

PETRONAS TECHNICAL STANDARDS

HEALTH, SAFETY AND ENVIRONMENT

GUIDELINE

LIFE CYCLE INVENTORY - CARBON FOOTPRINT ACCOUNTING

PTS 60.3207

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This revision of PTS 60.3207 – Life Cycle Inventory - Carbon Footprint Accounting (March 2011, Revision 0) has been developed to incorporate PETRONAS Lessons Learnt, Best Practice and new information issued by relevant industry code and standards.

The custodian of this PTS is: Manager - HSE MS, Standards & Regulations, GHSED.

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1.0 INTRODUCTION

1.1 BACKGROUND

The global market place is increasingly demanding science-based, verified and comparable information about the environmental performance of products and services. Life Cycle Assessment (LCA) is becoming more and more recognised as the most advanced method for obtaining such information on a quantitative, comparable basis. LCA is internationally standardized in the ISO 14040 series.

The table below illustrates the relationship of the ISO 14000 standards series to a product system.

Using Environmental Declaration and Claims 	Conducting Life Cycle Assessment 	Understanding the Standards 
ISO 14020 This document provides general principles which serve as a basis for the development of ISO guidelines and standards on environmental claims and declarations	ISO 14040 This document provides general principles, framework and methodological requirements for the LCA of products and services	ISO 14050 This document helps an organization to understand the terms used in the ISO 14000 series standards
ISO 14021 This document provides guidance on the terminology, symbols and testing and verification methodologies an organization should use for self declaration	ISO 14041 This document provides guidance for determining the goal and scope of an LCA study, and for conducting a life cycle inventory ISO 14042 This document provides guidance for conducting the life cycle impact assessment phase of an LCA study	
ISO 14024 This document provides the guiding principles and procedures for third-party environmental labeling certification programs	ISO 14043 This document provides guidance for the interpretation of results from an LCA study	
ISO /TR 14025 This document provides guidance and procedures on a specialized form of third-party environmental labeling certification using quantified product information labels	ISO / TR 14047 This document provides illustrative examples on how to carry out Life Cycle Impact Assessment ISO / TR 14048 This document provides information regarding the	

	formatting of data to support life cycle assessment	
	ISO / TR 14049 This document provides examples that illustrate how to apply the guidance in ISO 14041	ISO Guide 64: 1997 This document helps the writers of product standards to address environmental aspects in those standards.

Table 1: Relationship of ISO 14000 standards series to a product system.

Life Cycle Assessment (LCA) is a technique to assess the environmental aspects and potential impacts associated with a product, process, or service throughout its life cycle, by:

- i. Compiling an inventory of relevant energy and material inputs and environmental releases
- ii. Evaluating the potential environmental impacts associated with identified inputs and releases
- iii. Interpreting the results to help decision-makers make a more informed decision.

LCA can also be used:

- i. To identify opportunities to improve environmental performance of a products at various points of their life cycle
- ii. For marketing as in promoting an environmental claim, eco-labelling scheme or environmental product declaration.

The LCA process is a systematic, phased approach and consists of four components: goal definition and scoping, inventory analysis, impact assessment, and interpretation as illustrated in Figure 1:

1. Goal Definition and Scoping - Define and describe the product, process or activity. Establish the context in which the assessment is to be made and identify the boundaries and environmental effects to be reviewed for the assessment.

2. Inventory Analysis (or Life Cycle Inventory (LCI)) - Identify and quantify energy, water and materials usage and environmental releases (e.g., air emissions, solid waste disposal, waste water discharges).

3. Impact Assessment - Assess the potential human and ecological effects of energy, water, and material usage and the environmental releases identified in the inventory analysis.

4. Interpretation - Evaluate the results of the inventory analysis and impact assessment to select the preferred product, process or service with a clear understanding of the uncertainty and the assumptions used to generate the results.

LCA can be resource and time intensive. Depending upon how thorough an LCA the user wishes to conduct, data gathering can be problematic. The availability of data can greatly impact the accuracy of the final results. Therefore, it is important to weigh the availability of data, the time necessary to conduct the study, and the financial resources required against the projected benefits of the LCA.

LCA will not determine which product or process is the most cost effective or works the best. Therefore, the information developed in an LCA study should be used as one component of a more comprehensive decision process assessing the trade-offs with cost and performance.

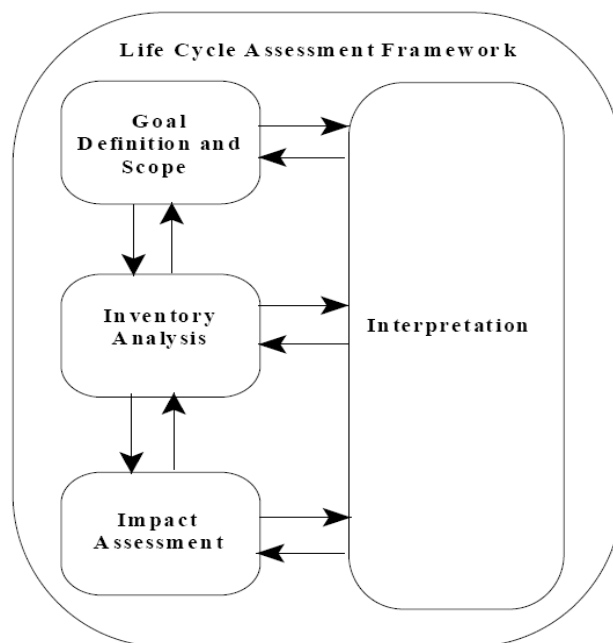


Figure 1: Phases of an LCA (source ISO 1997)

1.2 OBJECTIVE OF THIS GUIDELINE

This Document will only focus on the second component of the LCA i.e. the Inventory Analysis or Life Cycle Inventory (LCI).

This document is aimed to provide step by step guidance for products processed / manufactured and distributed by PETRONAS Group of Companies in establishing their carbon footprint using the LCI methodology for communication to Management as part of the decision making process and marketing strategy. Results will be used primarily to reduce carbon footprints of products. It may also be considered to support application for eco-labeling.

1.3 LIFE CYCLE INVENTORY

A life cycle inventory is a process of quantifying energy and raw material requirements, atmospheric emissions, waterborne emissions, solid wastes, and other releases for the entire life cycle of a product, process, or activity.

An inventory analysis produces a list containing the amount of energy and material consumed and the quantities of pollutants released to the environment. The results can be segregated by life cycle stage, media (air, water, and land), specific processes, specific component (e.g. carbon, heavy metals etc.), or any combination thereof. LCI result reflecting carbon emission is termed Carbon Footprint.

LCI serves as a basis to evaluate comparative environmental impacts or potential improvements.

LCI analysis can benefit an organisation in various ways:

- i. For products or processes comparison and considering environmental factors in material selection.
- ii. As a form of Corporate Social Responsibility (CSR) as it enables other industries to make references when they develop their product LCI

- iii. A marketing tool for products competitiveness in the business arena. E.g. The Carbon Border Adjustment (CBA) allows countries to apply penalty in the form of a tariff or obligation to purchase carbon credits on imports from countries which practice less stringent carbon emission standards.
- iv. To identify opportunities to improve environmental performance of a product at various points of their life cycle
- v. To showcase environmental performance. E.g. as found in the Annual Reports or specific Environmental / Sustainable Reports of major international companies (Japan and EU are leaders).
- vi. Can be used by downstream companies to eco-design their products such as lubricants, resins etc and eco-label them under third party certification or produce them as environmental report cards for business-to-business transactions.

1.4 ROLES AND RESPONSIBILITIES IN LIFECYCLE INVENTORY (LCI) EXERCISE IN PETRONAS

The table below illustrates the roles and responsible parties in the management of LCI in PETRONAS.

ROLES	RESPONSIBLE PARTY
Identify the need to conduct product LCI	Respective Business Units (BU)
Form LCI Project Team	Respective BU
Conduct LCI Study	Respective BU
Conduct Internal Review of draft report	BU to engage Group HSE Division (GHSED)
Finalise report for internal consumption	Respective BU
Conduct external review (if required)	BU to engage 3 rd party verifier
Formalise as public data	BU to consults Legal Services Unit (LSU)

Table 2: LCI Roles and Responsibilities Table

2.0 KEY STEPS OF A LIFE CYCLE INVENTORY FOR CARBON FOOTPRINT

Prior to moving on to the inventory analysis phase, it is important to note that all assumptions or decisions made throughout the entire exercise must be recorded and reported. If assumptions are omitted, the final results may be taken out of context or easily misinterpreted.

The figure below summarizes the main steps in conducting LCI Data Analysis

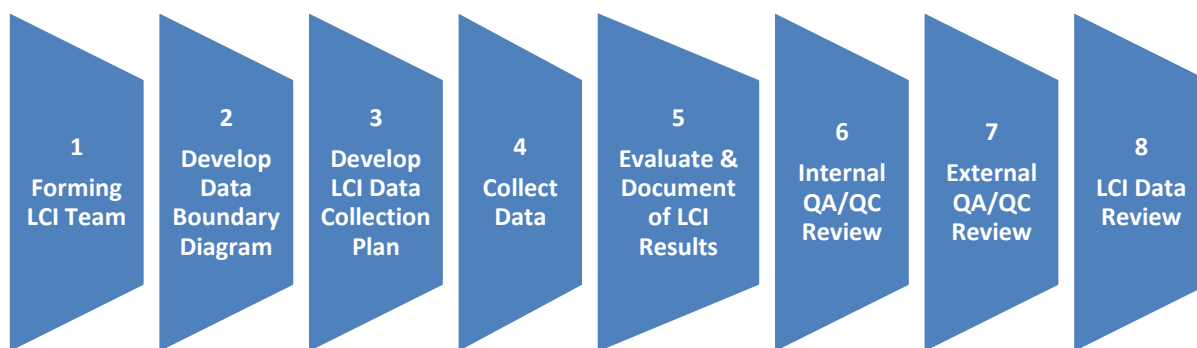


Figure 2: Main steps in conducting LCI Data Analysis

2.1 STEP 1: FORMING LCI TEAM

The Team shall include at least:

- i. 1 person who is familiar with LCI process
- ii. 1 person who is familiar with the product manufacturing process
- iii. 1 person who is familiar with the procurement and supply chain information
- iv. 1 person who is familiar with marketing and logistics information

2.2 STEP 2: DEVELOP A DATA BOUNDARY DIAGRAM

A data boundary diagram is a tool to map the inputs and outputs to a process or system. The “system” or “system boundary” varies for every LCA project. Figure 3 illustrates the components of a typical unit process for a given system boundary.

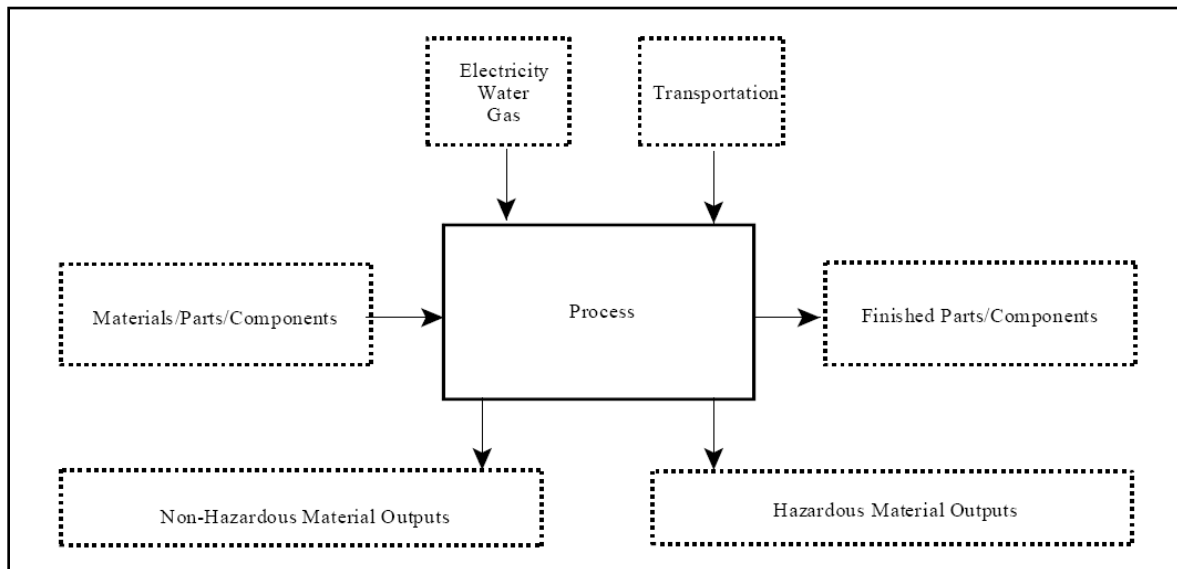


Figure 3: Typical Data Boundary Diagram

The following areas shall be excluded for preliminary data collection, however, they may be included in the future refinement:

- (i) **Capital Equipment** - The energy, water and materials that are required to construct buildings and to build process equipment.
- (ii) **Domestic Wastes** - personnel-related effluents from the manufacturing process as well as wastes from galley / cafeteria, energy use, air conditioning emissions, water pollution from sanitary facilities, and others. In addition, inputs and outputs during transportation of personnel from their residence to the workplace.
- (iii) **Contractors' Activities** – e.g. fabrication of structures, offshore supply vessel operations.