MALAYSIA GREEN BUILDING CONFEDERATION

# TOWARDS ZERO CARBON CITY

## AN INTRODUCTION TO ECO-LABELS AND LCA OF BUILDINGS

**Ar Von Kok Leong**
Past President MGBC
Director Arkitek MAA Sdn Bhd

# **ENVIRONMENTAL** MEASUREMENT

**"Environment consciousness has begun as the environment pollution increased in the world. Parallel to this consciousness, sustaining healthy survival of humans and improving the environmental quality has become the main goal of the companies in all of the sectors. Within this context the sectors have begun to measure the environmental performance of their products with some methods. One of these methods is Life Cycle Assessment (LCA)".**

Centre for EU Education and Youth Programmes
ISBS 2010

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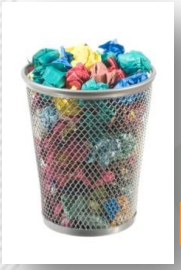
# **ENVIRONMENTAL** MEASUREMENT

## a **paradigm** shift



**WASTE MANAGEMENT**
**(Focus on waste handling)**

**POLLUTION MANAGEMENT**
**(Focus on organization)**

**ENVIRONMENT MANAGEMENT**
**(Focus on management)**

**LIFE CYCLE MANAGEMENT**
**(Focus on product)**

# **ENVIRONMENTAL** LABELS

a) **Communication tools to promote environmental responsibility**

b) **Voluntary programs; helps consumers to make decisions**

c) **"WIN-WIN-WIN" for the "Environmental Awareness - Economic Development - International Trade", thus strengthening link betw profitability and corporate environmental responsibility (CER)**

# TYPES OF **ENVIRONMENTAL LABELS** (ISO14020)

**There are many labels and declarations of environmental performance. This large and composite family should be referred to as "environmental labels". Ecolabels are a sub-group and they respond to special criteria of comprehensiveness, independence and reliability.**

**Even if the overall environmental relevance of labels is more significant as they consider the whole life cycle of products, reliable and third-party single issue labels (Ecolabels Type I) can be useful to target specific problems.**

**UNEP**

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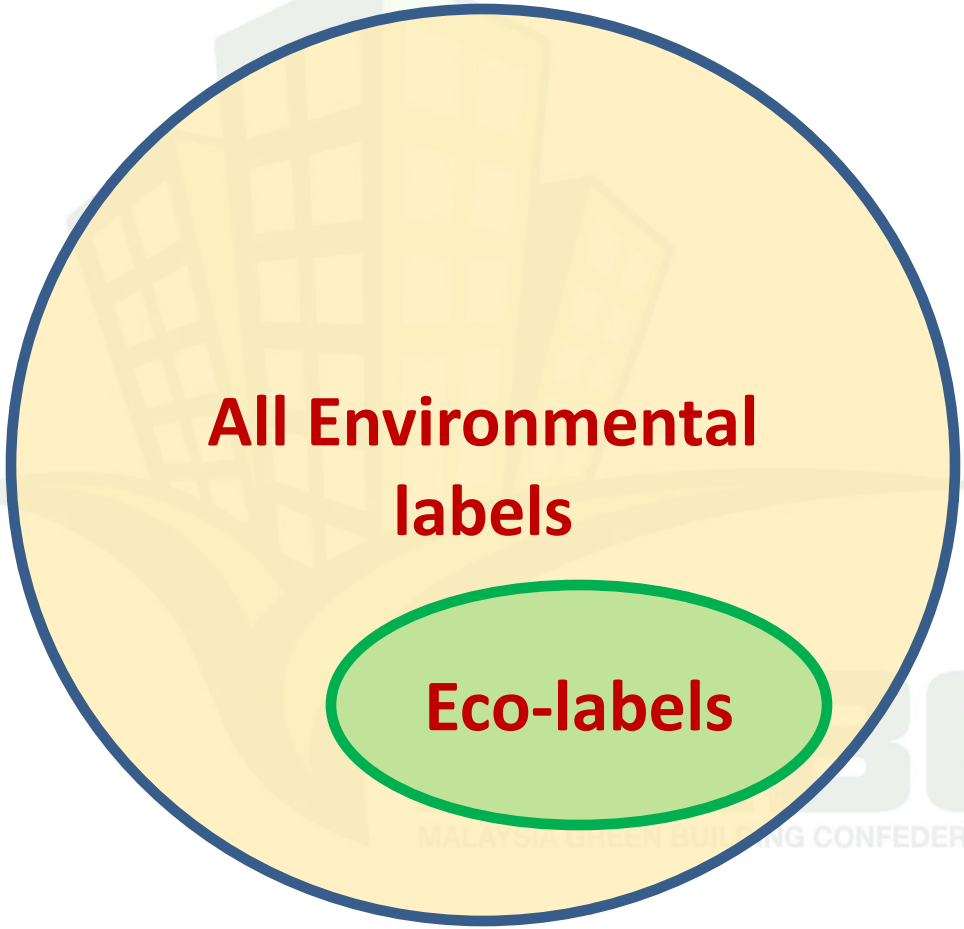
# TYPES OF **ENVIRONMENTAL LABELS** (ISO14020)



# **ENVIRONMENTAL** LABELS

## **International Environmental Labels**:

Ecomark
Japan

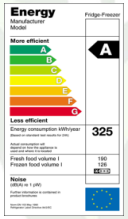
Eco Label
UK and Italy


Greenseal
USA


Env Choice Prog
Canada

## **International Eco Labels**:


Water Label
EU




Energy Label
EU


Green Label
Singapore


Green Label
Thailand

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## GLOBAL ECOLABELLING NETWORK (GEN)

**A non-profit association of third-party, environmental performance labelling organizations founded in 1994 to improve, promote, and develop the "ecolabelling" of products and services**

# ENVIRONMENTAL LABELS

1. Environmentally Degradable & Non-Toxic Plastic Packaging Material
2. Hazardous Metal-free Electrical & Electronic Equipment Component & Parts
3. Biodegradable Cleaning Agents
4. Recycled Paper
5. Biofibre Composite Construction Material
6. Food-Grade Lubricants
7. Floor Mat
8. Fabric Care Product
9. Tableware from Biomass
10. Adhesives
11. Water-Based Adhesives
12. Paper-Based Packaging Products
13. Organic Fertiliser
14. Recycled Rubber Products
15. Shampoo
16. Shower Liquid Products
17. Solid Body Soap Products
18. Recycled Plastic Products
19. **Paints**

# ENVIRONMENTAL LABELS



## SIRIM'S NATIONAL LCA PROJECT SECTORS

| |
|---|
| Agro Industry |
| Petroleum, Petrochemical and Plastic |
| Electrical and Electronic |
| Chemical |
| Heavy Industry (Cement, Iron, Steel, Aluminium) |
| Utilities and Services |
| General Consumer Goods |
| Waste Management (includes Recycling) |
| Impact Assessment |

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# TYPES OF **ENVIRONMENTAL LABELS** (ISO14020)

| **TYPE I**<br>ISO 14024 | **TYPE II**<br>ISO 14021 | **TYPE III**<br>ISO/TR 14025 |
|---|---|---|
| Multi-attribute single criteria label developed and certified by third party, based on LCA. | Single-attribute label developed by producer. Self declaration. Not verified Independently. | Product info based on full LCA. Quantitative data provided by producer. |
| **Eco-labels** | **Green Claims "Greenwash"** | **Environmental Impact** |

# TYPE I ENVIRONMENTAL LABELS

| Name of Label | Operator | Remark |
|---|---|---|
| The Australian Ecolabel Program | Good Environmental Choice Australia Ltd | Company |
| Ecomark Program | Japan Environment Association (JEA) | NGO |
| Green Seal | Green Seal Inc. | Company |
| Korea Eco-label | Korea Eco-Products Institute (KOECO) | Public organisation |
| Blue Angel | Federal Environment Agency | Public organisation |
| EU Flower | Dept for Environment, Food and Rural Affairs(DEFRA), UK | Public organisation |

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# TYPE II ENVIRONMENTAL LABELS

**Some common self-declared environmental claims**
**(single attribute, not auditable):**

- **Compostable**
- **Degradable**
- **Designed for disassembly**
- **Extended life product**
- **Recovered energy**
- **Recyclable**
- **Recycled content**
- **Reduced energy consumption**
- **Reduced resource use**
- **Reduced water consumption**
- **Reusable and refillable**
- **Waste reduction**

Hitachi

Omron

Toshiba

Ricoh

Anritsu

LG

# TYPE III ENVIRONMENTAL LABELS

- **Quantified environmental information**
- **Based on life cycle of a product**
- **Enables comparisons between products fulfilling the same function**
- **Primarily intended for business-to-business communication (does not preclude business-to-consumer communication)**
- **Based on Product Category Rules (PCR) developed through involvement of interested parties.**

# **LIFE CYCLE** ASSESSMENT

1. **LCA is a <u>procedure</u> of:**

   a) **Compiling the inputs (energy consumption) and outputs (env emissions) of a production.**

   b) **Quantifying and evaluating the potential environmental impacts associated with those inputs and outputs.**

   c) **Identifying opportunities to improve the environmental performance of the product.**

2. LCA allows specific values to be put to each step, eg, energy required for extraction of raw materials, manufacturing, transport and disposal; and the wastes produced at each step.

3. LCA can be used to compare the environmental sustainability of different products, allowing consumers to the decide which one will be more environmentally-friendly.

4. LCA is a quantitative measurement, and can be used to measure multiple environmental impacts.

5. LCA is different from Env Management System. EMS focuses on integrating pollution prevention and control principles into the organization's activities only. EMS certification concerns the company's policy, and not a product's environmental performance.

6. LCA expands the scope beyond the organization's boundaries for environment performance to the entire life cycle of the product.

7. LCA does not measure economic or social sustainability of a product or a product system.

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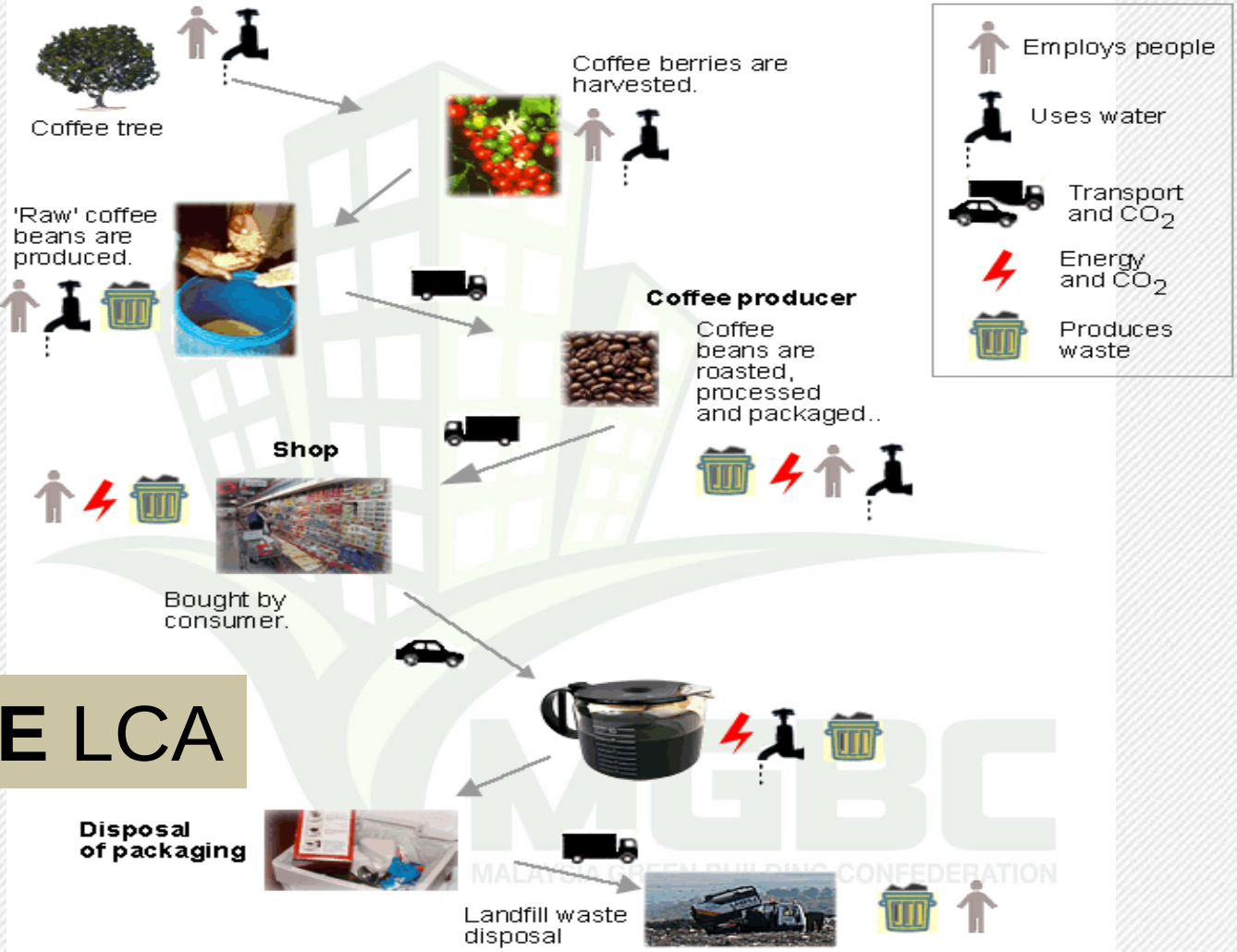
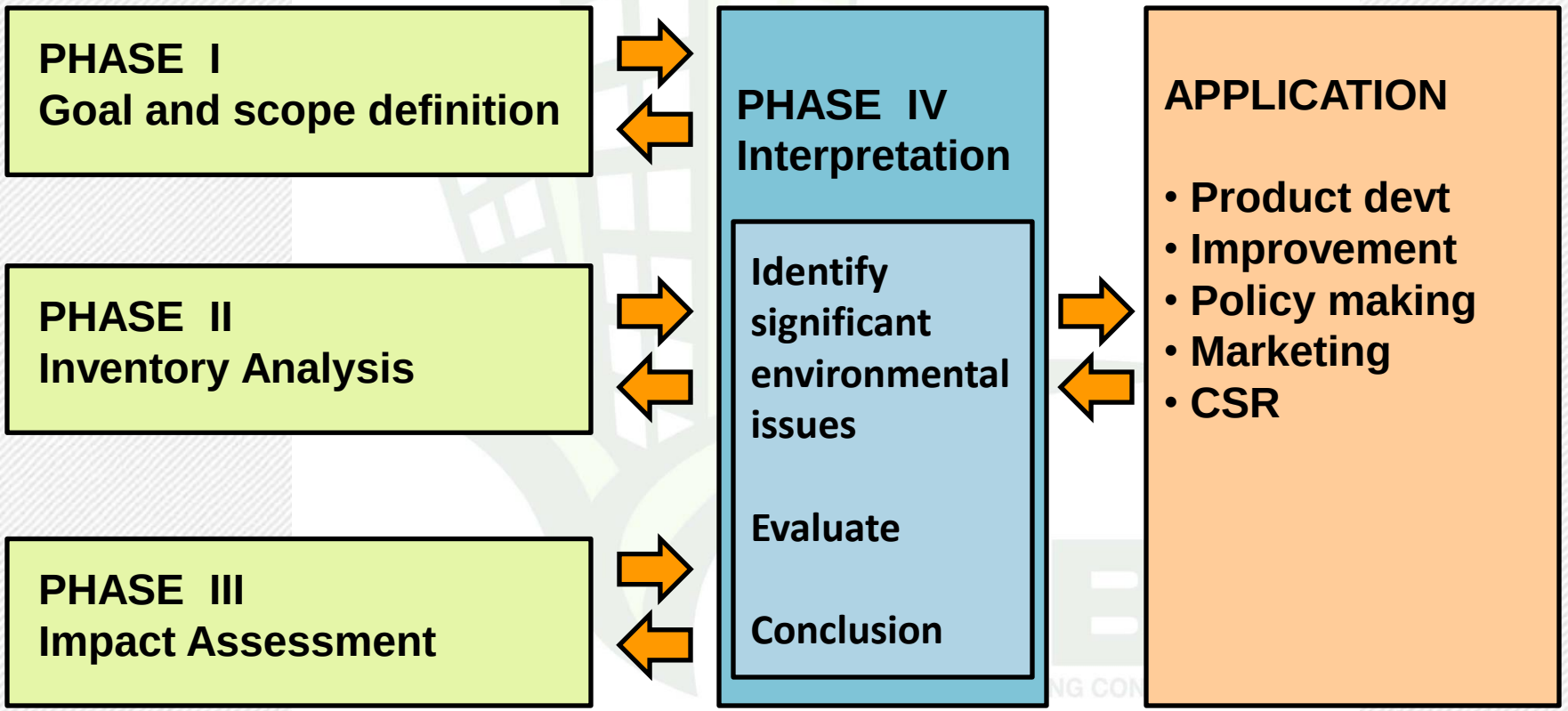



## COFFEE LCA

# LCA FRAMEWORK (ISO 14040)



# LCA FRAMEWORK (ISO 14040)

**PHASE I**
**Goal and scope definition**

**Goal and scope describes what the application covers, the reasons for the study, the target audience and a detailed technical description of the product or the product system.**

**PHASE II**
**Inventory Analysis**

**Life Cycle Inventory analysis is the data collection, compilation and quantification of the environmental inputs (eg energy) and outputs (eg $CO_2$) for the product throughout its life cycle.**

**PHASE III**
**Impact Assessment**

**Life Cycle Impact Assessment evaluates the magnitude and significance of the potential environmental impacts (eg global warming) of the product or the product system.**

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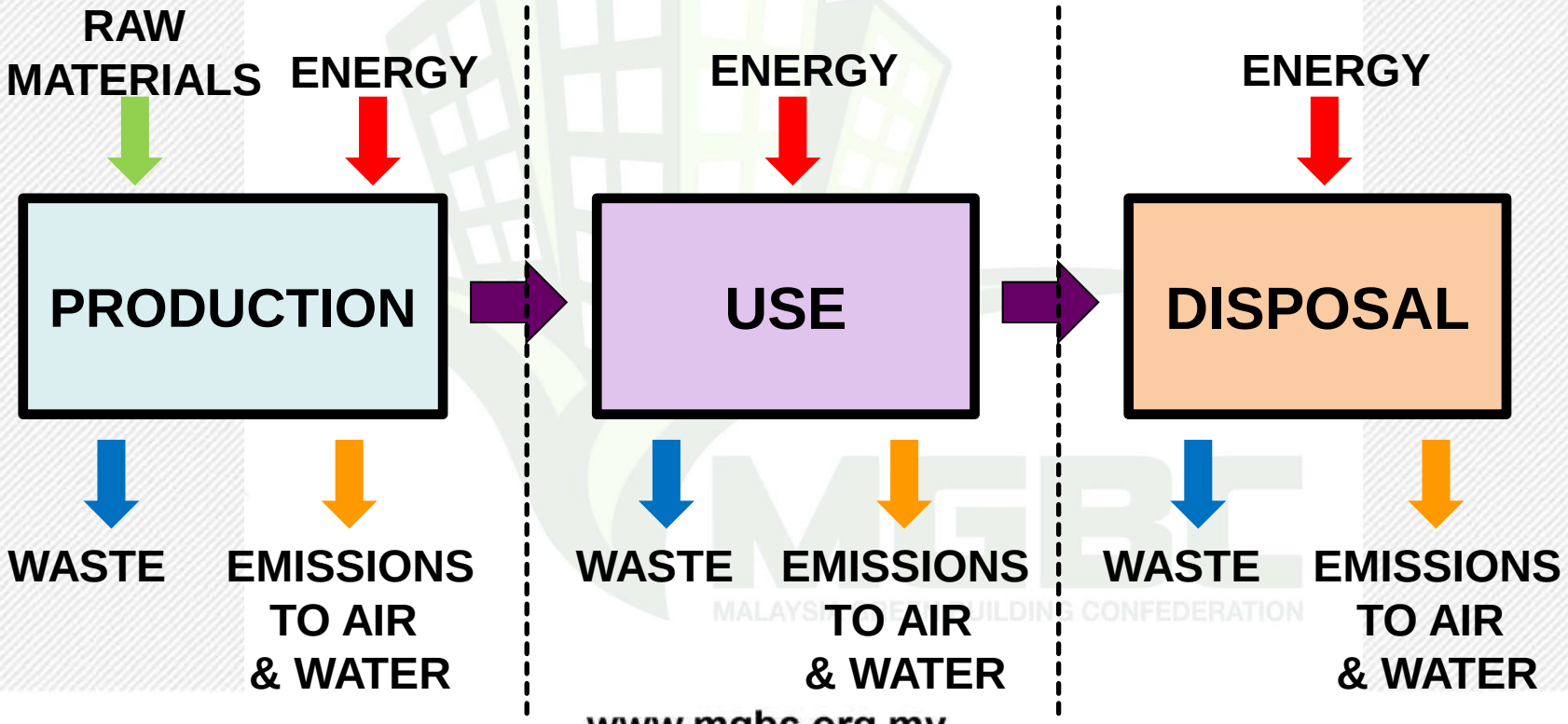
# LCA FRAMEWORK (ISO 14040)

## PHASE II - INVENTORY ANALYSIS

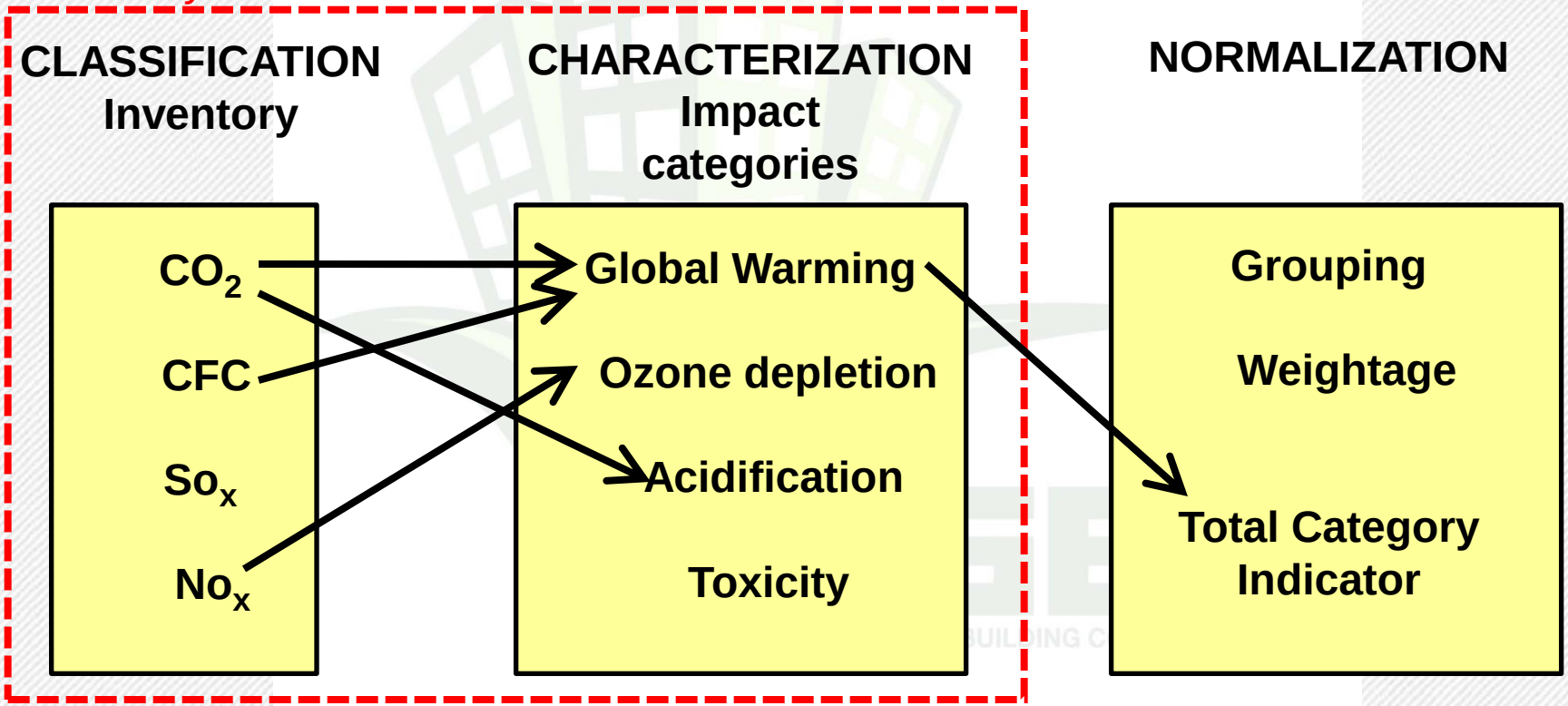
**(Emissions per kg, per MJ, per km)**



# LCA FRAMEWORK (ISO 14040)

## PHASE III - IMPACT ASSESSMENT

Mandatory



# FUNCTIONAL UNITS

**Functional units are quantified performance of a product system for use as a reference unit in a life cycle assessment study; examples:**

**1 kg of aluminium**
**1,000 wash cycles**
**10 sq m of painted surface**
**1 m length of copper wire**
**100 litres of liquid**
**1 sq m of GFA**

# GLOBAL WARMING POTENTIAL (GWP)

**Global warming potential (GWP) is a measure of how much a given mass of a greenhouse gas (GHG) contributes to global warming, compared to the same mass of Carbon Dioxide. $CO_2$ = 1 GWP.**

**Methane, a significant contributor to the greenhouse effect, has a GWP of 21, ie methane is approx 21 times more heat-absorptive than $CO_2$ per unit of weight.**

**Nitrous oxide ($N_2O$) = 300 GWP;**
**Hydrofluorocarbons (HFC) = 120 – 12,000 GWP**

# SYSTEM **BOUNDARIES**

**Reviewing a life cycle can be very complex.**

**How do we determine where to stop the assessment?**

**Usually based on physical (eg geographical area) or time horizon (eg lifespan of pollutants)**

**These boundaries are called system boundaries.**

# SYSTEM **BOUNDARIES**

1. **Cradle to Grave**
   - **Raw materials to disposal phase**

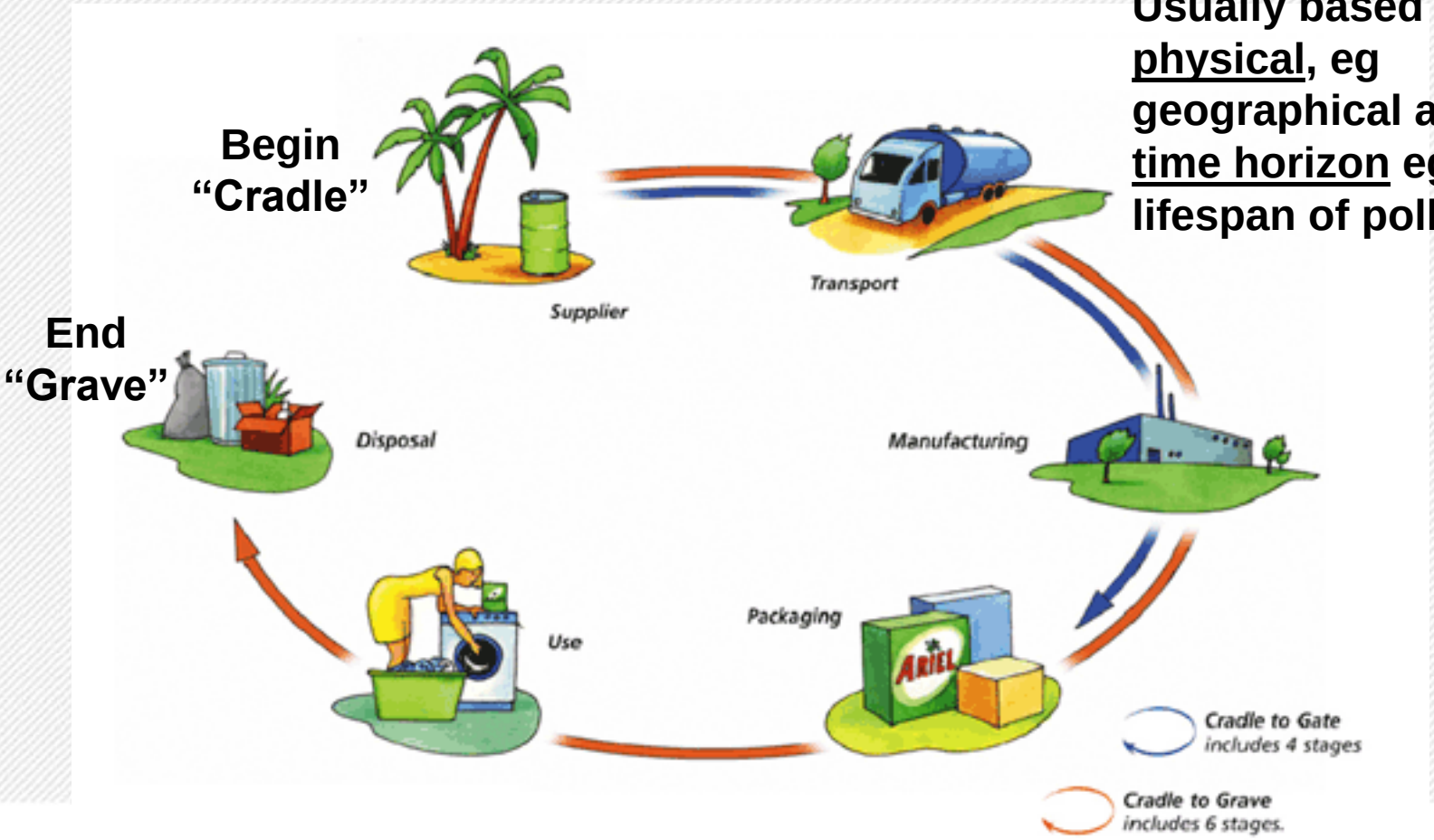
2. **Cradle to Gate**
   - **Raw materials to factory gate (pre-consumer)**

3. **Cradle to Cradle**
   - **Recycling begins from end-of-life disposal phase**

4. **Gate to Gate**
   - **A value-added process in the production chain**

# LIFE CYCLE PHASES

**Usually based on physical, eg geographical area; or time horizon eg lifespan of pollutants**

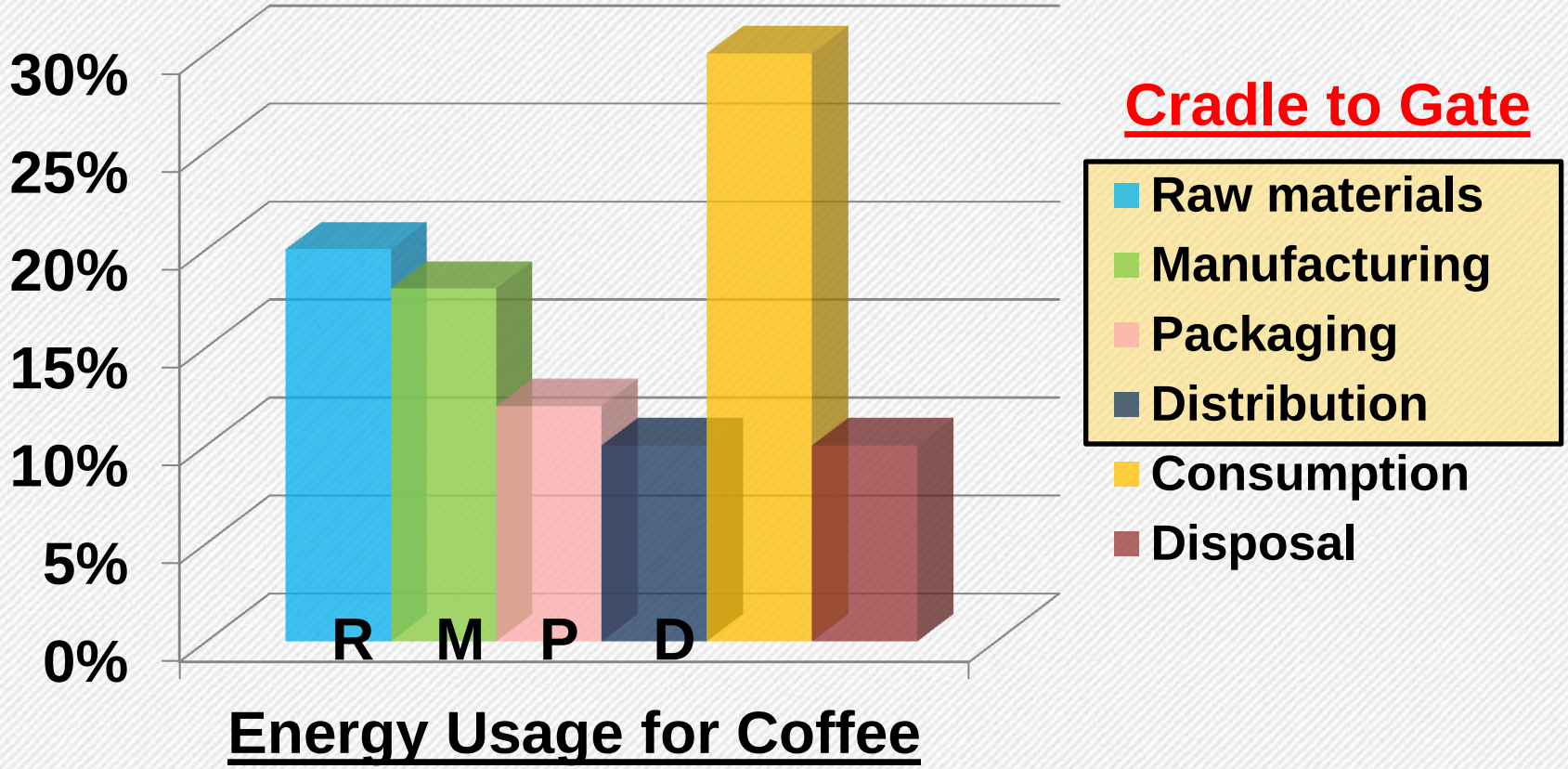


# SYSTEM **BOUNDARIES**

**LCA enables problems to be identified and avoids problems shifting from :**

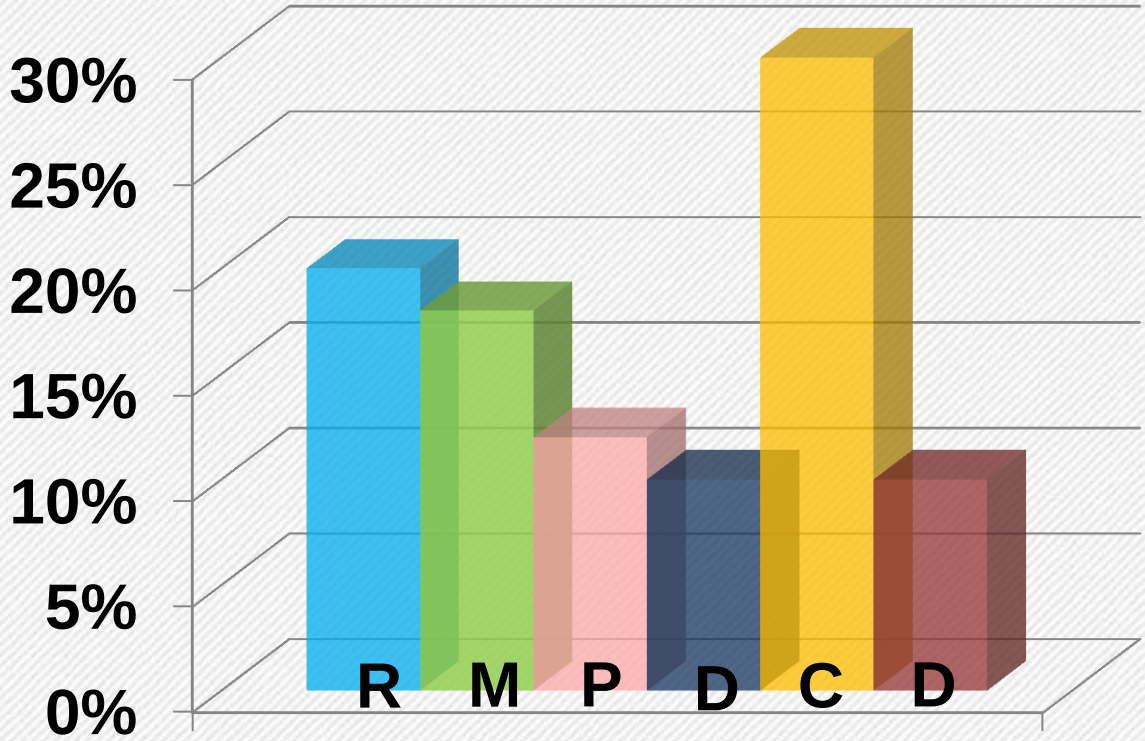
1. **One cycle stage to another cycle stage**
2. **One geographic area to another**
3. **One environmental medium to another**
4. **One protection target to another**

# SYSTEM **BOUNDARIES**




**Energy Usage for Coffee**

# SYSTEM **BOUNDARIES**




**Energy Usage for Coffee**

**Cradle to Grave**

- Raw materials
- Manufacturing
- Packaging
- Distribution
- Consumption
- Disposal

# **APPLICATIONS** OF LCA

1. **Environmental footprints of products and production systems**
2. **Enables product comparison**
3. **Know key areas to improve – Eco-design**
4. **Know key technologies to use**
5. **Understand the demands of your consumers**
6. **A tool of the Green Economy**

# APPLICATIONS OF LCA

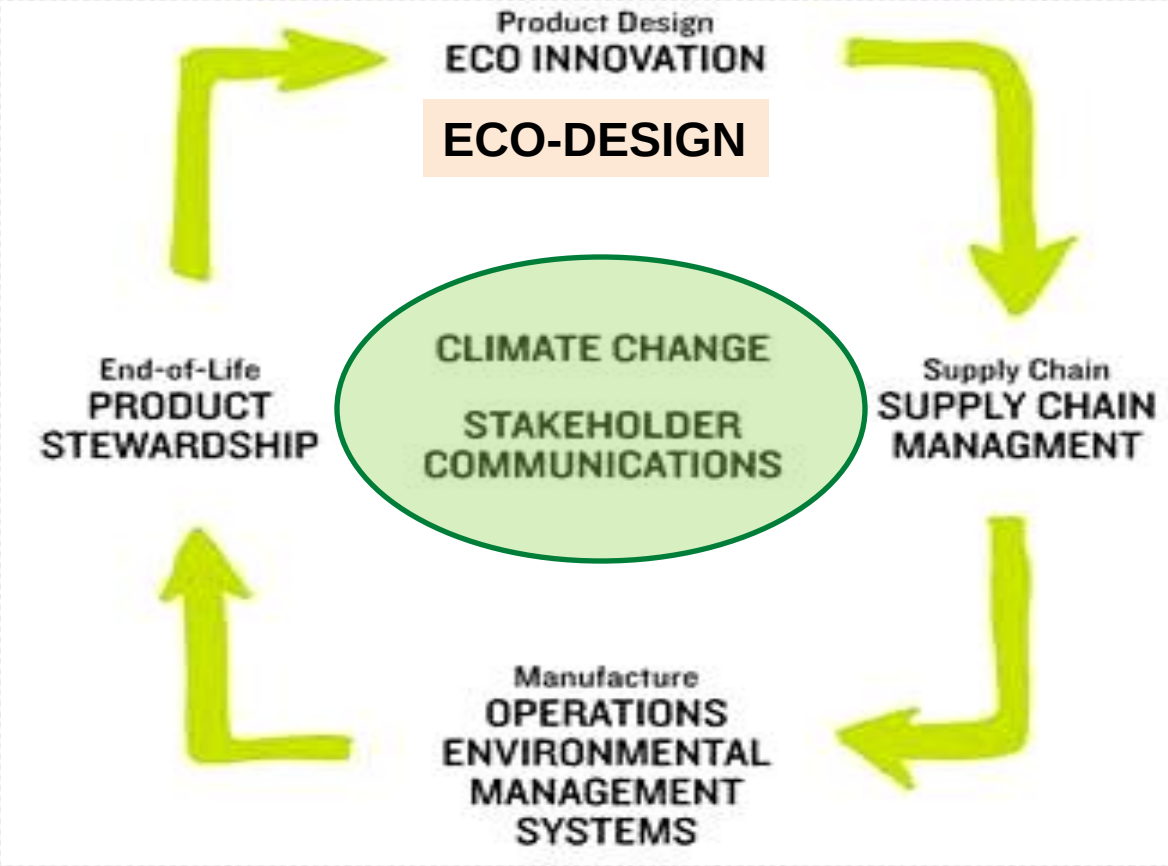
**The Green Economy is an emerging marketplace that seeks to optimize the synergy among three sets of values:**

**Social, Environmental and Economic.**

**This is most commonly referred to as the**


## "TRIPLE BOTTOM LINE."

# **APPLICATIONS** OF LCA



# **PRINCIPLES** OF LCA

1. <u>Voluntary</u> **participation.**

2. **Compliance with environmental legislation, and based on sound scientific principles.**

3. **Fit for purpose, relevant, credible and measurable.**

4. **Independence.**

5. **Criteria distinguishes leadership.**

# **ADVANTAGES** OF LCA

1. **Environmental performance oriented products.**
2. **Many possible impact assessments.**
3. **Scientific and quantifiable environmental performance assessment.**
4. **Allows objective comparisons between products.**
5. **Promotes product improvement.**

# **LIMITATIONS** OF LCA

1. **Limitations of data.**
2. **Does not predict safety margins.**
3. **Variable impact categories.**
4. **Cannot always demonstrate differences of impact categories due to limited inventory data.**
5. **Uncertainties in weightage and allocation.**

# EXAMPLE : **PAPER** v **PLASTIC** BAGS

| | | Paper bag | Plastic bag |
|---|---|---|---|
| 1 | Raw materials | Wood | Oil / gas |
| 2 | Energy to make | 1.7 MJ | 1.5 MJ |
| 3 | Solid waste | 50 g | 14 g |
| 4 | Total emissions to air | 2.6 kg | 1.1 kg |
| 5 | User preference | ★ | ★★ |

# EXAMPLE : **PAPER** v **PLASTIC** BAGS

| | | Paper bag | Plastic bag |
|---|---|---|---|
| 6 | Resource | Renewable | Non-renewable |
| 7 | Environmental effect | Land clearing | Emission release |
| 8 | Solid waste | Burning | Landfill |
| 9 | Recycling | Recycled | Reused |
| 10 | GWP | 0.23 kg | 0.53 kg |

# LCA FOR **GREEN BUILDINGS**

**True green building design looks at all products not merely in terms of their green attributes, but the sum of the attributes through LCA.**

**The assessment includes the entire life cycle of the building, the procurement processes and the on-site construction activities, encompassing the extraction and processing of raw materials, manufacturing, transportation and installation, followed by use, maintenance, recycling and finally, demolition.**

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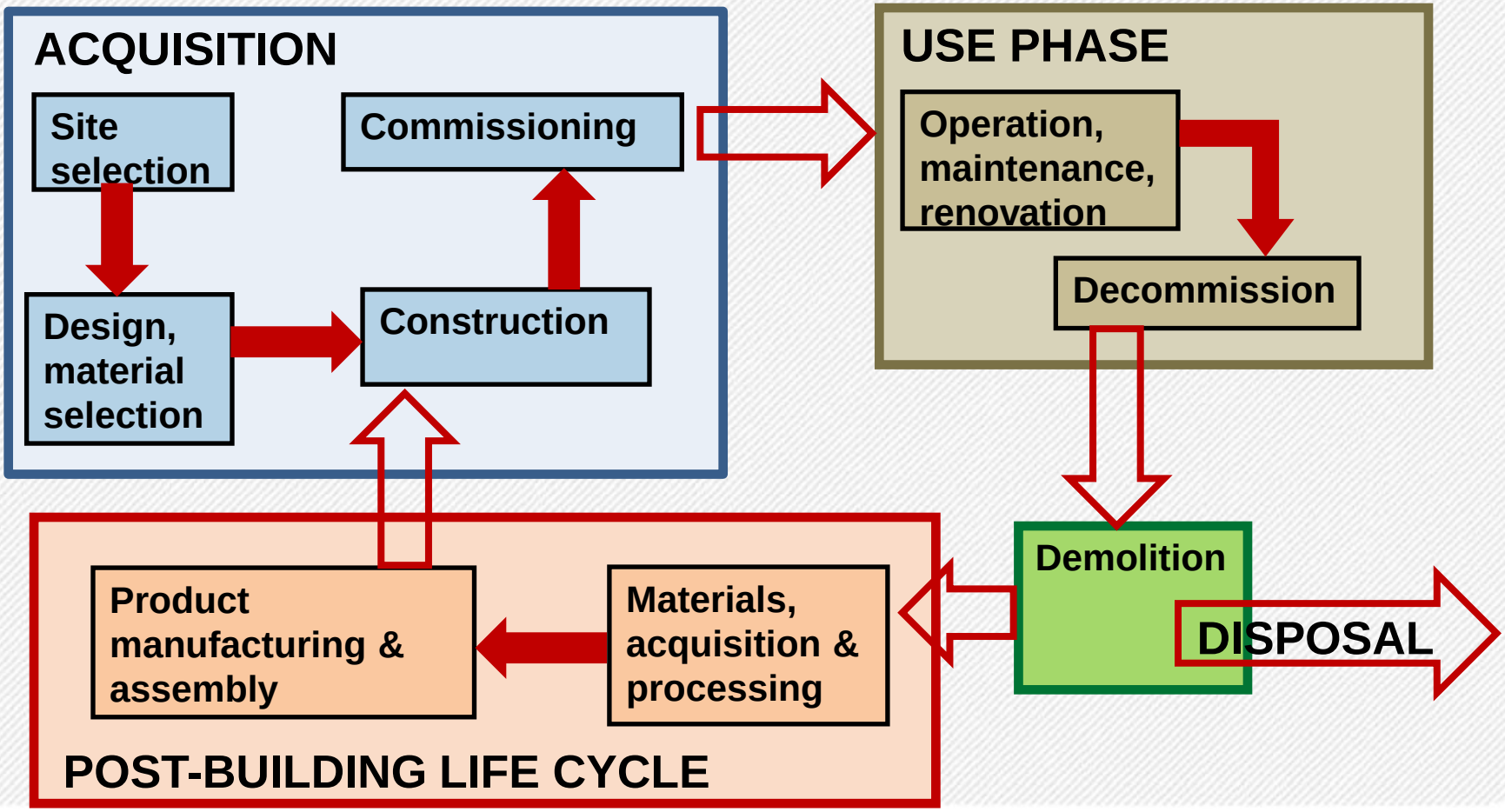
# LIFE CYCLE OF A BUILDING



# LCA FOR **GREEN BUILDING MATERIALS**

**The life cycle of construction materials is a cyclic process. It begins with extraction of raw materials; and consists of packaging, transportation, production, usage, maintenance, and disposal, recycling or reuse.**

**Construction materials are known to cause various environmental impacts during each stage of their life cycles. These impacts may be climate change, ozone depletion, acidification, nutrification, human toxicity, resource depletion, toxicity (air, water, soil), and deterioration of biodiversity, etc.**

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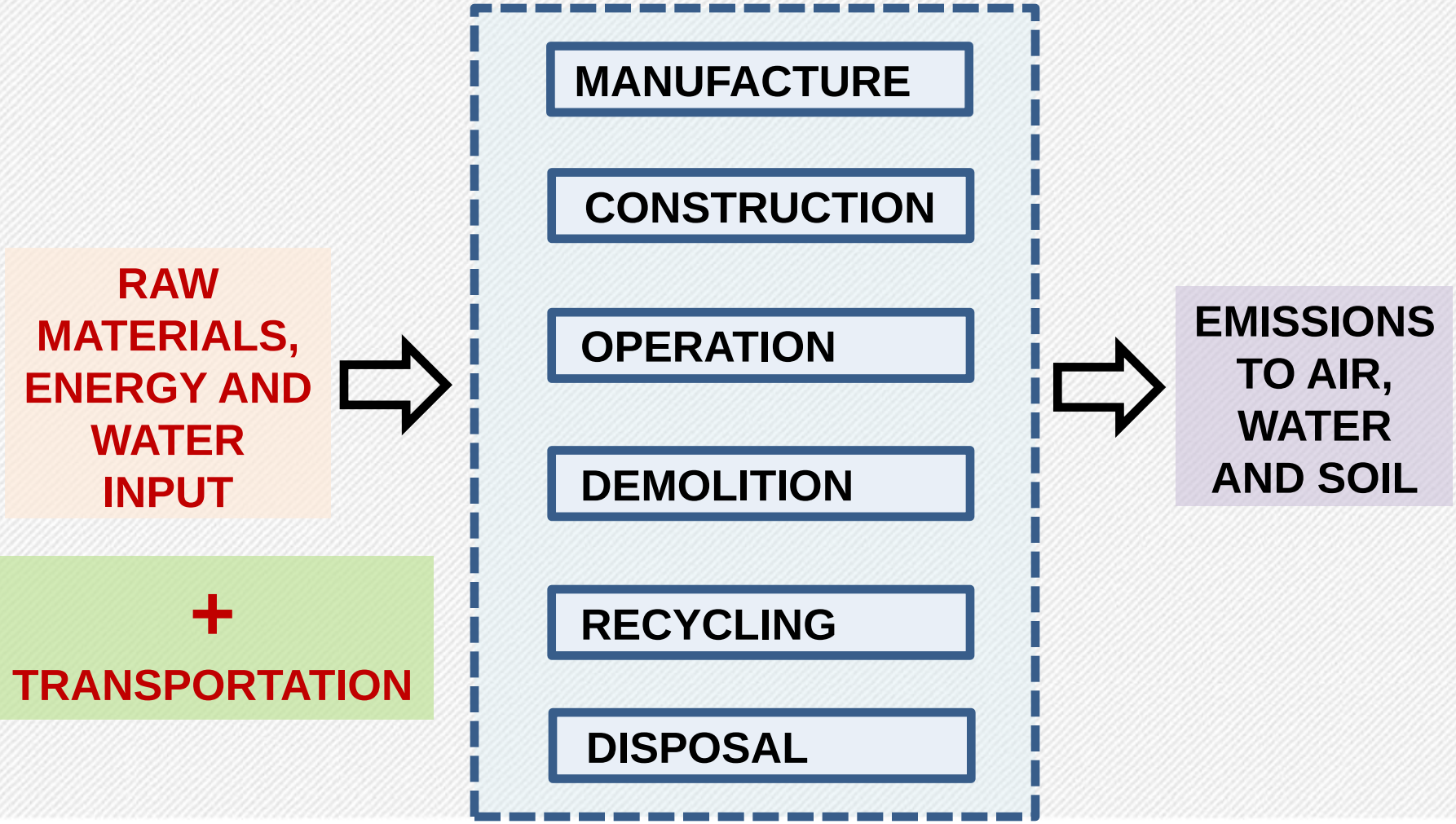


# LCA FOR **ALUMINIUM**

1. **LCA for aluminium covers the following production processes:**

   a) **Bauxite mining, the first step;**
   b) **Refining of bauxite to produce alumina;**
   c) **Production of primary aluminium using electrolysis;**
   d) **Aluminium is processed into finished products eg rolled products, extrusions, tubes and castings.**

# LCA FOR **ALUMINIUM**

2. **LCA for aluminium also covers the following post-production processes:**

   a. **Shop fabrication phase;**
   b. **Use phase;**
   c. **Finally, the recycling and re-use in new products.**

**The recycling of aluminium makes it more attractive in LCA, as recycling uses less energy and thus less GHG emissions, compared to that resulting from primary aluminium production eg mining and electrolysis.**

# LCA FOR **ALUMINIUM**

3. **LCA of aluminium also covers the impacts and benefits of the material throughout the lifespan of the different aluminium products, including their reuse and recycling.**

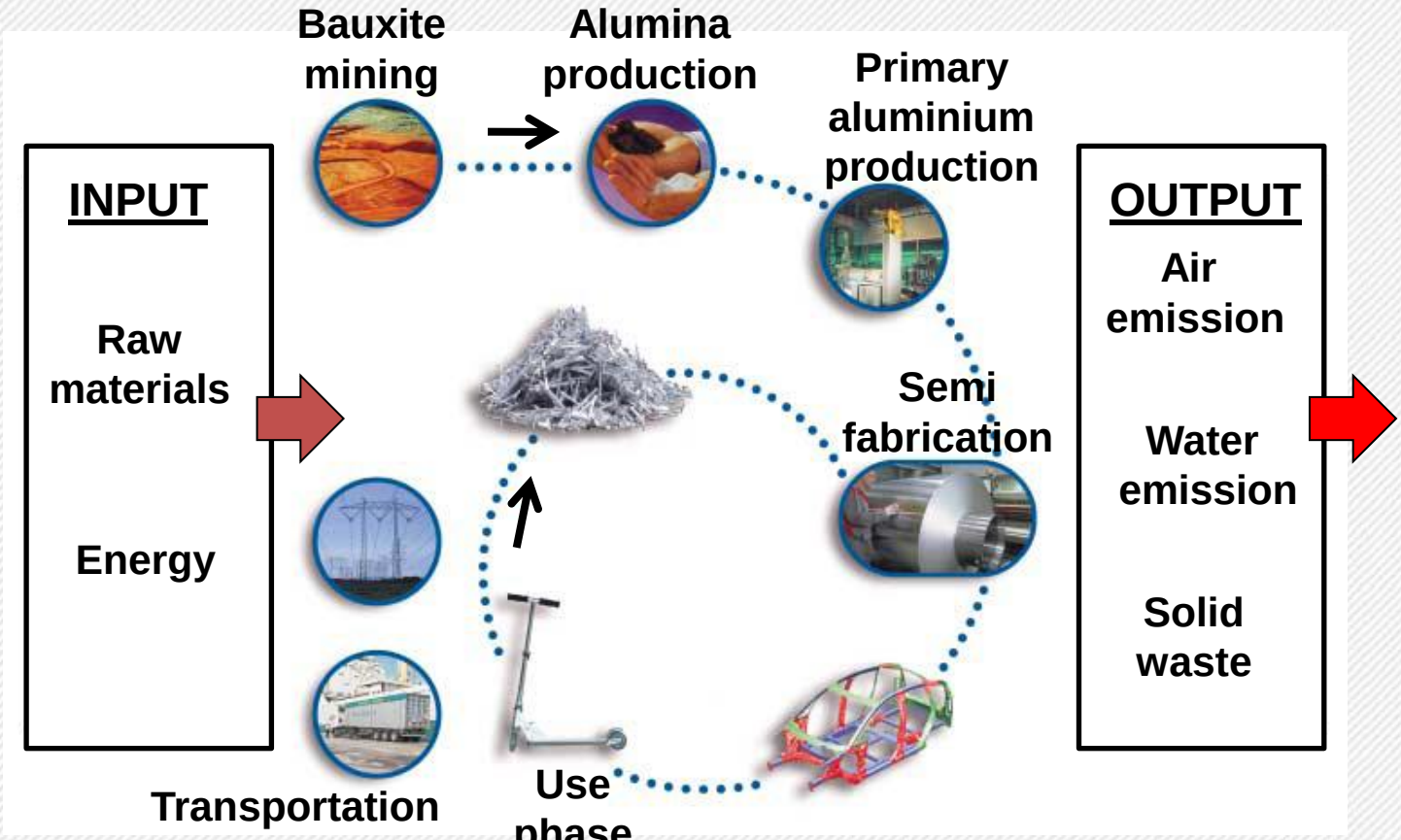



# LCA FOR **ALUMINIUM**

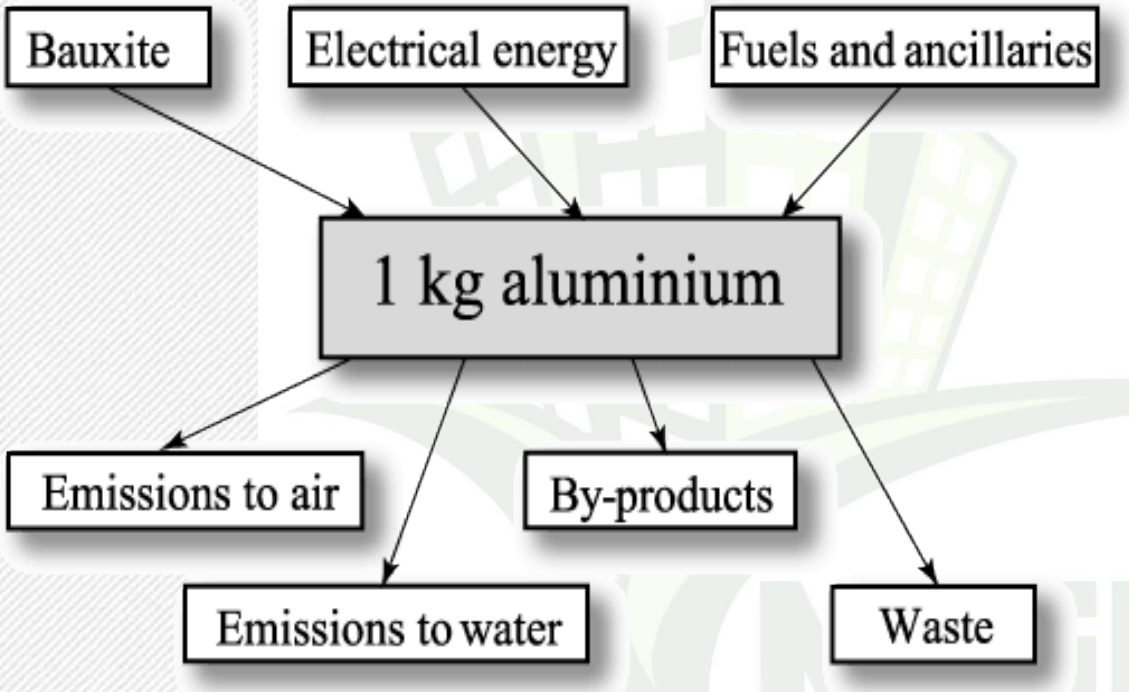
## 4. ANALYSIS

- German study comparing aluminium beer cans vs refillable glass bottles over 9 different environmental impact categories – result is inconclusive
- But for the single category of GWP, aluminium ranks lowest
- Danish study into LCA based on <u>env impact / kg</u> does not favour aluminium, but when recycling of aluminium was considered, the impact was more favourable.

# LCA FOR **ALUMINIUM**



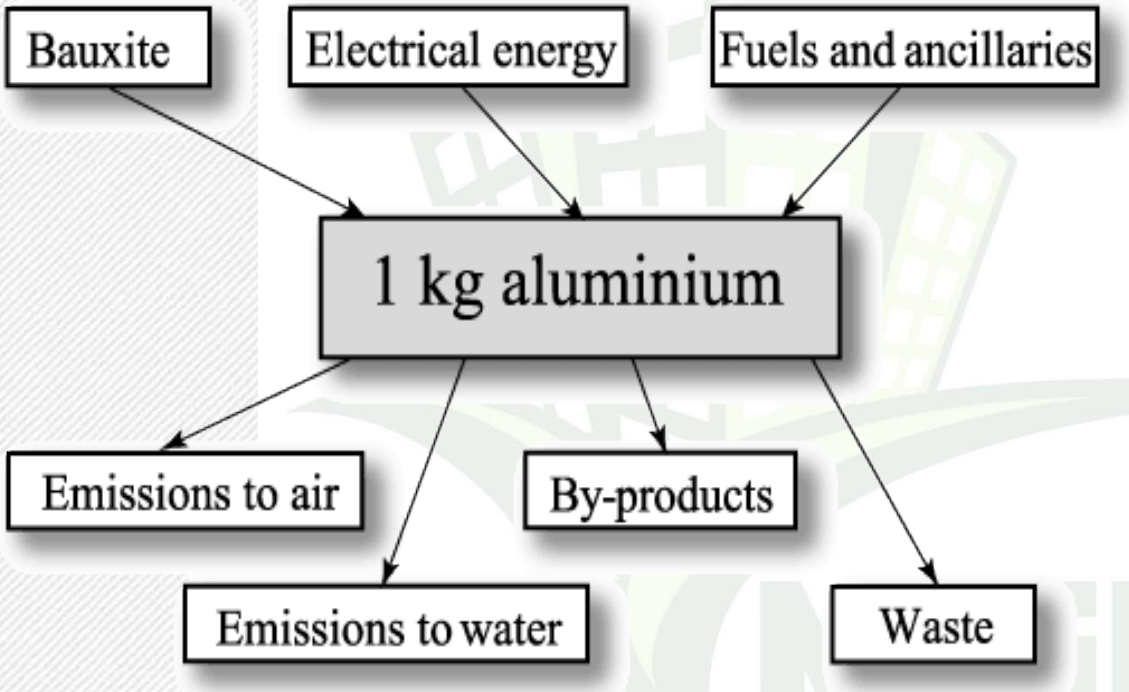
# LCA FOR **ALUMINIUM**




**Energy Usage**

**From bauxite mining**
**199 MJ/kg**

# LCA FOR **ALUMINIUM**




**Energy Usage**

**From bauxite mining**
**199 MJ/kg**

**From scrap**
**8 MJ/kg**

# LCA FOR **ALUMINIUM**

| Material | Energy for Production | GHG Emission from Electricity LCI |
|---|---|---|
| Aluminium from raw alumina | 199 MJ/kg | 9.9 kg $CO_2$/kg |
| Aluminium from scrap | 8 MJ/kg | 0.4 kg $CO_2$/kg |
| Carbon steel (plate) | 45 MJ/kg | 2.0 kg $CO_2$/kg |
| Steel plate from 90% steel scrap | 18 MJ/kg | 0.9 kg $CO_2$/kg |

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# LCA FOR **UAC Fibre cement products**

| Assessment parameters (per tonne) | Manufacturing | Use Phase (+ transport) | Total |
|---|---|---|---|
| Energy (non renewable, MJ) | 9,385.6 | 727.5 | 10,113.1 |
| Energy (renewable, MJ) | 2,668.1 | 0.7 | 2,668.8 |
| Secondary fuels (MJ) | 70 | 0 | 70 |
| GWP (kg CO2 eq) | 833.8 | 56.4 | 890.2 |
| Acidification (kg SO2 eq) | 3.94 | 1.43 | 5.37 |
| Eutrophication (kg PO4 eq) | 0.445 | 0.14 | 0.585 |
| ODP | 8.95E-06 | 5.84E-08 | 9.01E-06 |
| Photochemical Ozone Creation | 0.281 | 0.08 | 0.361 |

Source : UAC, Declaration number EPD-UAC-2010111-E

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# LCA INVENTORY OF AN OFFICE BUILDING

| BUILDING COMPONENTS | EMBODIED ENERGY (GJ) | SOLID WASTES (ton) | GWP (TON CO2eq) | WEIGHTED RESOURCE USE (ton) | AIR POLLUTION INDEX | WATER POLLUTION INDEX |
|---|---|---|---|---|---|---|
| STRUCTURE | 52,432 | 3,273 | 13,701 | 34,098 | 859 | 147 |
| CLADDING | 17,187 | 281 | 5,727 | 2,195 | 649 | 25 |
| ROOFING | 3,435 | 145 | 701 | 1,408 | 65 | 6 |
| TOTAL | 73,054 | 3,554 | 20,129 | 37,701 | 1,573 | 178 |
| PER SQ M | 2.36 | 0.11 | 0.65 | 1.21 | 0.05 | 0.006 |

Source : Trusty, Horst

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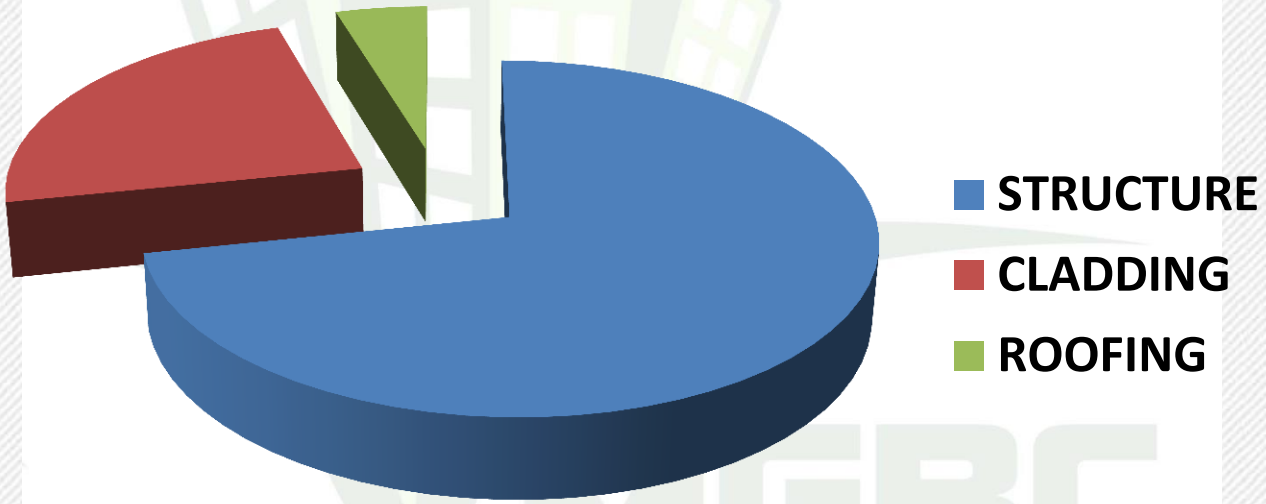
# LCA INVENTORY OF AN OFFICE BUILDING

## EMBODIED ENERGY




Source : Trusty, Horst. Integrated LCA Tools in Green Building Rating Systems

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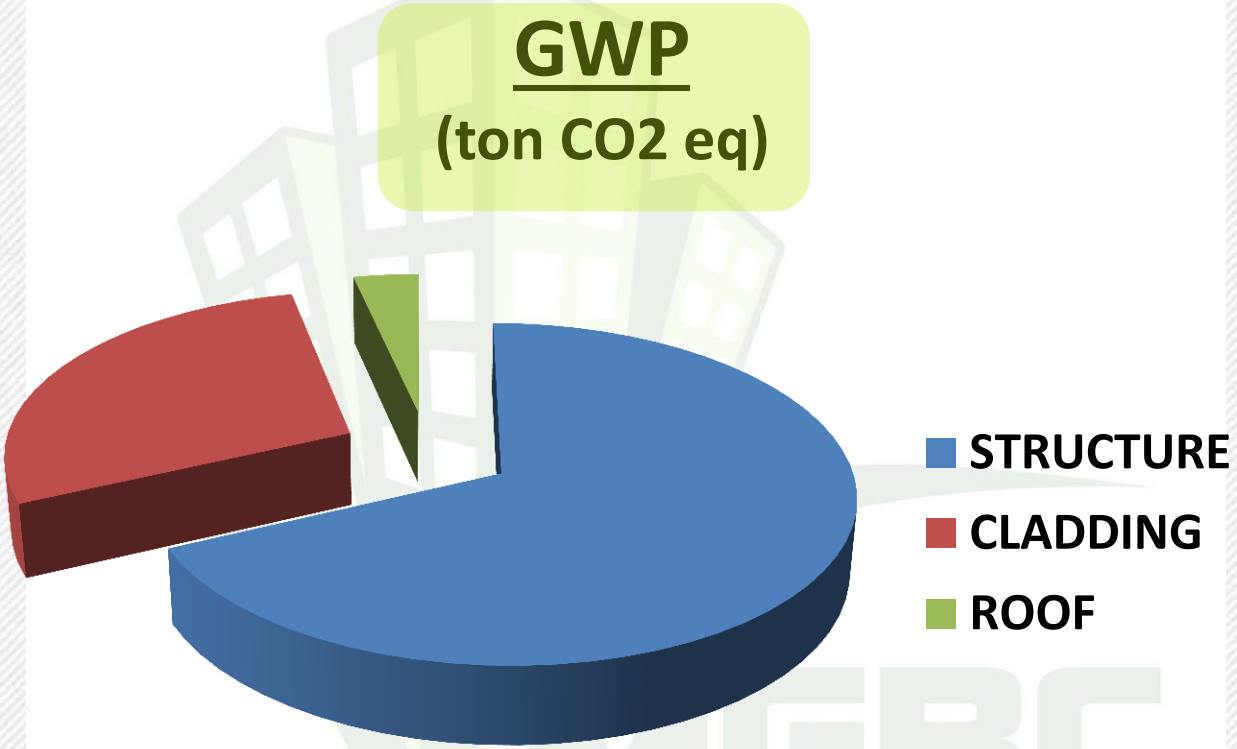


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# THANK YOU

**Ar Von Kok Leong**
**Past President MGBC**
**Director Arkitek MAA Sdn Bhd**