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Introduction

The environmental impact of packaging is becoming increasingly important and to provide an robust and independent view Rapak Europe commissioned PIRA International in the UK to report the findings of a Life Cycle Assessment. Based on the environmental impact of bag-in-box technology in comparison to conventional multi-material, paper, plastic and metallic alternatives.

The Sustainability Consulting team at PIRA International have been involved in the field of life cycle assessment and life cycle management for more than a decade. The team constantly performs LCA's and carbon foot printing projects for both private and public sector customers. It is a recognised world leader in LCA's of packaging based on the packaging expertise of PIRA International.



Introduction

- ~ What is LCA and why is it used?
- ~ What was the scope of the project?
- ~ What do the impact category results represent?
- ~ The subjects of the study
 - ~ Bag-in-box versus non reusable alternatives
 - ~ Bag-in-box versus non reusable alternatives for wine
 - ~ Bag-in-box versus reusable and non reusable alternatives
 - ~ Liner systems versus large reusable alternatives
- ~ One example of the output of the study





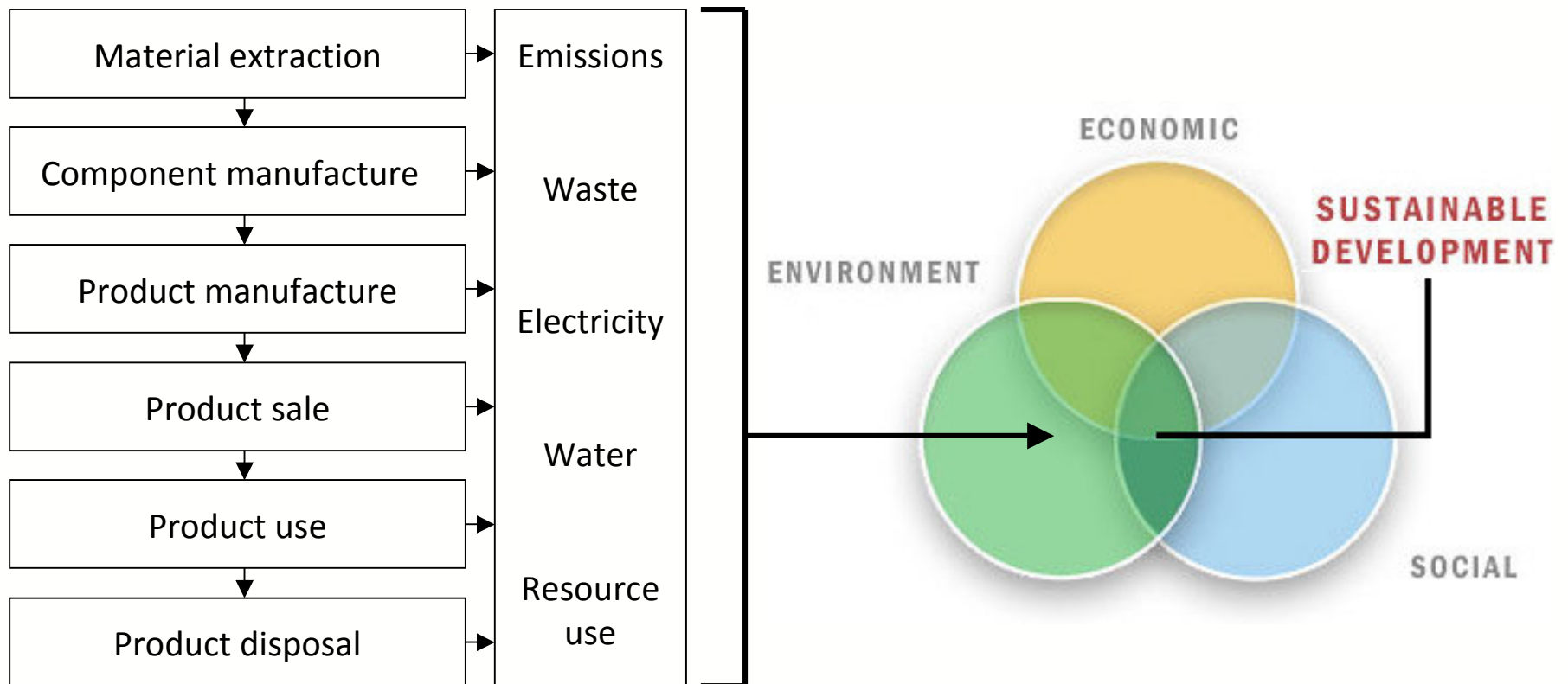
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Life Cycle Assessment is an objective process to evaluate the environmental burdens associated with a product, process, or activity by identifying energy and materials used and wastes released to the environment, and to evaluate and implement opportunities to affect environmental improvements. (SETAC, 1990)



Life Cycle Assessment



Life Cycle Assessment

Two LCA standards

ISO14040 – General concepts of LCA

ISO14041 – Goal and scope

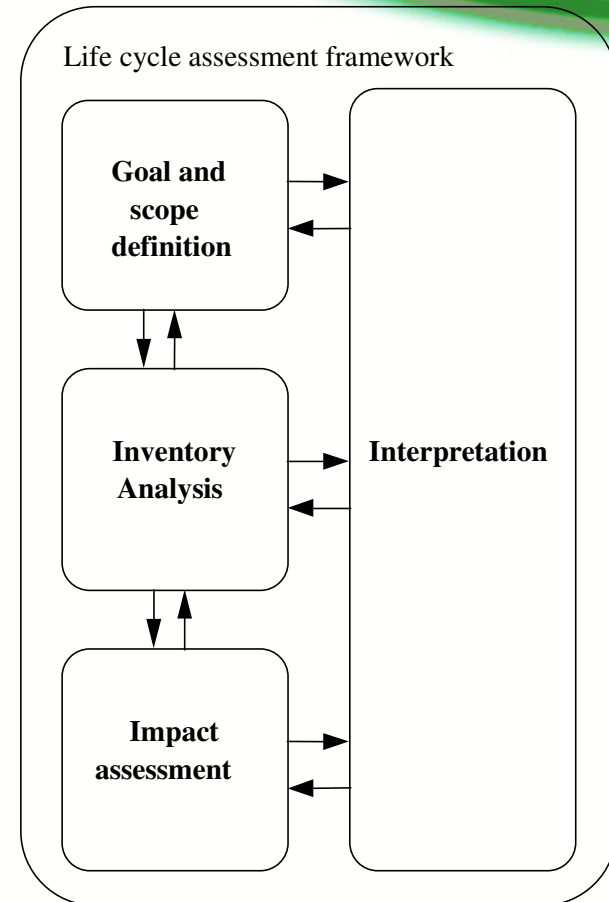
ISO14042 – Impact assessment

ISO14043 – Interpretation

ISO14044 – More detailed version

However...

Almost all recommendations and guidelines are dependant on the goal and scope of the LCA





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SimaPro

SimaPro – Worlds leading LCA software

Uses data libraries for inventory analysis stage

- ~ Ecoinvent 2 - 3500 materials and processes
- ~ Metals, plastics, construction, electronics, chemicals, food etc
- ~ 1kg, 1tkm, 1 litre, 1m3

Uses method libraries to conduct impact assessments

- ~ The CML 1992 method
- ~ Uses the characterisation factors developed by the Intergovernmental Panel on Climate Change (IPCC) for Global Warming Potential (GWP)



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Scope

The study included the comparison of **13 Rapak bag-in-box** and liner systems against **17 alternative products**, in 9 product categories including:

Juice (UK)

Postmix (UK)

Liquid egg (UK)

Dairy (UK)

Chemical (UK)

Edible oil (EU & US)

Drum (EU)

IBC (UK)

Wine (UK)





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Scope

The 13 Rapak bag-in-box and liner systems studied included:

A 10 litre aseptic cap BIB

A 10 litre intasept BIB

A 220 litre drum liner (EU)

A 1000 litre IBC liner

A 10 litre aseptic postmix BIB

A 10 litre edible oil BIB (EU)

A 15.5 litre edible oil BIB (US)

A 10 litre liquid egg BIB

A 10 litre dairy BIB

A 10 litre chemical BIB

A 1.5 litre metallised barrier laminate BIB

A 3 litre metallised barrier laminate BIB

A 3 litre EVOH based BIB



Exclusions

Certain parts of the lifecycle were excluded from the study to aid the comparison and to provide simplicity. These exclusions included:

- ~ Secondary and tertiary packaging
- ~ Irradiation
- ~ Contained product manufacture, transportation and use
- ~ Customer refrigeration



The logo for Rapak, featuring the word "Rapak" in a bold, blue, sans-serif font. Below the text is a thin, wavy orange line.

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The Impact assessment

Once the data was collated on the lifecycles of the Rapak systems and their competitors the impact assessment began. The impact assessment used the CML method to measure the bag-in-box and liner systems against their alternatives in 10 impact categories including:

Abiotic depletion

Acidification

Eutrophication

Global warming potential

Ozone layer depletion

Human toxicity

Fresh water aquatic ecotoxicity

Marine aquatic ecotoxicity

Terrestrial ecotoxicity

Photochemical oxidation



Abiotic depletion

What is it? This impact category refers to the depletion of non living (abiotic) resources such as fossil fuels, minerals, clay and peat.

Why is it an issue? In 2006, WWF International reported that mans impact on global resources has tripled since 1961 and is now 25% above the planets ability to regenerate itself. If the worlds population shared a western lifestyle, three planets would be required to meet their needs.

How is it measured? Abiotic depletion is measured in kilograms of Antimony (Sb) equivalents.

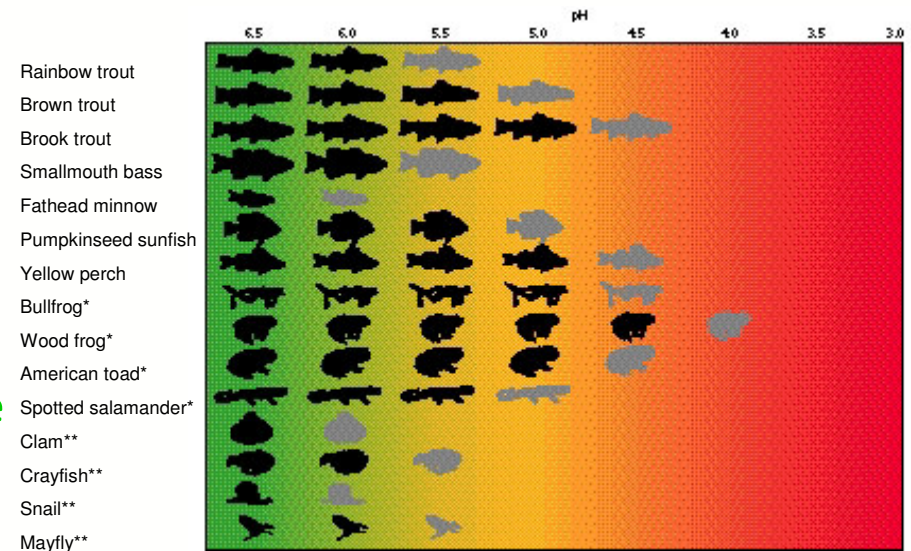


Acidification

What is it? This results from the deposition of acids which leads to a decrease in the pH, a decrease in the mineral content of soil and increased concentrations of potentially toxic elements in the soil solution. The major acidifying pollutants are SO₂, NO_x, HCL and NH₃.

Why is it an issue? Examples of impacts are fish mortality in lakes, leaching of toxic metals out of soil and rocks, damage to forests and damage to buildings and monuments.

How is it measured? Acidification is measured in terms of SO₂ equivalents.



Eutrophication

What is it? This is caused by the addition of nutrients to a soil or water system which leads to an increase in biomass, damaging other lifeforms. Nitrogen and phosphorus are the two nutrients most implicated in eutrophication.

Why is it an issue? Eutrophication was recognized as a pollution problem in European and North American lakes and reservoirs in the mid-20th century. Surveys showed that 54% of lakes in Asia are eutrophic; in Europe, 53%; in North America, 48%; in South America, 41%; and in Africa, 28%

How is it measured? Eutrophication is measured in terms of phosphate (PO_4^{3-}) equivalents

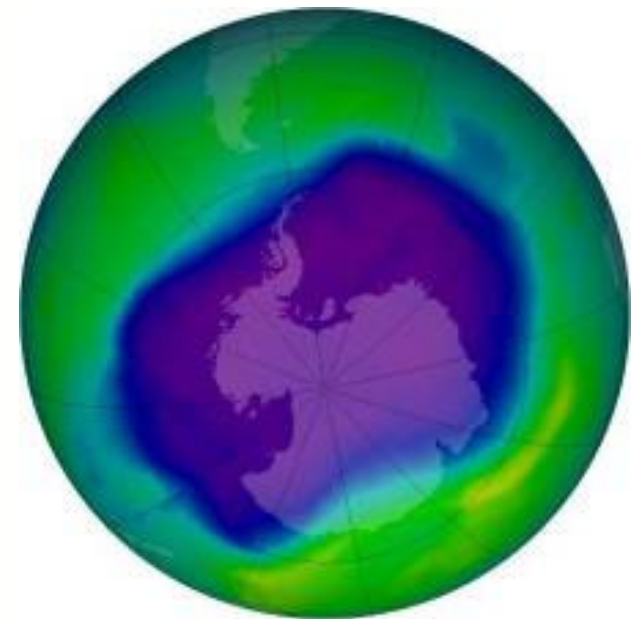


Ozone layer depletion

What is it? Changes to atmospheric ozone will modify the amount of harmful UV radiation penetrating the earth's surface with potential adverse effects on human health and ecosystems.

Why is it an issue? An increase in UV increases the risk of skin cancer as well as additional risks to human health. Even though the Montreal Protocol has reduced CFC emissions, the complete recovery of the Antarctic ozone layer will not occur till after 2050.

How is it measured? Ozone layer depletion is measured in terms of CFC equivalents.



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Toxicity

What is it? Toxicity is the degree to which something is able to produce illness or damage to an exposed organism. There are 4 different types of toxicity; human toxicity, terrestrial ecotoxicity, marine aquatic ecotoxicity and fresh water aquatic ecotoxicity.

How is it measured? Toxicity is measured in terms of dichlorobenzene equivalents.



Photochemical oxidation

What is it? The formation of photochemical oxidant smog is the result of complex reactions between NO_x and VOCs under the action of sunlight (UV radiation) which leads to the formation of ozone in the troposphere. The smog phenomenon is very dependent on meteorological conditions and the background concentrations of pollutants.

Why is it an issue? These substances are characteristic of photochemical smog (summer smog or Los Angeles smog), a known cause of health problems such as irritation to respiratory systems and damage to vegetation

How is it measured? It is measured using photo-oxidant creation potential (POCP) which is normally expressed in ethylene equivalents.



Global Warming Potential

What is it? Global warming potential (GWP) or carbon footprinting is a measure of how much of a given mass of a green house gas (for example, CO₂, methane, nitrous oxide) is estimated to contribute to global warming.

Why is it an issue? If no action is taken to reduce global carbon emissions, average temperatures are likely to rise by more than 2 degrees Celsius. This change will increase severe weather such as tropical storms, droughts and extreme heat waves and heavy precipitation. Stabilisation would require emissions to be at least 25% below current levels by 2050.

How is it measured? Global warming potential is measured in terms of CO₂ equivalents.





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Comparisons Made

The impact assessment on Orange Juice containers considered 4 different packaging alternatives adjusted to suit a functional unit of 10L

- ~ 1 x 10 Litre Aseptic Bag-in-Box
- ~ 1 x 10 Litre Intasept Bag-in -Box
- ~ 10 x 1L Pet Bottles
- ~ 10 x 1L Liquid Packaging Board Containers

The following sections outline the results for this product category in terms of global warming potential and provide real world comparisons.



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PET Bottle



LPB Container

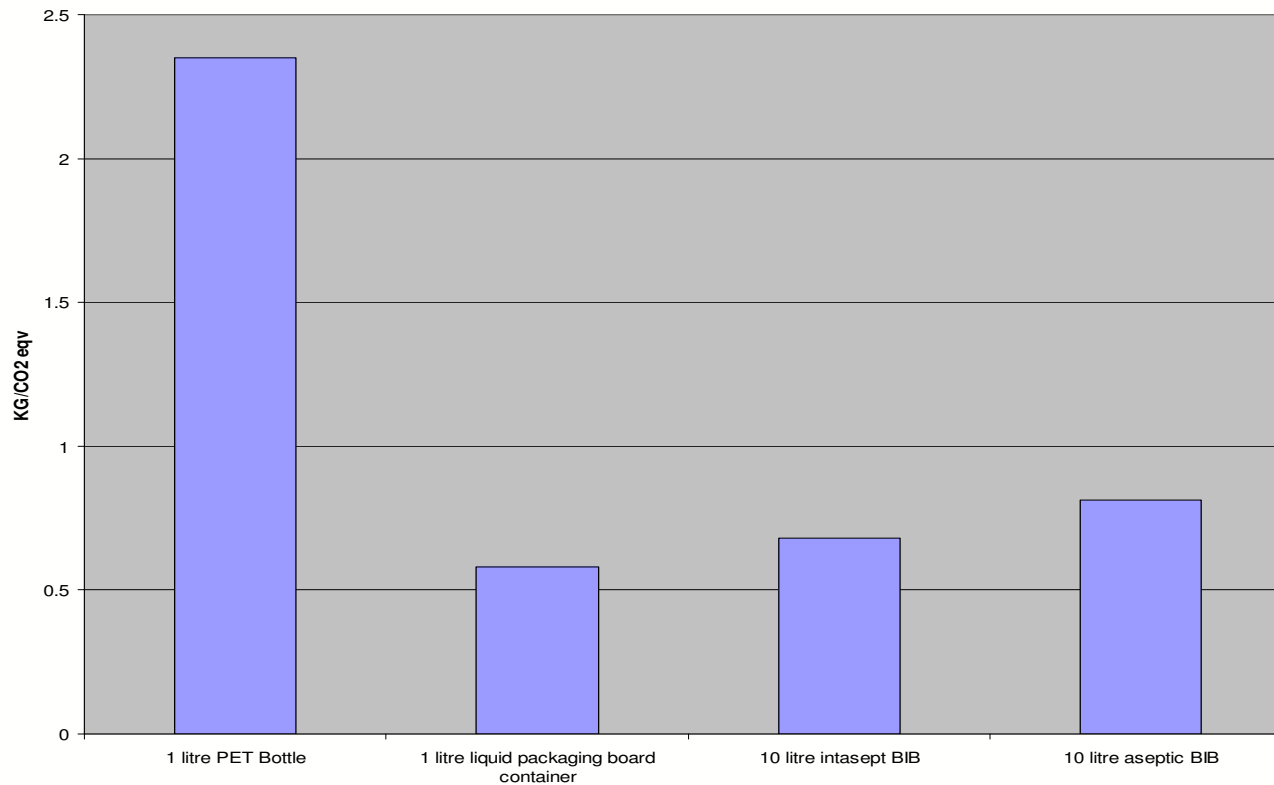


Bag in Box



Global Warming Potential

The GWP results show that the BIB alternative gave lower impact than the PET bottle and a similar impacts to the LPB container.



BIB results

The results from the Orange Juice container comparison found that:

- The 1L Pet bottle was the worst packaging of the 4 considered due to its weight per L and the impact of the bottle manufacturing process.
- The LPB container gave the lowest GWP results due to its use of renewable resources and the use of Biogenic substances (wood in this case) that provide a sink for CO₂ by absorbing it from the atmosphere.
- The BIB options were similar due to its lower weight per L and the use of Cardboard as part of the structural aspect to the container.





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Global Warming Potential

In terms of the real world examples, Therefore, every 10000 litres of Juice contained in the 10 litre BIB instead of the 1 litre Pet Bottle saves 1.54 Tonnes of CO₂ e.g. This equates to 1900Km by a typical 20T truck





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Carbon Calculator

- ~ Additional Tool based on the original data collected by PIRA
- ~ Excel based sheet that gives the ability to alter some of the inputs such as packaging weight and transport distance and then re-calculate the Carbon Effect.
- ~ Presents results in tabular form with text explanation of changes.



Work In Progress

- ~ Modifications to the Carbon Calculator to make it more flexible.
- ~ Assessment of water packaging for office cooler usage
- ~ Additional types of packaging in certain sectors.
- ~ Closer review of multi-trip containers versus single trip especially with regard to cleaning and handling cycles.



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BAG IN BOX TECHNOLOGY IS GREEN



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