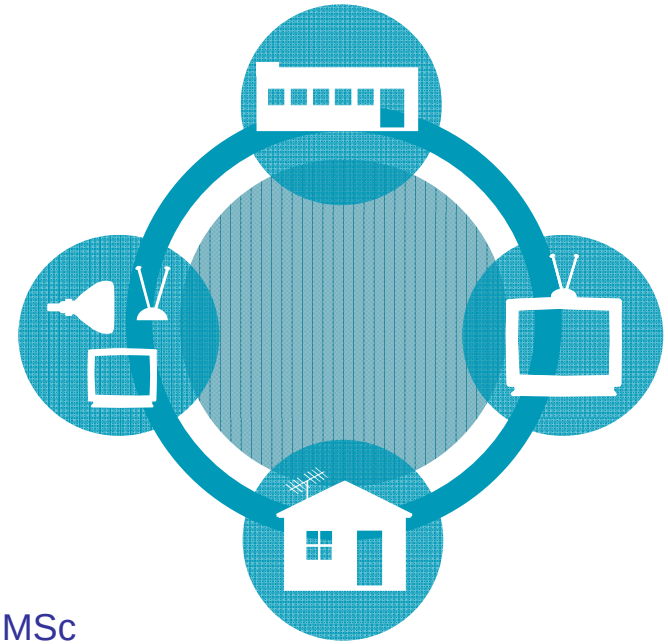
Postgraduate Education, Training and Capacity Building in Water, Environment and Infrastructure

UNESCO-IHE
Institute for Water Education

A Life Cycle Perspective to Cleaner Production

Life Cycle Analysis (LCA) - Introduction



Lecturer: Léon Dijk MSc
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Date: October 2012

eco-education services

UNESCO-IHE
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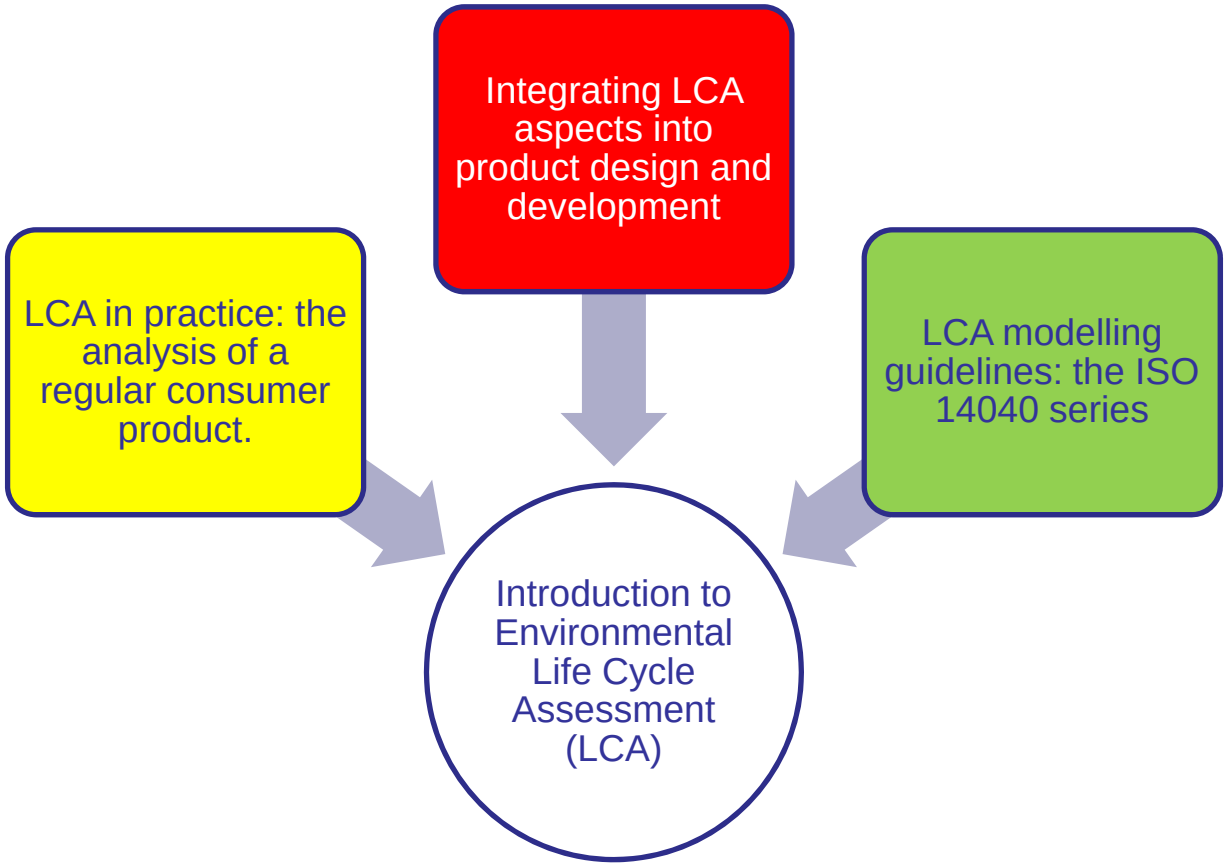
Programme


Integrating LCA aspects into product design and development
LCA in practice: the analysis of a regular consumer product.
LCA modelling guidelines: the ISO 14040 series
Introduction to Environmental Life Cycle Assessment (LCA)

Revision: a definition of CP

Cleaner Production

UNEP International Declaration on Cleaner Production

the continuous application of an integrated, preventive strategy applied to processes, products and services in pursuit of economic, social, health, safety and environmental benefits.

Source: http://www.unep.org/OurPlanet/imgversn/104/declare.html

Tools for CP (1)

Cleaner Production

UNEP International Declaration on Cleaner Production

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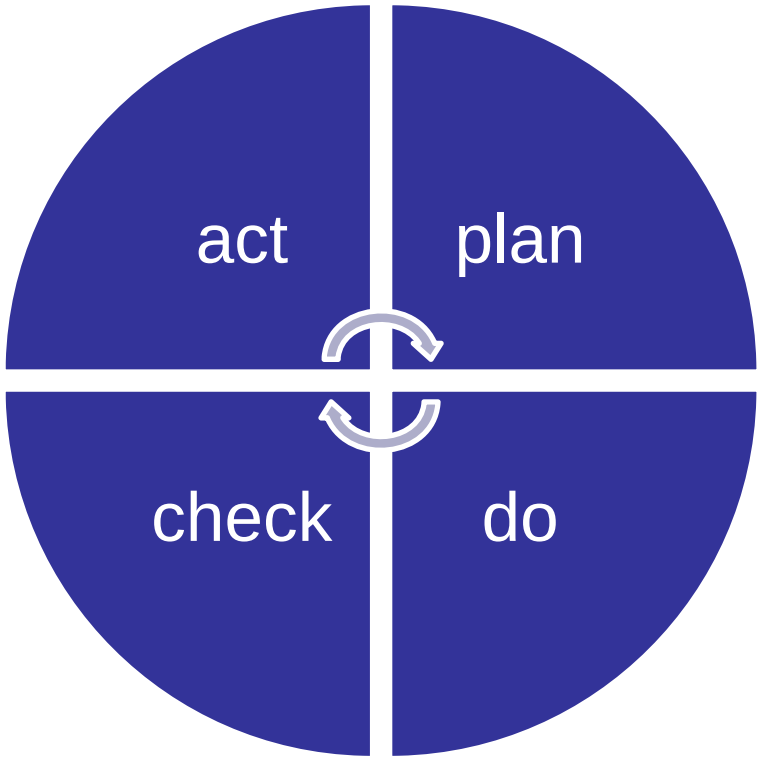
Source: http://www.unep.org/OurPlanet/imgversn/104/declare.html

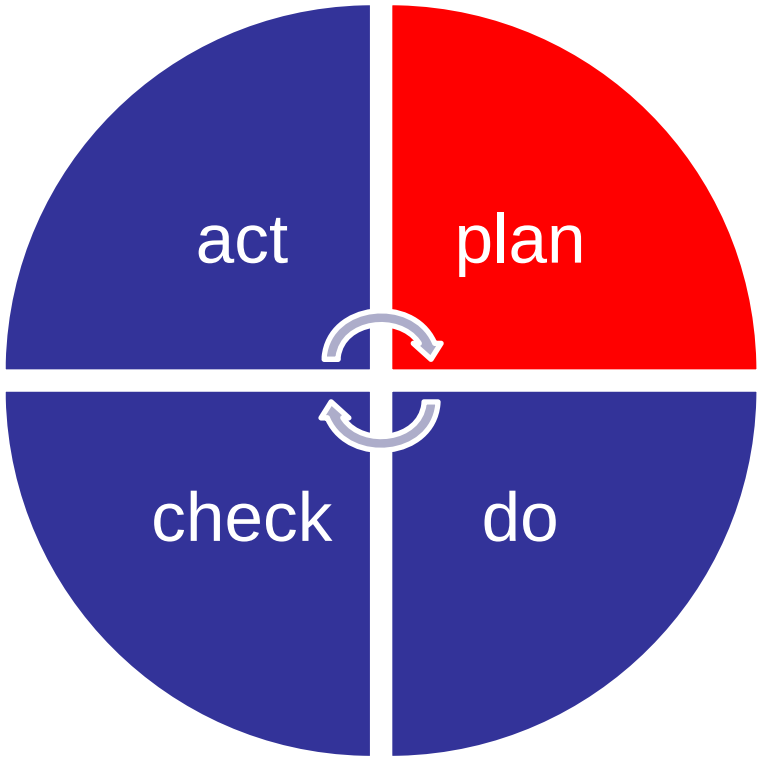
Environmental Management Systems (EMS)

EMS: improve environmental performance of the industrial facility

EMS according to ISO 14001



What plan do you suggest?



Some examples…

CP plan for manufacturer of washing powder?

Some examples…

CP plan for a city promoting clean mobility?

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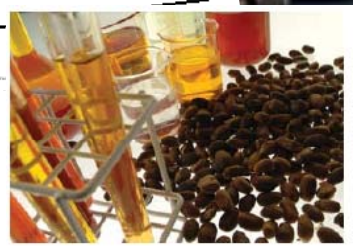
guardian.co.uk

UK biofuels target creating more emissions, environmentalists claim

The government's scheme to introduce biofuels to cut CO2 on roads has actually increased carbon emissions through deforestation, study finds

Alok Jha, green technology correspondent
guardian.co.uk, Wednesday 15 April 2009 11.11 BST



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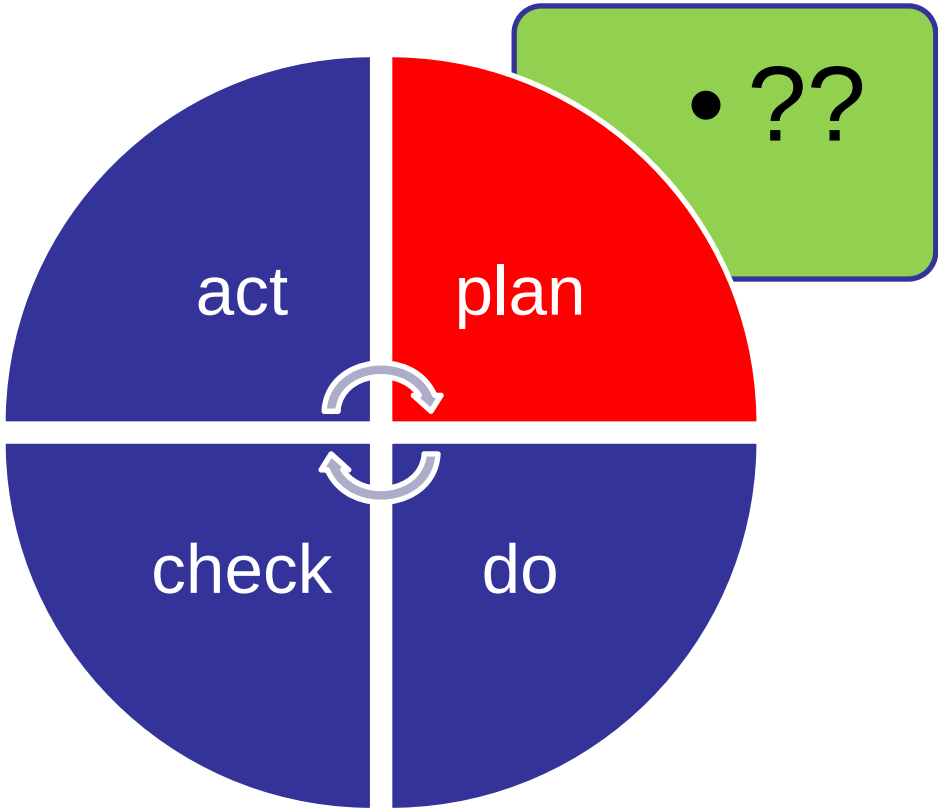
Some examples…

CP plan drinking water delivery systems

Some examples…

CP plan for personal hygiene?

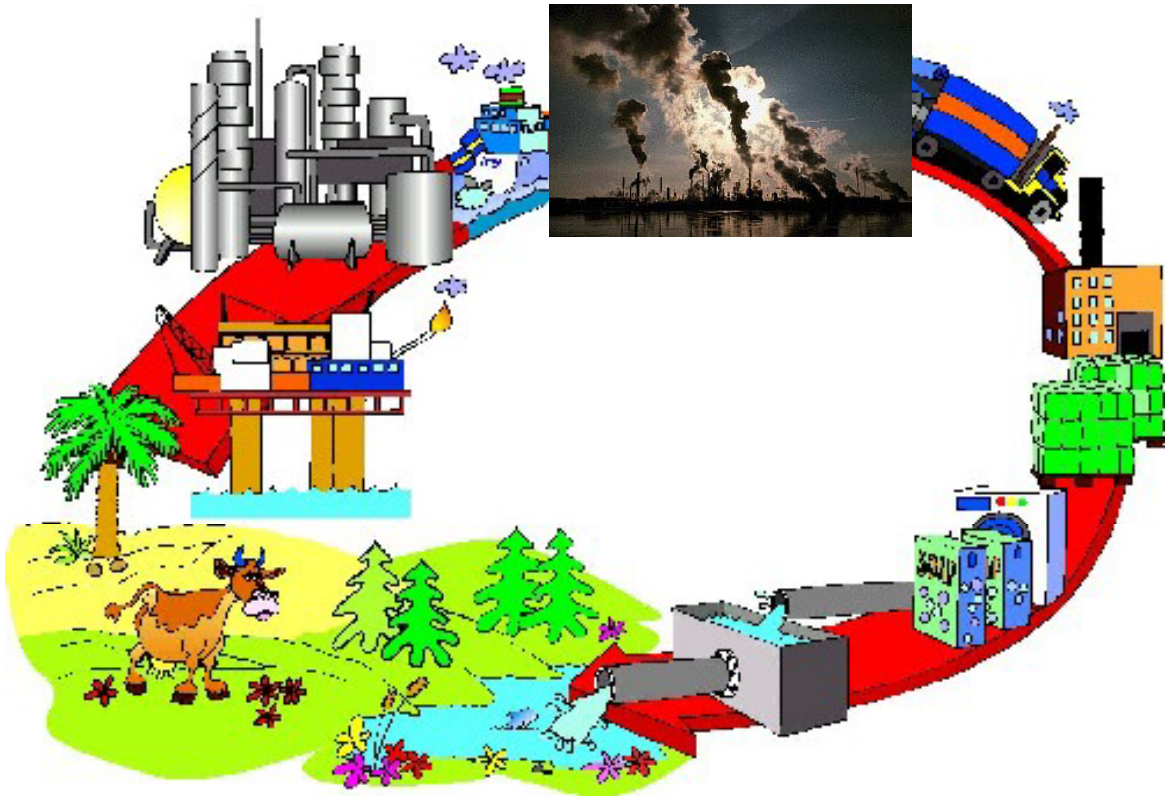
Problem: what's an *effective* plan?



Let's define the problem…

- ✓ Intuitive solutions do not correspond with a complex reality
- ✓ Comparison of alternatives are based on false assumptions
- ✓ Solutions introduce risks of suboptimization or even shifting of burdens
- ✓ There is a lack of quantitive environmental information
- ✓ Environmental information is poorly integrated with design and planning activities

Resolved: the industrial facility is just part of a product chain…



Back to…a definition of CP

Cleaner Production

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the continuous application of an integrated, preventive strategy applied to processes, products and services in pursuit of economic, social, health, safety and environmental benefits.

Source: http://www.unep.org/OurPlanet/imgversn/104/declare.html

If strategies are to improve the environmental performance of processes, products and services, we need to consider

1. their entire life cycle
2. all relevant (environmental) impacts

Tools for CP (2)

Cleaner Production

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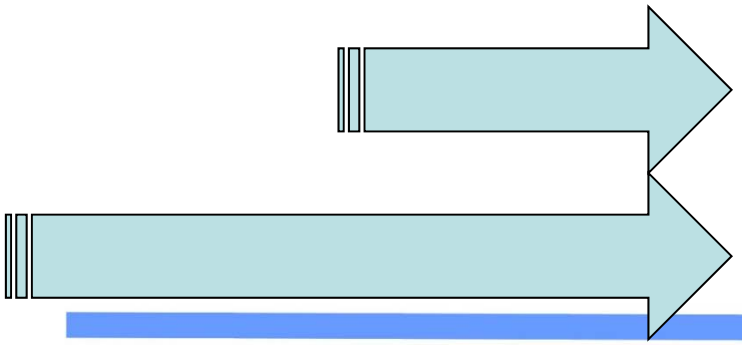
Source: http://www.unep.org/OurPlanet/imgversn/104/declare.html



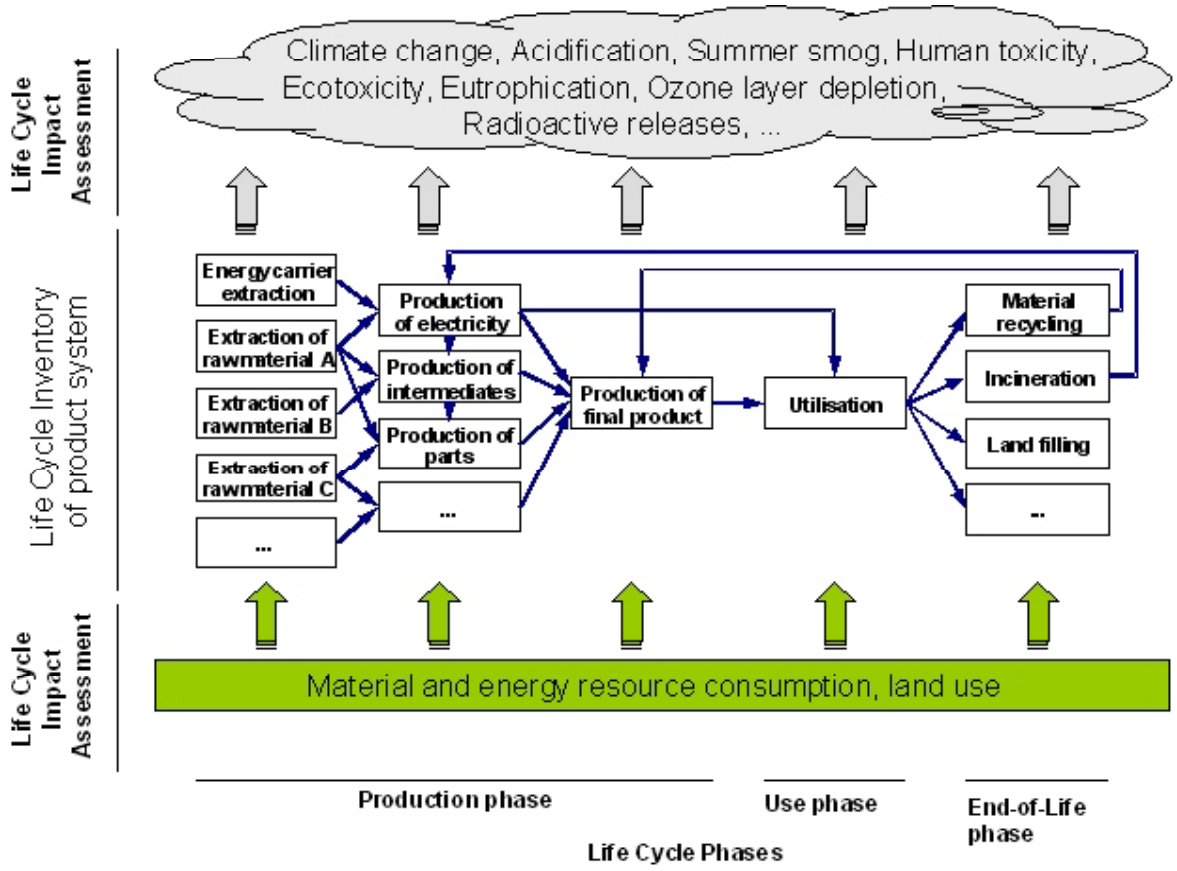
Environmental Management Systems (EMS)

Environmental Life Cycle Analysis (LCA)

Life Cycle Analysis is:

- ✓ Based on the fact that products do not pollute, but their production, use and disposal do;
- ✓ A quantitative integrated assessment of environmental impacts from ‘cradle to grave’;
- ✓ An analysis of *comparative* products, processes and services

Schematic overview of an LCA



LCA: a product-oriented method for sustainability analysis

Example of LCA results

Impact category	Incan**des**cent lamp	Fluor**esc**ent lamp
Climate change	120000 kg CO2-eq	40000 kg CO2-eq
Ecotoxicity	320 kg DCB-eq	440 kg DCB-eq
Acidification	45 kg SO2-eq	21 kg SO2-eq
Depletion of resources	0.8 kg antinomy-eq	0.3 kg antinomy-eq
etc	…	…

Examples of sectors in which LCA is used, include…

- Sustainable Mobility
- Sustainable Public Procurement
- Industry and Manufacturing
- Integrated Chain Management
- Building and Architecture
- Science for Sustainability

Related concepts:

- Eco-efficiency
- Eco-design
- Life Cycle Costing/Total Cost of Ownership
- Societal Life Cycle Analysis/Societal Cost Benefit Analysis


Saab
BioPower
118


TFP 282


SHAW GREEN EDGE INITIATIVE™ | 002 | Evergreen
Closed-loop cycle
Yarn Extrusion
Carpet Manufacturing
Carpet Yarn
Caprolactam
Finished Carpet
Collection Center
Evergreen Nylon Recycling
Old Carpet
Retail Floor Covering
Home
Landfill
Shaw's Anso® products carry the Type 6 designation.
Ansonylon

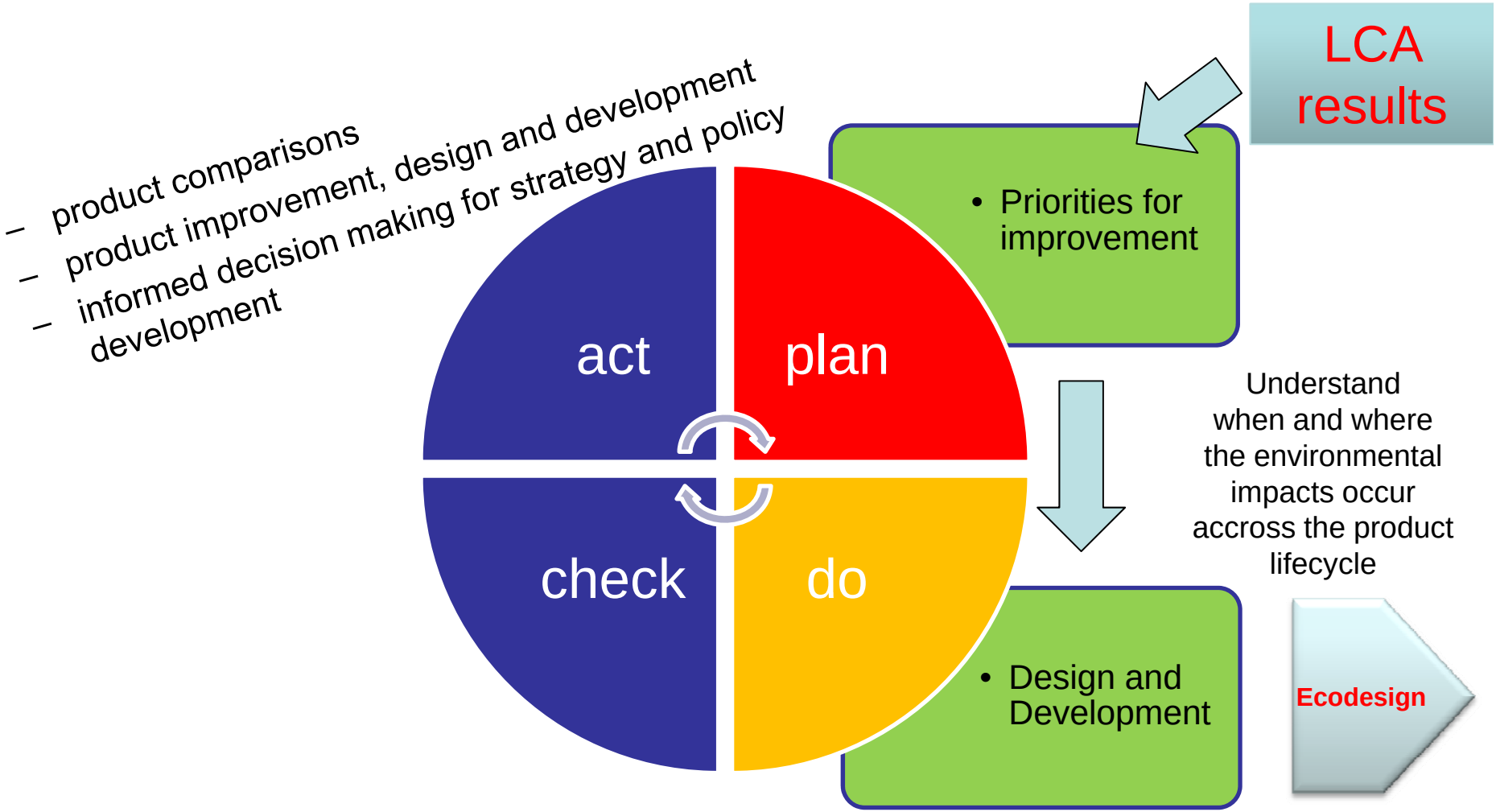
Sustainable Public Pocurement

•“Sustainable Procurement is a process whereby organisations meet their needs for goods, services, works and utilities in a way that achieves value for money on a whole life basis in terms of generating benefits not only to the organisation, but also to society and the economy, whilst minimising damage to the environment.”

•Public spending 8 and 30% of national GDP, making most governments the largest single consumers in their countries.
•Provides a major opportunity to shift to more sustainable production and consumption patterns through the example that governments can provide to other consumers and through the increased demand and the creation of new markets for sustainable products.

Source: Procuring the Future – the report of the UK Sustainable Procurement Task Force, June 2006)

LCA for continuous improvement



Applications of LCA (short videos)

LCA of Carbon in Biofuel Production and Consumption

LCA example of plastic bags vs biodegradable bags

LCA on Cascades paper

Eco-Design

Improving the Environmental Performance of Products through Design

Business drivers for Eco-design

A	• Product marketing, brand value, and Corporate Social Responsibility
B	• Legislation on energy and hazardous substances
C	• Cost & supply-chain management
D	• Stimulus for innovation

Source: Granta's 'Five Steps to Eco Design, Granta Design Limited, 2011

Eco-Design improves Eco-efficiency:

$$\text{Eco-efficiency} = \frac{\text{Functional performance provided by product over life cycle (€)}}{\text{Environmental Impacts of product over life cycle (Eco-points)}}$$

eco-efficiency

resource-efficiency

reduction haz. substances

Extractions from biosphere

Emissions to biosphere

Definitions for Eco-design, Design for Environment, Design for Sustainability…

Eco-design

"*the systematic consideration of design performance with respect to environmental, health, and safety objectives over the full product and process life cycle*" (*Fiksel, 1996 in Wrisberg et al. 2002*).

Ecodesign expands the *design* scope towards environmental and social implications of products and processes

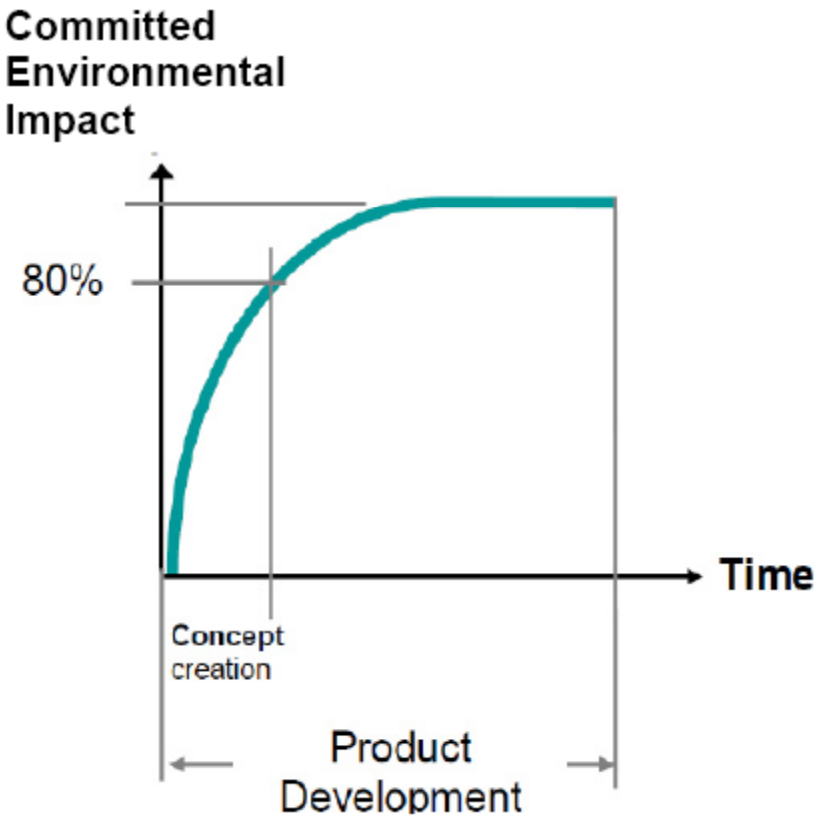
HOW??

Eco Design Steps

1. Consider environmental impact early in the design process
2. Consider the entire product system
3. Select materials and processes based on the assessment of environmental and technical properties

Source: Granta's 'Five Steps to Eco Design, Granta Design Limited, 2011

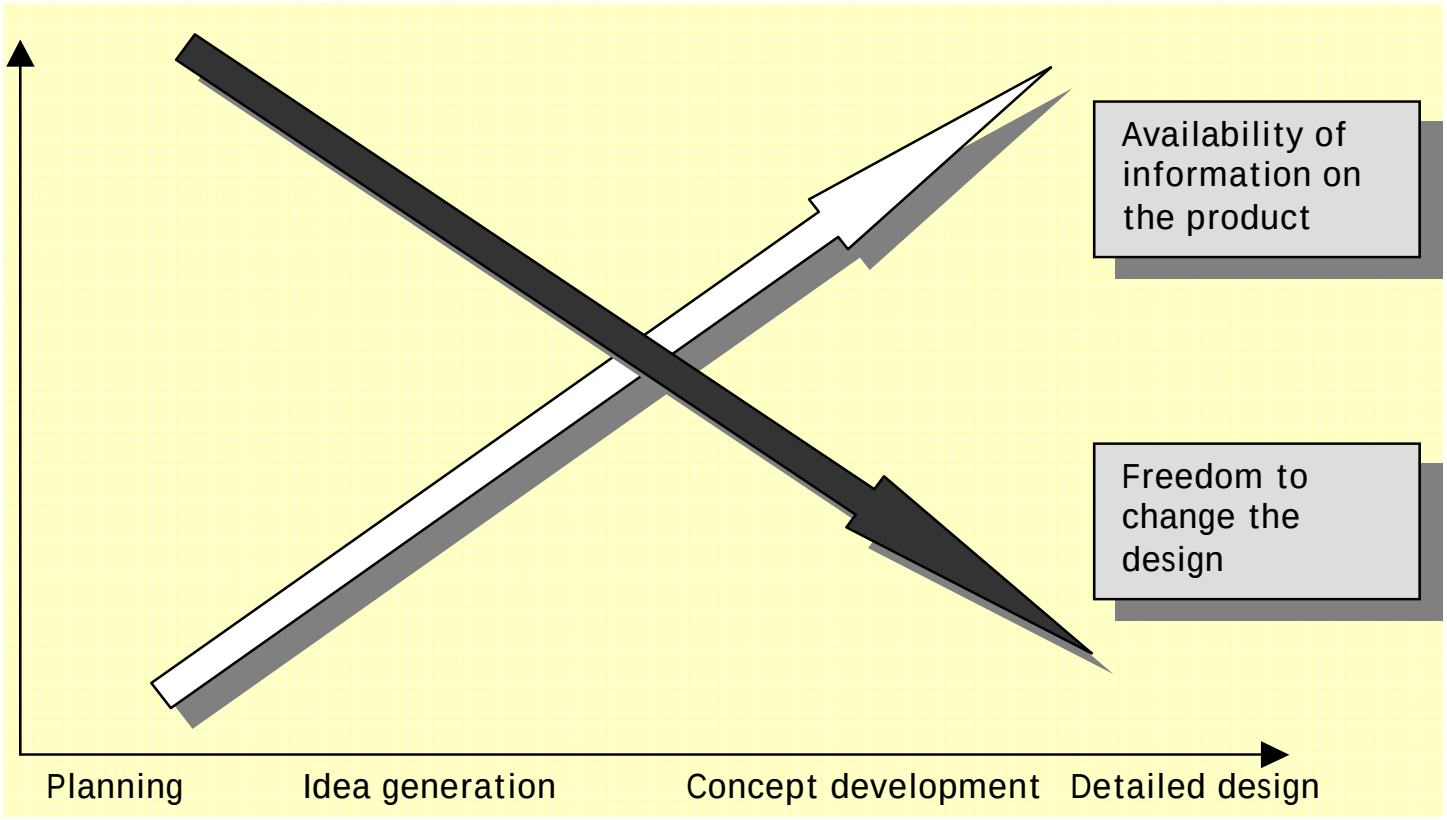
Consider environmental impact early in the design process



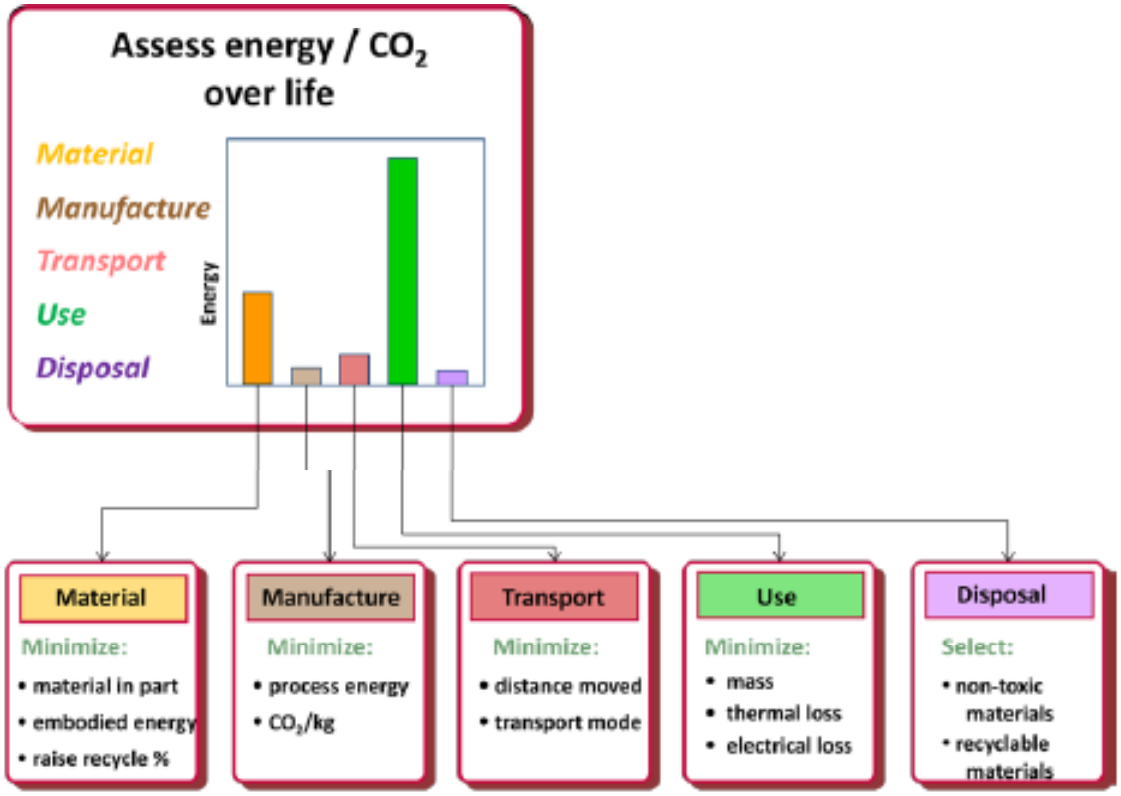
80% of a product's overall environmental impact has been built in by the end of the conceptual design phase

Source: Granta's 'Five Steps to Eco Design, Granta Design Limited, 2011

Implications for the Design Process

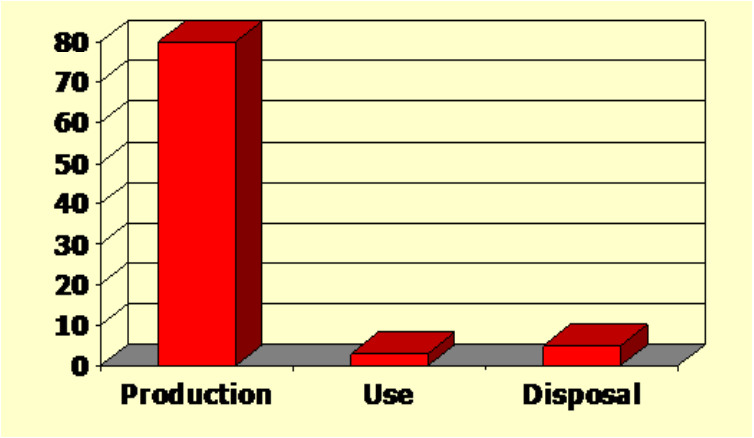


Consider the entire product system

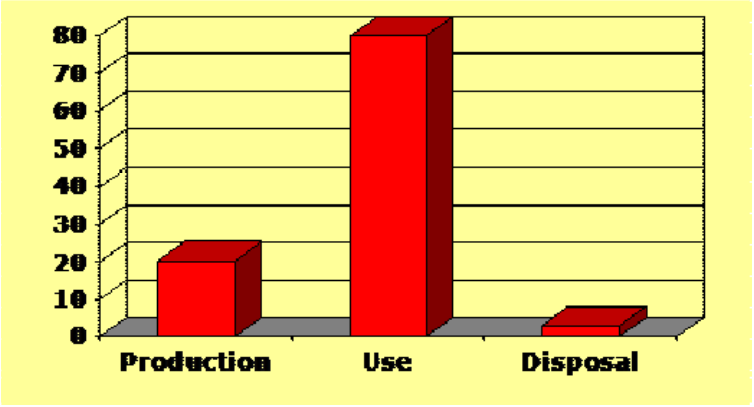


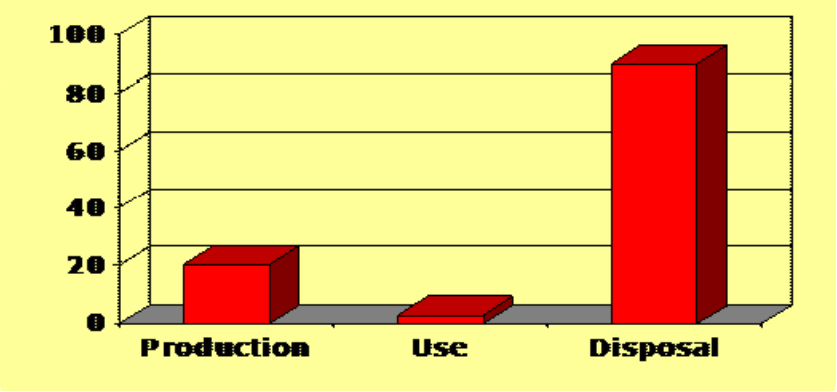
Source: Granta's 'Five Steps to Eco Design, Granta Design Limited, 2011

Some products have a dominating load during production, some during use, some during disposal



LCA gives input for priority setting in product system improvement strategies





Select materials and processes based on the assessment of environmental and technical properties

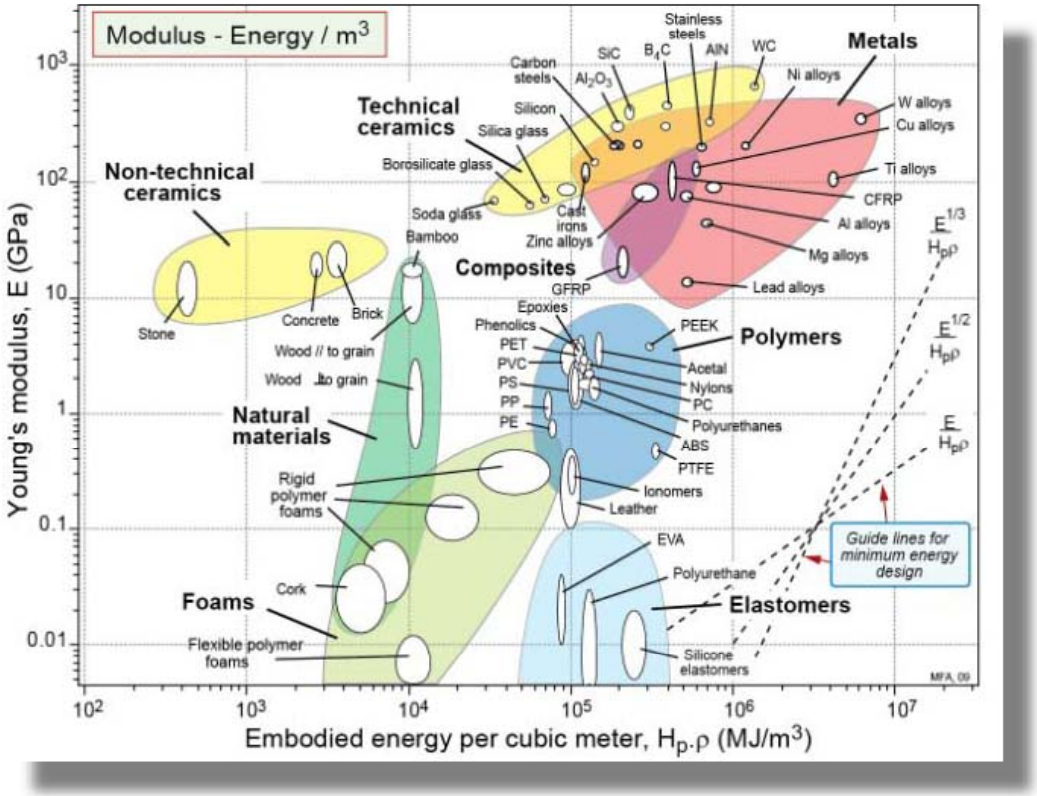
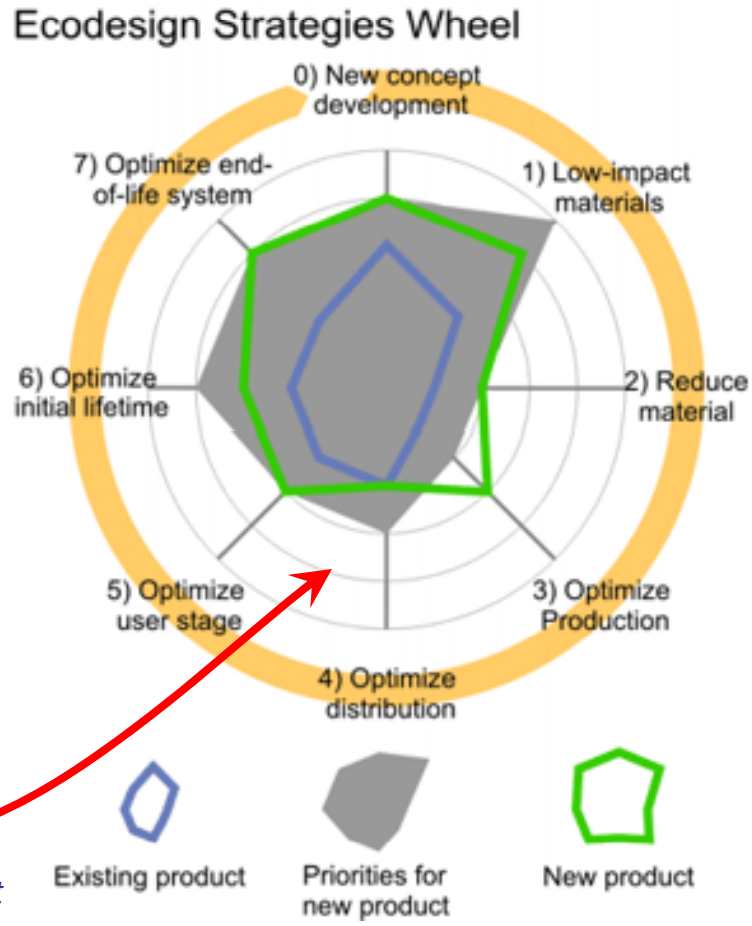


Figure 7: Ashby diagram showing embodied energy versus Young's modulus plotted using CES Selector

Source: Granta's 'Five Steps to Eco Design, Granta Design Limited, 2011

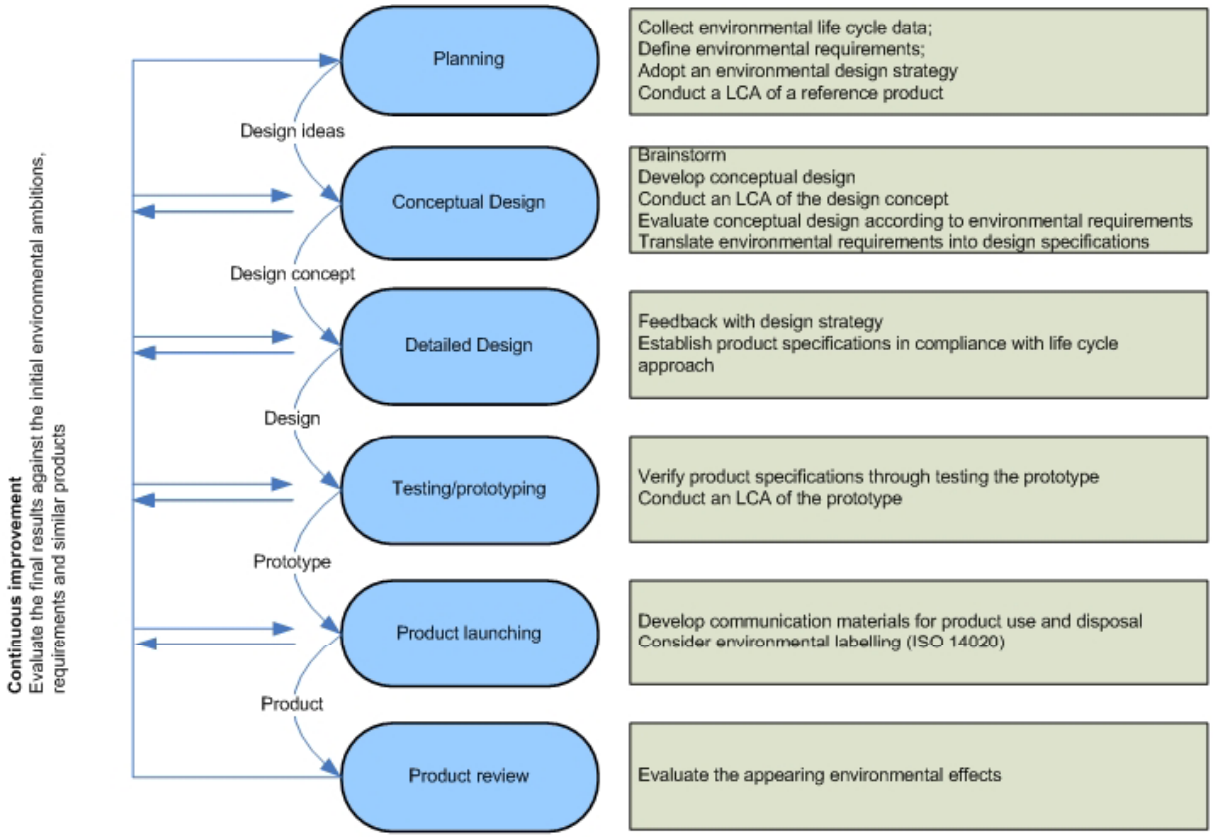
How to integrate LCA information into the design regime?

- The designer considers functionality requirements of the product including its environmental implications along the life cycle.
- The '*Lifecycle Design Strategies Wheel*' visualizes the guidelines of Eco-Design.
- A 'product profile' is created using LCA.



(Source: Brezet and Van Hemel, *Ecodesign, A Promising Approach to Sustainable Production and Consumption, 1997. Electronic figure available at www.matbase.com)*

Principles of eco-design according to ISO 14062 guidelines



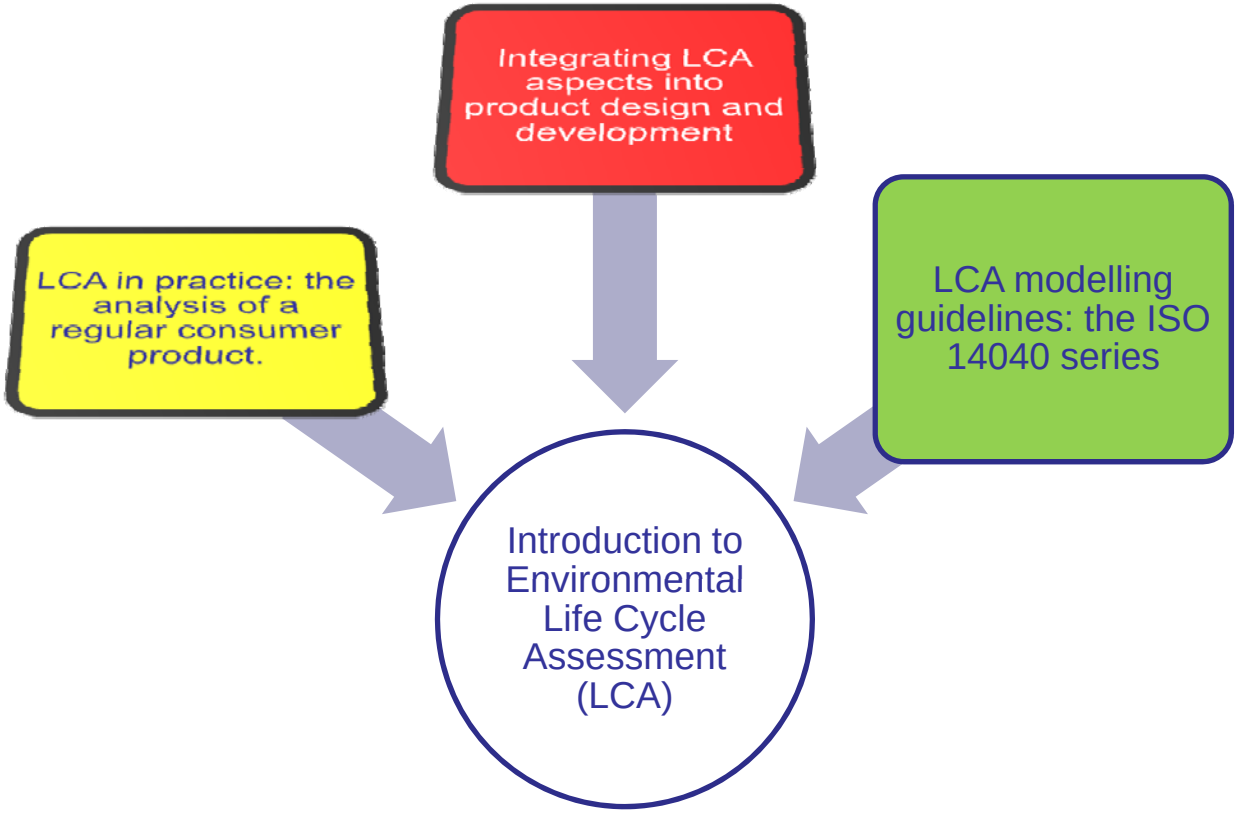
Design scheme according to ISO 14062 Environmental management – integrating environmental aspects into product design and development
(After: NEN, 2011, Milieumanagementsystemen, werken met ISO 14001, Nederlands Normalisatie Instituut)

Benefits from Eco-design

Consequences for solid waste:

- Reduction of natural resource extractions (materials and energy)
- Reduction or elimination of hazardous materials within waste
- Reduction of toxic emissions during incineration

Programme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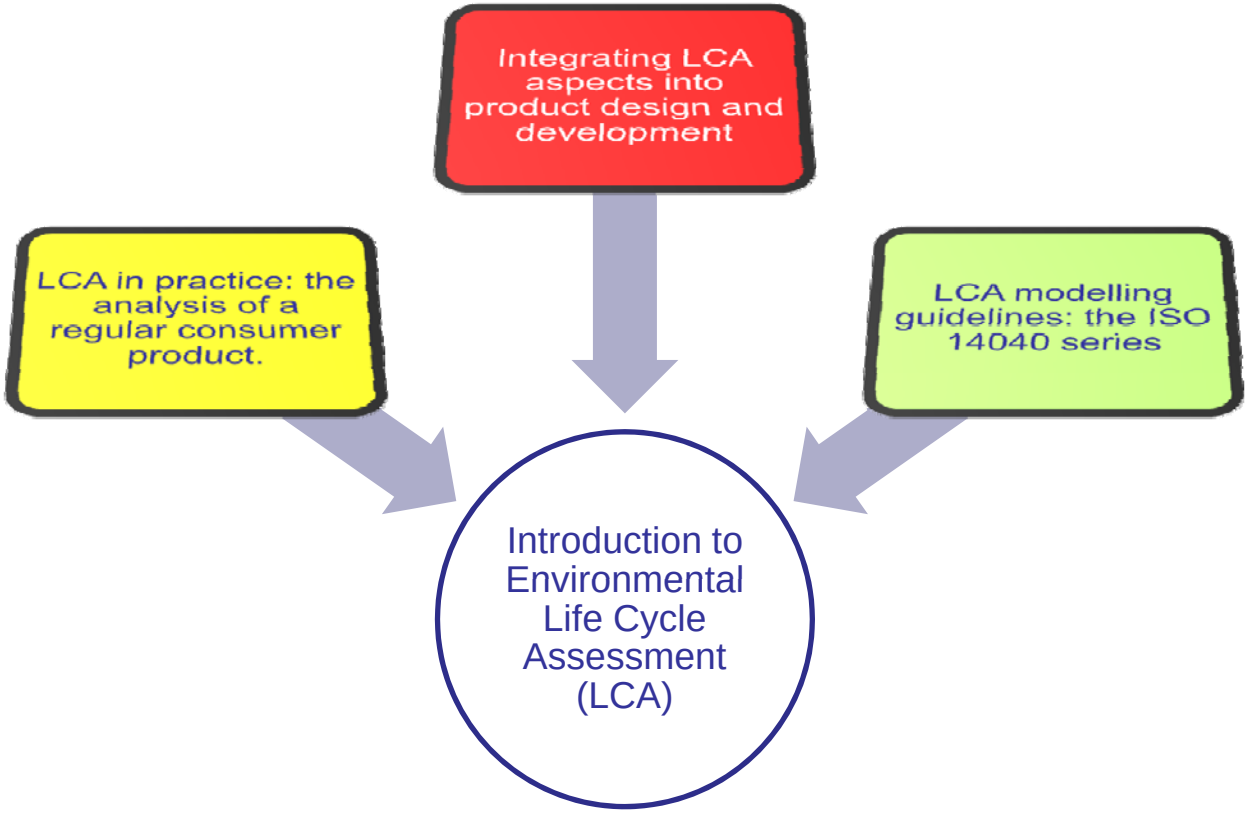
Programme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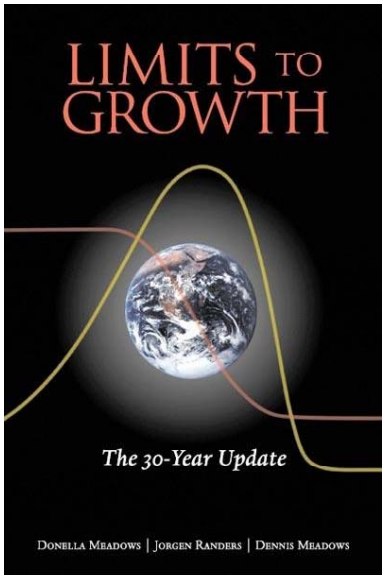
LCA modelling example

LCA of a hand dryer (Pré Sustainability Consultants)

LCA is a ‘young’ technique



SETAC®

ISO International Organization for Standardization

GECERTIFICEERD VOLGENS ISO-NORM 9002

CERTIFIED TÜV NEDERLAND QA B.V. SYSTEM

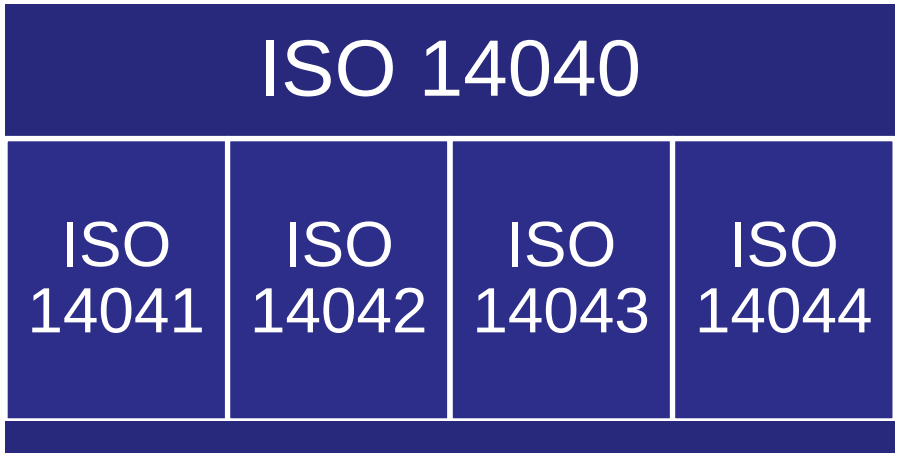
70’s: Limits to Growth

90’s: establishment of Society for Env. Toxicoloty and Chemistry, introduction of LCA (code of practice)

Since the evolvement of LCA thinking, there have been a lot of initiatives by governments, universities, businesses, researchers…

LCA is a standardized technique

International Organisation for Standardisation (ISO) developed the ISO 14040 series on the structure of LCA's



…which implies international consensus on procedure of conducting LCA's

EU policies and LCA

Lifecycle thinking is key concept in IPP (integrated product policy)

EuP (Energy using Products) or Eco-design directive, for all mass produced EuP's

European LCA center JRC (Joint Research Center)

Websites:

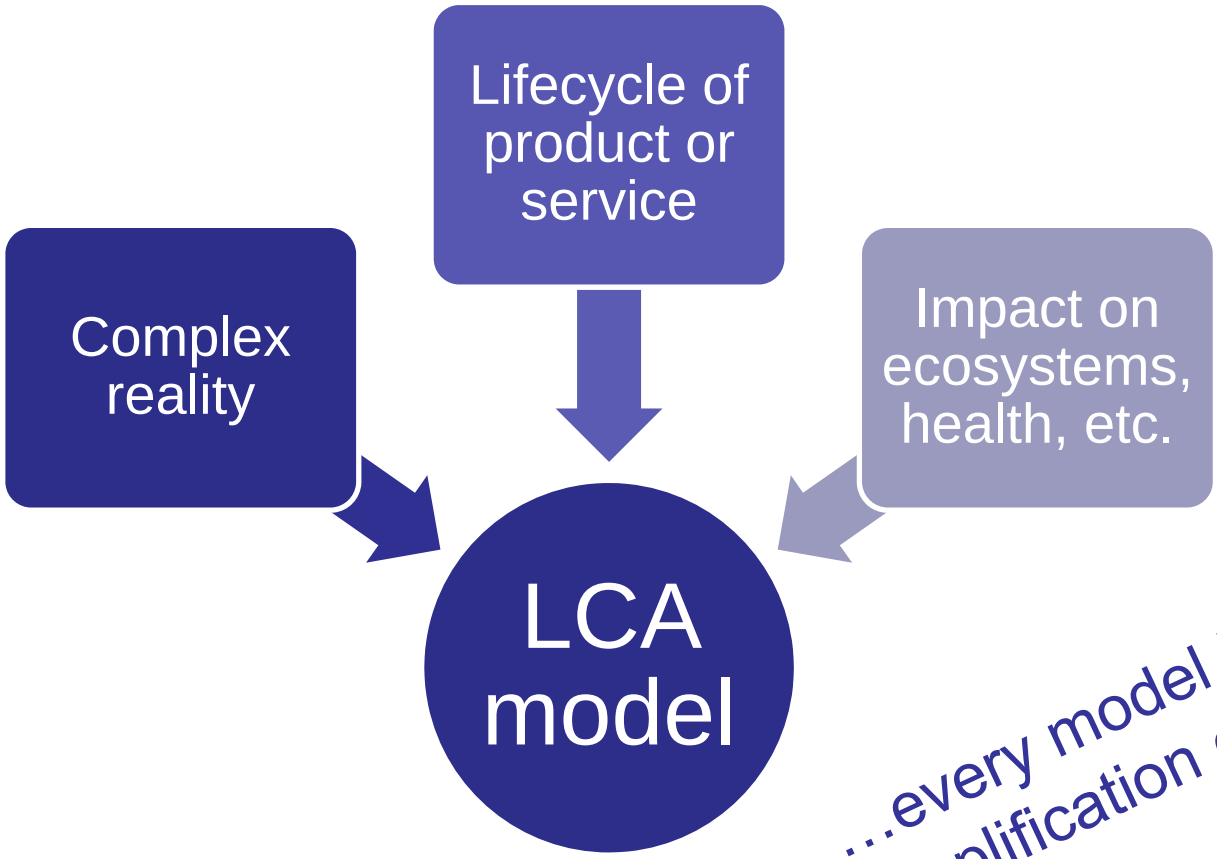
http: //ec.europa.eu/environment/ipp/home.htm

http://ec.europa.eu/enterprise/eco_design/index_en.htm

http://ec.europa.eu/environment/ipp/identifying.htm

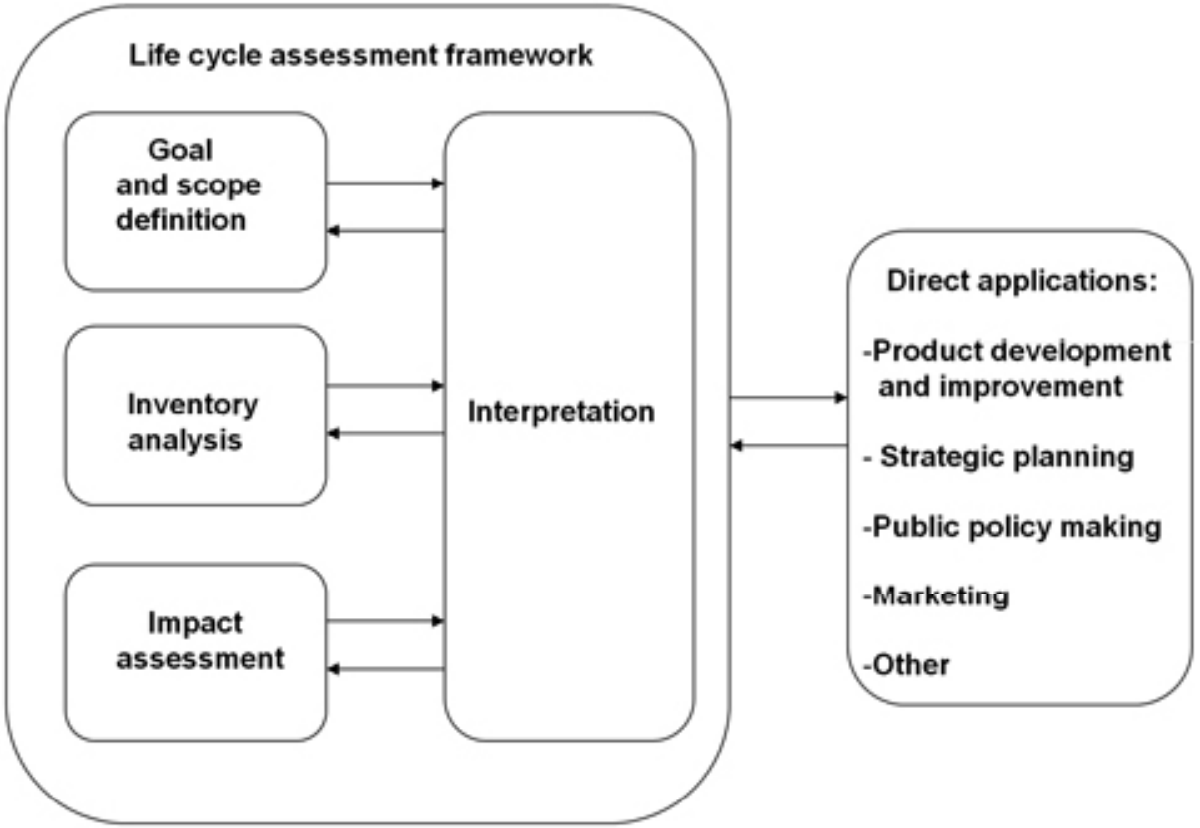
http://lca.jrc.ec.europa.eu/

What is implied in LCA model?



...every model is a simplification of reality!!

LCA framework (ISO 14040)



Scientific LCA discussions

SETAC conferences; Ecobalance Tsukuba, Japan; InLCA, USA; CILCA, Latin America, Chili; UNEP Lifecycle Initiative

Journals covering LCA:

- International Journal on Life Cycle Assessment
- Journal of Cleaner Production
- Journal of Industrial Ecology
- Environmental Science and Technology