Standards Committee on Type III Life-Cycle Impact Profile Declarations for Products, Services and Systems

Draft Standard for Committee Ballot

Life Cycle Impact Assessment Framework and Guidance for Establishing Public Declarations and Claims

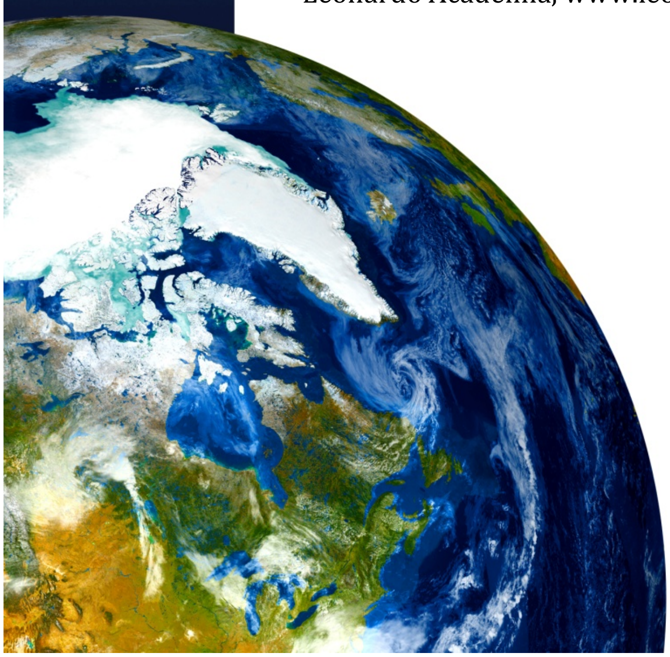
For:

Environmental Declarations for Products and Systems

Environmentally Preferable Product Claims

Carbon Footprint Profiles

February 2012



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0. Introduction.

This Section summarizes the need for the Standard.

Environmental declarations and claims have been the subject of prior international standardization efforts for environmental labeling and life cycle impact assessment. Environmental labeling guidelines defined within the international ISO 14020 standards series distinguish "Type III" environmental declarations from third-party certified eco-logos ("Type I") and self-declared single attribute environmental claims ("Type II").[1,2,3] According to ISO-14025, "Type III Environmental Declarations present quantified environmental information on the life cycle of a product to enable comparisons between products fulfilling the same function." Environmental Declarations and the claims derived from such declarations offer consumers, purchasers and other decision-makers a new level of transparency for evaluating and comparing the environmental performance of products and systems.[4] Type III Environmental Declarations have been used to verify the environmentally preferable product status conferred by Type I logos, to evaluate potential environmental trade-offs associated with single attribute Type II "green" claims, and to test environmental assumptions underlying product development, industry planning, and regulatory policy decisions.

Type III environmental declarations (ISO 14025) are based upon life cycle assessment (LCA). To facilitate the usefulness of environmental declarations in supporting product and system comparisons, the LCAs underlying these declarations should be conducted in a consistent, standardized manner. ISO-14044 is the international framework document providing high-level LCA requirements and guidance. This standard complements ISO 14044 and ISO 14025 by providing more detailed guidance for conducting the life cycle impact assessment (LCIA) phase and describing the technical requirements for environmentally relevant indicators and impact profiles.

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[1] ISO 14025: ISO/TC 207/SC3/WG1 TG Type III N22, "Type III Environmental Labeling," Scientific Certification Systems, 1997.

[2] ISO/TR 14025:2006. Environmental Labels and Declarations — Type III Environmental Declarations; http://www.iso.org/iso/catalogue_detail.htm?csnumber=38131

[3] European Commission, *Summary of Discussions at the 2nd Integrated Product Policy Expert Workshop, Environmental Product Declarations (ISO 14025 Technical Report),* Brussels, 16 May 2001, p 2. "Within the ISO framework an EPD contains a variety of information about the composition and environmental characteristics of a product based on life cycle assessment (LCA)... The information is then presented in a common format and in a neutral way that enables evaluations and comparisons by the purchaser but which does not seek to judge the environmental characteristics of a product. The quality of the information is then verified by a third-party source..."

[4] US Environmental Protection Agency, *Environmental Labeling: Issues, Policies, and Practices Worldwide,* Dec. 1998, p 13.

1. Scope.

This Section summarizes the scope and limitations of the Standard.

1.1. LCA Framework. This Standard, including its annexes, supplements the general LCA framework described in ISO-14044 by providing:

- further guidance pertaining to the iterative analysis process;
- a standardized list of impact categories and category indicators to be considered in the assessment in order to identify the applicable (i.e., "core") indicators;
- guidance pertaining to data collection, including system data, inventory data, and environmental characterization data;
- algorithms for calculating category indicator results for core impact categories;
- guidance for developing appropriate reference baselines to serve as the basis for comparisons; and
- guidance for data quality assessment that integrates both life cycle inventory (LCI) and LCIA data quality issues.

1.2. Guidelines for Environmental Declarations and Associated Claims. The Standard establishes specific guidance for environmental declarations beyond what is specified in ISO 14025, as well as for derivative environmental claims, in order to ensure a high level of rigor and consistency in the information reported (see Section 8). This Standard provides a sufficiently robust LCIA framework to support comparative assertions in conformance with ISO 14044.

1.3. Intended Users. This Standard is intended for use by:

- product manufacturers;
- service professionals;
- environmental professionals;
- policymakers;
- material and energy resource planners;
- environmental advocacy groups;
- industrial, commercial and residential customers;
- climate registries and programs;
- greenhouse gas management systems and operators;
- procurement agencies and professionals;
- qualified third-party LCA practitioners and certifiers of Type III environmental declarations and derivative claims.

1.4. Voluntary Standard. This Standard is not intended to replace regulatory requirements.

1.5. Limitations. This Standard does not address security and safety concerns associated with products or systems.

2. References.

This section lists key references that are considered normative to the Standard (incorporated by reference) and additional references.

2.1. Normative References.

- ISO 14044:2006. Environmental management — Life cycle assessment (LCA) —Requirements and guidelines
- ISO 14025:2006. Environmental labels and declarations — Type III Environmental Declarations — Principles and procedures

2.2. Additional References.

- International Life Cycle Reference Document Handbook: General guide for Life Cycle Assessment – Detailed Guidance
- International Life Cycle Reference Document Handbook: Analysis of existing Environmental Impact Assessment methodologies for use in Life Cycle Assessment
- Swiss Centre for Life Cycle Inventories, EcoInvent Report No. 1, "Overview and Methodology, Data v2.0" (2007), Edited by Rolf Frischknecht and Niels Jungbluth.
- ISO/IEC Guide 65: General requirements for bodies operating product certification systems
- ISO 14065:2007. Greenhouse Gases – Requirements for Greenhouse Gases Validation and Verification Bodies for Use in Accreditation or Other Forms of Recognition[5]
- The Climate Registry: General Reporting Protocol, Version 1.1 (2008).

[5] To be replaced by ISO 17065 when that standard is finalized.

3. Terminology.

*This section defines terms and abbreviations used in this Standard and its Annexes. Terms are not defined where they retain their normal dictionary definition. Some definitions are taken from ISO-14044 or ISO-14025 and included here for the convenience of the user; these are noted. In some cases, terms defined in those standards (indicated here by an asterisk *) have been updated to more precisely convey the meaning in the context of this framework.*

3.1. Terms and Definitions.

Abiotic Resource	Natural resources (including energy resources) such as iron ore and crude oil that are regarded as non-living.
Baseline Condition	The condition of a biome or species population before activity commenced related to the product, service, or system, against which disturbance, restoration, or population changes can be assessed.
Biotic Resource	A type of natural resource derived from the biosphere such as wood or agricultural material (including plant, animal, and marine materials).[6]
Biome	A complex biotic community characterized by distinctive plant and animal species and maintained under the climatic conditions of the region, especially such a community that has developed to climax.
Category Indicator	Quantifiable representation of an impact category *[Ref. ISO-14044] (Also referred to as "Impact Category Indicator," or simply, "Indicator.")*
Comparative Assertion	Environmental claim regarding the superiority or equivalence of one product versus a competing product that performs the same function. *[Ref: ISO 14044]*
Core Impact Category	An impact category in which a product or system contributes to either observed or measurable impacts.
Climate Forcer (CF)	Any greenhouse gas (GHG), particulate, aerosol or other substance that contributes to either positive or negative radiative forcing associated with climate change.
Cumulative Risk Factor	A factor representing the dose-response relationship to increases in ambient background concentrations.
Damage	Diminishment of environmental quality or functionality (e.g., air quality, water quality, climate stability, ecosystem services).
Data Quality	Characteristics of data that relate to their ability to satisfy stated requirements *[Ref: ISO 14044].*
Data Quality Indicators	Qualitative indicators that reflect the overall data quality of LCI data and environmental characterization data. The specific parameters that apply to data quality indicators fall into one of four levels, where the highest level is Level 1 and the lowest level is Level 4.
Disturbance	A measurable or observed change in the composition and/or structure of the flora and fauna of a biome.
Effect	A change to human health or the environment.
Emission Loading	The fraction of total emissions associated with impacts, reported in a

[6] Farm Security and Rural Investment Act of 2002 (Public Law 107-17), "2002 Farm Bill", Section 9002.

	unit of mass.
Endpoint	Attribute or aspect of natural environment, human health, or resources, identifying an environmental issue giving cause for concern *[ISO-14044]* It is the final impact on the natural environment, human health or natural resource reserves that can be linked back to a stressor(s) through a defined environmental mechanism. * *(Also referred as "Category Endpoint")*
Environmental Characterization Data	Data used in the characterization step to establish the relevant environmental characterization factors for each selected category indicator.
Environmental Characterization Factor (E-CF)	A mathematical expression representing the scale, duration and severity and exceedance of threshold (if applicable), of the impact at a specific node in the stressor-effect network.
Environmental Declaration	Claim which indicates the environmental aspects of a product or service. *[Ref. 14025]* The findings of an LCA conducted in accordance with ISO 14025, ISO 14044 and this Standard, wherein the LCIA profile of a product or systems is compared to a reference baseline, along with a brief summary of the scope of work, unit operations used in the assessment, assumptions, a summary of LCI results and the characterization factors used to calculate category indicator results.*
Environmental Exposure Coefficient	A measurement of the cumulative human exposure over acceptable health thresholds to a pollutant emitted from a unit operation, for a given impact category.
Environmental Mechanism	The distinct physical, chemical, radiological or biological processes that link stressors to effects on human health or the environment.* (*Also referred to as "Environmental Impact Pathway."*)
Environmentally Preferable	A product or system that has lower environmental impacts than the reference baseline to which it is compared, without trade-offs in any impact category.
Environmental Relevance	The degree of linkage between a category indicator result and the category endpoint(s). *[Ref. ISO 14044, § 4.4.2.2.2]*
Functional Unit	Quantified performance of a product system for use as a reference unit. *[Ref. ISO 14044].* A unit of production or output against which category indicator results are normalized.*
Impact	A negative effect to human health or the environment, the depletion of resources or disturbance of natural ecological biomes.
Impact Category	Class representing environmental issues of concern to which life cycle inventory analysis results may be assigned *[Ref: ISO-14044].* Observed or measurable environmental or human health impact *
Impact Group	Impact categories with common or similar midpoints/endpoints or environmental mechanisms.
Impact Profile	The full set of category indicator results representing the environmental impacts of a product or system, normalized to a specific functional unit. *(Also referred to as "profile" or "eco-profile.")*
Input	Product, material or energy flow that enters a unit process . *[Ref. ISO 14044].*

Life Cycle	Consecutive and interlinked stages of a product, service or system, from raw material acquisition or generation from natural resources to final disposal.*
Life Cycle Assessment (LCA)	Compilation and evaluation of the inputs, outputs and environmental and human health impacts of a product, service or system throughout its life cycle.*
Life Cycle Impact Assessment (LCIA)	The LCA phase in which the magnitude and significance of the environmental and human health impacts of a product or system are evaluated throughout the life cycle, considering each node along the stressor-effects network.[7] *
Life Cycle Inventory (LCI)	The LCA phase involving the identification, compilation and quantification of inputs and outputs associated with a given product or system throughout its life cycle.*
Midpoints	A distinct node along a stressor-effects network representing an observed or measurable chemical, physical or biological change or level of impact that is linked to the final impact endpoint(s).
Node	The modeled representation of distinct, observed or measurable chemical, physical or biological changes within distinct environmental mechanisms.
Output	Product, material or energy flow that leaves a unit process . *[Ref. ISO 14044].*
Potential	a. The first node in a stressor-effect network b. A characterization factor used to establish the potency equivalency of stressors at the first node
Product	Any goods or service. *[Ref: ISO 14025]*.
Product Category	Group of products that can fulfill equivalent functions *[Ref: ISO 14025]*.
Product Category Rule (PCR)	A set of specific rules, requirements and guidelines for developing Type III environmental declarations for specific product categories *[Ref: ISO 14025]*. A Comparative PCR (C-PCR) establishes the minimum requirements for making comparisons within a product or system category.*
Program Operator	Body or bodies that conduct a Type III environmental declaration program. *[Ref. ISO 14025]*
Providing Environment	The locale from which resources are derived or extracted.
Receiving Environment	The air, water, soil, and ecosystems into which emissions and wastes are released, deposited, or reside.
Reference Baseline	The scenario against which a product or system is compared.
Resource Depletion	The degree to which the consumption of a natural resource results in a reduction in its reserve base or economic reserve that is irreversible within a timeframe relevant to human activities, taking into consideration such mitigating factors as resource recycling rates and

[7] At this phase, core impact categories, category indicators, and characterization models are selected (considering all nodes along the stressor-effects network), and inputs and outputs (including LCI results and impacts with no LCI corollary) are classified and characterized using S-CFs and E-CFs to calculate category indicator results.

	renewability.
Sensitivity Analysis	Systematic procedures for estimating the effects of the choices made regarding methods and data on the outcome of a study. *[Ref. ISO-14044]*
Stressor	Any life cycle inventory input, output, or physical activity associated with a product or system that can be linked to an effect.
Stressor Characterization Factor (S-CF)	A mathematical expression used to aggregate related stressors based on their relative potency with respect to a specific impact category. *(Also referred to as "Potency Factor")*
Stressor-Effects Network	A model used to represent an environmental mechanism, in which a chain of events or nodes links the inputs, outputs, and direct landscape alterations and biome disturbance associated with the life cycle of a product or system to impact endpoints. *(Also referred to as "Cause-Effect Chain")*
System	A complex set of industrial unit operations that are linked together to produce a product, provide a service, or fulfill a function. (Examples of industrial sector systems are regional power grids and steel production. Examples of service systems include building systems and telecommunications systems).
Third Party	Person or body that is recognized as being independent of the parties involved, as concerns the issues in question. *[Ref. ISO 14025]*
Threshold	A recognized environmental condition that, when exceeded, is linked to adverse environmental or human health effects.
Time Horizon	A specified timeframe within which stressors accrue toward projected threshold exceedances.
Ton	Metric ton (1,000 kilograms or 2,204.6 pounds).
Uncertainty Analysis	Systematic procedure to quantify the uncertainty introduced in the results of a life cycle assessment due to the cumulative effects of model imprecision, input uncertainty and data variability.*
Unit Operation	Group of linked unit processes in a given location that together perform a defined function
Unit Process	Smallest element considered in the life cycle assessment for which input and output data are quantified *[Ref: ISO 14044].*
Verification	Confirmation, through the provision of objective evidence, that specified requirements have been fulfilled. *[Ref: ISO 14025].*
Verifier	Person or body that carries out verification. *[Ref: ISO 14025].*

3.2. Abbreviations and Acronyms. The following abbreviations and acronyms are found in the Standard and its Annexes.

ACP	Annual Cooling Potential
AHTP	Annual Heat Transfer Potential
AOT60	Accumulated Ozone Concentration over Threshold (>60 ppb)
BAF	Bioaccumulation Factor
BC	Black Carbon
BCF	Bioconcentration Factor
BDF	Biome Disturbance Factor

BRF	Biome Recovery Factor
C	Consumption
$CaCO_3$	Calcium Carbonate
CAA	Clean Air Act
CANDU	Canadian Deuterium Uranium reactor
Carc.	Carcinogenic
CASTNET	Clean Air Status and Trends Network
CERCLA	Comprehensive Environmental Response, Compensation & Liability Act
CF	Climate Forcer
CFC	Chlorofluorocarbon
CFR	US Code of Federal Regulations
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide equivalents
COPC	Chemicals of Potential Concern
C-PCR	Comparative Product Category Rule
CREL	Chronic Reference Exposure Level
CRF	Cumulative Risk Factor
DBH	Diameter at Breast Height
DQI	Data Quality Indicator
DQR	Data Quality Rating
E-CF	Environmental Characterization Factor
EDIP	Danish LCIA Guidelines
EEA	European Environmental Agency
EEC	Environmental Exposure Coefficients
EIA	Energy Information Agency
EOT	Exceedance of Threshold
EBD	Environmental Building Declaration
EPA	US Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
EPOCA	European Project on Ocean Acidification
EPD	Environmental Product Declaration
EPP	Environmentally Preferable Product
ERL	Effects Range-Low
EU	European Union
g	Grams
GCP	Global Cooling Potential
GHG	Greenhouse Gas
GLO	Ground Level Ozone
GMT	Global Mean Temperature
GWP	Global Warming Potential
Ha	Hectare
HEF	Human Exposure Factor
HFC	Hydrofluorocarbons
HLRW	High Level Radioactive Waste

HYSPLIT	Hybrid Single Particle Lagrangian Integrated Trajectory model
IARC	International Agency for Research on Cancer
ILCD	International Life Cycle Reference Document
ILO	International Labour Organization
IPCC	Intergovernmental Panel on Climate Change
IRIS	Integrated Risk Information System
ISO	International Organization for Standardization
J	Joules
kg	Kilograms
km	Kilometer
K_{OC}	Soil adsorption coefficient
LCA	Life Cycle Assessment
LCI	Life Cycle Inventory Analysis
LCIA	Life Cycle Impact Assessment
LOEL	Lowest Observable Effect Level
m	Meter
MIR	Maximum Incidental Reactivity
NERC	North American Electric Reliability Corporation
NOAA	National Oceanic and Atmospheric Administration
NOEL	No Observable Effects Level
Non-Car.	Non-Carcinogenic
NO_2	Nitrogen Dioxide
NOx	Nitrogen Oxides
O_3	Ozone
ODC	Ozone Depleting Chemical
ODP	Ozone Depletion Potential
PAH	Polycyclic aromatic hydrocarbons
pCO_2	Partial pressure carbon dioxide
PCR	Product Category Rule
PD	Population Density
pH	Measure of acidity or basicity
PM	Particulate Matter
PO_4	Phosphate
ppm	Parts per million
ppb	Parts per billion
R	Reserve Base
RAINS	Regional Air Pollution Information and Simulation model
RCRA	Resource Conservation and Recovery Act
RDF	Resource Depletion Factor
RF	Radiative Forcing
RfC	Reference Concentration
RfD	Reference Dose
RWP	Regional Warming Potential
RMT	Regional Mean Temperature
S-CF	Stressor Characterization Factor

SDF	Species Depletion Factor
Se	Selenium
Seq.	Sequestered
SGWP	Steady-state Global Warming Potential
SO_2	Sulfur dioxide
SOx	Sulfur oxides
STRE	Surface temperature response per unit continuous emissions
TH	Time horizon
TO	Tropospheric Ozone
TRI	Toxic Release Inventory
TSA	Tropospheric Sulfate Aerosol
μg	Micrograms
μm	Micrometers
USGS	US Geological Survey
VOC	Volatile Organic Compound
W/m^2	Watts per meter squared
WHO	World Health Organization

4. Significance and Use.

This section summarizes the key objectives fulfilled by the Standard.

4.1. Complements the ISO-14044 LCA Framework. While ISO-14044 provides high-level guidance for the LCIA phase, additional guidance is needed to establish the complete set of environmentally relevant category indicators sufficient for public claims, such as Type III environmental declarations. This Standard provides further guidance to enable users to conduct LCA in a manner sufficiently rigorous to support Type III environmental declarations and related claims. This includes guidance on the iterative process involved in conducting an LCA, a description of data collection requirements, guidance on impact classification and characterization (e.g., spatial, temporal, potency, intensification), and calculation algorithms for each impact category. In addition, the framework supports comparative assertions by establishing environmentally relevant category indicators, accounting for impact midpoints and endpoints (including those that accumulate or intensify over time), and describing the necessary levels of data quality assessment.

4.2. Provides Standardized Protocols for the Public Reporting of Findings. The Standard sets out specific requirements for public environmental declarations and claims based on LCA. These requirements include, but are not limited to, compliance with ISO-14044 and with the specific additional guidance of ISO-14025 to provide accurate and complete life cycle impact profiling of products, systems and services.

4.3. Ensures that Public Claims are Backed by Comprehensive LCA. The Standard requires assessment and reporting of all core impact categories applicable to the product, system, service or reference baseline.

4.4. Supports Technology Neutrality. The Standard is technology-neutral. Environmental performance is documented for all core impact categories. Advantages and trade-offs against a reference baseline are made transparent.

4.5. Supports Tracking of Incremental Changes. The Standard allows for the tracking of incremental changes in impact levels over time in each impact category.

4.6. Adds Credibility and Full Transparency to Environmental Declarations. The LCIA framework accounts for all impacts to human health and environment, and provides guidance for comprehensive impact profiles of products, systems and services that include direct comparisons to reference baselines.

5. Summary of LCA Practice.

This section summarizes the LCA process. Further details pertaining to the LCIA phase are described in Section 6, while environmental characterization data needs, calculation algorithms and data quality requirements are provided in the Annex to this Standard.

5.1. Goal and Scope Definition. Goals, study scope and boundary conditions are established consistent with ISO 14044 guidance, including its requirements for comparative assertions, and should be sufficient to address products, systems and services and the reference baselines against which they will be compared. In general, all unit processes associated with the extraction of raw materials, processing of materials, transportation, energy inputs, manufacturing, use, distribution, recycling, reuse, waste treatment, and final disposition are included.

Product Category Rules (PCRs) established or adopted during the scoping process shall be developed consistent with the guidance provided in Section 8.1.4. PCRs address the common functionality issues of the product, system or service category.

5.2. Comprehensive Set of Impact Categories. To support comparative assertions that conform to ISO 14044, a comprehensive set of impact categories must be assessed. Impact groups are described in Table 1 (Section 5), while impact categories are listed in Table 3. They should be screened for their applicability to the product, system, or service, or to the reference baseline.

Before proceeding with the iterative LCA process described below, non-quantitative "hot spot" analysis should be conducted to identify those unit operations that screening or general knowledge would indicate are major contributors to specific impact categories. Such "hot spots" may not always be quantifiable, but can nevertheless provide critical information to be included in the environmental declaration as well as to point out the limitations of the impact profile.

Environmentally relevant category indicators are identified based on the stressor-effects network that represents the environmental mechanism for each impact category. A detailed discussion of indicators is contained in the Annex to this Standard. In some cases, there may be more than one active indicator per impact category. For example, there may be multiple rivers affected by a wood extraction operation, each of which may need to be accounted for separately (see Annex).

5.3. Functional Unit and Reference Baseline.

5.3.1. Selection of the Functional Unit. The functional unit is the unit of output or production of the product, system or service to which the final LCIA category indicator results are normalized.

5.3.1.1. Scale. The functional unit is the basis of comparison, and should be scaled to a level of production or operation relevant to the product, system or service or system being assessed. Sensitivity analysis should be used to determine whether the functional unit is appropriately scaled to yield all measurable indicator results. For example, scaling the functional unit to annual production levels may be required to yield meaningful indicator results.

5.3.1.2. Factoring in Enhanced Performance. The PCR should include equivalencies to account for differences in useful lifetime, durability or functionality among products, services or systems in a given category. This will allow users of this Standard to determine transparently how enhanced performance can influence the reported impact profile per functional unit for competing environmental declarations within the same category.

5.3.2. Establishing the Reference Baseline. The impact profiles of competing products, systems or services can be compared to a common reference baseline. The following types of reference baselines are recognized by this Standard:

- **Historic Impact Baseline.** This type of baseline represents the past performance of the same product, service or system being assessed. The historic timeframe represented by this baselines shall be disclosed. Comparisons to this type of baseline can only be used to demonstrate improvements, and must disclose any coresponding impact trade-offs. Comparisons to historic baselines shall not be used to imply superiority of competing products.

- **Averaged Impact Baselines (Products and Service Only).** This type of baseline differs from a single reference product baseline, and is used when the objective is to allow competing products, systems or services to be compared to a single baseline. This baseline represents the averaged impact level established separately for each category indicator, based on representative sampling within the product, service or system category. The sample used for such baselines shall be representative of the product, service or system category, and the sample size shall not be fewer than three. All representative sampling should be transparently disclosed to the user of the declarations.

- **Direct Comparative Assertion Baselines.** This type of baseline represents the impact profile of a competing product, service or system against which the impact profile of a given product, service or system is compared on an indicator-by-indicator basis.

- **Standard Practice or Standard Design System Baselines.** The complexity of many systems (e.g., buildings) may make the use of averaged impact baselines cumbersome or impractical. In such cases, standard practice or design parameters that would typically be applied to the system can serve as the reference baseline. Such is the case for building declarations that compare proposed "green" building practices with other design options.

5.4. Iterative LCA Process. ISO-14044 describes LCA as an "iterative" assessment process. Likewise, the 2010 ILCD Handbook, "General Guide for Life Cycle Assessment —Detailed Guidance,", states: "In order to achieve the required precision with the minimum necessary effort, it is recommended to collect data and select external data sources in an iterative manner."[8] This iterative approach applies to all three LCA phases covered by this Standard, as shown in Figure 1: goal and scope definition, LCI, and LCIA.[9] The optional life cycle interpretation phase described in ISO 14044, which allows for the use of weighting factors and may permit unjustified aggregation of category indicators, introduces a high level of subjectivity and significantly reduces transparency, and is therefore not considered suitable for comparative assertions or included in this Standard.

Here, the iterative process calculations are incorporated into the interface between the LCI and LCIA phases. This iterative process has been made possible through the refinement and completion of the LCIA framework, which includes protocols to establish environmentally relevant category indicators for the impact categories listed in Table 3 (Section 6). These impact categories reflect global, regional and local impacts to human health and environment, depletion of natural resources and disturbances to ecological systems. This iterative process starts with LCI data that can be readily integrated with characterization factors to produce initial category results. Through sequential iterations, the inventory and environmental data collection can be streamlined to target those unit operations with actual "on-the-ground" impacts (Figure 1).

[8] According to ILCD Handbook (pg. 25), "… the first iteration may use generic or average data for the background and also many parts of the foreground system … This can be combined with expert judgment to identify the key processes and elementary flows of the product system. The main effort of data collection and acquisition can thereby be focused on the relevant parts of the system."

[9] In so doing, this Standard seeks to address an issue in conventional LCA practice in which the iterative process has been largely confined to the LCI phase. The unintentional result of this limitation has been to overemphasize the LCI phase in terms of the application arbitrary cut-off rules for data collection, over-aggregation of results, and use of category indicators with little or no environmental relevance as defined in ISO 14044.

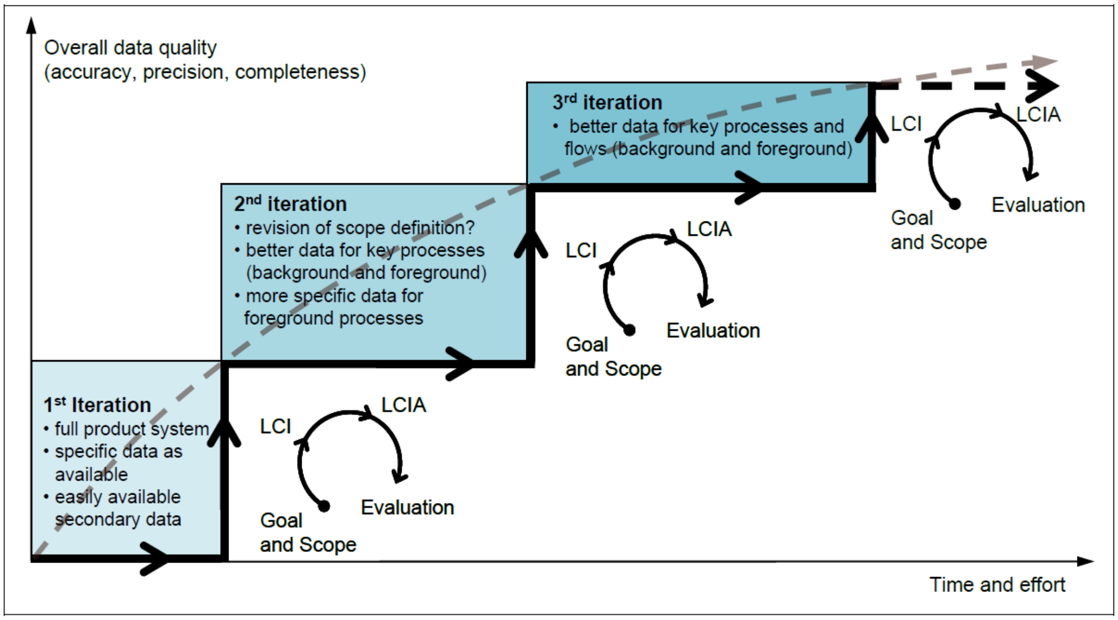

Figure 1. Iterative Process. "Iterative nature of LCA (schematic). LCAs are performed in iterative loops of goal and scope definition, inventory data collection and modeling (LCI), impact assessment (LCIA), and with completeness, sensitivity and consistency checks (Evaluation) as a steering instrument. This is done — with a possible, limited revision of the goal and scope — until the required accuracy of the system's model and processes and the required completeness and precision of the inventory results has been attained." *[Caption and figure from Figure 4, 2010 ILCD Handbook, General Guide for Life Cycle Assessment — Detailed Guidance.]*

5.5. Initial Iteration. Initial inventory and environmental data (required primarily for E-CFs) should be collected for each unit process consistent with the scope, using the integrated iterative process for LCI, classification, and characterization described herein (Section 6). Category indicator results should be calculated using Annex A. If site-specific inventory or environmental data are unavailable for the initial iteration, generic LCI and characterization factors may be used as an approximation as long as the general spatial and temporal conditions are factored into these calculations.

During the first iteration, the category indicator results should be compiled in a preliminary summary of category indicator results by unit operation, and should remain unaggregated. This allows for selective elimination of irrelevant inventory data at the unit operation level and the exclusion of unit operations that cannot contribute to the impact profile. Sensitivity analysis should be applied before eliminating either LCI data or unit operations from further assessment.

5.5.1. Life Cycle Inventory. During this initial data collection stage, readily available inventory data are collected for unit operations as a first approximation. The geographic locations of unit operations that measurably contribute to a regional and local category indicator result should be included. Standard sensitivity analysis tools should be used prior to collection of additional site-specific data or the inclusion of more geographic locations. This includes contribution analysis of LCI and category indicator results to determine the contribution from a single unit operation to the total category indicator for the product, system or service under assessment.

LCI cut-off rules should not be used to streamline inventory data collection, because such cut-offs may result in a failure to account for certain category indicators due to low inventory mass thresholds. For example, toxic chemical emissions may fail to meet an LCI-based cut-off percentage, even though their impacts even at low levels may be significant relative to regional impact thresholds. Toxic chemical emissions are often reported in small quantities and should be screened using standard LCIA methods (see Annex A) at the unit operational level before being eliminated from consideration.

5.5.2. Life Cycle Impact Assessment. In most cases, the iterative process will serve as a filter to narrow the impact categories listed in the scope to a "core" subset of categories. Core impact categories are defined as those categories in which there are observed or measurable impacts.

As part of the LCIA phase, it is important to identify those impact categories that are linked to LCI results (mass and energy inputs and outputs) as well as those impact categories that have no corresponding LCI data sets, such as impacts from direct land use (Table 1 and Annex A).

In order to proceed through the LCIA iterative process, indicators should be narrowed down to core impact categories at the unit operational level, using "hot spot" analysis as described above. This analysis involves identifying unit operations located in highly polluted locations, associated with significant land use or occupation, using significant non-renewable resources, producing toxic emissions or using toxic chemicals, creating hazardous wastes or having unit operations linked to upstream unit operations with similar issues. For example, unit operations with measurable NOx emissions located in highly polluted airsheds should be included because of the probability of contributing to category indicator results. Upstream unit operations linked to electricity grids from regions with little or no regulations should be assumed to be linked to high impacts and should also be included at this initial stage.

The basic iterative steps for producing an LCIA profile sufficient for environmental declarations, claims of environmental preferability and carbon footprint profiles are classification and characterization.

5.5.2.1. Classification. The general ISO 14044 LCIA rules of classifying LCI results into their relevant impact categories should be followed. Classification generally can be completed during the initial iteration since all LCI results should be assigned to appropriate impact categories. Care should be taken to ensure that LCI results are classified to all of their appropriate impact categories, particularly those with serial and parallel environmental mechanisms. For example, just as NOx is typically classified to both ground level ozone and eutrophication impact categories CO_2 should be assigned to global climate change, ocean acidification and ocean warming to reflect parallel and serial environmental mechanisms.

5.5.2.2. Characterization. Initially, this step is the first approximation of the characterization, involving the establishment of characterization factors required to calculate category indicator results (Annex A), which are then compiled into an impact profile. Most stressor characterization factors found in Annex A can be used on a generic basis, but environmental characterization factors may require site or region-specific data. It may be necessary to collect regional or even site-specific environmental data in order to establish even initial category indicator results.

During this first iteration, those unit operations linked to possible measurable regional and site specific impacts should remain disaggregated in order to determine if midpoint or endpoint impacts have been observed or are measurable within the domain of the relevant unit operation.

5.5.3. Analysis of First LCA Iteration. For a given unit operation, the core impact categories and their respective category indicators from the total listed impact categories found in Table 3 can be eliminated from further evaluation if one of the following conditions exist.

- There are no corresponding inventory results linked to the category indicator.
- There are no observable or measurable midpoints or endpoints linked to the specific inventory result for the unit operations assessed, based on characterization factors found in or derived from Annex A.
- The initial category indicator result was found to have a value less than 1 in the reported minimum unit of measure in Table 3. This elimination step should be used only after the completion of the data quality step.

5.6. Second Iteration of LCA. The second iteration involves data quality analysis. If high degrees of uncertainty are found for indicator results for unit operations remaining after the first iteration, it may be necessary to collect additional site specific LCI and environmental data in order to support an accurate overall LCIA profile of the product. Specific environmental data sets to establish the necessary characterization factors can be found in Annex A. The steps in Sections 5.5.1 and 5.5.2 should then be repeated, replacing generic data with collected data and evaluating the resultant data quality. Iterative steps should be repeated until a level of certainty can be established that meets the goals of the LCA. If additional data sets are unavailable or beyond the budget of the assessment, data quality analysis can be used to document the limitations of the impact profile to provide full transparency of uncertainties.

5.7. Final Iteration of LCA. After completing the category indicator calculations derived from the LCI results, it is important to set up a screening process to investigate the potential for impacts associated with impact categories that have no corresponding LCI (mass/energy) results, such as land use ecological impacts. For example, wood products derived from forest extraction can be assumed to involve land use ecological impacts that have no corresponding LCI results.

At this point, it may be necessary to collect site and region-specific data in order to complete the LCIA. Annex A provides specific guidance on how best to calculate these related impacts. As described in the Annex, this process can be simplified by making certain informed assumptions and still support meaningful category indicator results.

This step can be challenging for indirect and upstream processes used by the industrial process under assessment. For example, the land use ecological impact group linked to regional electricity with high percentages of hydropower, wind, biomass, solar or mountaintop removal coal mining may be associated with high land use ecological impacts. On the other hand, regional electricity grids more associated with high percentages of nuclear, coal from shaft mining or natural gas typically have lower land use related impacts. Sensitivity analysis can be used to exclude upstream impact sources before pursuing assessment of such upstream unit operations and their related impacts. If there are no observable or measurable midpoints or endpoints for category indicators that have no corresponding LCI results linked to the unit operations assessed, the impact category can be eliminated.

5.8. Calculating the Impact Profile. Category indicator results at the unit operations levels are additive and yield overall indicator results for the product, service or system. The LCIA impact profile is the summation of category indicator results across all active unit operations – i.e., unit operations with observed or measurable effects – for the product, system, or service.

6. LCIA Technical Framework

This section describes the LCIA technical framework applied in this Standard.

The LCIA framework described herein is based upon guidance in ISO 14044. The framework includes:

1) groups of impact categories with similar endpoints (Table 1);
2) lists of all major impact category categories with observable or measurable environmental mechanisms (Table 3);
3) procedures to establish the environmental relevance of category indicators based upon modeled stressor-effects networks; and
4) guidance regarding the acquisition of the necessary types of environmental data with sufficient accuracy and availability to support environmental declarations and associated public claims.

6.1. Impact Groups. Impact categories are assigned to one of six groups (Table 1).

Table 1. Grouping of Impact Categories

Group	Description
1. Resource Depletion	Impacts associated with the extraction of raw material resources for the production of products, materials and energy.
2. Land Use Ecological Impacts	Impacts on flora and fauna that are caused by biophysical changes imposed at a landscape level during the lifecycle of the product, service or system.
3. Impacts from Greenhouse Gases and Black Carbon	Impacts related to greenhouse gases and black carbon associated with products, services or systems. These impacts include global and regional (Arctic) climate change, oceanic warming, and ocean acidification.
4. Emissions Linked to Regional Environmental Impacts	Regional environmental impacts related to emissions associated with products or systems. Such emissions can be linked to multiple environmental endpoints.
5. Emissions Linked to Human Health Impacts	Impacts on human health caused by emissions associated with products or systems. Such emissions can be linked to multiple human health endpoints.
6. Untreated Hazardous Waste Impacts	Risks to the environment or human health associated with hazardous wastes that are not adequately treated or are untreatable, and that have the potential to breach containment over the toxicity lifetime of the wastes.

6.2. Major Impact Categories. Impact categories are established whenever observed or measurable midpoints or endpoints can be identified and characterized from distinct environmental mechanisms, and modeled by their corresponding stressor-effect networks.

6.2.1. Environmental Mechanisms. Each impact category and associated category indicator represents a distinct environmental mechanism – i.e., the physical, chemical, radiological or biological processes that link the product or system to effects on human health or the environment. Figure 2 shows an example of an environmental mechanism – in this case, regional acidification.

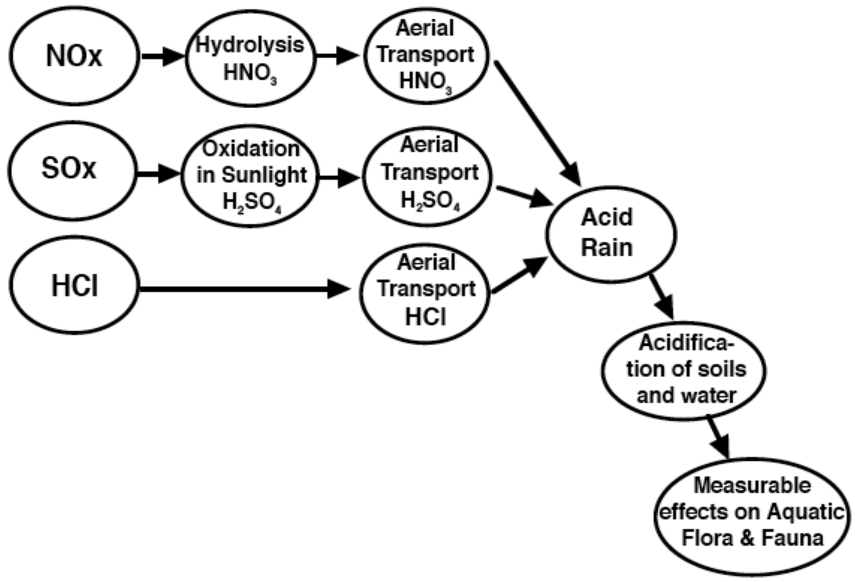

Figure 2. Example of an Environmental Mechanism: Regional Acidification

6.2.2. Stressor-Effects Networks. In turn, each environmental mechanism is modeled as a unique stressor-effects network. A stressor-effects network is a model of the impact pathway, or chain of events, that links the inputs, outputs, and landscape alteration activities associated with a product or system to their respective endpoint impacts. Each modeled node in this network is a "potential," a "midpoint" or an "endpoint," depending on its position within the pathway. The stressor-effects network starts with the stressor that initiates the environmental mechanism. In the case of Figure 2, the NO_X, SO_X and HCl emissions are the stressors, expressed as equivalency potentials (Node 1).

The current models of stressor-effects networks for each impact category are found in the Annex A. An example – the stressor-effects network for the regional acidification impact category – is shown in Table 2.

Table 2. Example of Stressor-Effects Network: Regional Acidification

Node	Characterization of the Node	Environmental Relevance (Strength of Linkage to Endpoints)	Types of Environmental Data Required to Calculate Results at this Node
1 (Potentials)	Total strong acid (i.e., proton) emissions, expressed in SO_2 equivalents	No Environmental Relevance	• Relative Acid Strengths
2 (Midpoint)	Atmospheric dispersion of strong acids	No Environmental Relevance	• Dispersion modeling data
3 (Midpoint)	Deposition into receiving environments that exceed their buffering capacities	Moderate Environmental Relevance	• Dispersion modeling data • Ground monitoring data • Mapping of areas of exceedance
4 (Midpoint)	Accumulated deposition leading to changes in pH of water bodies and soils	High Environmental Relevance	• Ground monitoring data • Contribution of specific emissions to pH changes in specific water bodies – No environmental data available
5 (Multiple Endpoints)	Various endpoint effects (e.g., changes to vegetative composition, fish kills)	Endpoint	• Contribution of specific emissions to endpoint effects — No environmental data available

A "potential," by definition, has no direct link to the endpoint effect and, thus, has no environmental relevance. Subsequent midpoint and endpoint nodes are mapped to represent distinct levels of disturbance or damage along the environmental mechanism, with levels of environmental relevance characterized as none, low, medium or high. A more detailed discussion of environmental relevance is included in Section 6.3 below.

6.2.3. List of Major Impact Categories. The major impact categories to be considered are shown in Table 3. This table also indicates whether site or regional characterization is required, summarizes the environmental relevance of the corresponding category indicators (as discussed in Section 6.3 below), and shows the minimum units of measure required to calculate results. The nomenclature used to identify impact categories represents their corresponding endpoints.

Table 3. Impact Categories by Group, Site or Regional Characterization Requirements, Environmental Relevance of the Corresponding Category Indicators, & Minimum Units of Measure

Impact Groups and Impact Categories	Site or Regional Data and Characterization Required	Degree of Environmental Relevance[10]	Minimum Unit of Measure
Resource Depletion Group			
Energy Resource Depletion (Biotic/Abiotic)	Yes	Moderate	Eq. Gigajoules
Water Resource Depletion	Yes	High	Gallons or liters
Minerals and Metals Resource Depletion (by type)	No	High	Kilograms (by material)
Biotic Resource Depletion (by type)	Yes	High	Established by biotic source
Land Use Ecological Impact Group			
Terrestrial Biome Disturbance	Yes	Moderate	Eq. 100% acres disturbed*years
Fresh Water Biome Disturbance	Yes	Moderate	Percentage of total biome disturbed*years
Riparian/Wetland Biome Disturbance	Yes	Moderate	Eq. 100% acres disturbed (non-linear)* years
Loss of Key Species (by species)	Yes	High	% loss of populations*years, or eq. 100% acres disturbed of suitable habitat*years
Impacts From GHG/BC Emissions Group			
Global Climate Change	No	High	Eq. kilograms carbon dioxide (CO_2e)
Arctic Climate Change	Yes	High	Eq. kilograms of carbon dioxide
Ocean Acidification	No	Moderate	Kilograms of carbon dioxide (CO_2)
Ocean Warming	No	High	Eq. kilograms of carbon dioxide (CO_2e)
Regional Environmental Impacts From Emissions Group			
Regional Acidification	Yes	Moderate	Eq. kilograms of sulfur dioxide (SO_2)
Stratospheric Ozone Depletion	No	Moderate	Eq. kilograms of CFC-11
Ecotoxicity	Yes	High	Eq. kilograms 1,4-dichlorobenzene
Eutrophication	Yes	Moderate	Eq. kilograms phosphate (PO_4) or kilograms of BOD or COD
Human Health Impacts From Emissions Group			
Ground Level Ozone	Yes	High	Persons * ppm ozone * hours
PM 2.5	Yes	High	Persons * eq. μg PM 2.5 / m^3* hours
Toxic Emissions – Effects from Inhalation (Chronic, Non-Carc.)	Yes	Moderate	Persons * eq. μg benzene / m^3
Toxic Emissions – Effects from Inhalation (Carcinogenic)	Yes	Moderate	Persons * eq. μg benzene / m^3
Indoor Air Toxic Emissions – Inhalation	Yes	Moderate	Person-hours * eq. μg formaldehyde / m^3 above ½ CREL
Toxic Emissions – Effects from Ingestion (Chronic, Non- Carc.)	Yes	Moderate	Eq. μg methylmercury (MeHg)
Toxic Emissions – Effects from Ingestion (Carcinogenic)	Yes	Moderate	Eq. μg Arsenic V
Risks From Untreated Hazardous and Radioactive Waste Group			
Risks from Radioactive Wastes	Yes	Moderate	Eq. Becquerels
Risks from Hazardous Wastes (by type)	Yes	Moderate	Established by waste stream

Table Abbreviations: Eq. is equivalent; PM stands for particulate matter; ppm is parts per million; CREL is the California Office of Environmental Health Hazard Assessment's Chronic Reference Exposure Limit; μg is microgram

[10] The degrees of environmental relevance reported in this table is discussed further under each impact category in the Annex. The degree of environmental relevance is based on the strength of the linkage of the result at the indicator node to the endpoint.

Indicator results should not be reported in units less than those listed in this table; results less than 1 reported in these minimum units are considered to be not environmentally relevant and should not be included in the final impact profile (see Section 5.5.3).

Impact categories with no known or measurable midpoints/endpoints shall not be listed.[11] Under certain circumstances, additional category indicators may be required to represent the range of observed impacts for a single impact category. For example, forest extraction practices can affect several rivers and watersheds that must be reported as separate category indicator results under the river biome disturbance impact category.

As discussed in Section 5, the list of impact categories is not be limited by the LCI phase since many impacts do not have corresponding LCI results. Instead, if active midpoints or endpoints can be identified, and corresponding impact categories shall be listed and included in the impact assessment.

6.3. Environmental Relevance

6.3.1. Establishing Environmentally Relevant Category Indicators. Category indicators represent the stressor-effects nodes at which impact levels associated with the product, service or system are measured. Category indicators are linked to the intensity, duration and scale of the corresponding midpoints or endpoints along the modeled stressor-effects network. The degree to which a category indicator accurately reflects the impact contributions of a product, service or system to these midpoints or endpoints determines the indicator's degree of environmental relevance, consistent with ISO 14044 standard.

According to the international standard, the environmental relevance of a category indicator is determined by degree of linkage to its respective endpoints. The closer the selected indicator is linked to the endpoint, the higher the environmental relevance of the selected indicator. This selection of category indicators lies at the heart of the characterization levels achieved within the LCIA phase. The types, uncertainty and availability of environmental characterization data limit the degree of environmental relevance that currently can be achieved for a selected category indicator.

The environmental relevance of category indicators that can be achieved given the current limitations in types, accuracy and availability of environmental data is

[11] Ionizing radiation is a classic example of a phantom impact category that has no known midpoint or endpoint. This impact category is promoted as measuring the ionization radiation exposures from nuclear power plants that pose risks to surrounding populations. Aside from catastrophic releases from the three major nuclear power failures in the US, Russia and Japan, no measurable ionization radiation is emitted from normal nuclear plants operations that could cause any measurable risks, which are not included in the representations of ionizing radiation. In fact, the ionization radiation exposure from flying from New York to Bonn Germany is 40,000 higher than the lifetime ionization radiation exposure from someone standing at the gate of a nuclear power plant.

summarized in Table 3 above, and addressed further in Annex A. As more accurate and new levels of environmental data become available, practitioners are encouraged to move to higher levels of environmental relevance for a given category indicator.

Environmental Relevance

Excerpts from ISO 14044:2006

§ 4.4.2.2.2 — Environmental relevance encompasses a qualitative assessment of the degree of linkage between category indicator result and category endpoints; for example high, moderate or low linkage.

§ 4.4.2.2.4 — The environmental relevance of the category indicator or characterization model should be clearly stated in the following terms:

a) the ability of the category indicator to reflect the consequences of the LCI results on the category endpoint(s), at least qualitatively;

b) the addition of environmental data or information to the characterization model with respect to the category endpoint(s), including

– the condition of the category endpoint(s),

– the relative magnitude of the assessed change in the category endpoints,

– the spatial aspects, such as area and scale,

– the temporal aspects, such as duration, residence time, persistence, timing, etc.,

– the reversibility of the environmental mechanism, and

– the uncertainty of the linkages between the category indicators and the category endpoints.

Annex A presents the current modeling of each impact category with its appropriate stressor-effects network, along with the degree of environmental relevance of its category indicator in accordance with ISO 14044 § 4.4.2.2.2. For each stressor-effects network, guidance is also provided on the types, accuracy and current availability of environmental data that limit the overall degree of environmental relevance that can be achieved by each category indicator.

6.3.2. Environmentally Relevant Units of Measure. While establishing the overall environmental relevance of selected category indicators has been widely accepted in practice, the selection of the unit of measure is as important as determination of the environmental relevance of the selected indicator. In order for a selected unit of measure to be environmentally relevant, it should be scaled to the size, duration and intensity of the measurable midpoint or endpoint. Often the unit of measure can be based on regulatory reporting units of measure that have already incorporated these factors into an amount that could affect the scale of impacts associated with a given impact category. For example, Stratospheric Ozone Depleting Chemicals (ODCs) are regulated as kilograms because kilograms of emissions are required to affect the concentration of stratospheric ozone. Reporting grams or micrograms of these ODCs is not considered an environmentally relevant category indicator result.

The scale of a given category indicator result is dependent upon the selection of the functional unit; therefore, sensitivity analysis should be used to scale the functional unit to determine if the indicator results yield significant, measurable results. For example, the choice to scale a product to its annual production volume can be used to determine whether the indicator result reaches measurable levels of impact.

6.4. Establishing Environmentally Relevant Characterization Factors. Two types of characterization factors shall be used to calculate indicator results — stressor characterization factors (S-CFs) and environmental characterization factors (E-CFs).

6.4.1. Stressor Characterization Factor (S-CF). An S-CF represents the relative potency of individual stressors that contribute to a common endpoint. The S-CF establishes an equivalency among these stressors, making it possible to aggregate inventory results to establish Node 1 "potentials."

6.4.2. Environmental Characterization Factor (E-CF). For category indicators at Node 2 or higher, E-CFs are applied to characterize both the receiving environments and providing environments. E-CFs allow the integration of four types of environmental characterization data:

- *Temporal Characterization* – accounting for the duration, residence time, persistence, and timing of onset.
- *Spatial Characterization* – accounting for the geographic areas affected by the identified stressor-effect network.
- *Characterization of Severity of Damage, Depletion or Disturbance* – measuring the intensity of a specific midpoint or endpoint.
- *Threshold Characterization* – accounting for the degree to which established human health and environmental threshold(s) have been or are projected to be exceeded.

7. Data Quality Assessment

This section describes the protocols required to conduct the overall data quality assessment and to establish data quality ratings to support Environmental Declarations and related public claims.

7.1. Data Quality Indicators. Ten data quality indicators (DQIs) shall be applied to assess the inventory and environmental characterization data. These DQIs, summarized in Table 4, are based upon the ten data quality requirements described in ISO 14044.

Consistent with the process outlined in the 2010 ILCD Handbook, the DQIs for LCI data and environmental characterization data are interdependent. For example, LCI data that do not measurably contribute to LCIA category indicator results have lower data quality requirements.

Data quality performance parameters should be established for each of the DQI categories (columns 2 and 3 of Table 4), similar in nature to performance levels used in LCA databases.[12]

7.2. Overall Data Quality. The overall level of data quality achieved shall be established based on the following DQIs: time-related coverage, geographic coverage, technology coverage, completeness, reproducibility, sources of data, precision, and uncertainty. The remaining DQIs – representativeness and consistency – shall be factored in separately.

7.3. Data Quality Ratings. Once the overall data quality is calculated, the average level of data quality achieved shall be rated from 1 to 4, where the highest level (Level 1) is the most exacting, derived from Level 1-4 ratings used by EcoInvent in the maintenance of its LCI database. Average data quality ratings for these data must be Level 1 or 2 in order to support environmental declarations and public claims.

[12] See Table 7.4, Swiss Centre for Life Cycle Inventories, EcoInvent Report No. 1, “Overview and Methodology, Data v2.0” (2007), Edited by Rolf Frischknecht and Niels Jungbluth.. Guidelines for data quality evaluation in the U.S. LCI Database (NREL) are in draft form at the time of the writing, but may also suitable for use (Athena Institute and the National Renewable Energy Laboratory). See “U.S. LCI Database Overview and Data Submission Requirements. Version (DRAFT) 2.” (2010).

Table 4. Data Quality Indicators Applied to this Standard

DQI Category	LCI DQIs required in this Standard	Environmental Data DQIs required in this Standard
Time related (temporal) coverage	Age of data and the length of time for which data is collected	- Age of data. - Duration and intensification of linked midpoint and endpoint effects. - Time of year of linked midpoint and endpoint effects. - Time horizons over which potential exceedances of threshold (EOTs) may occur.
Geographical (spatial) coverage	Location of the unit processes	Location of the unit processes and geographic boundaries of the linked midpoints and endpoints.
Technology Coverage	Technology or combination of technologies that perform a defined function.	Technology or combination of technologies that perform a defined function.
Precision	Measure of the variability of data values for LCI data points	Measure of the variability of data values for environmental characterization data.
Completeness	Percentage of LCI data collected that meets the specified data quality levels.	Percentage of environmental characterization data collected that meets specified data quality levels.
Representative-ness	Qualitative assessment of degree to which LCI dataset reflects the true population of interest (e.g., geographical coverage, time period, and technology coverage).	Qualitative assessment of degree to which the environmental characterization dataset reflects the true population of interest (e.g., geographical coverage, time period, and technology coverage).
Consistency	Qualitative assessment of whether the LCI methodology is applied uniformly to the various components of the analysis.	Qualitative assessment of whether the LCIA methodology is applied uniformly to the various components of the analysis.
Reproducibility	Extent to which LCI results can be reproduced by other accredited practitioners.	Extent to which environmental characterization data and indicator results can be reproduced by other accredited practitioners.
Sources of data	Transparency of data sources used for the LCI datasets, supported by documentation.	Transparency of data sources used for the environmental characterization datasets, supported by documentation.
Uncertainty	Uncertainty of the LCI datasets.	Uncertainty analysis of the environmental characterization datasets.

8. Environmental Declarations and Related Claims.

This section describes declarations and claims based on LCA, and the minimum requirements for each.

8.1. Environmental Declarations (comparative and non-comparative). The purpose of Environmental Declarations is to provide a transparent summary of the environmental and human health impacts associated with a product, service or system, and to provide the basis for fair, comprehensive marketplace claims and comparisons. Consistent with this goal, each declaration shall, at a minimum, meet the requirements of ISO 14025 and present the impact profile of the product or system studied, based on LCA conducted in accordance with this Standard.

8.1.1. Types of Declarations. The following declarations may be developed in accordance with this Standard:

8.1.1.1. Environmental Product Declaration (EPD) – A declaration of the impacts associated with a product (or service) over its lifetime.

8.1.1.2. Comparative Environmental Product Declaration (C-EPD) – A declaration of the impacts associated with a product (or service) over its lifetime compared to a reference baseline (see Section 5.5.4.4.).

8.1.1.3. Environmental System Declaration (ESD) – A declaration of the impacts associated with entire industrial systems and not specifically focused on specific products. For example, an **Environmental Building Declaration (EBD)** is a declaration of impacts associated with a building over its lifetime, including impacts associated with construction and materials, landscape alteration, energy consumption, the functionality of the building and its occupants over the projected service life of the building, and end-of-life.

8.1.2. Sustainability Declarations are Not Allowed – Annex A includes impact categories with oncoming thresholds that, if exceeded, will affect the fundamental carrying capacity of the planet. Product, services or systems that make incremental reductions in their impact profiles are not appropriately scaled to affect these projected thresholds. Therefore, attempts to link incremental improvements (LCIA indicator reductions compared to reference baselines) to claims of long-term sustainability under any form of sustainability declarations are considered misleading and are not supported by this Standard.

8.1.3. Reporting Requirements. Consistent with ISO 14025, all environmental declarations shall be accompanied by the following information:

- name and description of organization making the declaration;
- description of product;
- product identification (e.g. model number);
- name of the program, the program operator's address, and if relevant, logo

and website;
- product category rule (PCR) identification (see 8.1.5 below);
- publication date and period of validity;
- data from LCA, LCI or information modules;
- additional environmental information;
- content declaration covering materials and substances to be declared (e.g., information about product content, including specification of materials and substances that can adversely affect human health and the environment, in all stages of the life cycle);
- information on which stages are excluded from assessment, if the declaration is not based on an LCA covering all life cycle stages;
- statement that environmental declarations from different programs may not be comparable; and
- information on where explanatory material may be obtained.

In addition to the above requirements, the declaration shall include:
- the functional unit;
- key assumptions;
- a description of the reference baseline (if comparative); and
- a data quality assessment.

8.1.4. Comparative Declaration Requirements. All comparative declarations must conform to the requirements for comparability specified in ISO-14025, including:
- identical functional unit;
- equivalent system boundaries;
- equivalent description of data;
- identical criteria for inclusion of inputs and outputs;
- equivalent data quality requirements;
- identical units of measure;
- equivalent LCI data collection methods;
- identical LCI calculation procedures;
- equivalent allocation procedures;
- identical impact reporting categories;
- equivalent environmental data collection procedures;
- identical LCIA procedures;
- equivalent material and substance declarations;
- equivalent instructions for creating the data;
- equivalent declaration format;
- equivalent scope of study; and
- equivalent period of validity.

Care should be taken to ensure that the declarations are brief and include only information that are environmentally relevant. All misleading information and marketing information should be excluded from the declaration.

8.1.5. Product Category Rules (PCRs). Product category rules (PCRs) shall be established for each product, service or system category and for the reference baselines to be used. Such PCRs shall set the scope of assessment by establishing functionality and any functional equivalencies by product, service or system category.

Care should be taken before setting a product category definition to ensure that the complete function has been included. For example, tile or carpets are parts of flooring systems with very different functionalities. Before attempting to set up separate PCRs for carpet or tile components for such flooring systems, it is important to include the intent of the environmental declaration. If the intent is to compare carpet to tile, then the entire flooring system must be compared and not limited to component comparisons.

PCRs should not be used to reset and limit the LCA requirements of either ISO 14044 or the technical requirements of this Standard. PCRs shall require that impact profiles be completed in conformance with ISO 14044 and shall be presented within the declaration format in a place of prominence with other information being provided as support information. PCRs should not be developed that promote the benefits of LCA but do not provide full disclosure of LCIA results.

8.2. Public Claims Derived from LCA

8.2.1. Environmentally Preferable Product (EPP) Claim. Environmentally Preferable Product (EPP) claims are based on comparative environmental product declarations that demonstrate environmental superiority in a product (or function) category defined by a PCR. An EPP claim shall only be applicable for use when all category indicator results represented on the impact profile are lower than or equal to corresponding indicators in the reference baseline. Quantification of the exact level of impact reduction achieved is not required for each impact category, provided that there is sufficient evidence to prove that the impact levels do not exceed the established reference baseline for the category.

8.2.2. Carbon and Climate Footprinting. The purpose of this section is to apply these LCA protocols to amend and build upon existing standards for accounting for greenhouse gases and black carbon.

- For claims related to products or systems, all protocols in this standard framework shall be used.

- For claims related to entities, the Climate Registry General Reporting Protocol (GRP) or the equivalent should be followed for the scoping of: 1) organizational boundaries; 2) operational boundaries; 3) facility-level reporting; 4) updating the base year; 5) transitional reporting; and 6) historical reporting. However, in terms of the gases to be reported, quantification of methods, and scoping of upstream processes, the LCA protocols in this standard framework shall be used to supplement the GRP.

8.2.2.1. Carbon Footprint Profile. The Carbon Footprint Profile is a summary of the indicator results of a product, system, or entity in the four impact categories related to greenhouse gases and black carbon. This profile is reported in tons of CO_2e (or simply CO_2, for ocean acidification) for each impact category.

8.2.2.2. Carbon or Climate Footprint Reduction. A Carbon Footprint Profile can be supplemented, where warranted, with claims of a reduction when compared to a reference baseline (see below). The Arctic Climate Change shall not be an active core impact category if such a claim is to be made.

Two types of claims related to reductions are recognized, which can apply to products, services, or entities:

- *Climate Footprint Reduction.* This claim can be used if a reduction in the Global Climate Change indicator result can be documented against a reference baseline.
- *Carbon Footprint Reduction.* This claim can be used if a reduction in Global Climate Change, Ocean Acidification, and Ocean Warming indicator results can be documented against a reference baseline.

For products or services, the reference baseline can be any of the baselines described in Section 5.3.2 of this Standard. For entities, an internal reference baseline shall be used, set against a base year selected in accordance with GRP protocols. The reduction is reported in tons of CO_2e (or CO_2, for ocean acidification), or as the percent change from the reference baseline by impact category. Reductions should not reported at a gram or kilogram basis.

8.2.2.3. Carbon or Climate Neutrality. Claims of an absolute level of carbon or climate neutrality allowed under this Standard are meant to supplement carbon or climate footprint reduction claims for products, services, or entities. Offsets may only be included if it has been demonstrated that best available practices have been implemented (for a given product or system category) to reduce emissions of greenhouse gases and black carbon, commensurate with the resources and size of the entity. An additional requirement for these claims is that Arctic Climate Change is not an active core impact category.

Two claims are recognized:

- *Climate Neutral Product, System, or Entity.* This claim is allowed when indicator results, adjusted for acceptable offsets, are less than or equal to zero in the Global Climate Change impact category.
- *Carbon Neutral Product, System, or Entity.* This claim is allowed when indicator results, adjusted for acceptable offsets, are less than or equal to zero within the Global Climate Change, Ocean Acidification, and Ocean Warming impact categories.

For all claims, offsets must occur in the same timeframe (defined as less than one year from the beginning of the activity) as the activity being offset. Only offsets that meet the required protocols of this standard are acceptable.

8.2.2.4. Net Carbon Storage Claims. This claim applies to products, systems, or entities, with direct net sequestration of CO_2. Carbon storage constitutes an acceptable source of offset credits in this standard. Additionally, Arctic Climate Change cannot be an active core impact category.

9. Accreditations Applicable to Third-Party Verifiers.

This section summarizes the qualification for third-party certifiers to this Standard.

Third-party practitioners conducting assessments, quantifying results and verifying data for Environmental Declarations and related claims intended for public use should, at a minimum, be accredited to ISO/IEC Guide 65 (or current) third-party verification body protocols *[Ref: ISO/IEC Guide 65].*

Third-party practitioners verifying data for climate programs should, at a minimum, be accredited to ISO 14065 *[Ref: ISO 14065]*.