing and Photographic and Audio and Visual Equipment and Supplies
Module	46000000	Defense and Law Enforcement and Security and Safety Equipment and Supplies
Module	47000000	Cleaning Equipment and Supplies
Module	48000000	Service Industry Machinery and Equipment and Supplies
Both	49000000	Sports and Recreational Equipment and Supplies and Accessories
LCA	50000000	Food Beverage and Tobacco Products
Both	51000000	Drugs and Pharmaceutical Products
Module	52000000	Domestic Appliances and Supplies and Consumer Electronic Products
Both	53000000	Apparel and Luggage and Personal Care Products
LCA	54000000	Timepieces and Jewelry and Gemstone Products
LCA	55000000	Published Products
LCA	56000000	Furniture and Furnishings
LCA	60000000	Musical Instruments and Games and Toys and Arts and Crafts and Educational Equipment and Materials and Accessories and Supplies
Both	70000000	Farming and Fishing and Forestry and Wildlife Contracting Services
Both	71000000	Mining and oil and gas services
Both	72000000	Building and Construction and Maintenance Services
Module	73000000	Industrial Production and Manufacturing Services
Both	76000000	Industrial Cleaning Services
Both	77000000	Environmental Services
Module	78000000	Transportation and Storage and Mail Services
Module	80000000	Management and Business Professionals and Administrative Services
Module	81000000	Engineering and Research and Technology Based Services
Module	82000000	Editorial and Design and Graphic and Fine Art Services
Module	83000000	Public Utilities and Public Sector Related Services
Module	84000000	Financial and Insurance Services
Both	85000000	Healthcare Services
Both	86000000	Education and Training Services
Both	90000000	Travel and Food and Lodging and Entertainment Services
LCA	91000000	Personal and Domestic Services
Both	92000000	National Defense and Public Order and Security and Safety Services
Both	93000000	Politics and Civic Affairs Services
Module	94000000	Organizations and Clubs

Where a product represents a module, it can sometimes be developed into a full, comparable EPD, when standard scenarios are provided. For example, all building components and equipment and supplies can be analyzed over the life cycle if a reference building scenario is employed. Fuels can only

be evaluated cradle to grave if one has decided on a reference combustion scenario. For example, automotive fuels can only be evaluated in the context of a standard model automobile scenario.

There are five kinds of documents developed under the Earthsure program:

- The Product Category Rule
- Sector-specific guidance for PCRs
- The LCA study to support the EPD
- The Environmental Product Declaration
- The on-product label

5 Elements of the Earthsure Environmental Product Declaration Program

The Earthsure ecolabel is a Type A label^{xiii} that is, it discloses the environmental impact indicator results. The list of impact indicators is variable, depending on the product in question. Climate change is always required, as are certain other categories depending on the product type (see section 8.2.1). In some



cases there may also be non-impact category indicators, such as total energy used. All products may display the Earthsure logo, for the time period during which the EPD is valid. The information about the LCIA results may be printed on the packaging, or they may be available on the product-specific website and/or in printed materials.

Dependent on the specific product category rules, the ecolabel program may also require an environmental management system and disclosure of significant environmental aspects, goals for improvement and past history of meeting goals.

The program may also require substantive compliance to environmental laws and regulations.

6 Product Category Rules

6.1 Elements of the PCR

The Product Category Rule is a detailed document identifying exactly how the studies supporting the EPD are to be performed, and how the information is to be disclosed. It should be clear and detailed enough that no matter who performs the studies behind an EPD, the results will be the same within the natural variability of the data. The PCR is the property of IERE, with all copyrights reserved.

Product category rules developed under the Earthsure program are made available without charge to all users, and it is not a requirement that IERE be used for the validator of the EPD developed from the PCR. However all validators must be certified LCA professionals, through either the American Center for Life

Cycle Assessment LCACP Program, or through a comparable program, such as the LCACP from the Australian LCA Society or the LCA Society of New Zealand. PCRs, however are not available for reuse or repackaging in other formats, e.g. software. IERE retains the copyright on all PCRs developed under the Earthsure program. Where PCRs are jointly developed under two or more program operators the copyright is shared equally among those program operators.

The PCR includes:

- The name of the product category
- Whether the PCR refers to a product or a module
- The UNSPSC code(s) it applies to
- The dates of development and expiry of the PCR
- The names and affiliations of members of the PCR committee
- How the PCR was funded
- Efforts undertaken to assure openness and transparency in development
- Details of LCA scoping (see below)
- A description of additional information to be included (if any)
- If the additional information is a separate claim, how that should be documented
- Any PCR-specific verification required in addition to the usual programmatic verification
- The content and format of the EPD itself
- The content and format of the on-package label, if any

6.2 Process of Earthsure PCR Development

6.2.1 Existing PCRs

IERE seeks existing PCRs through intense internet searches. If a defunct PCR exists, the program operator is invited to participate in the process. If a current PCR exists, IERE reviews it to determine whether it is possible to use it as is or whether it must be modified to reflect the current situation.

6.2.2 LCA Studies Search

IERE seeks LCA studies of the product being evaluated through documented internet searches. A bibliography of existing LCAs is developed and used for scoping the PCR. If no such studies exist, an LCA is commissioned.

6.2.3 PCR Committee Makeup

Development of the Product Category Rule (PCR) is done in committee, including representatives of the organization(s) funding the PCR and other interested parties. The PCR Committee shall range in size from six to twelve participants. At least half of the participants shall be representatives of the industry to which the PCR refers. Consultants may be committee members only if they are representing one or more committee members, i.e. a company in the relevant industry, a governmental member or a non-governmental organization, and that representation must be disclosed. No one interest may represent more than 50% of a PCR Committee.

Independence of committee members is determined by the extent of their financial interest. Any organization whose income depends less than 10% upon another organization represented in the committee is deemed to be independent. Individuals are deemed to be independent if their income or any immediate family member's incomes are less than 5% dependent on an organization represented in the committee. Members of the PCR committee are required to sign a disclosure of conflicts of interest, also kept in the PCR record.

IERE invites participants in the PCR committee. At least two governmental and/or non-governmental interested parties must be invited. It also seeks a range of potential interested parties, including academics and invites them to participate through either email or through phone calls. Records of these invitations are kept in the PCR background documentation. IERE reserves the right to refuse or terminate membership to disruptive individuals.

The process and decisions undertaken by the committee are substantially similar to those shown in the study: [Guidance for Multi-Stakeholder Life Cycle Scoping, with a Food Container Example](#)^{xiv}(Schenck et al., 2008). The primary output is all the scoping decisions for the LCA in accordance with the table shown as an appendix in that document. With few exceptions, the committee meets via teleconference or web meeting.

6.2.4 Validation of PCR

Whenever a new PCR is developed a third-party review of the analysis is performed and the review includes a review of both the PCR and the supporting LCA. That review is by a panel (at least three people) led by an LCACP, and includes at least one industry sector expert.

The review committee is charged with evaluating whether:

- The PCR has been developed in accordance with the ISO 14040 series of standards and, specifically, in accordance with 6.7.1 of ISO 14025;
- The PCR fulfills these general program instructions;
- The LCA-based data, together with the additional environmental information prescribed by the PCR, give a description of the significant environmental aspects of the product.

At the same time that the PCR is being reviewed by a panel of experts, it is also posted for at least 30 days, and open for public comment. IERE will post it on its Earthsure website, and will provide notification through its mailing list (over 1000 LCA experts) and will also post a notification on the Earthsure website. All comments from an identifiable source shall be addressed. IERE addresses all editorial comments, with the PCR committee deciding by consensus on any substantive comments.

Once final corrections are made, the PCR Committee chair shall provide confirmation of conformity to the relevant documents, and that confirmation becomes a part of the PCR documentation.

6.2.5 Public Comments, Right of Appeal

IERE addresses all editorial comments, with the PCR committee deciding by consensus on the substantive comments. Responses to all public comments are posted on the Earthsure website. Any

public commenter who believes that his or her comments have not been adequately addressed has the right to appeal to IERE within 30 days of posting. IERE and the PCR committee will review and respond to such appeal.

7 PCR Sector Guidance

There are times when having a document describing a sector is useful. Such a document should be developed in the same manner as developing a PCR for a single functional unit or module. However, the goal of the sector guidance is to make sure that the maximum number of the LCA scoping decisions are made, and the document can be incorporated by reference, reducing the work of developing any of the PCRs in that sector.

As an example, a PCR sector guidance document can develop the scenarios which can be used to model all the products within a sector. This scenario development is necessary to assure that individual PCRs are consistent and the module EPDs they support can be added together to form a complete life cycle assessment. An example of sector guidance can be found at:

<http://iere.org/wp-content/uploads/2013/08/SAC-PCR-Guidance-Final-2013.pdf>

8 LCA Study Defaults

Normally the LCA study is carried out by the organization seeking the EPD, either internally or through a contractor. IERE may carry out the study itself if desired by the customer. Such studies are reviewed by a third party per the ISO 14040 and 14044 standards. IERE may automate EPD production, and in this case the IERE software is reviewed by a third-party. The approach taken in the Earthsure program is strict environmental accounting, with system boundary expansion (including consequential analysis) not allowed.

8.1 Life cycle inventory modeling defaults

Regardless of the product, assumptions must be made to perform an LCA. Some of these assumptions apply across the entire life cycle of the product, while others affect only one life cycle phase, or even one unit process.

8.1.1 Allocation

When processes have more than one output the impact is allocated based on mass of the outputted products or, for energy producing processes, on the usable energy (exergy) outputs. Where processes, such as waste management, have multiple inputs and no technosphere output the impacts are allocated according to the mass of the inputs. Where data for mass allocation is not available (e.g. where production is only accounted for by piece) a sensitivity analysis covering the range of possible masses must be performed.

Where background unit process data is only available based on system boundary expansion data, any negative flows (except those appropriately due to carbon sequestration) shall be converted to zero. Any

flow representing more than five percent of the mass or energy inputs for which only system boundary expansion or consequential data is available must be subjected to a sensitivity analysis.

8.1.2 Units

All units for LCA modeling and reporting must be in standard international (metric) units. Ancillary documentation (e.g. test results) need not be translated into SI units, but can be included in the PCR documentation as is.

8.1.3 Functional Units

Functional units for full system, cradle to grave analyses must reference an amount (or extent), a time measure and a measure of quality. Where consensus standards exist for product quality, these standards must be referenced. Where no industry consensus standard exists, the definition of the functional unit may develop a quality definition for the functional unit pro-tem, but efforts should be made to promote the development of such a standard.

In the case of a food item, the functional unit is one serving per the US Department of Agriculture^{xvixvi}.

In the case of a fuel item, the functional unit does not contain a temporal component.

8.1.4 Module Reference Unit

Where the product in question is a module, not a complete product, the module reference unit (or declared unit) will also follow the format of the functional unit, but will clearly state that the entire life cycle of the product is not covered, and it may lack temporal characteristics.

8.1.5 Precision

No LCIA results may be expressed with more than two significant figures.

8.1.6 Raw Material Extraction

All inventory data of extracted minerals must be expressed as in-ground, in-air or in-water amounts.

Life Cycle inventories are either complete or system terminated inventories. A complete inventory has only ecosphere flows (elementary flows) and one technosphere output flow (the product). All other life cycle inventories have both input and output technosphere flows.

Recycling into a raw material is considered to be a form of raw material extraction.

8.1.7 Cutoff Rules

All known mass, energy and toxic inputs must be included. At a minimum, the life cycle inventory must include at least 95% of the mass and energy of all technosphere inputs and all known toxic chemical inputs. No energy or mass input representing 1% or more of the mass or energy may be excluded. Where specific data for a unit process is not available, a proxy dataset may be used. Proxy data must be identified as such, and they may not represent more than 10% of the mass of the finished product.

8.1.8 Models of Recycling

Recycling and recycled content are modeled using a cutoff rule. All materials that are recycled from unit processes (including those sent to energy recovery) are considered to have left the system. Where the

product system has specified recycled content, all the environmental burdens of recycling must be included in the raw material portion of the inventory. Where recycled content is not specified, the average inventory data from the relevant industry sector must be used, with any negative ecosphere flows set to zero.

8.1.9 Waste Management

Where primary data exists on the disposal methods for waste streams, that data must be used for calculating the life cycle inventory of the waste unit processes. Where no primary data is available, the national average data provided by the relevant national body collecting this data must be used. In the United States, this is the U.S. EPA Office of Solid Waste.

8.1.10 Transportation

Where primary data on fuel consumption and transport method are known, these must be the basis of the analysis. Where these are not known, the models imbedded in the US Life Cycle Inventory database or its successor must be used. Where these do not exist, the following assumptions shall be made:

- Rail: all transportation is one-way, and the rail energy expenditure is assumed to be derived from diesel fuel.
- In the US, where primary data is absent, road freight shall be modeled per the Energy Information Agency data, Department of Transportation and Census Bureau. Where comparable data is available in other countries, that data is used. Where there is no data, road freight is assumed to be in heavy trucks, with a fuel efficiency of 2.3 km/liter (5.5 miles per gallon), and the haul-back empty 50% of the time.
- Ocean Freight is assumed to be one-way, using container vessels.
- Air freight is one-way.

8.1.11 Electric Power Grids

Wherever possible, the electric grid data should represent the electricity actually purchased or generated by the local entity. Where primary data is available for the electrical power grid for a given unit process, it shall be used to model the purchased electricity source. If data is not available at that level, the next highest aggregation of electrical grid data must be used, with a preference of local>regional>national>multi-national. In the US, the source of national grid data is the US LCI Database, the U.S. Federal LCA Digital Commons or the Energy Information Agency.

Carbon offsets or Renewable Energy Credits may not be used in the inventory. On-site renewable energy from solar cells or other renewable energy source owned by the organization operating the unit process is assumed to be used on-site by the facility.

8.1.12 Age of Data

All non-primary data must be no more than 10 years old, unless it can be verified by an industry expert to be unchanged. All Primary data shall be no more than three years old. It should represent enough data to cover production variability, e.g. the entire season for a crop, the annual use of a manufacturing unit process, etc.

8.1.13 Geography

All primary data shall represent the actual unit processes.

Non-primary data is preferred to be geographically relevant. Where local data is not available, alternative source data can be used, modified to use the local energy mix. OECD sourced data so modified is acceptable for processes in other OECD countries.

8.2 Life Cycle Impact Assessment

The Earthsure life cycle impact assessment is based primarily on the US EPA TRACI models, as noted below. However, it may also include in tandem impact models from the CML set of characterization factors or other models.

Although different products have different impacts on the environment, the following impact categories are often included in environmental product declarations. We here provide default guidance on when to collect life cycle inventory and impact assessment of these key impact categories. Other models may be used and additional impact categories may be needed for particular products.

Climate change is the result of the anthropogenic addition of greenhouse gases into the atmosphere. Greenhouse gases are released primarily from combustion and enteric fermentation. These gases trap heat in the atmosphere, leading to a wide diversity of effects, including sea level rise and acidification, extreme weather events such as hurricanes and tornadoes and droughts and floods, and ultimately effects such as crop failure and increased incidence of disease leading to human mortality and losses of species and ecosystems. The majority of greenhouse gases are derived from combustion, and all products include combustion in their value chains, even if only for the purpose of transportation.

The midpoint indicator of climate change is the CO₂ equivalents, a measure of infrared radiative forcing. CO₂ is the most common and important greenhouse gas in terms of fraction of the greenhouse effect. The lifetime of CO₂ in the atmosphere is very variable, but a weighted average is near 100 years, and thus the 100 year time horizon is selected. The characterization factors are derived from the Intergovernmental Panel on Climate Change's (IPCC) most recent 100-year horizon global warming potentials. In addition to CO₂, N₂O, and CH₄ are major drivers of climate change. Minor drivers of climate change include many refrigerants and some industrial chemicals. All of them must be accounted for in estimating the climate change impact.

Acidification causes the destruction of aquatic and terrestrial ecosystems through the wet and dry deposition of strong acids and ammonia. The acidification of soils mobilizes the aluminum in the soils and this has direct toxic effects on fish and other species, as well as an indirect effect through inhibition of uptake of potassium by plants, leading to loss of forest ecosystems. Acidification also affects the built environment, causing the slow dissolution of buildings. The indicator of acidification is calculated as the stoichiometric gram equivalents of hydrogen ion for emissions of oxides of sulfur and nitrogen, ammonia, HCL, HF, H₂SO₄ and H₃PO₄, whether these are to the atmosphere or directly to water bodies, using the most recent US EPA Traci Model^{xvii}.

It is clear that the emissions of CO₂ into the atmosphere have led to decreased pH in precipitation world-wide. Currently, rain in equilibrium with the atmosphere is considered to be pH 5.5. As recently as 1985, that pH was 6.2, an increase of five times in acid content. This increased acid precipitation is leading to ocean acidification, and the loss of organisms having calcium carbonate shells. Until better estimates of the relationship between CO₂ emissions and marine acid deposition are developed, the acidification due to these emissions are not calculated.

Stratospheric Ozone Depletion is the decrease in the layer of ozone (O₃) in the stratosphere. Although this layer is very thin, it offers substantial protection of the earth from UV radiation. Halogenated chemicals react in the atmosphere to decrease the ozone, producing ordinary oxygen (O₂), which does not screen out UV light. These chemicals are primarily refrigerants and flame retardants, although there are other uses for ozone depleting chemical, e.g. as solvents and as pesticides. The loss of the ozone layer leads to increasing cases of cataracts and skin cancer as well as to damage of crops. The Earthsure impact model is based on the equivalents of CFC-11 per the Montreal Protocol as embodied in the TRACI model.

Eutrophication is the overgrowth of biomass caused by the anthropogenic release of nutrients, particularly fixed nitrogen and phosphorus. Eutrophied water bodies show early effects in terms of species distribution and toxic algal blooms, and ultimately as algae decompose eutrophication causes oxygen depletion leading to fish kills. Large portions of the world's near shore and freshwater bodies are subject to eutrophication seasonally. The most important causes of excess nutrient releases are agriculture, human and animal wastes, and combustion processes. All bio-based products contribute to eutrophication.

In the 1930's A.C. Redfield discovered that the ratio of carbon to nitrogen to phosphorus uptake into marine ecosystems was constant (C:N:P = 106:16:1, on an atom basis) and subsequently this ratio was confirmed to be the same in freshwater systems. The Redfield ratio is the basis of all eutrophication life cycle impact models. We report the nitrogen mass equivalents of carbon, nitrogen and phosphorus compounds released, using the Redfield Ratio.

Ecotoxicity represent direct effects of releases of toxic materials organisms. It is anticipated that toxic materials will be emitted during the production and application of pesticides and fertilizers and during the transportation of components, packaging and products, and during the production and consumption of fossil fuels. As a default approach, the Earthsure model uses the [Usetox](#) model, in the latest version in TRACI.

The Usetox model is based on the concentration at which half of all organisms in a volume of water die. Because of the poor quality and high uncertainty of human toxicity models Earthsure does not calculate a human toxicity impact.

Photochemical smog is produced when oxides of nitrogen and volatile organic substances are present in the lower atmosphere in the presence of sunlight. Ozone is formed, and this form of oxygen causes many direct effects, reducing crop yields, causing asthma and other respiratory effects in humans and animals. The production of ozone has been shown to be more related to the

existence of oxides of nitrogen (NO_x) than to the release of volatile organic substances. All combustion processes in a product's life cycle are potential sources of photochemical smog.

Earthsure's default impact model for smog is the most recent U.S. EPA TRACI method, expressed in mass of ozone equivalents.

Respiratory Effects: Particulate Matter causes severe respiratory problems, leading to at least one million deaths annually, and potentially as many as six million deaths annually on a global basis, primarily in Asia. Particulate matter is caused by the emissions of oxides of sulfur, carbon, ammonia and other inorganic substances, primarily from combustion processes.

It is measured in units of PM₁₀ equivalents, using the US EPA TRACI model.

Water is an important component of foods and water is used in agriculture and in cleaning processes. The human extraction of freshwater means that every continent has rivers that no longer reach the ocean (e.g. the Colorado River) and aquifers that are much depleted. There is currently no consensus on how to measure water resource depletion, so at this time, Earthsure uses consumptive freshwater use as its indicator. Consumptive water use includes all the use of freshwater resources where the water is not replaced into the same watershed. Irrigation and evaporative cooling are examples of consumptive water use.

New approaches to water consumption modeling are being developed, and we expect that these will be available in the near future, at which time they will be adopted.

Land use is an important impact of all food and forest products. Land that is not used for producing food or fiber can presumably be used for wildlife and native ecosystems. In addition, there is ever-increasing evidence of the economic value of the ecosystem services offered by native ecosystems, primarily forests. Unfortunately, there are no good models available for life cycle impacts of land use in North America, so the Earthsure model simply reports the impact in units of land occupation-m²-years. Only the land use for crop and wood/fiber production will be reported, because the other sources of land use (transport, manufacture, storage and use) are anticipated not to be significant sources of land use. All products that include bio-based materials (including in packaging) must report the land occupation.

Fossil Fuel Depletion has economic impact, not directly affecting the rest of the earth's ecosystem. It should be considered as a separate issue from the impacts of combustion of these fuels, many of which are discussed above.

It is a measure of the declining stocks of fuel, whether they are coal, natural gas, or oil. The Dutch CML factors^{xviii} are used. They ratio the energy content of the fuels versus the total global reserve of these fossil fuels, and have units of Megajoules (MJ).

Mineral Resource Depletion is also an economic impact category. We account for this by using the CML resource depletion factors, with units of mass of antimony.

Figure 1 Default Life Cycle Impact Assessment Models

Impact Category	Category Indicator	Model Source
Climate Change	Mass of CO ₂ Equivalents	Intergovernmental Panel on Climate Change ^{xix} , most recent publication
Stratospheric Ozone Depletion	Mass CFC-11 equivalents	Montreal Protocol (TRACI)
Acidification	Mass H+ Equivalents	Stoichiometric equivalents (TRACI)
Eutrophication	Mass N equivalents	Redfield Ratio ^{xx,xxi} (TRACI)
Ecological toxicity	CTUe	Use-tox
Photochemical Smog	Mass O ₃ equivalents	TRACI
Respiratory Effects	Mass PM 10 equivalents	TRACI
Water Use	Volume of fresh water consumed	Inventory
Land Use	Land occupied in m ² yr	Inventory
Fossil Fuel Depletion	MJ	CML ^{xxii}
Mineral Resource Depletion	Mass Sb	CML

8.2.1 Required Impact Categories

Ideally all EPDs should disclose all the impact categories that can be measured, even when they are near-zero results. The absence of impact of a product is as important to the customer as the presence of impact of a product.

All PCRs shall include Climate Change and at least two other impact categories. For bio-based products, land use, water use and eutrophication shall be included. For raw materials the depletion of the resource shall be reported. For transportation and power generation EPDs, respiratory effects, eutrophication and ecotoxicity shall be included

9 EPD Review

IERE may from time to time subcontract the performance of LCA studies or of verification activities under the Earthsure program, but it remains responsible for the quality and accuracy of the Earthsure ecolabels. The LCA studies performed as the basis of the label are typically the responsibility of the owner of the EPD (usually the product manufacturer), not of IERE. Any LCA studies must be verified under the direction of a Life Cycle Assessment Certified Professional (or the equivalent).

EPDs developed from an approved PCR must be reviewed by an independent third party. The review includes both the third party LCA report and the EPD itself. The issues being reviewed include whether the LCA study and the draft EPD are in conformance with:

- The PCR;
- The ISO 14040 series of standards;
- The general program instructions in this document.

and

- The data has adequate coverage, precision, completeness, representativeness, consistency, reproducibility, sources and uncertainty;
- The LCA-based data is plausible and of adequate quality and accuracy;
- The additional environmental information is of adequate quality and accuracy;
- Any supporting information is of adequate quality and accuracy.

If IERE develops the EPD under an Earthsure PCR, the review of the EPD is performed by an external third party. If the EPD is developed by another party it may be reviewed by IERE.

For automated EPD systems, the software itself is validated. In this process, a third-party report per ISO 14044 is developed, representing the range of expected EPD results. The reviewer uses this report to evaluate the questions posed above, and in addition has access to the electronic LCA files behind that report and validates that permutations of those files yield the same results as permutation of the EPD automation software.

10 Format of the PCR and EPD

The PCR layout shall conform to the Guidance for PCR Development^x.

10.1 Third-party Report

All EPDs shall be backed up by a third-party report, per ISO 14040 and 14044. This report may be used directly as the EPD.

10.2 Multiple products on one EPD

When an EPD is desired for a product with several permutations, a single EPD may be produced when none of the LCIA results vary more than 10% for any impact category when the permutations are modeled as scenarios within the same LCA model and software.

10.3 On-product Labels/Near-product Labels

The Earthsure program can produce on-product or near product labels. These can be of different types:

- The Earthsure logo with a url to the website with the full EPD
- The Earthsure logo with a QR code linked to the website with the full EPD
- A subset of the impact indicator results, with a url or QR code to the internet location. The impact indicators must include climate change (the carbon footprint) and two to four other indicators relevant to the product. In the case of food products these will be eutrophication, land use and water use.
- A table tent or hang tag or shelf label with the information in any of the options above.

10.4 Electronic Labels

Electronic versions of the labels may also be produced, e.g. the EPDs at <http://beer.iere.org>. These may be stand-alone or linked to a printed labels as noted in section 10.3

11 Funding of Program Development

The Earthsure program was developed by IERE from general program funds, without a specific sponsor. Development of new Product Category Rules is variously funded (usually by the first companies interested in the label) and the program is maintained by fees for the use of the ecolabel. Fees are developed on a case-by-case basis.

12 Harmonization with Other EPD Programs

IERE actively seeks cross recognition with other EPD programs. These other programs must be shown by a third-party audit to have equivalent:

- PCR and EPD review procedures
- Data quality requirements
- System boundaries
- Allocation methods and rules
- Impact categories
- Assumptions about waste and transportation.

13 Posting of EPDs and Use of the Earthsure Logo

Provided that this is not forbidden by other operators' general program instructions, IERE will validate and post EPDs derived from PCRs created by other program operators as well as those created through the Earthsure program itself. Where an EPD is created using a PCR developed by other program operators, that fact must be clearly stated on the EPD itself. The Earthsure® logo is registered through the US Patent and trademark office. EPDs from organizations who maintain their annual fees will remain on the Earthsure website may use the Earthsure logo in their communications.

Use of the logo when the certification does not exist or has expired or for which the annual fees have not been paid is a violation of US law. IERE will take whatever actions (including legal actions) are needed to protect its intellectual property.

EPDs developed from Earthsure PCRs must be posted on the Earthsure website. Where cross-recognition agreements have been developed with other program operators, they may be posted elsewhere, subject to any fees for this activity.

14 Review of Program

The Earthsure Program is reviewed at least every five years or as needed. Review is triggered by process improvement efforts within IERE, by policy changes within IERE or by known changes in law, relevant standards or policy. The review includes:


- Checking for updates on relevant international standards;
- Checking of EPD Programs developed by others for opportunities to harmonize programs;
- Making changes in the program to accommodate changing policy goals and to conform to the standards (if necessary);
- Posting changes on the IERE website.

Appendix A PCR Decision Worksheet

The work of the PCR committee is primarily to make the decisions outlined in the worksheet below. Default decisions are shown. During the development process, all decisions are validated and any that are changed are justified.

Required Point for ISO 14040/44/25	Default	
The intended application 14040: 5.2.1.1; 14044:4.2.2	Type III Environmental Product Declarations	
The reasons for carrying out the study 14040:5.2.1.1; 14044:4.2.2	To support the EPD; to learn more about environmental impacts of the product; to improve environmental performance	
The intended audience, i.e. to whom the results of the study are intended to be communicated 14040: 5.2.1.1; 14044:4.2.2; 14025:9.1	Business customers	
Whether the results are intended to be used in comparative assertions intended to be disclosed to the public. 14040:1.2.1.1; 14044:4.2.2	No comparative assertions are intended	
Product system to be studied 14040:5.2.1.2; 14044:4.2.3.1; 14025:6.7.1	Use UNSPSC codes	
Functions of the product system 14040: 5.2.1.2; 14044:4.2.3.1; 14025:6.7.1		
Functional unit 14040: 5.2.1.2; 14040:5.2.2; 14044:4.2.3.1; 14044:4.2.3.2; 14025:6.7.1		
System boundary 14040: 5.2.1.2; 14040:5.2.3; 14044:4.2.3.1; 14044: 4.2.3.3.1; 14025:6.7.1	Shown in product-specific flow chart	
Which life cycle stages are included		
Unit Process Descriptions 14044: 4.2.3.3.2	Needed for each PCR separately; flow chart and information modules	
Allocation procedures 14040: 5.2.1.2; 14040:5.3.4; 14044:4.2.3.1; 14025:6.7.1	No system boundary expansion permitted; allocation via mass; sensitivity analysis whenever mass is not available.	
Impact categories selected and methodology of impact assessment, and subsequent interpretation to be used; 14040: 5.2.1.2; 14044:4.2.3.1; 14044:4.2.3.4; 14025:6.7.1	Impact Category	Model
	Climate Change	IPCC 2007et seq.
	Stratospheric Ozone Depletion	Montreal Protocol
	Acidification	Stoichiometric
	Eutrophication	Redfield ratio
	Photochemical smog	TRACI
	Ecotoxicity	USE-tox equivalent
	Water resource depletion	Consumptive freshwater use
Mineral resource depletion	Mineral use for reserves<200 years	

Required Point for ISO 14040/44/25	Default	
	Fossil fuel depletion	CML
	Land use/biodiversity	Area of land occupied-years
	Soil depletion.	Mass of soil lost from site, Revised Universal Soil Loss Equation or equivalent
Units: 14025:6.7.1	Standard International (metric) units per functional unit	
Interpretation 14040: 5.2.1.2; 14044:4.2.3.1		
Types and sources of Data 14044:4.2.3.5	Primary Data > Peer reviewed secondary > Databases	
Sensitivity analysis	If the proxy data represents in excess of 5% of the mass of the product	
data quality requirements 14040: 5.2.1.2; 14044:4.2.3.1; 14044: 4.2.3.6.2; 14025:6.7.1		
Age	No data over ten years old, unless it can be documented that the unit process has not changed.	
Geography	Relevant to location. Primary>Regional>National, OECD modified for local grid	
Cutoff values	99% of mass & energy; all known toxicity issues	
Technology coverage	described in unit process descriptions	
Precision	No more than 2 significant figures.	
Industry coverage	Calculated based on mass or number estimates of total industry	
Representativeness	one year's production (year disclosed)	
Uncertainty of the information	Ranges estimated by primary data source	
Additional Environmental Information 14025:6.7.1		
Materials and Substances to be declared 14025:6.7.1		
Content and format of the label 14025:6.7.1	See below	
Assumption: 14040: 5.2.1.2; 14044:4.2.3.1		
Value Choices: 14044:4.2.3.1		
Limitations 14040: 5.2.1.2; 14044:4.2.3.1; 14044:4.2.3.1	Applicable only to particular product for time of validity	
Period of validity of the label 14025:6.7.1	Three years	
Initial data quality requirements 14040:5.2.1.2; 14044:4.2.3.1	See above	
Type of critical review, if any 14040:5.2.1.2; 14044:4.2.3.1; 14044: 4.2.3.8; 14025:5.7	At least three member review for PCR; led by LCACP (or equivalent), including at least one industry expert	
Type and format of the report required for the study 14040:5.2.1.2; 14044:4.2.3.1; 14025:6.7.1	Must conform to PCR Instructions	

Required Point for ISO 14040/44/25	Default
Content of the Label ISO 14025:7.2.1	
Identification and description of the organization making the declaration;	
Description of product	
Product identification (e.g. model number)	
Name of the program and the program operator's address and, if relevant, logo and website	Institute for Environmental Research and Education http://iere.org/earthsure.aspx 
PCR identification	(name and UNSPSC designation) and date
Date of publication and period of validity	
Data from LCA, LCI or information modules	LCIA results
Additional environmental information	
Content declaration covering materials and substances to be declared (e.g. information about product content, the including specification of materials and substances that can adversely affect human health and the environment, in all stages of the life cycle)	To the best of our knowledge, this product contains no materials known to substantially damage human health or the environment, outside of those noted in the LCA study found at: _____
Information on which stages are not considered, if the declaration is not based on an LCA covering all lifecycle stages	
Statement that environmental declarations from different programmes may not be comparable	Ecolabels from other sources may not be directly comparable to this one
Information on where explanatory material may be obtained.	for more information, go to http://iere.org/index.php/programs/earthsure
PCR review, was conducted by:	Chair name and organization: for contact information email staff@iere.org
Independent verification of the declaration and data, according to ISO 14025:2006	Must be LCACP

References

- ⁱ ISO 14020 Environmental labels and declarations – General principles
- ⁱⁱ ISO 14021:1999 Environmental labels and declarations — Self-declared environmental claims (Type II environmental labelling)
- ⁱⁱⁱ ISO 14025 Environmental labels and declarations — Type III environmental declarations — Principles and procedures
- ^{iv} ISO 14040-2006 Environmental management — Life cycle assessment — Principles and framework
- ^v ISO 14044-2006 Environmental management — Life cycle assessment — Requirements and guidelines
- ^{vi} ISO 14050, Environmental management — Vocabulary
- ^{vii} ISO 17024-2003 Conformity assessment — General requirements for bodies operating certification of persons
- ^{viii} ISO 21930 Sustainability in building construction — Environmental declaration of building products
- ^{ix} British Standards Institute 2011. PUBLICLY AVAILABLE SPECIFICATION 2050 Specification for the assessment of the life cycle greenhouse gas emissions of goods and services
- ^x Product Category Rule Guidance Development Initiative (2013). Guidance for PCR Development <http://www.pcrguidance.org/>
- ^{xi} AFNOR BP X30-323. General principles for an environmental communication on mass market products
- ^{xii} <http://UNSPSC.org>
- ^{xiii} ISO 14025 Environmental labels and declarations — Type III environmental declarations — Principles and procedures
- ^{xiv} Schenck, RC, Mike Levy and Keith Christman, Robert Strieter, Joseph J. Cattaneo, Dennis Sabourin, Bill Heenan. 2008. Guidance for Multi-Stakeholder Life Cycle Scoping, with a Food Container Example. IERE. <http://www.iere.org/scoping/MultistakeholderLCAScopingGuidance.pdf>
- ^{xv} 9 CFR 317.312 Table 2 Reference amounts customarily consumed per eating occasion
- ^{xvi} 21 CFR Sec. 101.12 Reference amounts customarily consumed per eating occasion.
- ^{xvii} USEPA Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts (TRACI) <http://www.epa.gov/nrmrl/std/sab/traci/>
- ^{xviii} Dutch CML-IA <http://cml.leiden.edu/software/data-cmlia.html>
- ^{xix} Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, 2007 Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.) Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. (Note: updates anticipated in 2012)

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^{xxi} Redfield, A.C. 1958. The biological control of chemical factors in the environment. *Am. Sci.* 46:205-21.

^{xxii} Guinée, J.B.; Gorrée, M.; Heijungs, R.; Huppes, G.; Kleijn, R.; Koning, A. de; Oers, L. van; Wegener Sleeswijk, A.; Suh, S.; Udo de Haes, H.A.; Bruijn, H. de; Duin, R. van; Huijbregts, M.A.J. Handbook on life cycle assessment. Operational guide to the ISO standards. I: LCA in perspective. IIa: Guide. IIb: Operational annex. III: Scientific background. Kluwer Academic Publishers, ISBN 1-4020-0228-9, Dordrecht, 2002, 692 pp.