Introduction to Life Cycle Assessment methodology and Standards

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Part 1: Introduction to life cycle assessment methodology

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Disclaimer

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Life Cycle Assessment

An **industrial** environmental management approach to look **holistically and comprehensively** at products, processes, and activities.

Life Cycle Assessment is…

- The identification and quantification of natural resource usage and releases to the environment across all stages of the life cycle;

- The assessment of the potential environmental impacts of these material uses and releases;

- The identification of opportunities to reduce environmental burdens and achieve system-wide improvements.
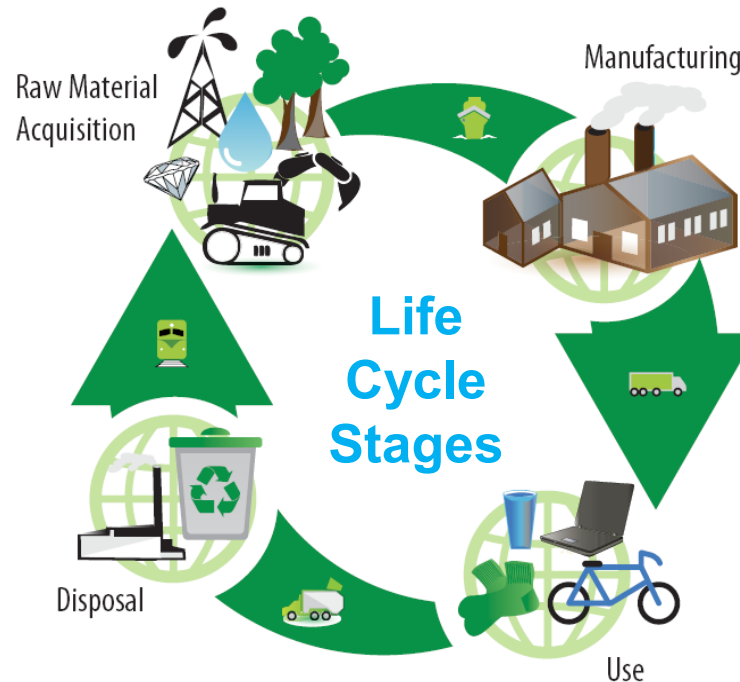
What is LCA Used For?

The results of an LCA can be used for many purposes, for example:

- Product comparison ("Comparative Assertion" is required by ISO to undergo peer review).
- Develop a baseline of environmental and human health consequences associated with a given product, process or activity.
- Identify opportunities for system improvement.
- Policy development (private and public).
- Provide the basis for eco-labeling.
- Etc.

LCA: Four Steps

Goal & Scope Definition:
- Determine the scope and system boundaries

Life Cycle Inventory:
- Data collection, modeling & analysis

Impact Assessment:
- Analysis of inputs/outputs using category indicators
- Group, normalize, weight results

Interpretation:
- Draw conclusions
- Checks for completeness, contribution, sensitivity analysis, consistency w/goal and scope, analysis, etc.

Life cycle assessment framework
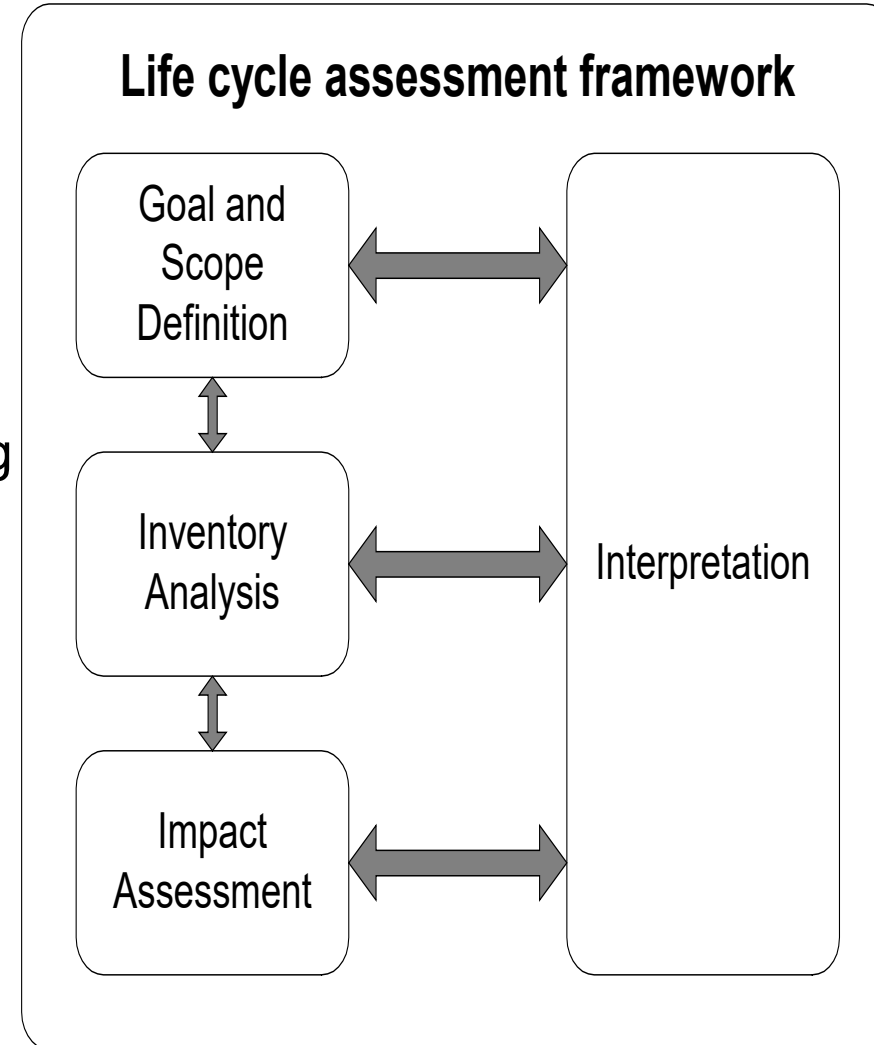
A clearly defined goal:

- Determines the scope of the study
- Sets the boundaries and scale
- Identifies the product or process function
- Sets the Functional Unit (important for comparing equivalent systems).
- Defines the level of data detail & quality

HOW DO THEY COMPARE?

- CRISP
- SWEET
- PEEL IS PERFECTLY EDIBLE
- MAKES GREAT PIE
- CIDER

- JUICY
- TANGY
- ZEST FROM PEEL GOOD FOR RECIPES
- MAKES GREAT MARMALADE
- OJ

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Life Cycle Inventory: Data Selection and Computation

- LCIs are generally a mix of:
  - Primary "foreground" data from the processes that make the product or process unique
  - Secondary "background" data, generally from existing LCI sources
- Data quality requirements should be specified
- Ranges should be collected, not just averages, where possible
- Needs to be comprehensive without "cut-offs" or truncation unless specified by other standard as acceptable
- Application of assumptions, rules of exclusion, etc., must be transparent.

Some "background" data providers…

Life Cycle Impact Modeling: Midpoints and Endpoints

Emissions (CO_2, Methane, CFCs, N_2O, etc.)

GWP Characterization Factors:
$CO_2 = 1$ $CH_4 = 25$ $N_2O = 298$

GhG's calculated as CO_2-equivalents

MIDPOINT measures Global Warming Potential (GWP)

Increased global warming can lead to **ENDPOINTS**

Spread of Disease

Drought, Crop Loss, etc.

Increased Severe Weather

Coastal Area Damage

Marine Life Damage

Loss of Species
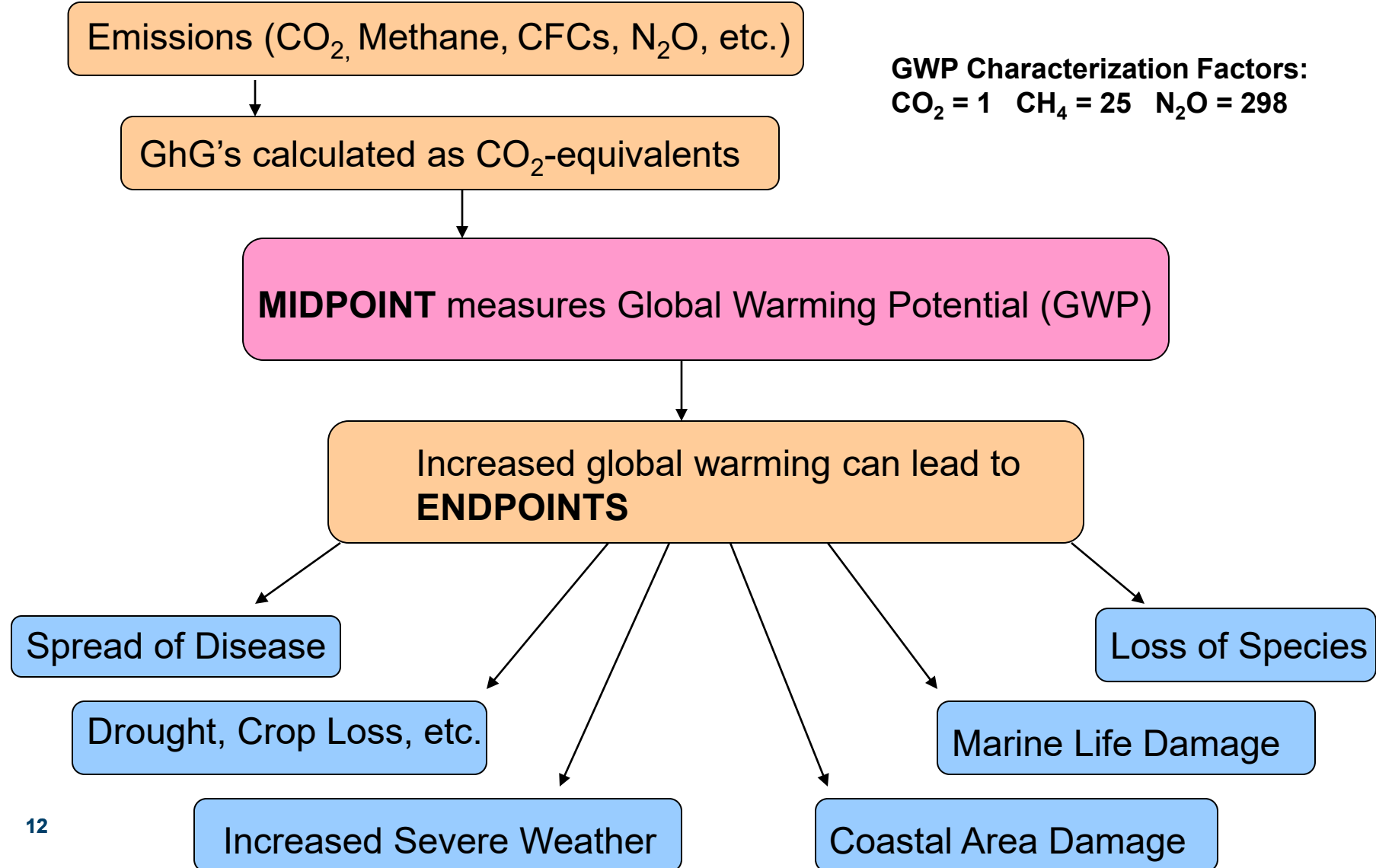
Life Cycle Impact Categories
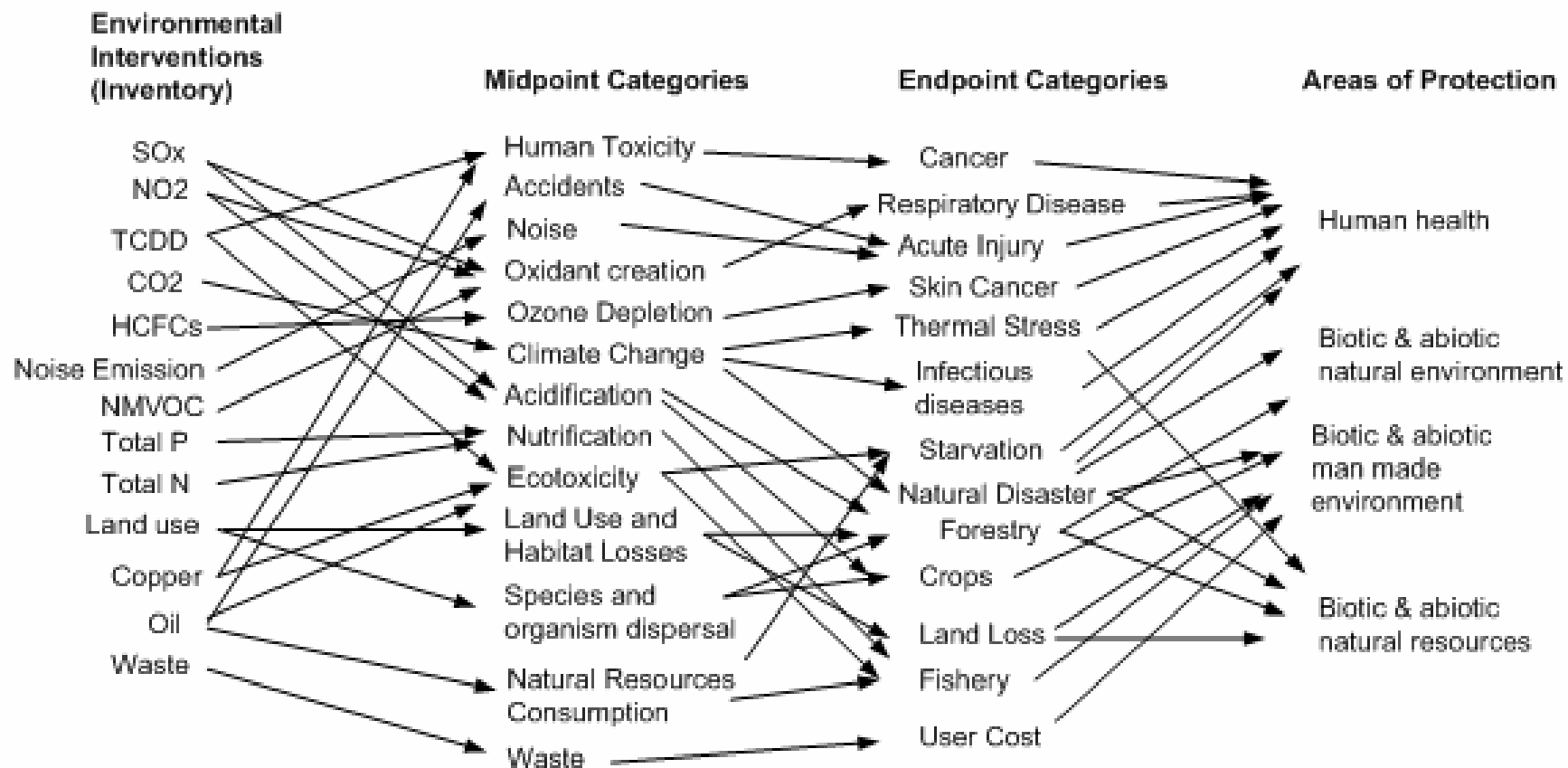
Interpretation

- Pair LCIA and LCI results with:
  - Data quality score evaluation
  - Sensitivity/uncertainty assessment
  - Scenario analysis

- Describe limitations

- Draw conclusions

Acknowledgments

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Part 2: LCA Standards

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Taxonomy of Life Cycle Assessment (LCA) standards

Overarching standard

Sector & product agnostic standards and Guidance

Sector specific Guidance / Product Category Rules

Less specific

More specific

Rule and guideline related to

- Definition of product system, function unit and system boundary (minimum list of processes)

- Data sources, quality and guidelines

- Mandatory and complementary impact categories
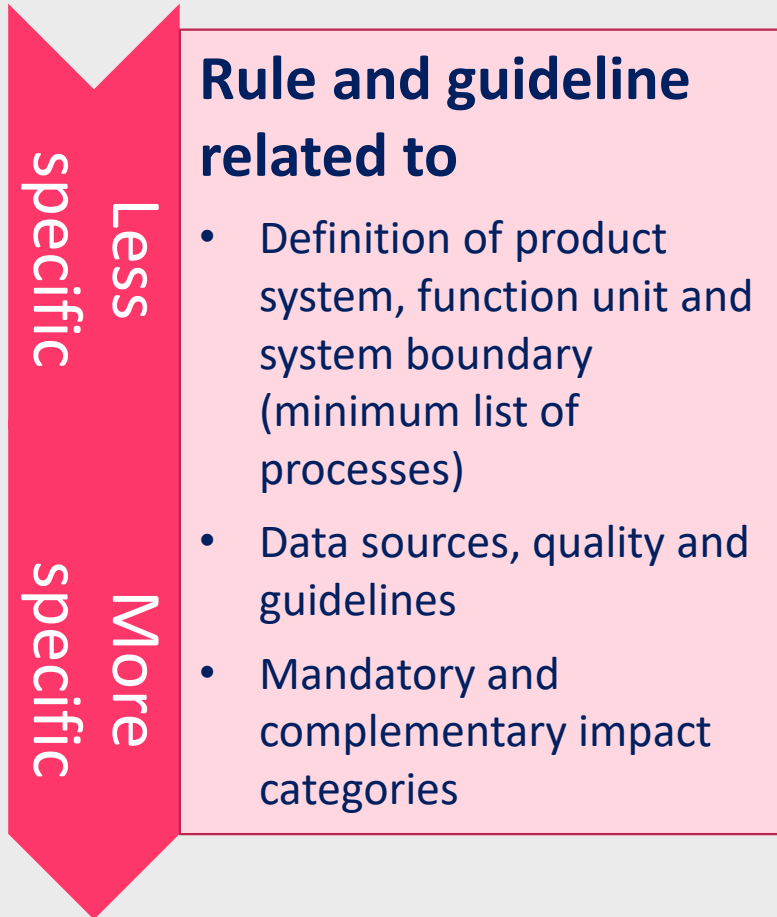
Other questions to consider:

- Aim of the standard (Provide guidance and/or support comparability of the results)

- Type of environmental impact assessment (Greenhouse Gases only or other types of environmental impacts

Taxonomy of LCA standards

Overarching standard	ISO **14040** and **14044** series

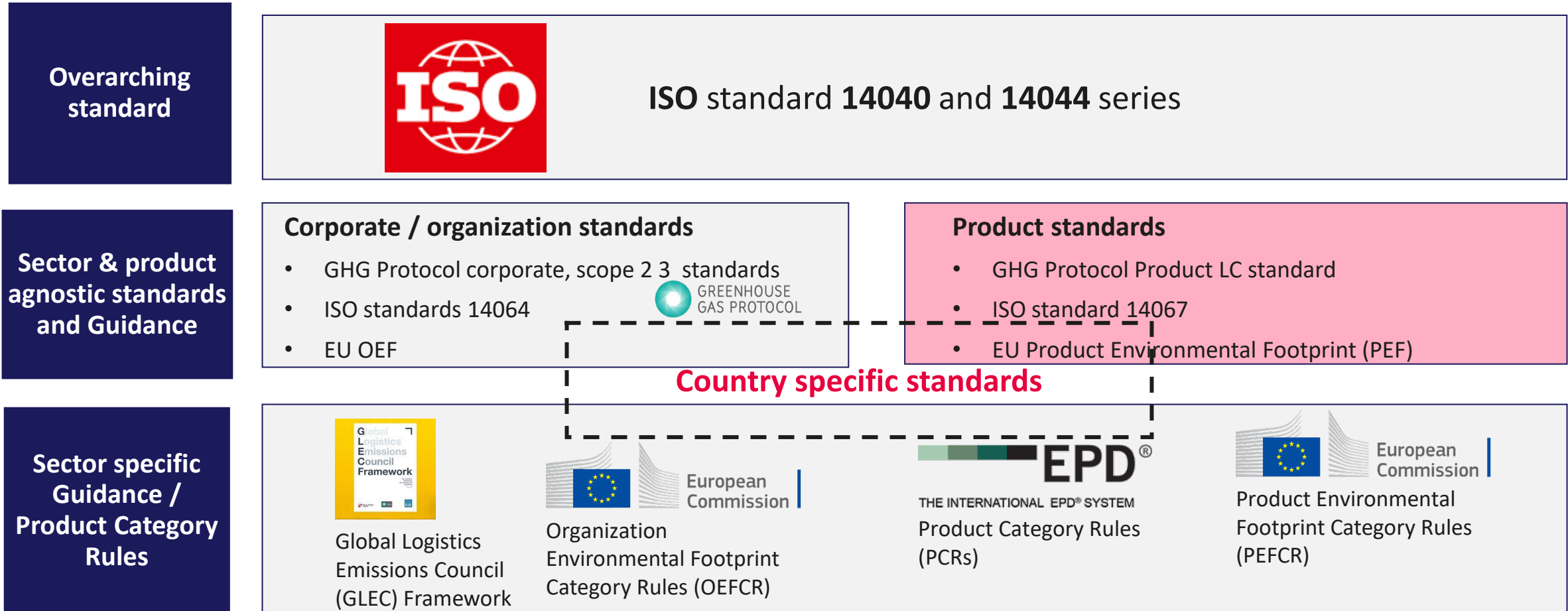|	
Sector & product agnostic standards and Guidance	**Corporate / organization standards** • GHG Protocol corporate, scope 2 3 standards • ISO standards 14064 • EU OEF	**Product standards** • GHG Protocol Product LC standard • ISO standard 14067 • EU Product Environmental Footprint (PEF)

Country specific standards

Sector specific Guidance / Product Category Rules	Global Logistics Emissions Council (GLEC) Framework — Organization Environmental Footprint Category Rules (OEFCR) — Product Category Rules (PCRs) — Product Environmental Footprint Category Rules (PEFCR)

ISO 14040 LCA standards

ISO 14040 series is the foundation and leading international standards on life cycle assessment (LCA).

ISO 14040 provides the guidelines and principles for conducting life cycle assessment studies
- The definition of four phase of LCA (goal and scope, life cycle inventory and impact assessment, interpretation)
- reporting and critical review of the LCA,
- limitations of the LCA, relationship between the LCA phases, and conditions for use of value

ISO 14040 **describes the "principles and framework for LCA"**
ISO 14044 **"specifies requirements and provides guidelines" for LCA.**

- All future Standards and Guidance are built according to the ISO standard 14040:2006
- ISO 14040 LCA standard is applicable to LCA studies at products, organization (or country) level

Overarching Standard

Corporate/ Organization Standards and Guidance (1/2)

Corporate/organizational LCA standards provide requirements and guidance for companies and other organizations to quantify and report on their environmental impacts.

**The GHG Protocol is the most widely used GHG accounting guidance**

- GHG Protocol is convened jointly by **WBCSD and World Resources Institute** (WRI)

- **It supplies the world's most widely used GHG accounting standards**

  - The Corporate Accounting and Reporting Standard provides the accounting platform for virtually every corporate GHG reporting program in the world

  - **92% of Fortune 500 companies** responding to the CDP claim to **use GHG Protocol** directly or indirectly.
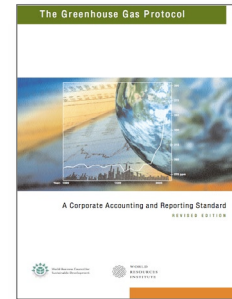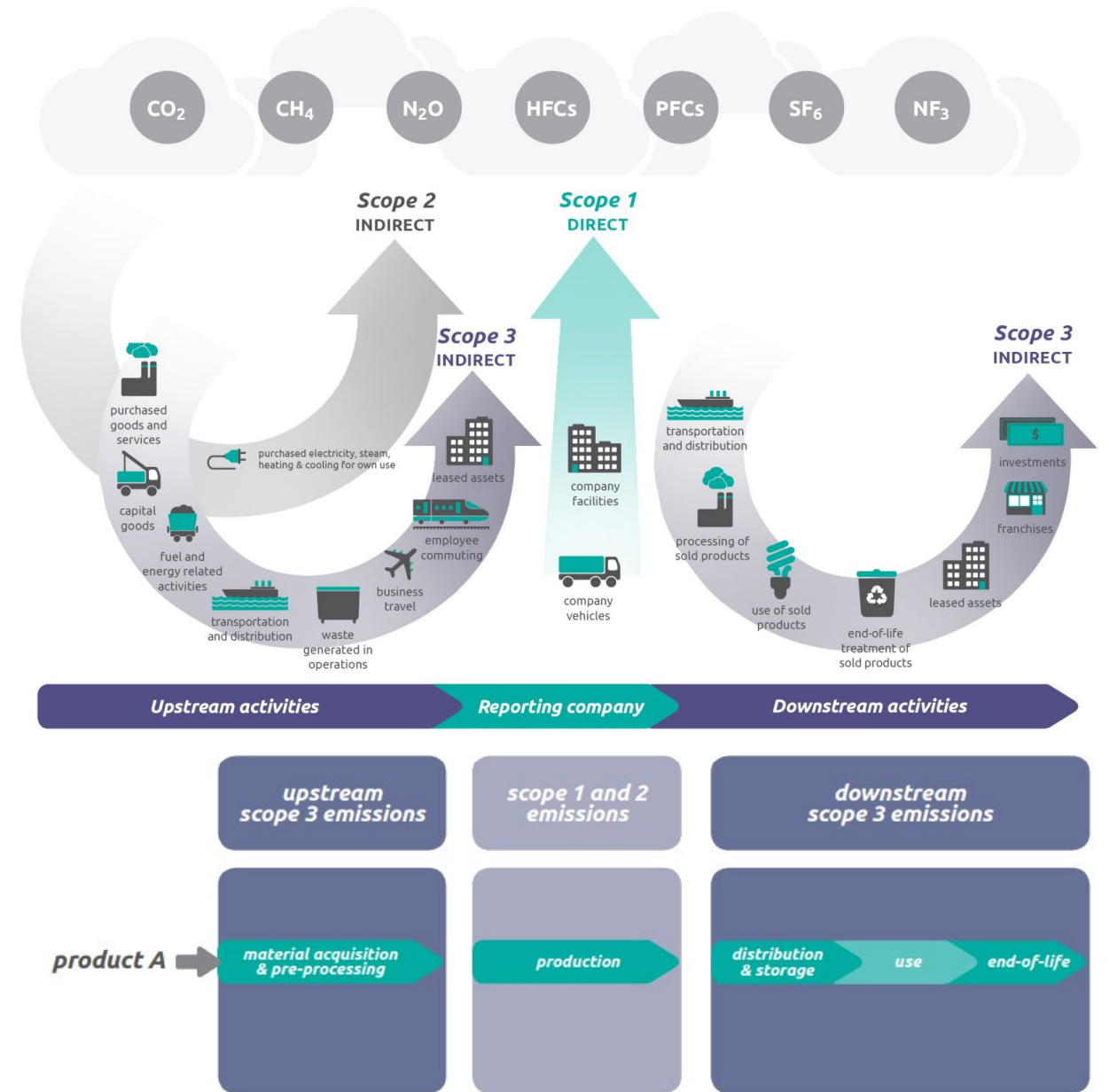
Corporate Standard

Scope 2 Guidance
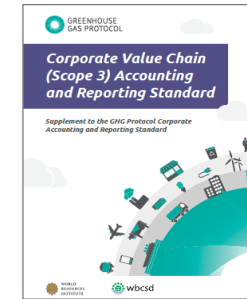
Corporate Value Chain (Scope 3) Standard

GREENHOUSE GAS PROTOCOL

Sector agnostic standards

Greenhouse Gas Protocol
Scope 1, 2 3 and product life cycle

- **Scope 1 emissions** are direct greenhouse (GHG) emissions that occur from sources that are controlled or owned by an organization
- **Scope 2 emissions** are **indirect emissions** from the generation of purchased energy (**electricity, steam, heating and cooling**) consumed by the organization
- **Scope 3 emissions** includes all other indirect emissions that occur in a company's value chain, both upstream and down-stream

Sector agnostic standards/ Guidance

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Corporate/ Organization Standards and Guidance (2/2)

ISO 14064

- Provides the principles and requirements at organization level for the quantification and reporting of greenhouse gas (GHG) emissions and removals.
- The ISO 14064 series is GHG programme neutral. If a GHG programme is applicable, requirements of that GHG programme are additional to the requirements of the ISO

European commission Orgnaizational Environmental Footprint (OEF)

- detailed and comprehensive technical guidance on how to conduct an Organizational environmental study in any sector
- Envisage the development of additional OEFSRs in complement to the more general guidance in order to further increase methodological harmonisation, specificity, relevance and reproducibility for a given sector
- Consideration of other types of environmental impacts in addition to GHG (e.g. acidification)

Sector agnostic standards/ Guidance

Product standards and Guidance

- *Product standards and Guidance provide general framework and guidance for companies and other organizations to quantify and report on the environmental impacts of products and services. A few existing sector agnostic standards and Guidance for LCA at product level*

ISO standard 14067

GHG Protocol Product LC standard

Product Environmental Footprint (PEF) by EC

PAS 2050 (UK)
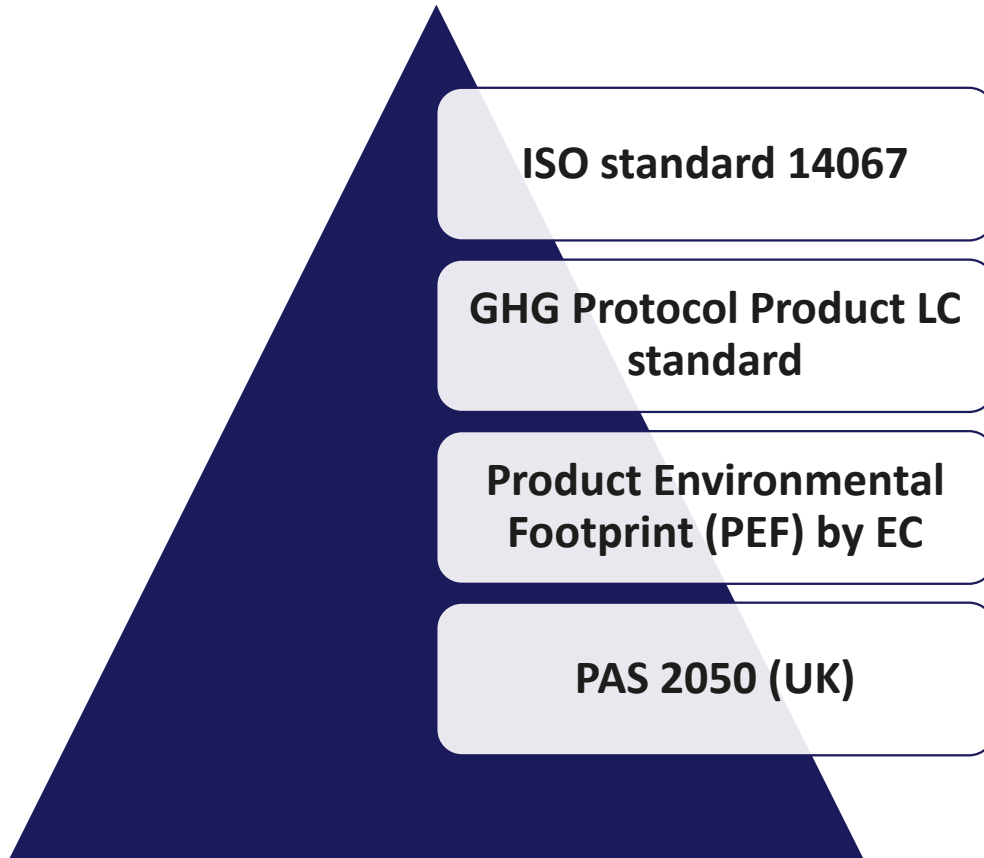
- All these standards are compliant with ISO 14044:2006

- While these standards provide more specific guidance to calculate products / service environmental footprint (e.g. in terms of definition of system boundary, allocation, life cycle impact assessment methods), they leave significant room for interpretation e.g. in terms of product specific/ sector system boundary, data quality and exact allocation rules.

- Such standards (GHG Protocol, PEF) envisage the use of sector- and organization-specific rules to provide more product- and sector-related rules

Product Category Rules / Sector specific Guidance

Product Category Rules (PCRs) complement the product (and corporate) standards by providing product- and sector-specific rules and add further requirements where the product standards provides several choices:

- Functional unit
- minimum list of processes and life cycle stages (system boundary)
- Data quality guidelines (Data quality (quality and source of data, both secondary and primary)
- Allocation in the case of multi-functional processes
- Mandatory and complementarity impact categories

Product rules support comparability of environmental claims through providing a set of product specific consistent rules

The two main guidance on Product specific guidance are
- Product Category Rules (PCRs) by EPD international
- Product Environmental Footprint Category Rules (PEFCRs) by European commission

There are other sector and product specific recommendation, guidance, and best practices published by industry associations, NGOs
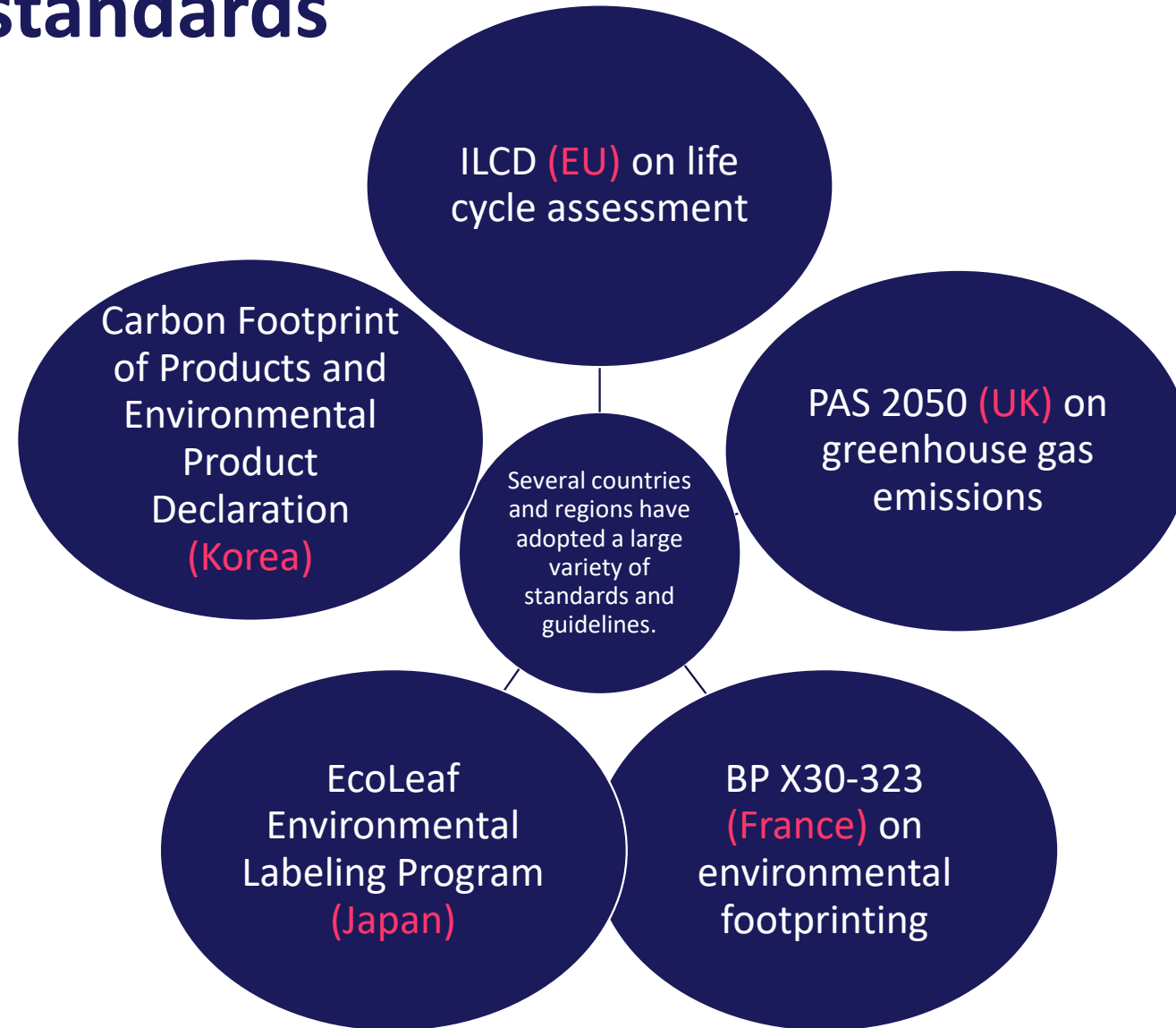
Combined standards and guidelines

Only GHG
GHG programme neutral

GHG and other environmental impacts
Proprietary internal rules

Publisher	Organizational standard / Guidance	Product Standard / Guidance	Sector specific Standard / Guidance (examples)	Applicable Product-specific standard / Guidance	Application
European Commission	Organizational Environmental footprint	Product Environmental Footprint (PEF)	Organisation Environmental Footprint Sector Rules (OEFSRs)	Product Environmental Footprint Category Rules (PEFCRs)	EU
GHG Protocol (WRI/WBCSD)	GHG Protocol Corporate, Scope 2 and Scope 3 Standards	GHG Protocol Product Life cycle Standard	• Agriculture Guidance • Global Logistics framework (GLEC) • Land Sector and Carbon Removal Guidance	Product Category Rules*	Global
ISO	**ISO 14064:** principles and requirements for the quantification, monitoring, reporting, verification and validation of activities to reduce greenhouse gas emissions or of ways to enhance removal, at the organization and project level	**ISO 14067** on the carbon footprint of products	**ISO 20915:2018** Life cycle inventory calculation methodology for steel products	**ISO 22526 parts 1, 2, 3 and 4 on** carbon footprint and removals for biobased plastics Product Category Rules	Global

* PCRs mostly include other environmental indicators but the rules can be used for GHG assessment

Country specific standards

ILCD (EU) on life cycle assessment

Carbon Footprint of Products and Environmental Product Declaration (Korea)

Several countries and regions have adopted a large variety of standards and guidelines.

PAS 2050 (UK) on greenhouse gas emissions

EcoLeaf Environmental Labeling Program (Japan)

BP X30-323 (France) on environmental footprinting

Many Country specific standards are adopted and accepted at a global scales, e.g. PAS 2050.

Questions?

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