

# Life Cycle Assessment

## Unit 1. Fundamentals



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Departamento de Ingenierías Química  
y Biomolecular



# UNIT 1. LIFE CYCLE ASSESSMENT (LCA) FUNDAMENTALS



Jonathan Albo Sánchez, Antonio Domínguez Ramos, María Margallo Blanco, Javier Pinedo Alonso  
Life Cycle Assessment (LCA) fundamentals

# **LEARNING TARGETS**

**SUSTAINABLE DEVELOPMENT  
DEVELOPMENT OF THE LCA CONCEPT  
LIFE CYCLE SUSTAINABILITY ASSESSMENT  
EUROPE 2020  
LIFE CYCLE THINKING**



# 1.1. SUSTAINABLE DEVELOPMENT





# SUSTAINABLE DEVELOPMENT

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## Global Environmental Outlook 6 Pan-European

### *Air Pollution*

500k

**premature deaths caused  
by outdoor air pollution**

The proportion of the population living in areas exceeding WHO air quality guideline values varies by pollutant, with between 87-93 per cent of the EU population exposed to high levels of fine particles (PM2.5), 61-83 per cent to PM10, and 97-98 per cent to high levels of ozone (O3).



# SUSTAINABLE DEVELOPMENT

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Global Environmental Outlook 6 Pan-European

## *Climate Change*

**0.31**

°C per decade was the  
temperature rising  
between 1980 and 2009



# SUSTAINABLE DEVELOPMENT

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Global Environmental Outlook 6 Pan-European

## *Chemicals and Waste*

**12M**

Tonnes Waste from electrical goods and electronic equipment in Europe are expected to be generated in 2020



# SUSTAINABLE DEVELOPMENT

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## Global Environmental Outlook 6 Pan-European *Coastal, Marine and Oceans*

7

**% of marine species indicate ‘favourable conservation status’.**

The chemical status of pan-European oceans and seas has generally improved, but harmful substances continue to degrade coastal areas and open oceans, nutrient loads remain high and the impacts of new pollutants, including plastic wastes forming marine litter, are growing.



# SUSTAINABLE DEVELOPMENT

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## Global Environmental Outlook 6 Pan-European

### *Land*

20

per cent of Natura 2000 (protected) territories have already been lost to sealing and land take.



# SUSTAINABLE DEVELOPMENT

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Global Environmental Outlook 6 Pan-American

*Options for the region moving forward*

- Decarbonize energy and transport systems
- Restoring ecosystems
- Decoupling resource use from economic growth
- Strengthening environmental responsibility in business
- Incentivizing lifestyle changes

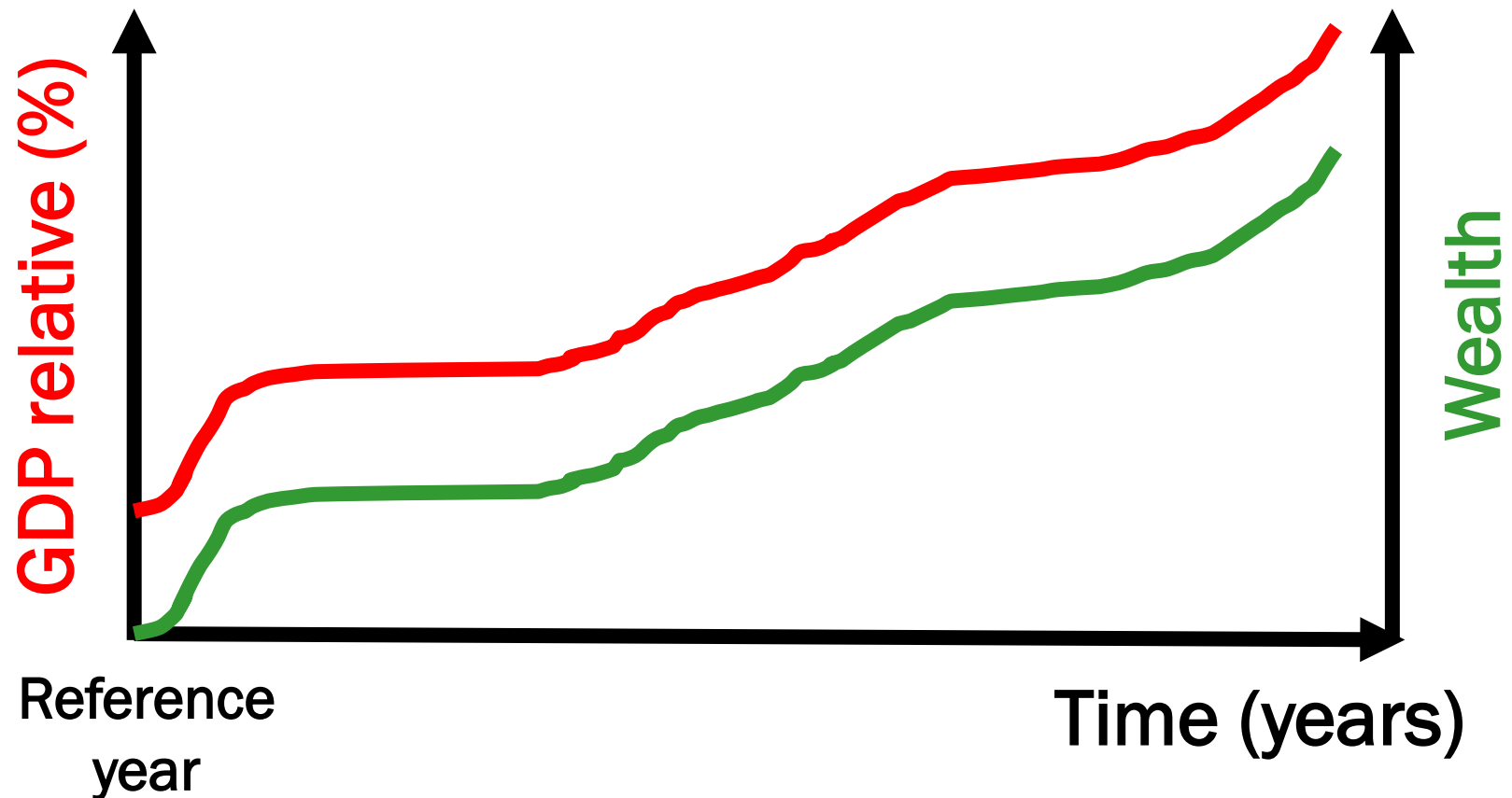




# SUSTAINABLE DEVELOPMENT

Development as economic development

Classical identification between economic growth and economic development



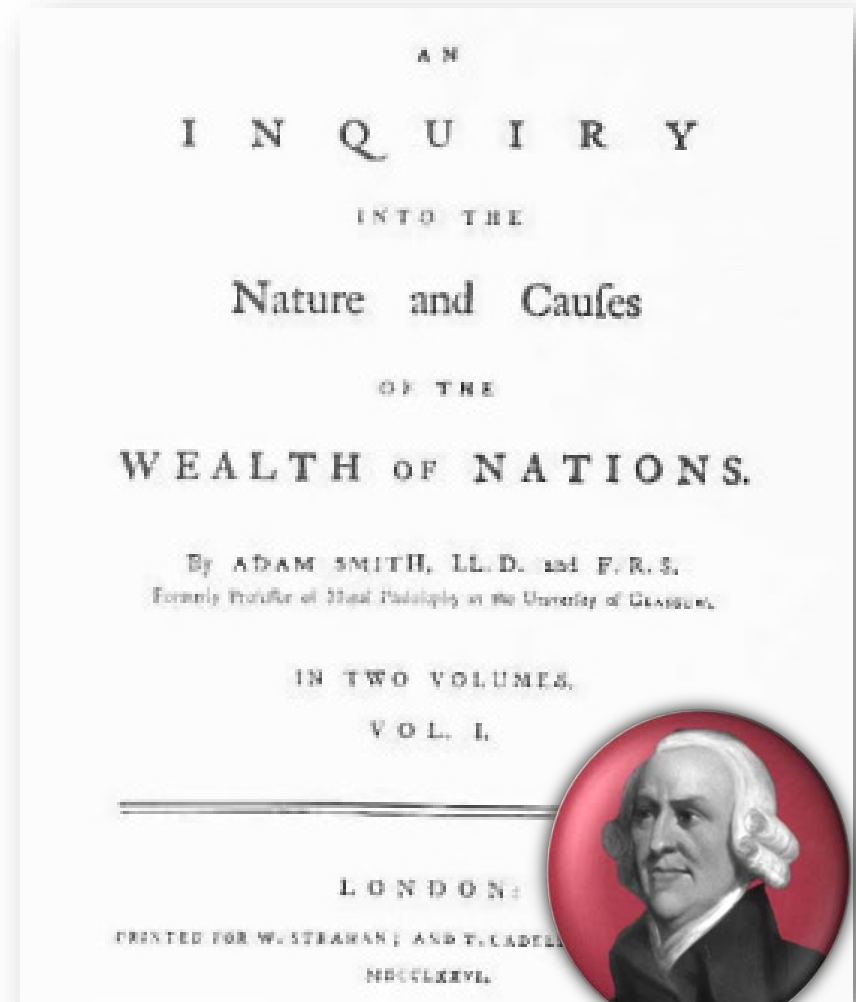
# SUSTAINABLE DEVELOPMENT

Development as economic development

## *The Wealth of Nations*

An Inquiry into the Nature and Causes of the **Wealth of Nations**, by Adam Smith 1776; Book 1, Chapter 8, Of the Wages of Labour [36]

*“...No society can surely be flourishing and happy, of which the far greater part of the members are poor and miserable...”*

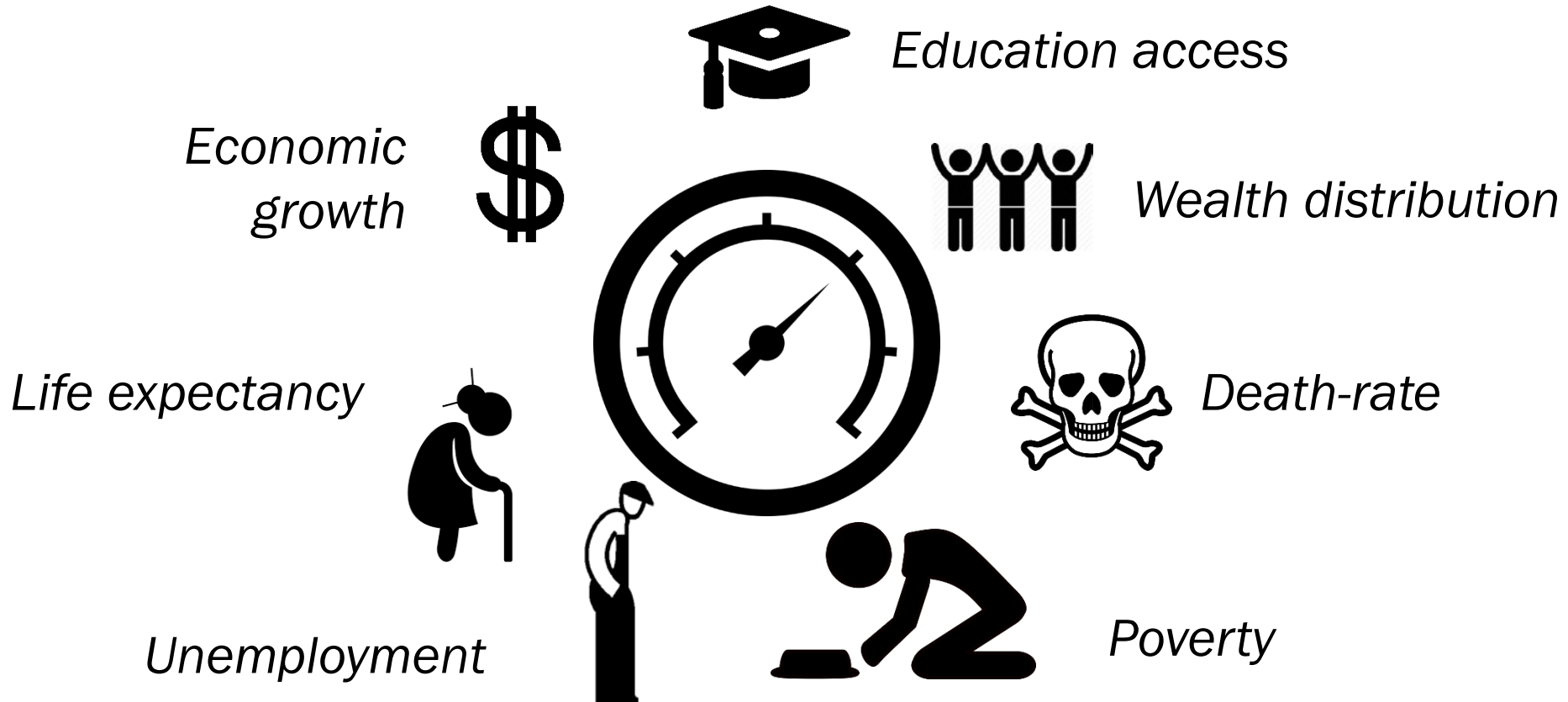


# SUSTAINABLE DEVELOPMENT

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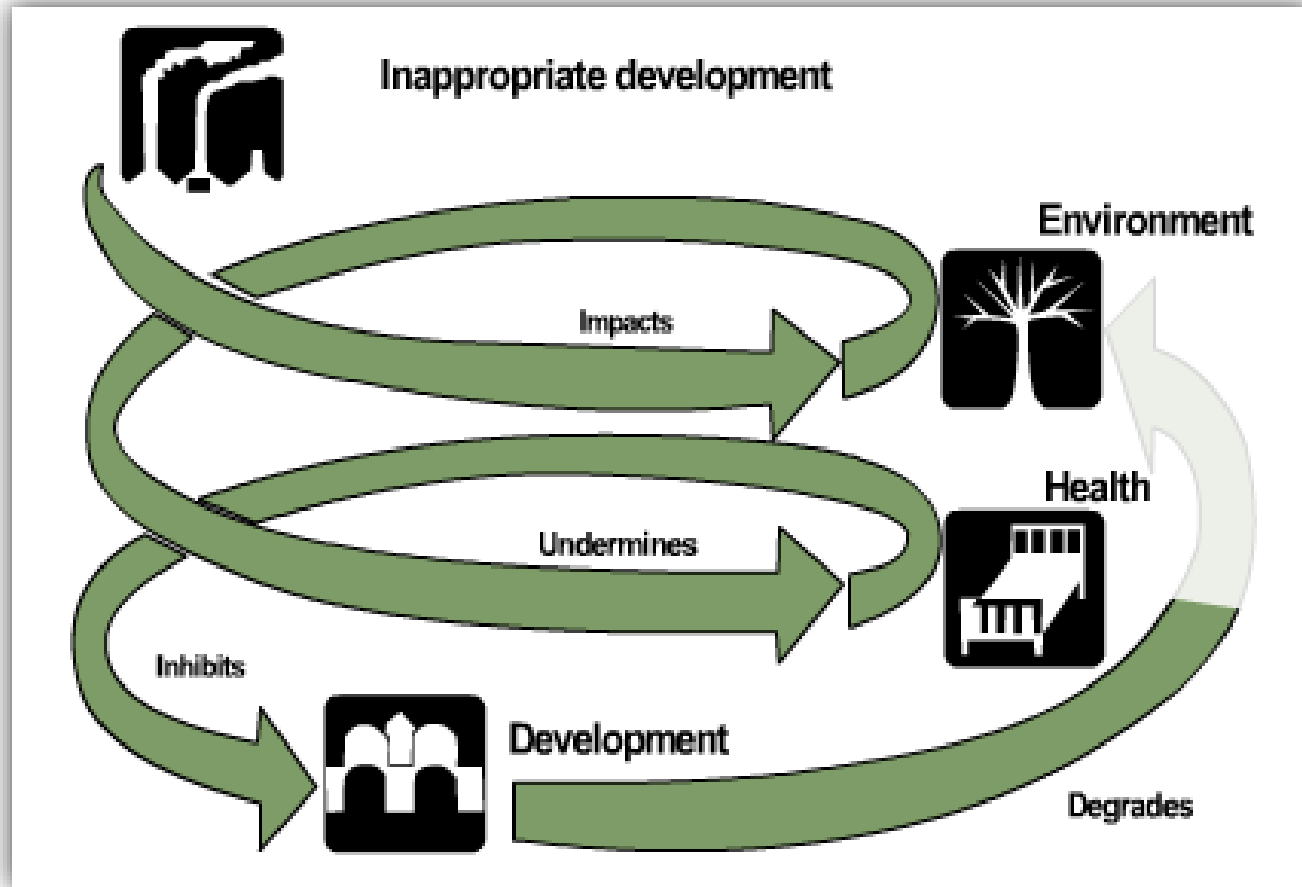
Development definition

*Economic growth is different  
from Economic Development*



# SUSTAINABLE DEVELOPMENT

## The descending spiral of unsustainable development



The descending spiral of unsustainable development is not the result of a single factor rather than a combination of factors that reinforce each others

# SUSTAINABLE DEVELOPMENT

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## The origin of the concept

*“...11. Until recently, the planet was a large world in which human activities and their effects were neatly compartmentalized within nations, within sectors (energy, agriculture, trade), and within broad areas of concern (environment, economics, social). These compartments have begun to dissolve. This applies in particular to the various global 'crises' that have seized public concern, particularly over the past decade. These are not separate crises: an environmental crisis, a development crisis, an energy crisis. They are all one.”*

**Report of the World Commission on Environment and Development: Our Common Future (1987), I.2. The interlocking Crises**



**Gro Harlem Brundtland**  
Ex-head of the World  
Commission on Environment  
and Development

<http://www.un.org/News/dh/hlpanel/brundtland-bio.htm>

# SUSTAINABLE DEVELOPMENT

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## Approaches to Sustainable Development



New socio-economic paradigm

<http://www.undp.org/content/undp/en/home/>

**VS**



**THE WORLD BANK**  
IBRD • IDA

Traditional economic approach

<http://www.worldbank.org/>



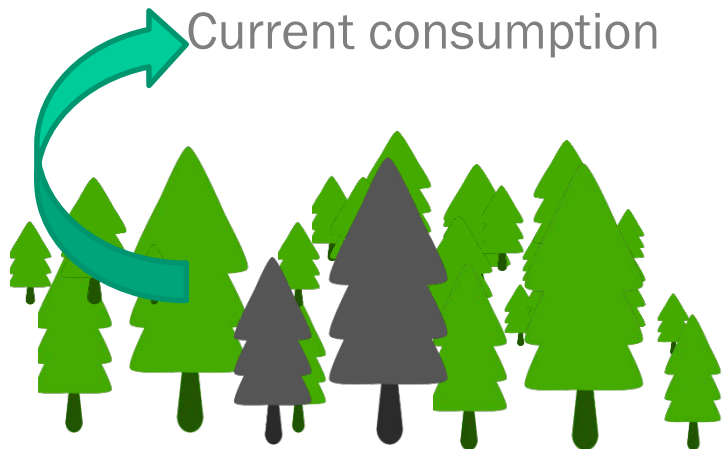
# SUSTAINABLE DEVELOPMENT

## Sylvicultura Oeconomica 1713

Hans-Carls von Carlowitz develops the basic law of silviculture: *“that not more wood should be removed from the forests as can grow in the long run”*



Present



Future



# SUSTAINABLE DEVELOPMENT

## Wall Street Crash 1929

Economic growth concept raises as a driver for the massive increase of goods purchase. Consumption is linked to development and progress

## Planned Obsolescence

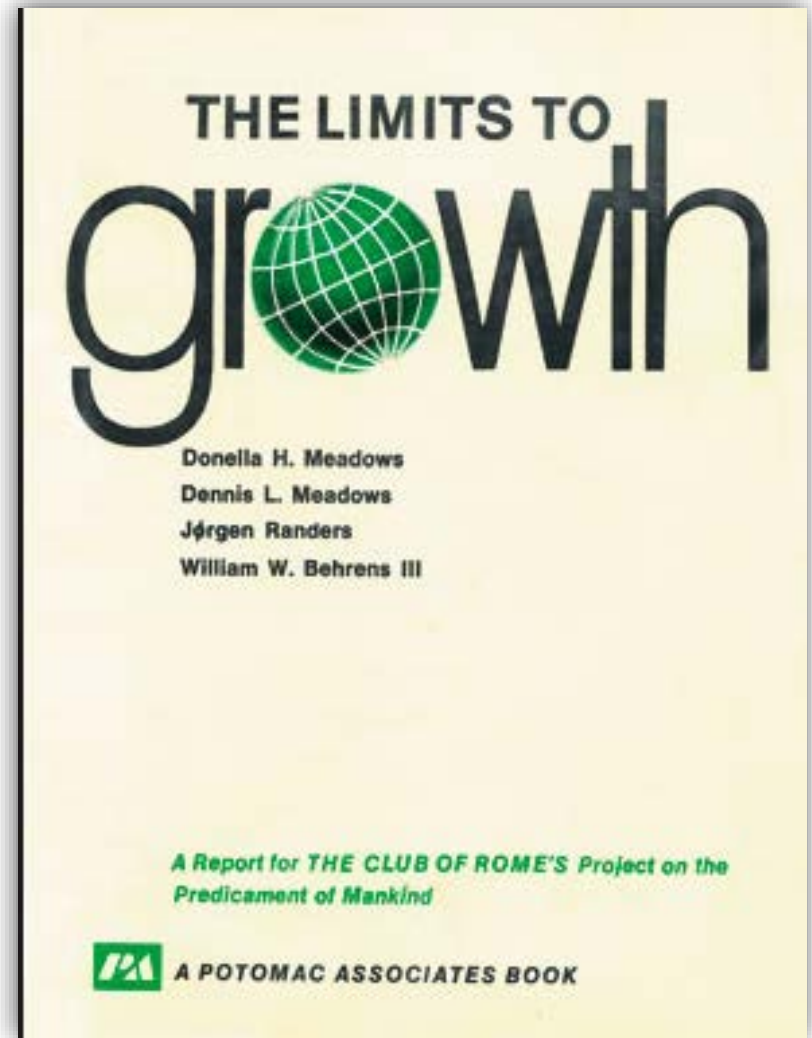


# SUSTAINABLE DEVELOPMENT

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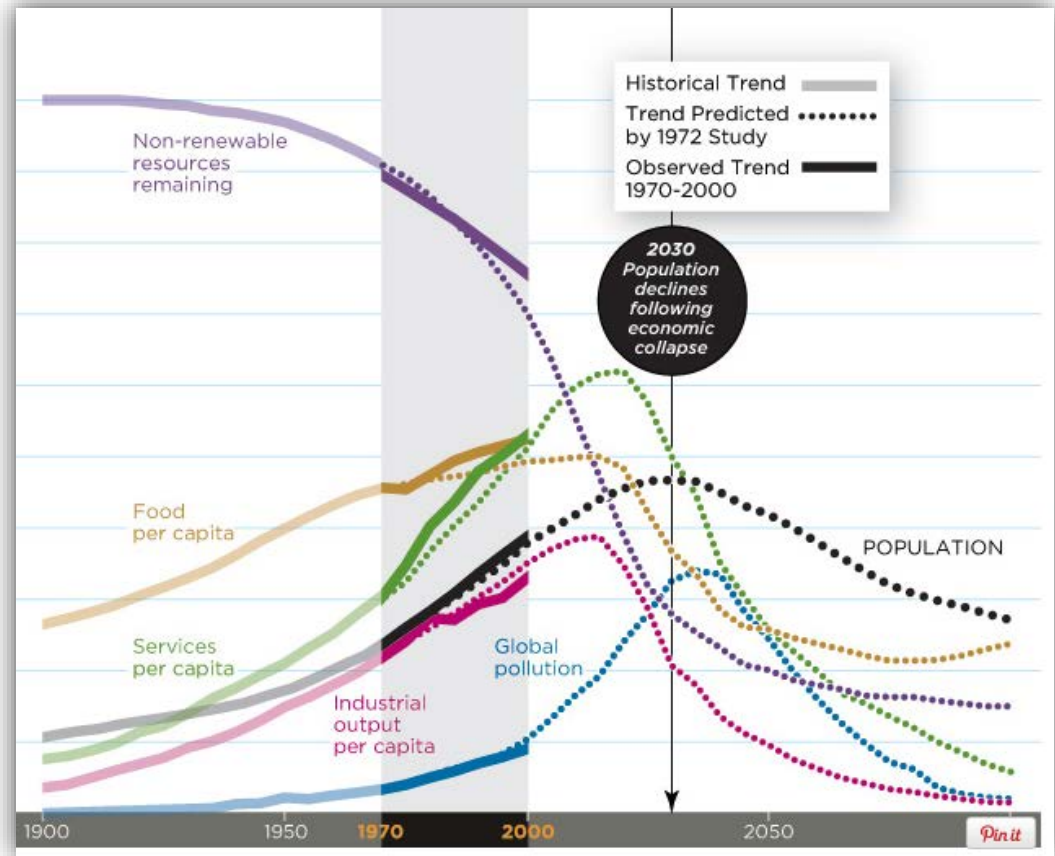
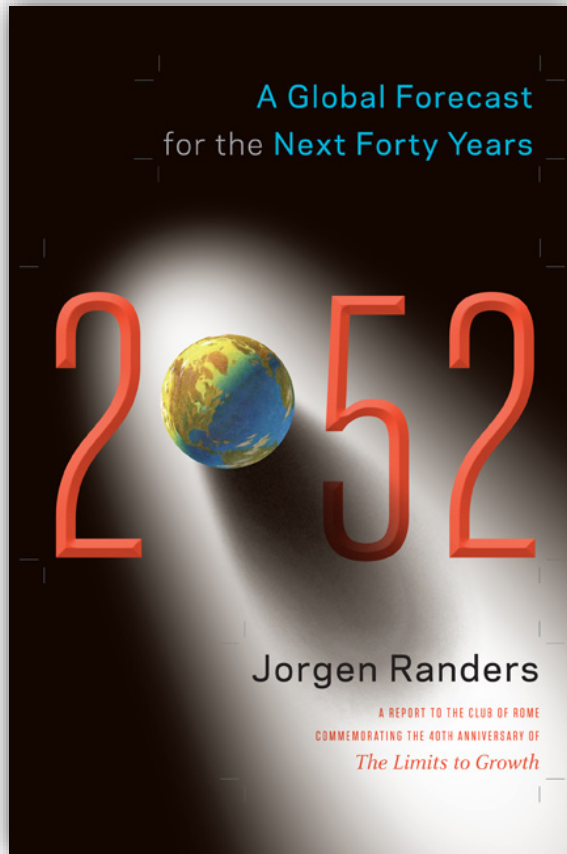
1st Report of the Club of Rome “The limits to growth” 1972

Contradiction between a non-finite growing and a non-restringing grow of the consumption in a world of finite resources bringing this issue to the world agenda



# SUSTAINABLE DEVELOPMENT

## 40 years after “The limits of growth” in 2012



*“Professor Randers’ analysis of where the world could be in 40 years has demonstrated that ‘Business as usual’ is not an option if we want our grandchildren to live in a sustainable and equitable planet. It took 40 years before the full message of The Limits to Growth was properly understood. We cannot afford any more lost decades.”*

<http://www.lastcallthefilm.org/>

<http://www.smithsonianmag.com/science-nature/Looking-Back-on-the-Limits-of-Growth.html#>

<http://www.clubofrome.org/?p=703>

# SUSTAINABLE DEVELOPMENT

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United Nations Conference on the Human Environment Stockholm 1972

Preparatory meetings in 1971 expressed concern about the environmental consequences of increasing global development, while nations that were still developing raised their own continuing need for economic development



# SUSTAINABLE DEVELOPMENT

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United Nations Conference on the Human Environment Stockholm 1972

To examine the world's growing environmental and development problems with a view to making recommendations to national governments and international bodies on appropriate actions

## United Nations Development Program





# SUSTAINABLE DEVELOPMENT

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World Comm. on Env. and Dev. "Brundtland Commission" in 1983

The 3 goals of the Commission:

1

to **re-examine** critical environmental and development **problems** around the world and **formulate** realistic **proposals** to address them



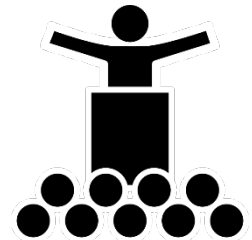
2

to **strengthen** international **cooperation** on environmental and development issues



3

to raise the level of understanding and **commitment** to sustainable development on the part of **individuals, organizations, businesses** and **governments**



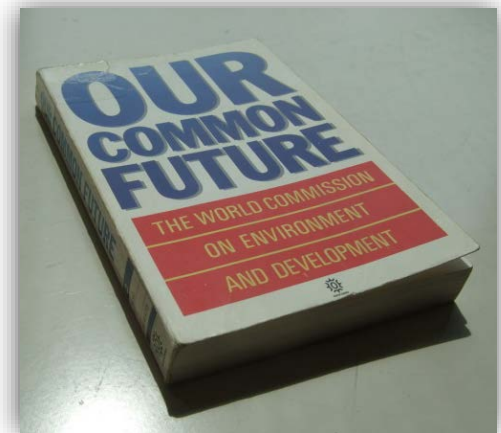
# SUSTAINABLE DEVELOPMENT

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Definition from “Our Common Future” 1987

**“... development that meets the needs of the present without compromising the ability of future generations to meet their own needs”**

Our Common Future  
a.k.a. “Brundtland report”, 1987  
(Chapter 2: Towards Sustainable Development,  
article 1) Oxford University Press, ISBN-13: 978-  
0192820808



# SUSTAINABLE DEVELOPMENT

## The three pillars of Sustainable Development

### ENVIRONMENT



- ✓ To avoid overexploitation
- ✓ Sinks functions
- ✓ Non renewable resources
- ✓ Atmospheric stability
  
- ✓ To produce goods and services
- ✓ To avoid extreme debt
- ✓ To avoid sectorial imbalances

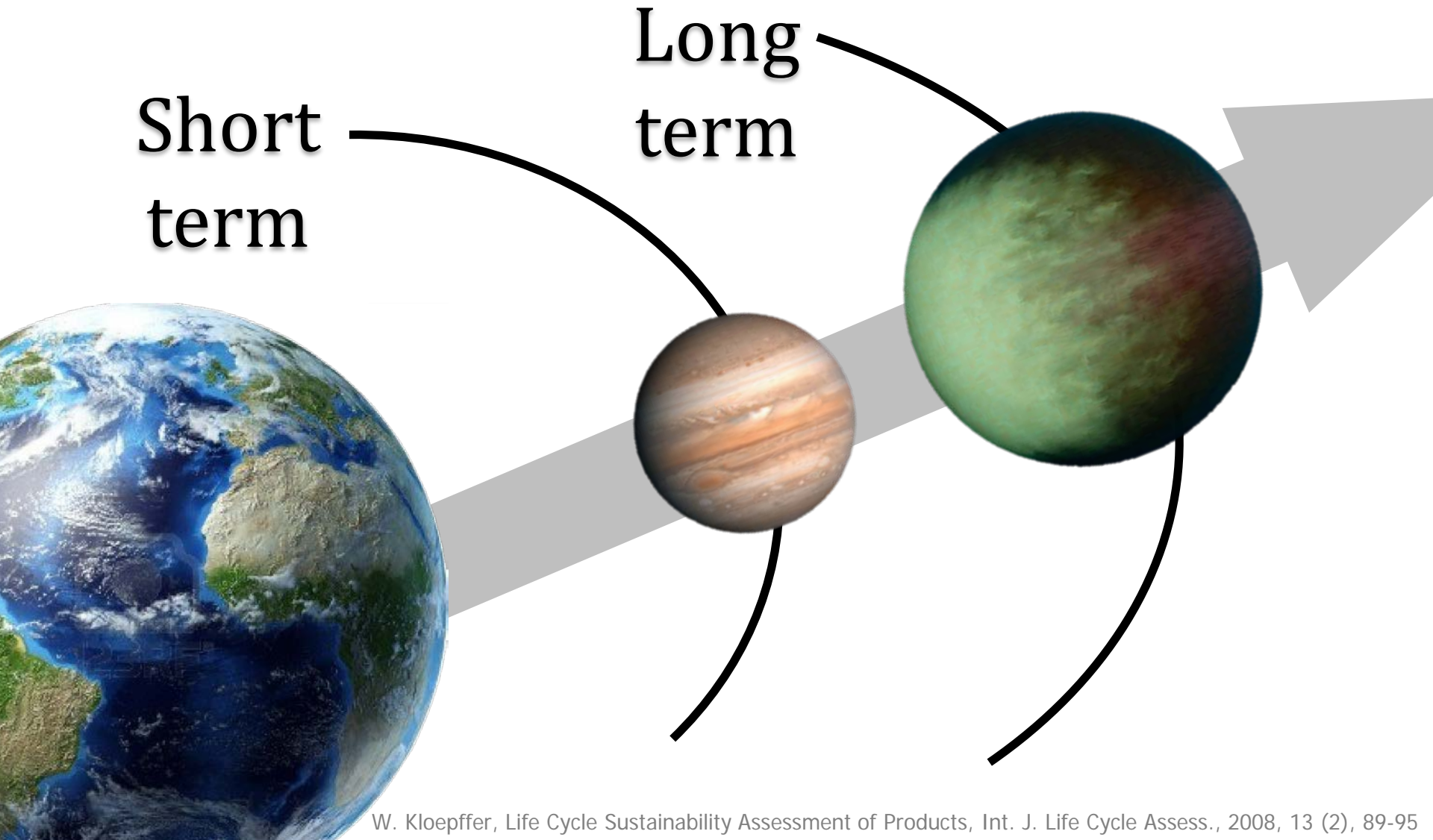
- ✓ Fairness in distribution
- ✓ Health
- ✓ Education
- ✓ Gender equity
- ✓ Political accountability
- ✓ Social participation

### ECONOMY

### SOCIETY

# SUSTAINABLE DEVELOPMENT

Short and long term alignment approach



# SUSTAINABLE DEVELOPMENT

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## The role of the engineers

“...Engineers have never mattered more in a sustainable world, in which they are challenged to incorporate the additional requirements and conditions in making a sustainable design...”





# SUSTAINABLE DEVELOPMENT

## SUSTAINABLE DEVELOPMENT GOALS

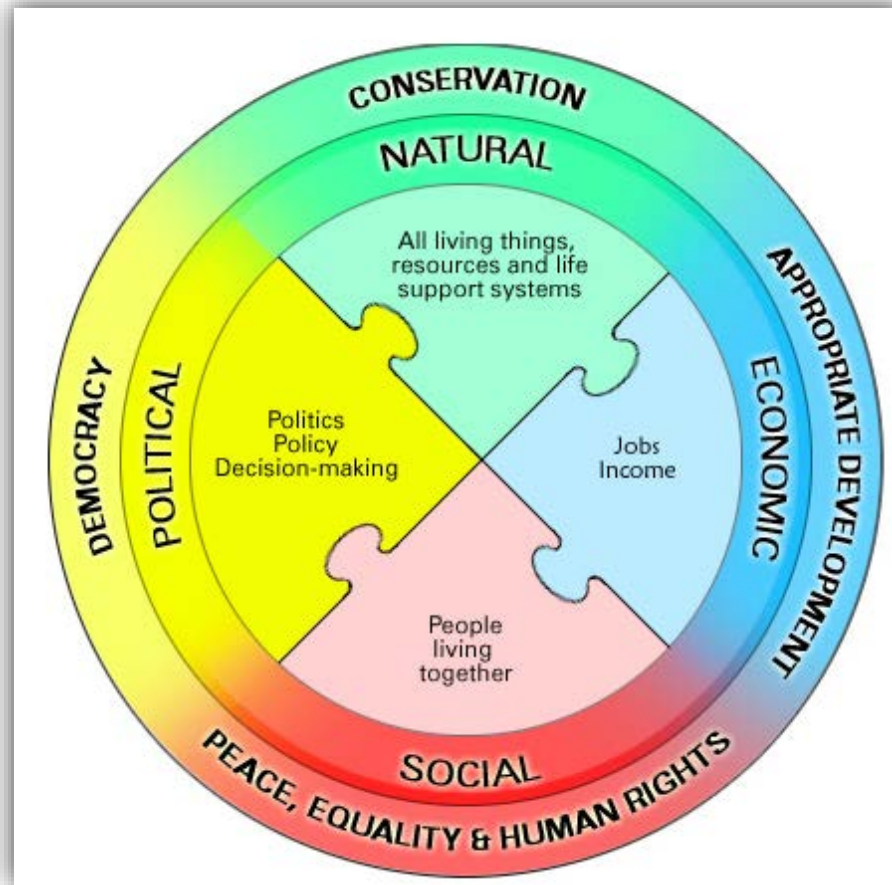
# SUSTAINABLE DEVELOPMENT GOALS





# SUSTAINABLE DEVELOPMENT

## Politics & culture



*Politics and culture determines the interactions between the three pillars*

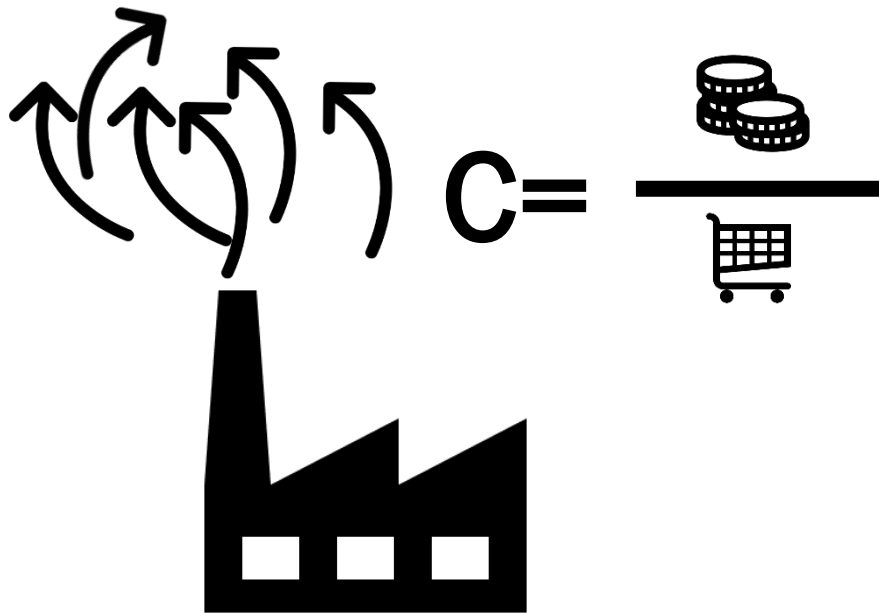
# SUSTAINABLE DEVELOPMENT

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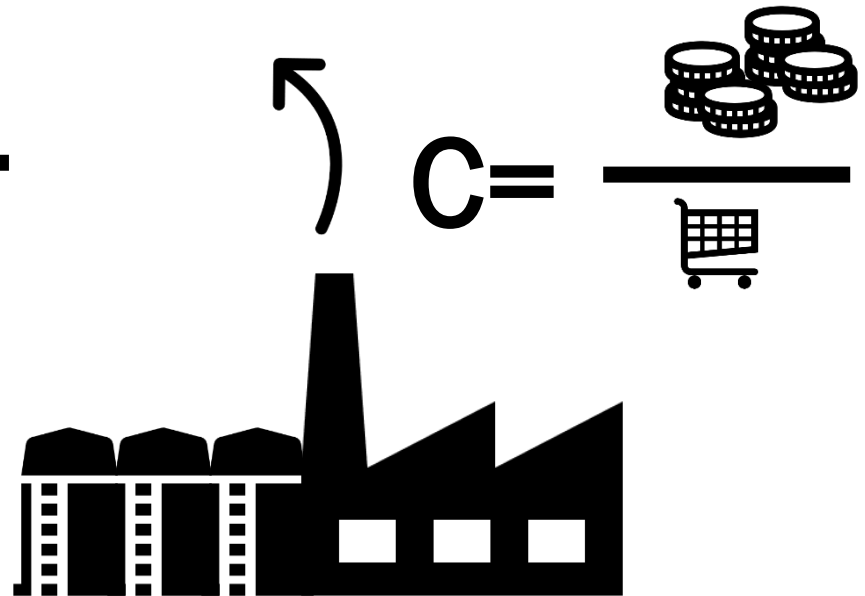
How much does it cost to pollute less?

Pollute less means more money

Untreated stream



Treated stream



# SUSTAINABLE DEVELOPMENT

## Insight China

industry  
tap *into news*

Architecture

Automotive

Aviation

Construction

Design

Energy

Engineering

Technology

**Air Pollution Killing 700,000 Chinese a Year and Millions More Worldwide**



# SUSTAINABLE DEVELOPMENT

## Insight China

### China's solar power capacity more than doubles in 2016

Reuters Staff

2 MIN READ



BEIJING (Reuters) - China's installed photovoltaic (PV) capacity more than doubled last year, turning the country into the world's biggest producer of solar energy by capacity, the National Energy Administration (NEA) said on Saturday.



Installed PV capacity rose to 77.42 gigawatts at the end of 2016, with the addition of 34.54 gigawatts over the course of the year, data from the energy agency showed.

# SUSTAINABLE DEVELOPMENT

## Insight China

Environment ▶ Climate change Wildlife Energy Pollution

Energy industry

### China to invest £292bn in renewable power by 2020

World's largest energy market looks to move from coal towards cleaner fuels

Reuters

Thu 5 Jan 2017 08.27 GMT



This article is 1 year old

4,694 285



China will plough 2.5tn yuan (£292bn) into renewable power generation by 2020, the country's energy agency has said, as the world's largest energy market continues to shift away from dirty coal power towards cleaner fuels. The investment will create more than 13m jobs in the sector, the National Energy Administration said in a blueprint document that lays out its plan to develop the nation's energy sector during the five-year 2016 to 2020 period.

<https://www.theguardian.com/business/2017/jan/05/china-invest-renewable-fuel-2020-energy>



# SUSTAINABLE DEVELOPMENT

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Another view of the pillars of the Sustainable Development

## Sustainable Development

**Future generations as  
subjects of right**

**Consciousness of social,  
technological and  
economic limits**

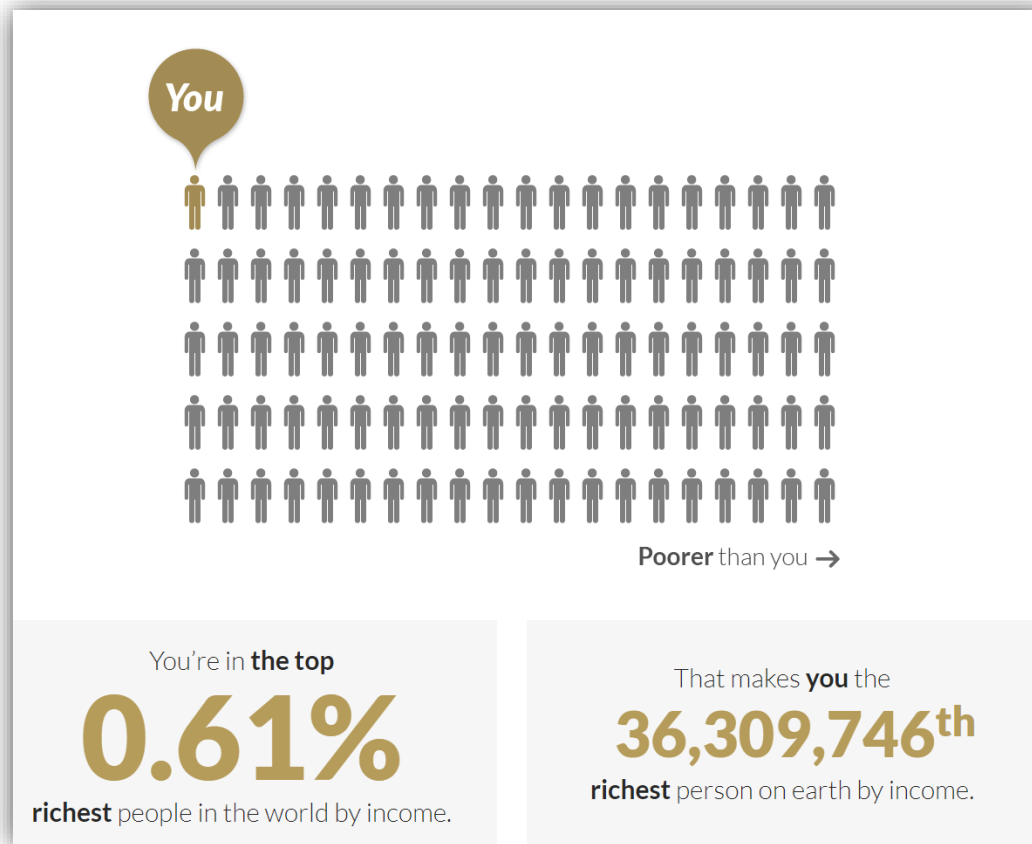
**Equity**

**Well-being and  
life quality**

# SUSTAINABLE DEVELOPMENT

Equity at the center

Sustainable Development has equity on its very own center





# SUSTAINABLE DEVELOPMENT

## Equity at the center

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**The super-rich** **World's 26 richest people own as much as poorest 50%, says Oxfam**

**Charity calls for 1% wealth tax, saying it would raise enough to educate every child not in school**

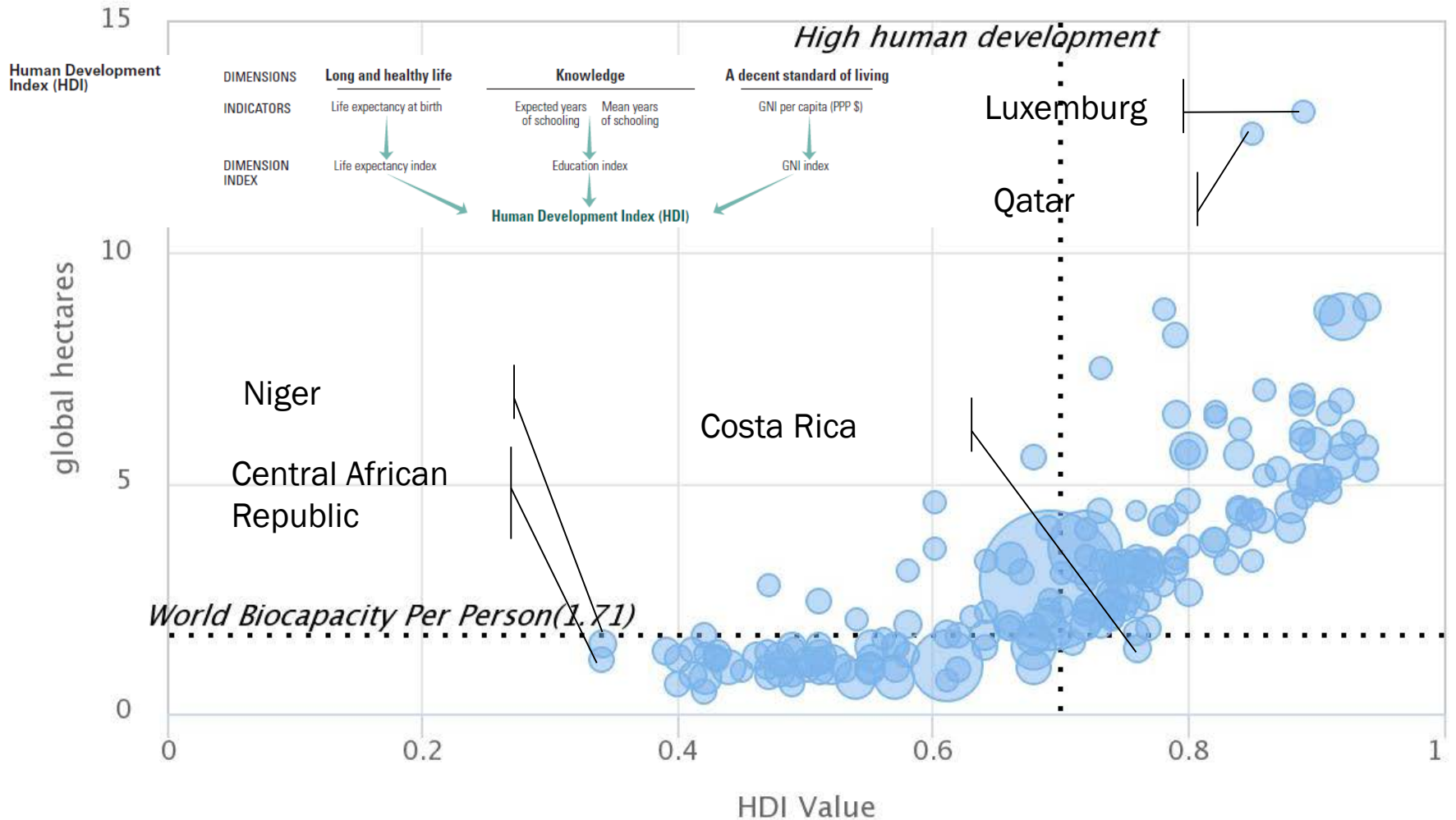
**Larry Elliott**  
Mon 21 Jan 2019 00:01 GMT

[f](#) [t](#) [e](#) 110.775



# SUSTAINABLE DEVELOPMENT

## Human Development Index vs Global Footprint

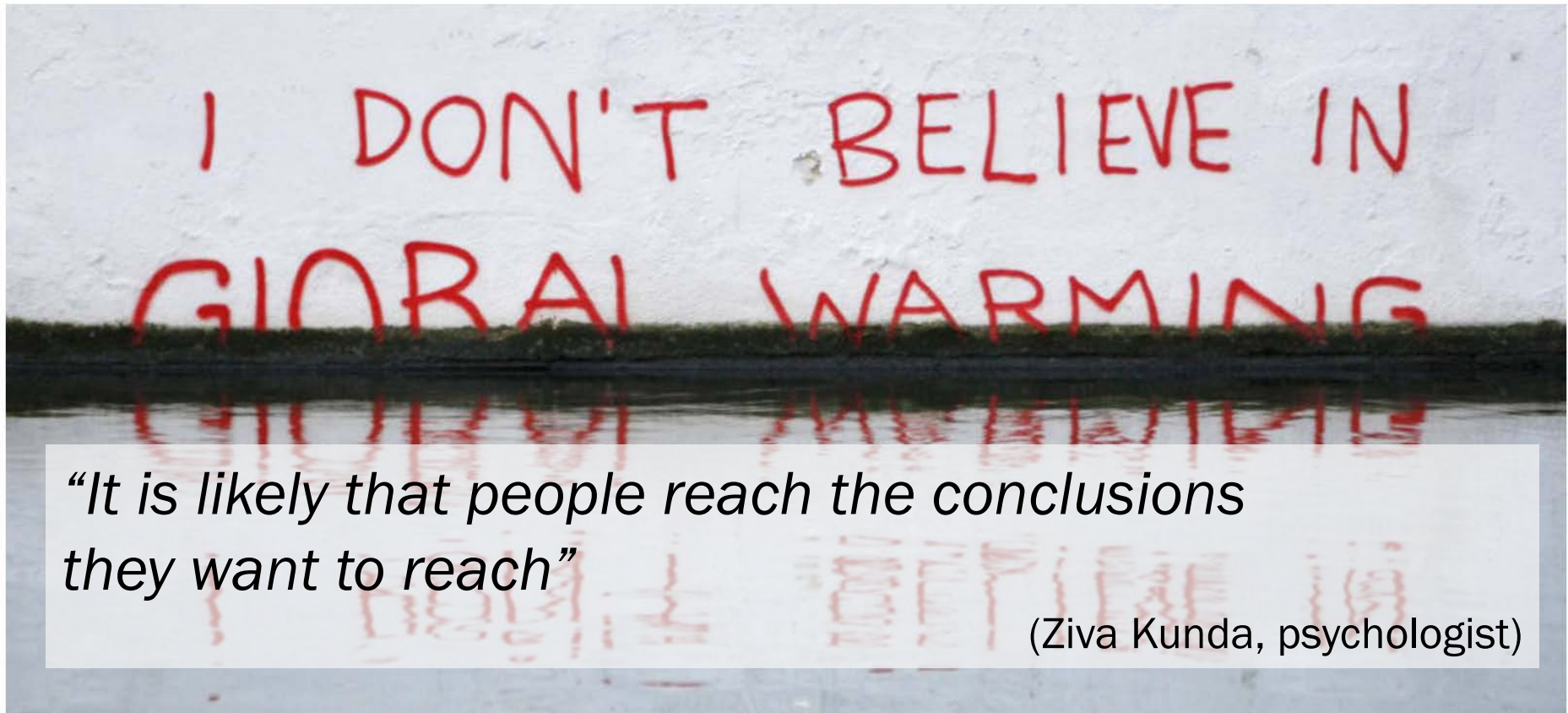


Global Footprint Network, 2017 National Footprint Accounts

# SUSTAINABLE DEVELOPMENT

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## Equity at the center



*“It is likely that people reach the conclusions they want to reach”*

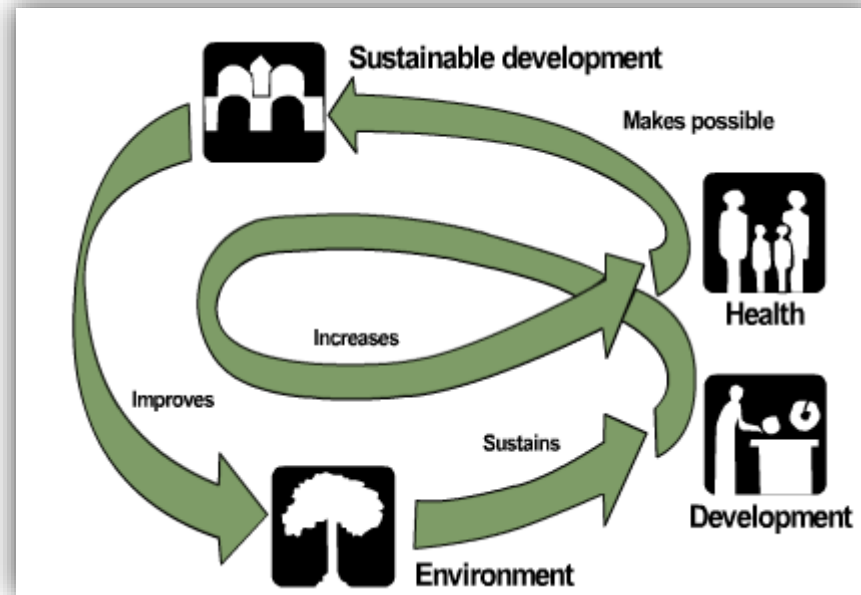
(Ziva Kunda, psychologist)

Pintada en Londres atribuida a Banksy: “No creo en el cambio climático”. REUTERS

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# SUSTAINABLE DEVELOPMENT

## The ascending spiral of Sustainable Development



### The message from Sustainable Development:

A strong interaction between elements

Human well-being is as least as important as economic development

It is not possible economic development in the long-term without considering human development and the status of the environment

# 1.2. DEVELOPMENT OF THE LCA CONCEPT





# DEVELOPMENT OF THE LCA CONCEPT

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A definition

**Compilation and  
evaluation of the inputs,  
outputs and the potential  
environmental impacts of  
a product system  
throughout its life cycle**

# DEVELOPMENT OF THE LCA CONCEPT

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LCA can assist at...

**Improvement of  
environmental  
performance**

A circular diagram illustrating the LCA process. The stages are: Resource Extraction and Processing, Manufacturing and Retail, Distribution, Use, Collection, and Re-use, Recycling, Energy Recovery, Disposal. A central green arrow points clockwise through these stages. The word 'Good' is written in the center.

**Information to  
decision-  
makers**

A photograph of three business professionals (two men and one woman) in a meeting, looking at a laptop screen. The image is semi-transparent and overlaid on the slide.

**Selection of  
relevant  
indicators**

A 3D bar chart with a green bar being the tallest. The word 'NUMBERS' is written at the top. The chart is semi-transparent and overlaid on the slide.

**Marketing**

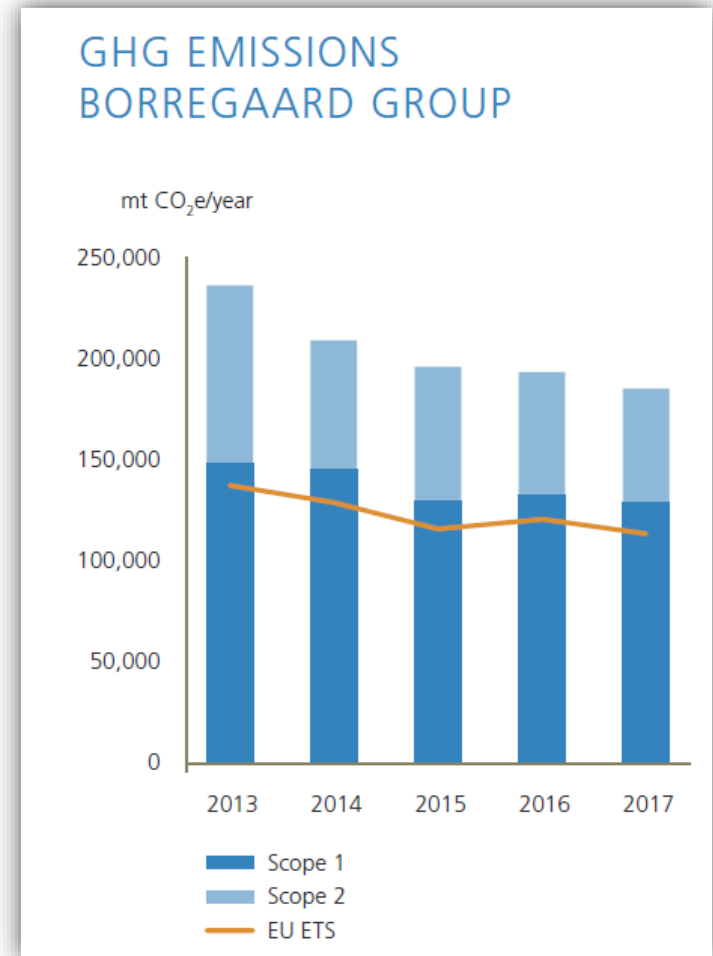
A photograph showing the silhouettes of several business people standing in front of a world map. The image is semi-transparent and overlaid on the slide.



# DEVELOPMENT OF THE LCA CONCEPT

LCA can assist at...

**Improvement of  
environmental  
performance**



# DEVELOPMENT OF THE LCA CONCEPT

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LCA can assist at...

**Information  
to decision-  
makers**



# DEVELOPMENT OF THE LCA CONCEPT

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LCA can assist at...

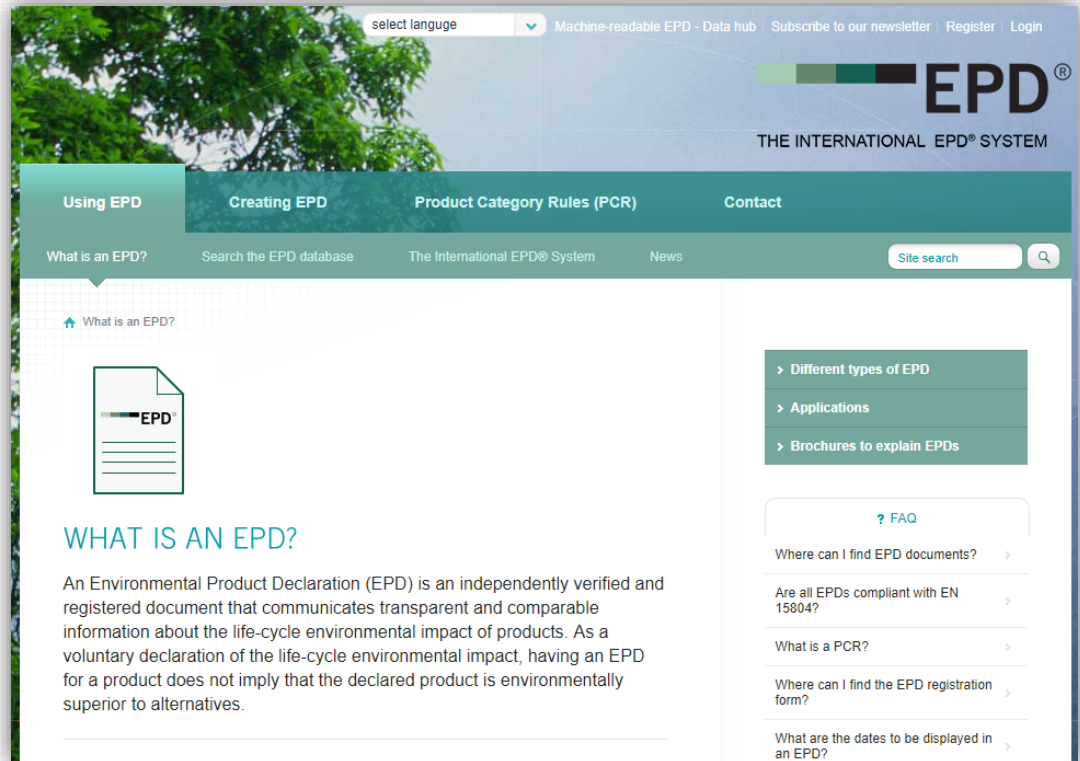
**Selection of  
relevant  
indicators**



# DEVELOPMENT OF THE LCA CONCEPT

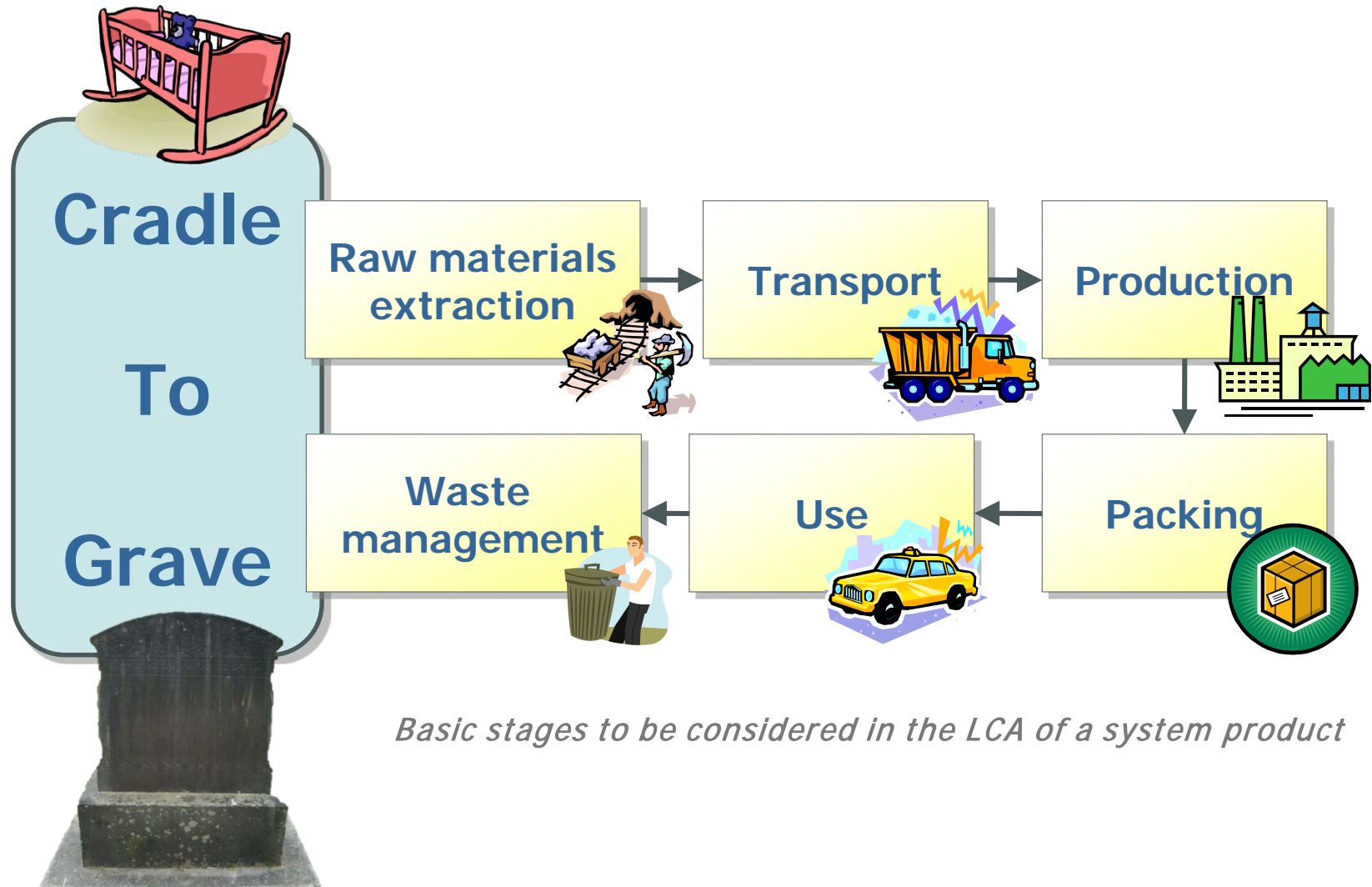
LCA can assist at...

# Marketing



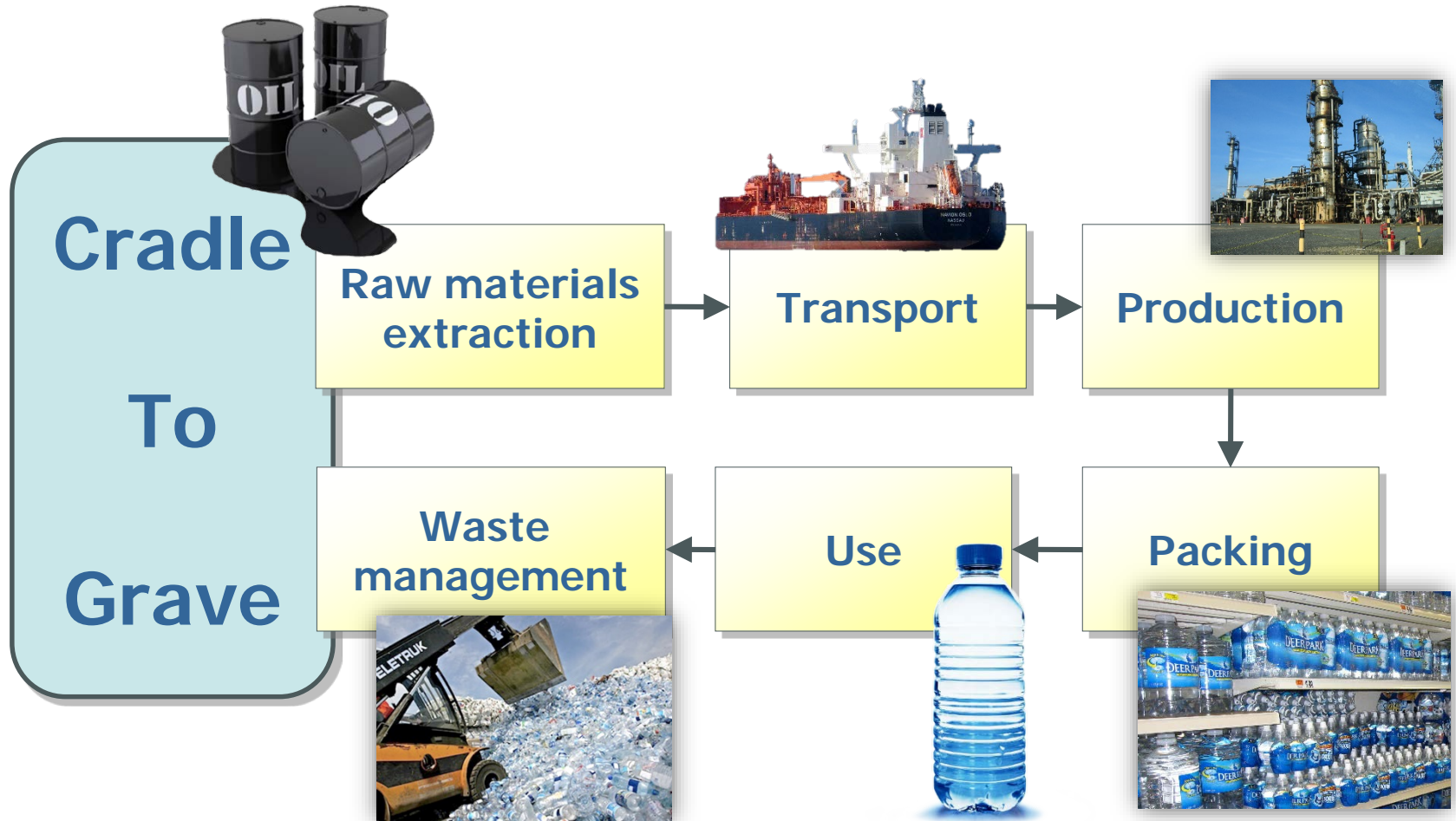
# DEVELOPMENT OF THE LCA CONCEPT

Life Cycle basic stages of a system product



# DEVELOPMENT OF THE LCA CONCEPT

Life Cycle basic stages of a system product

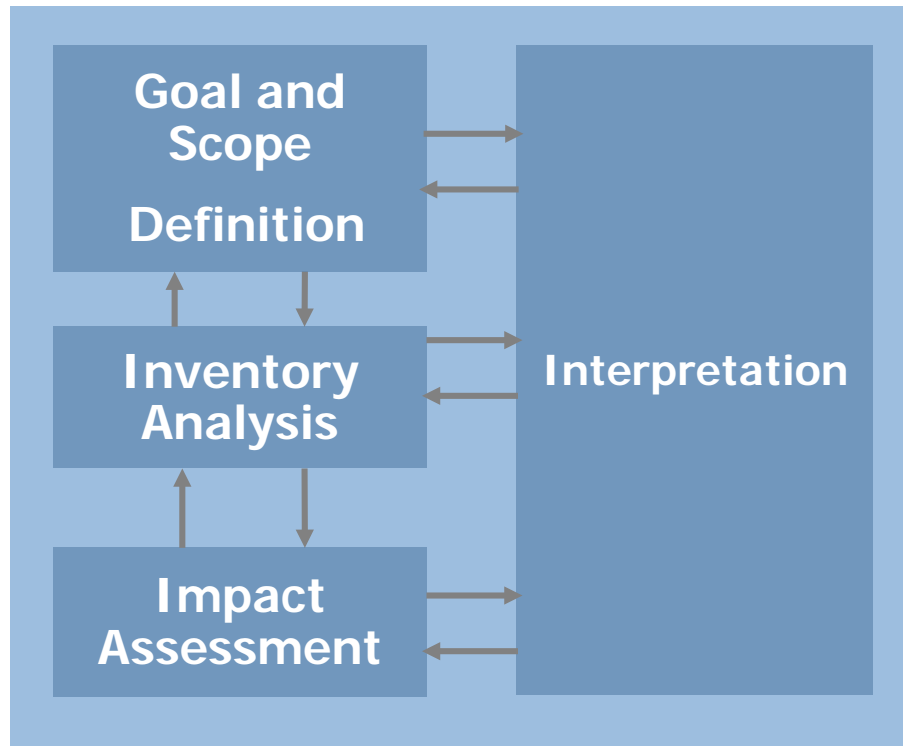


*Basic stages to be considered in the LCA of a water bottle*

# DEVELOPMENT OF THE LCA CONCEPT

## Stages to be performed in a LCA study

### *Inter-linked stages in LCA (iterative character)*



### *Stages in LCA*

#### **1. Goal and Scope Definition**

What? Process, product, service  
Why? Reasons  
To whom? Public & readership

#### **2. Inventory Analysis**

Inputs & outputs of  
energy, materials and emissions

#### **3. Impact Assessment**

How much  
environmental impact?

#### **4. Interpretation**

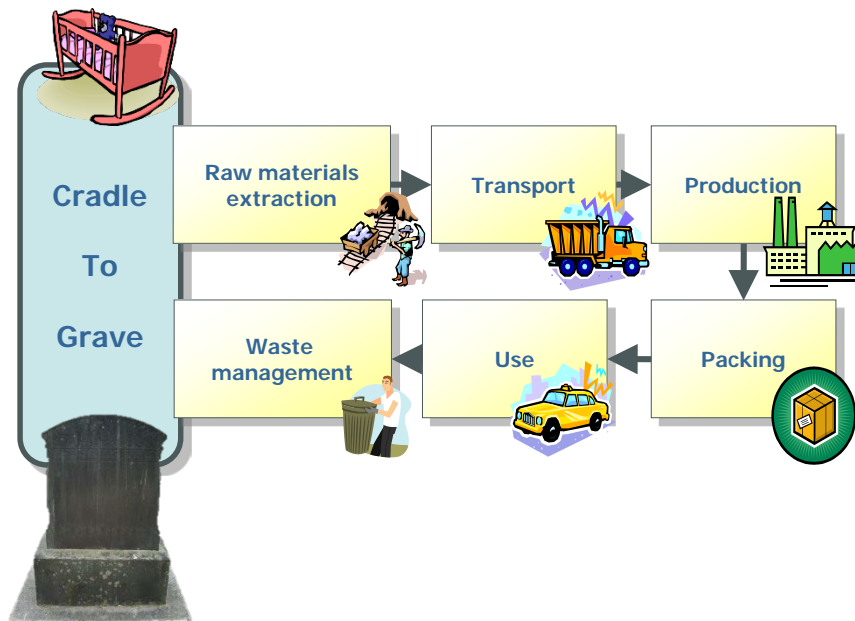
What is the best option?  
What is the hot point throughout  
Life Cycle?



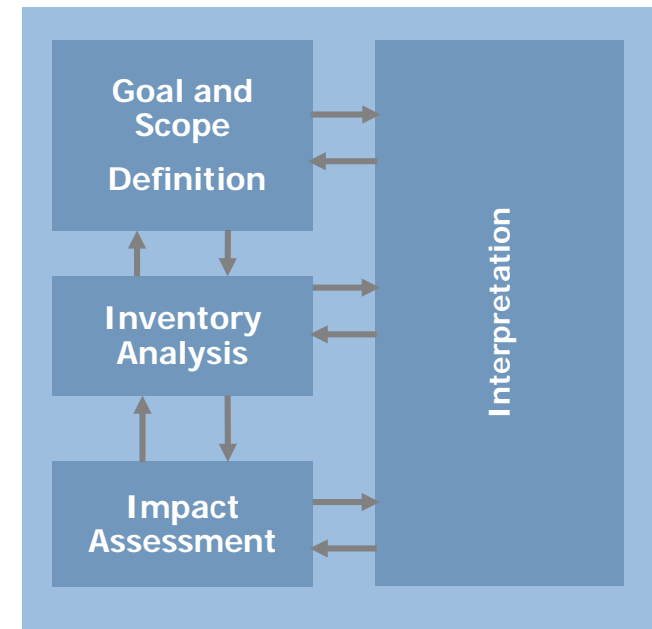
# DEVELOPMENT OF THE LCA CONCEPT

LC basic stages are different of the stages to be performed in a LCA study

*Basic stages to be considered in the LCA of a system product*



*Inter-linked stages in LCA (iterative character)*



Basic stages in the LC of a system product **are different** from the 4 inter-linked stages in a LCA study

# DEVELOPMENT OF THE LCA CONCEPT

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What are the main features of LCA compared to other env. tools?

## Life cycle perspective<sup>[1,2]</sup>

**1** All phases ... of the life cycle of a product (good or service) have to be assessed with regard to all relevant material and energy flows.

## Cross-media environmental approach<sup>[1]</sup>

**2** All relevant environmental impacts are taken into account, i.e., ...use of resources... and ... emissions to air, water and soil, including waste.

## Functional unit<sup>[2]</sup>

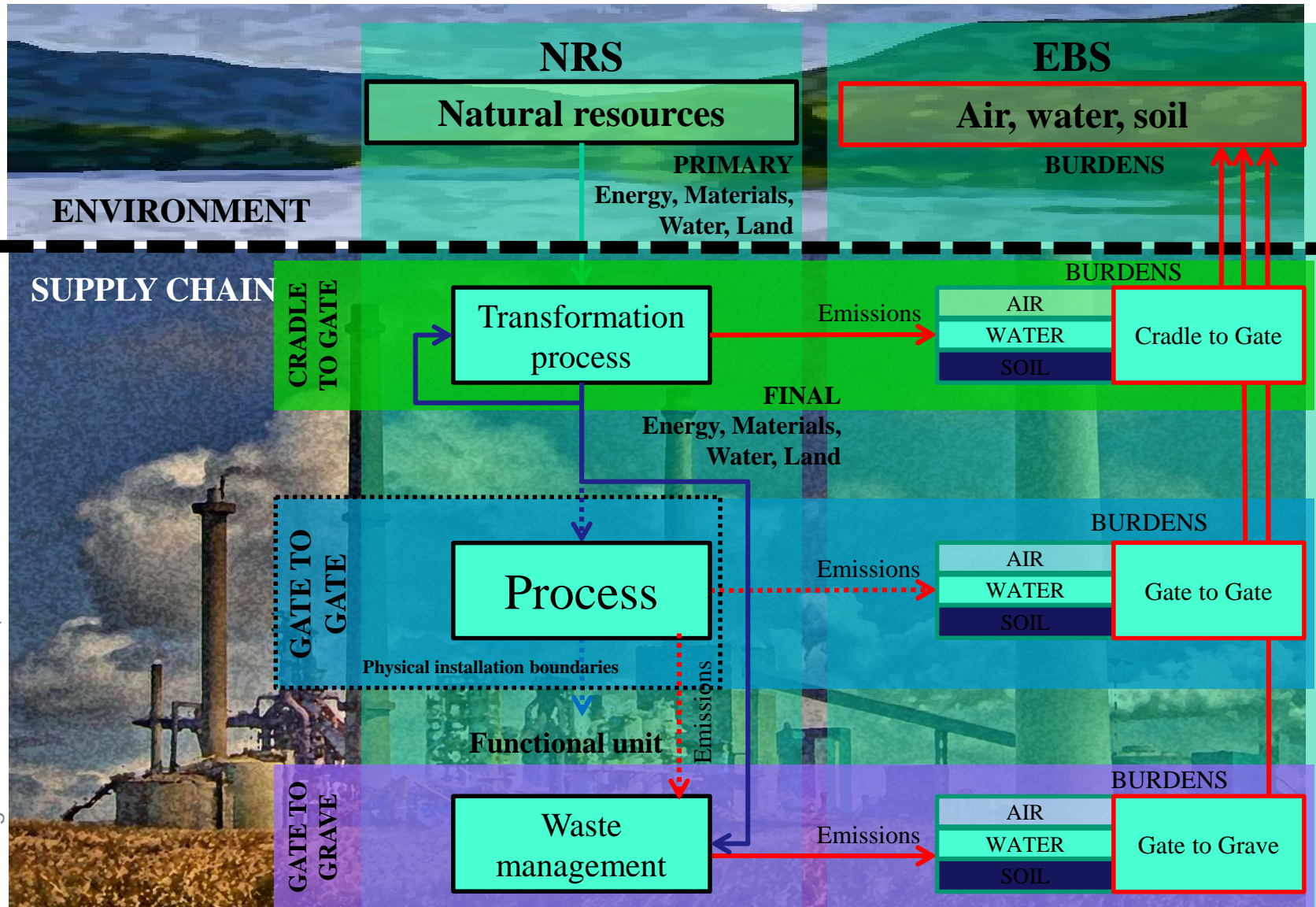
**3** The use of a functional unit for comparative studies

[1] Finkbeiner M, Schau EM, Lehmann A, Traverso M. Towards Life Cycle Sustainability Assessment. Sustainability. 2010; 2(10):3309-3322.

[2] Kloepffer, W. . Life Cycle Sustainability Assessment of Products. International Journal of Life Cycle Assessment 2008; 13 (2):89-95

# DEVELOPMENT OF THE LCA CONCEPT

## Environmental Sustainability main components and its relation with LCA



# DEVELOPMENT OF THE LCA CONCEPT

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## Early LCA activities (70s)

The first LCA study is considered to be conducted for Coca-Cola in 1969-70 by the Midwest Research Institute in USA

Switching from glass to plastic bottles was huge because of the bad reputation of plastic



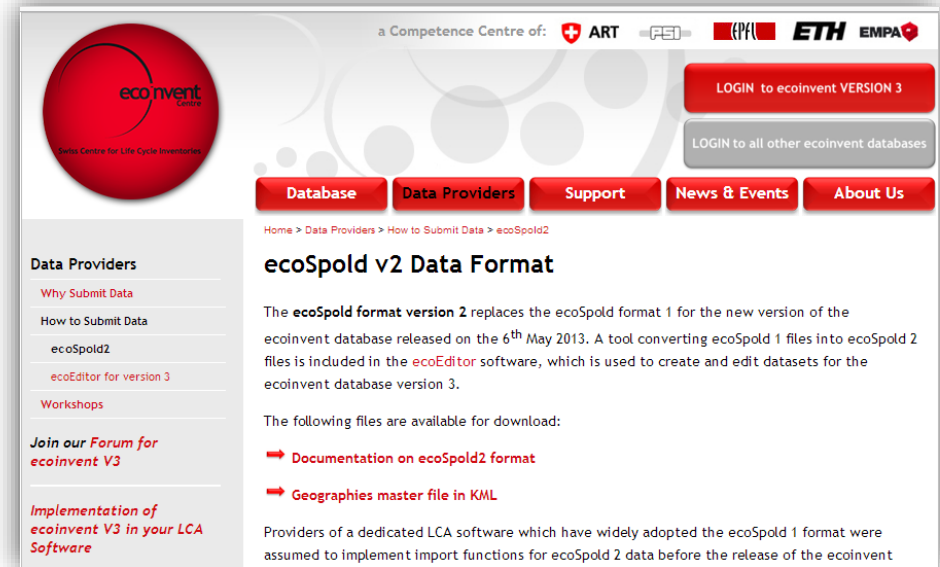
# DEVELOPMENT OF THE LCA CONCEPT

## Advances in the 90s

### The need for LCA databases

LCA promotion lead to design engineers to complete fast LCA studies thanks to LCA software. Consequently, there were a need of LCA databases

Very soon professionals realized the need of define formats and structure for their information content. The SPOLD format was born



The screenshot shows the website for the ecoinvent Centre, a Competence Centre of ART, EPFL, ETH, and EMPA. The page is titled 'ecoSpold v2 Data Format' and provides information about the new version of the ecoSpold format. It includes a navigation menu with links for 'Database', 'Data Providers', 'Support', 'News & Events', and 'About Us'. The main content area explains that the ecoSpold format version 2 replaces the ecoSpold format 1 for the new version of the ecoinvent database, released on the 6th of May 2013. It also lists available files for download: 'Documentation on ecoSpold2 format' and 'Geographies master file in KML'. A sidebar on the left contains links for 'Data Providers', 'Why Submit Data', 'How to Submit Data', 'ecoSpold2', 'ecoEditor for version 3', 'Workshops', 'Join our Forum for ecoinvent V3', and 'Implementation of ecoinvent V3 in your LCA Software'.

# DEVELOPMENT OF THE LCA CONCEPT

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## Advances in the 90s

Towards a uniform methodology

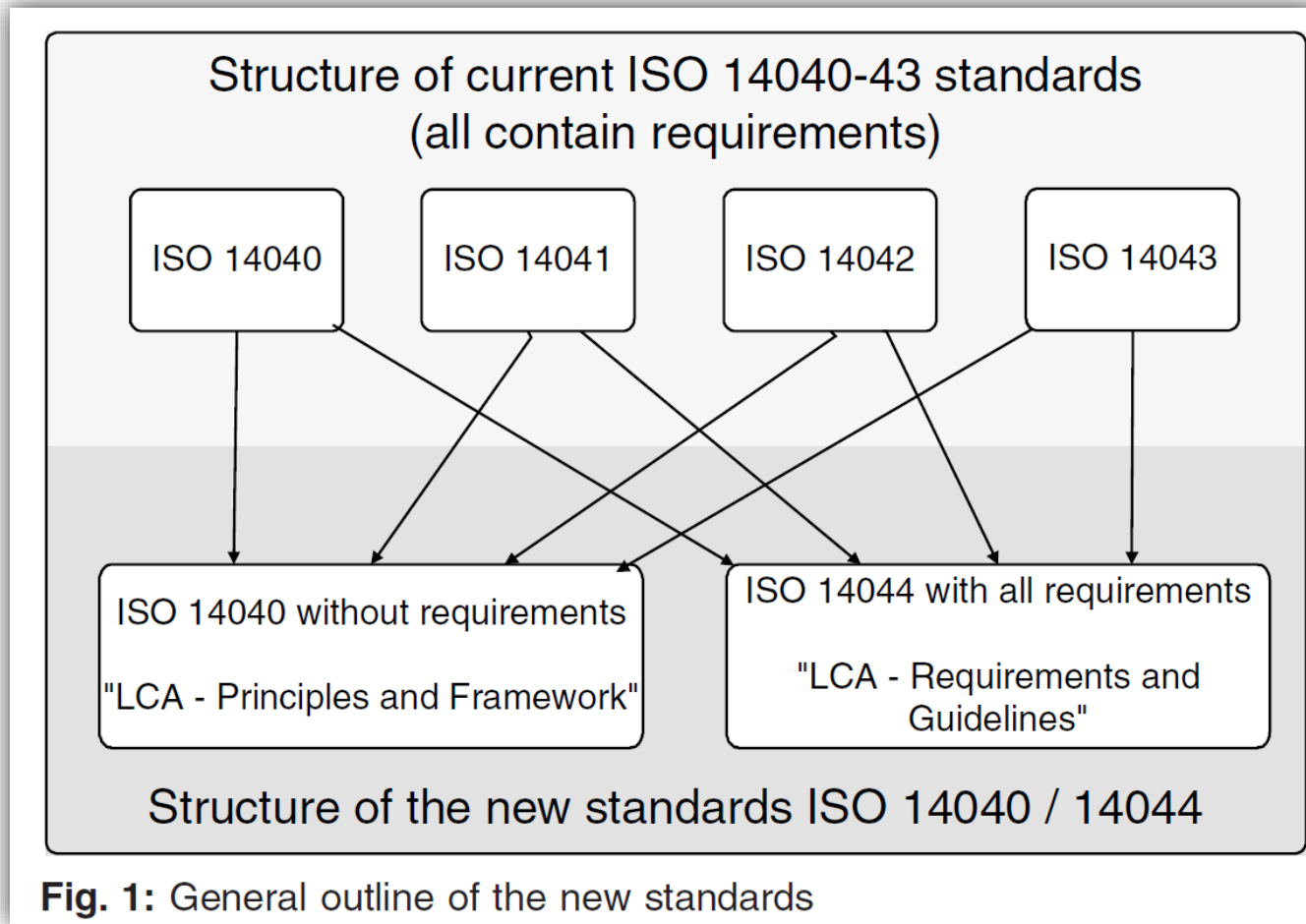
The standardization was the next step, which started in 1993 within the framework of the International Organization for Standardization (ISO)

<b>Date</b>	<b>Number</b>	<b>Name</b>
1997	ISO 14040	LCA – principles and framework
1998	ISO 14041	LCA – goal and scope definition and inventory analysis
2000	ISO 14042	LCA – life cycle impact assessment
2000	ISO 14043	LCA – life cycle interpretation
2002	ISO/TS1 14048	LCA – Data documentation format



# DEVELOPMENT OF THE LCA CONCEPT

## Actual ISO rules





# DEVELOPMENT OF THE LCA CONCEPT

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## Actual ISO rules

Date	Number	Name
2000 (1997)	ISO 14040	Environmental management — Life cycle assessment — Principles and framework
<del>1998</del>	<del>ISO 14041</del>	<del>LCA—goal and scope definition and inventory analysis</del>
2000	ISO 14042	LCA—life cycle impact assessment
2000	ISO 14043	LCA—life cycle interpretation
2006	ISO 14044	Environmental management — Life cycle assessment — Requirements and guidelines

# DEVELOPMENT OF THE LCA CONCEPT

## Actual ISO rules

Date	Number	Name
2012	ISO 14045	Environmental management — Eco-efficiency assessment of product systems — Principles, requirements and guidelines
<b>2014</b>	<b>ISO 14046</b>	<b>Environmental management — Water footprint — Principles, requirements and guidelines</b>
2003	ISO/TR 14047	Environmental management — Life cycle impact assessment — Examples of application of ISO 14042
2002	ISO/TS 14048	Environmental management — Life cycle assessment — Data documentation format
2000	ISO/TR 14049	Environmental management — Life cycle assessment — Examples of application of ISO 14041 to goal and scope definition and inventory analysis
<b>2013</b>	<b>ISO 14067</b>	<b>Greenhouse gases — Carbon footprint of products — Requirements and guidelines for quantification and communication</b>
2014	ISO/TS 14072	Environmental management -- Life cycle assessment -- Requirements and guidelines for organizational life cycle assessment

# **1.3. LIFE CYCLE SUSTAINABILITY ASSESSMENT**



# LIFE CYCLE SUSTAINABILITY ASSESSMENT

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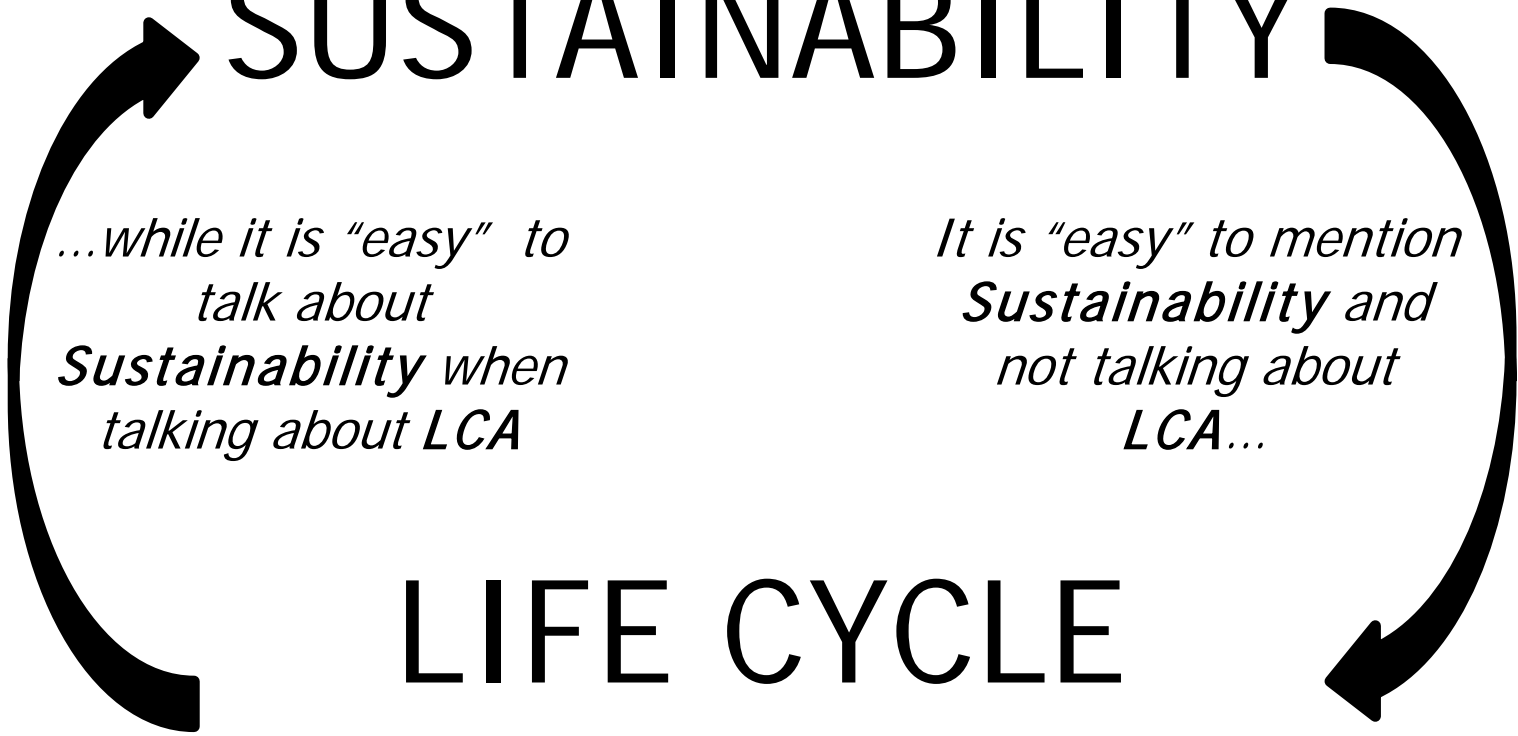
## Sustainability and LCA

SUSTAINABILITY

*...while it is "easy" to  
talk about  
Sustainability when  
talking about LCA*

*It is "easy" to mention  
Sustainability and  
not talking about  
LCA...*

LIFE CYCLE  
ASSESSMENT

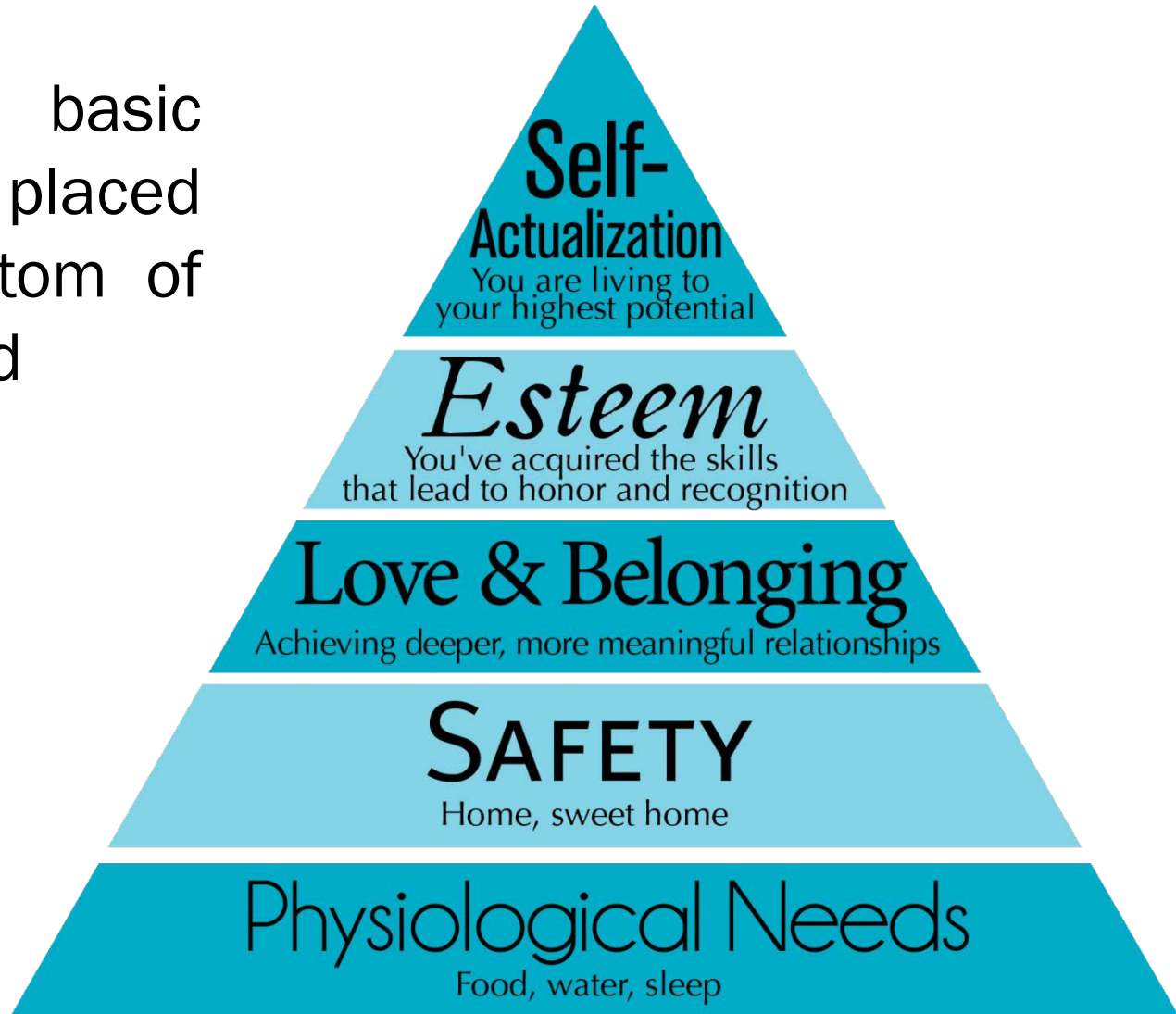


# LIFE CYCLE SUSTAINABILITY ASSESSMENT

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## The Maslow hierarchy of needs

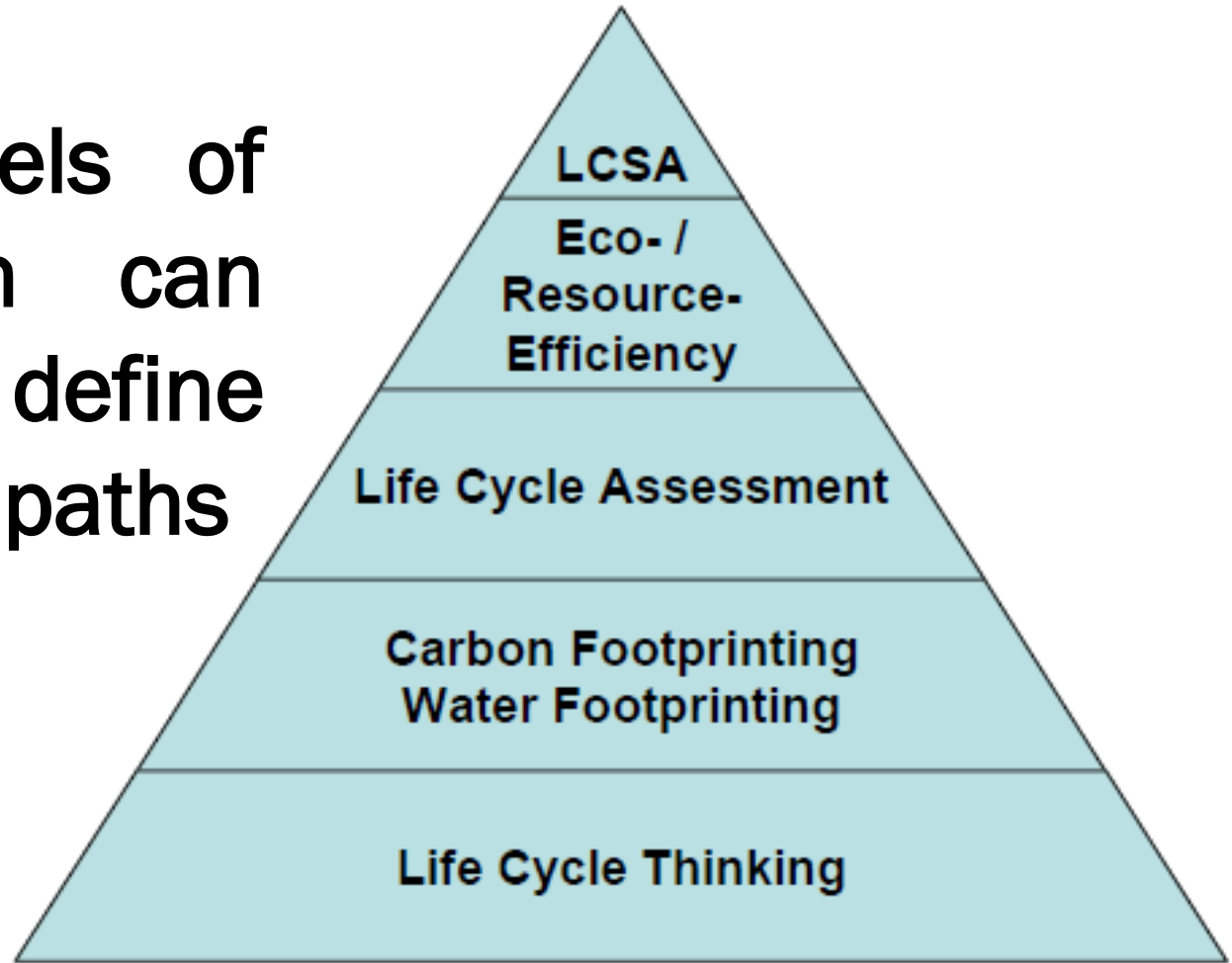
The most basic needs are placed in the bottom of the pyramid



# LIFE CYCLE SUSTAINABILITY ASSESSMENT

## Maslow's Pyramid of Environmental and Sustainability Assessment Tools

Different levels of sophistication can be used to define development paths



*The most basic needs are placed in the bottom of the pyramid*



# LIFE CYCLE SUSTAINABILITY ASSESSMENT

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Concept formula

$$\mathbf{LCSA = LCA + LCC + SLCA}$$

Where:

**LCSA** = Life Cycle Sustainability Assessment

**LCA** = Environmental Life Cycle Assessment

**LCC** = LCA-type Life Cycle Costing

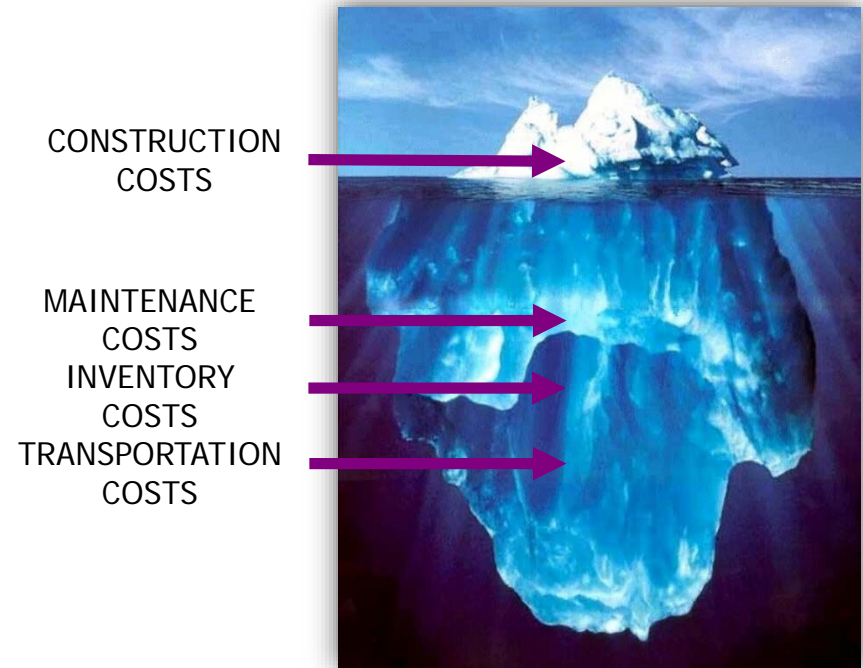
**SLCA** = Social Life Cycle Assessment

# LIFE CYCLE SUSTAINABILITY ASSESSMENT

## Life Cycle Cost LCC

The life cycle costs are the total costs of a system or product, produced over a defined life time

The term life cycle costing is used for total-cost-of-ownership assessments as well as external or social cost assessments



*CONSTRUCTION COSTS MAYBE  
JUST THE TIP OF THE ICEBERG!*

# LIFE CYCLE SUSTAINABILITY ASSESSMENT

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## Social Life Cycle Assessment

*“The topic of SLCA is currently still in its infancy...” “However, the selection of social criteria and their quantification is still one of the major challenges when implementing the concept of sustainability.”*

# LIFE CYCLE SUSTAINABILITY ASSESSMENT


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## Weighting problems with LCSA

**Weighting of individual indicators** within each of the three sustainability dimensions, i.e., weighting between e.g., different environmental indicators like global warming potential and acidification potential (the same applies to social and economic indicators)

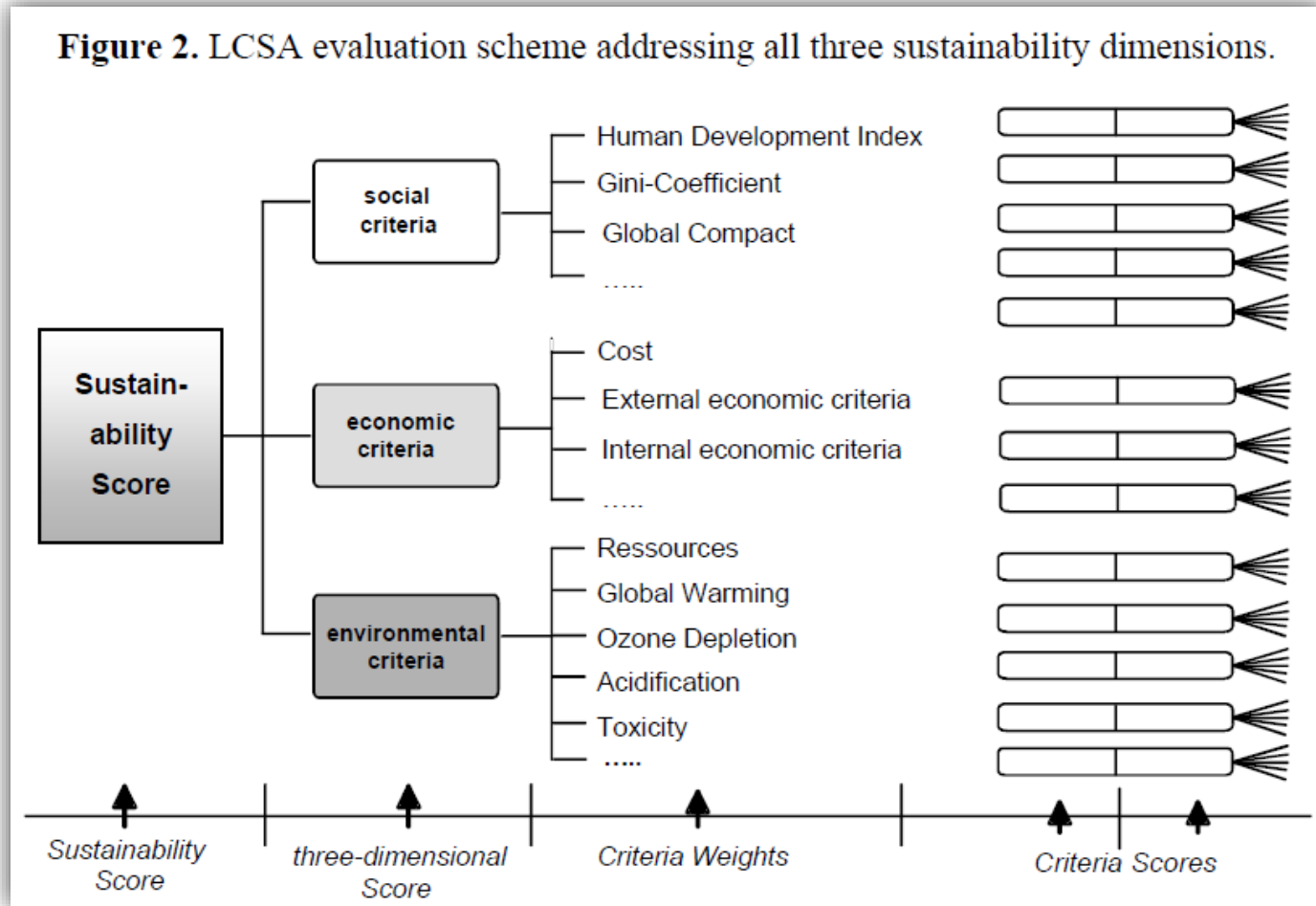
 CC+AA+OD+ ...

**Weighting among the three dimensions of sustainability** (environmental, economic, social).

 ENV+ECO+SOC

# LIFE CYCLE SUSTAINABILITY ASSESSMENT

## Weighting problems with LCSA

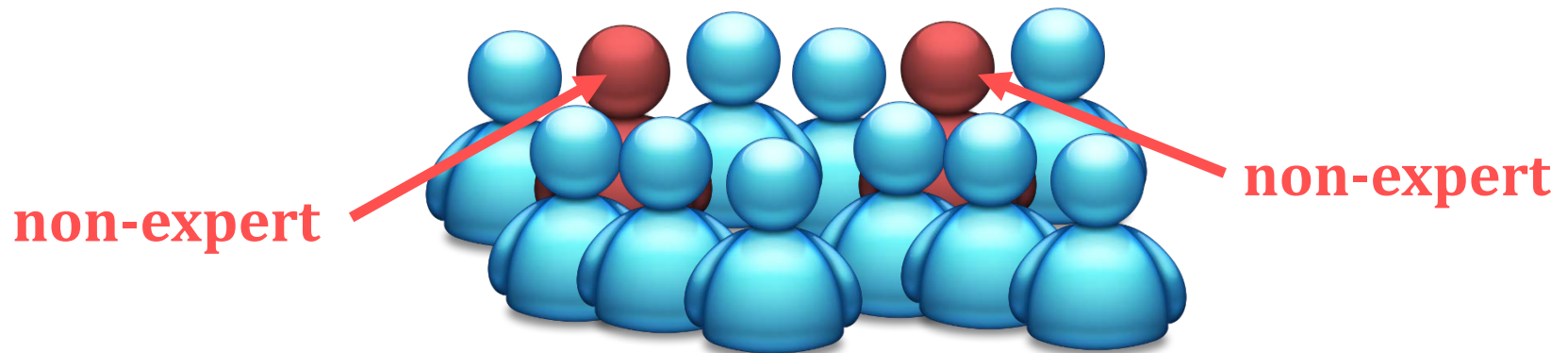


# LIFE CYCLE SUSTAINABILITY ASSESSMENT

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## LCSA evaluation schemes

“To support decision-making LCSA results are faced with the challenge to be difficult to understand and to interpret for a non-expert audience. But non-experts are usually represented in the target audience of the decision-makers. Therefore, an understandable, yet comprehensive presentation of LCSA results is a key challenge for the application of LCSA”



**Target audience: decision-makers**



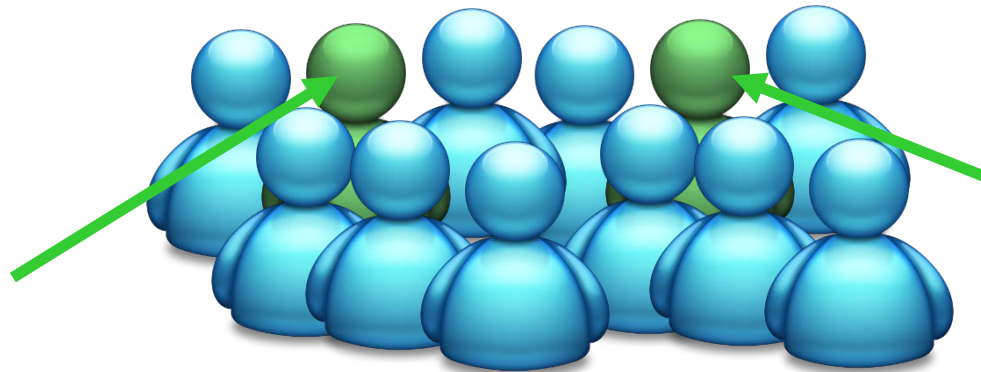
# LIFE CYCLE SUSTAINABILITY ASSESSMENT

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## LCSA evaluation schemes

*YOU NEED TO BE ABLE TO EXPRESS YOUR RESULTS IN SUCH A WAY THEY CAN BE UNDERSTOOD AND CONSEQUENTLY THEY ARE HELPFUL FOR DECISION-MAKING!*

non-expert  
which  
understand  
the results



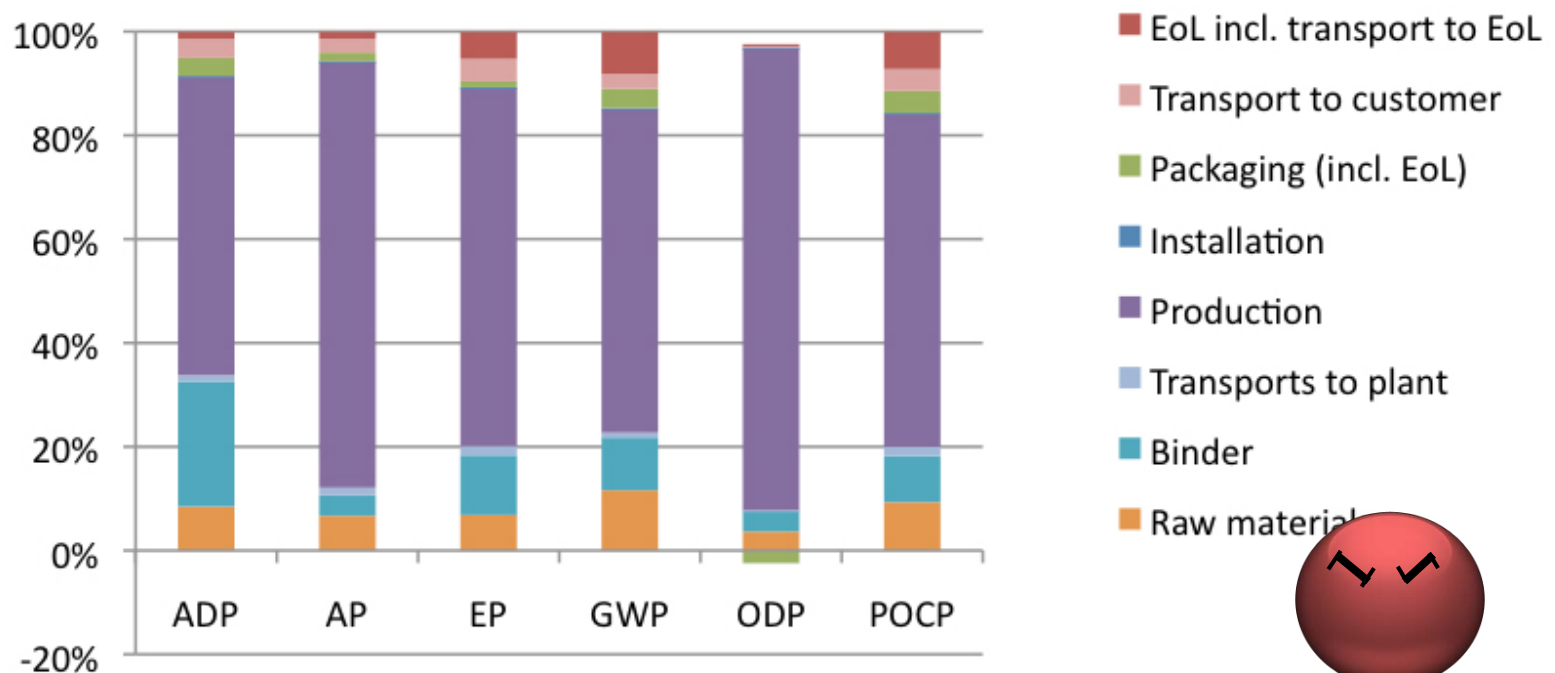
non-expert  
which  
understand  
the results

Target audience: decision-makers

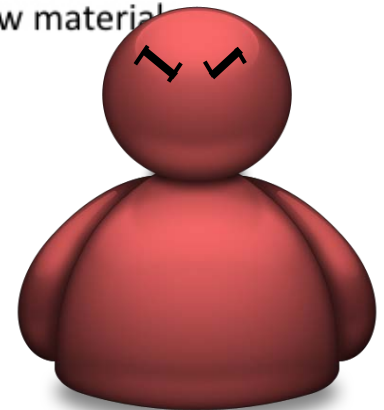
# LIFE CYCLE SUSTAINABILITY ASSESSMENT

Expressing results...

Relative contributions to environmental impact categories,  
Life Cycle MW wall 035, 1m<sup>2</sup>

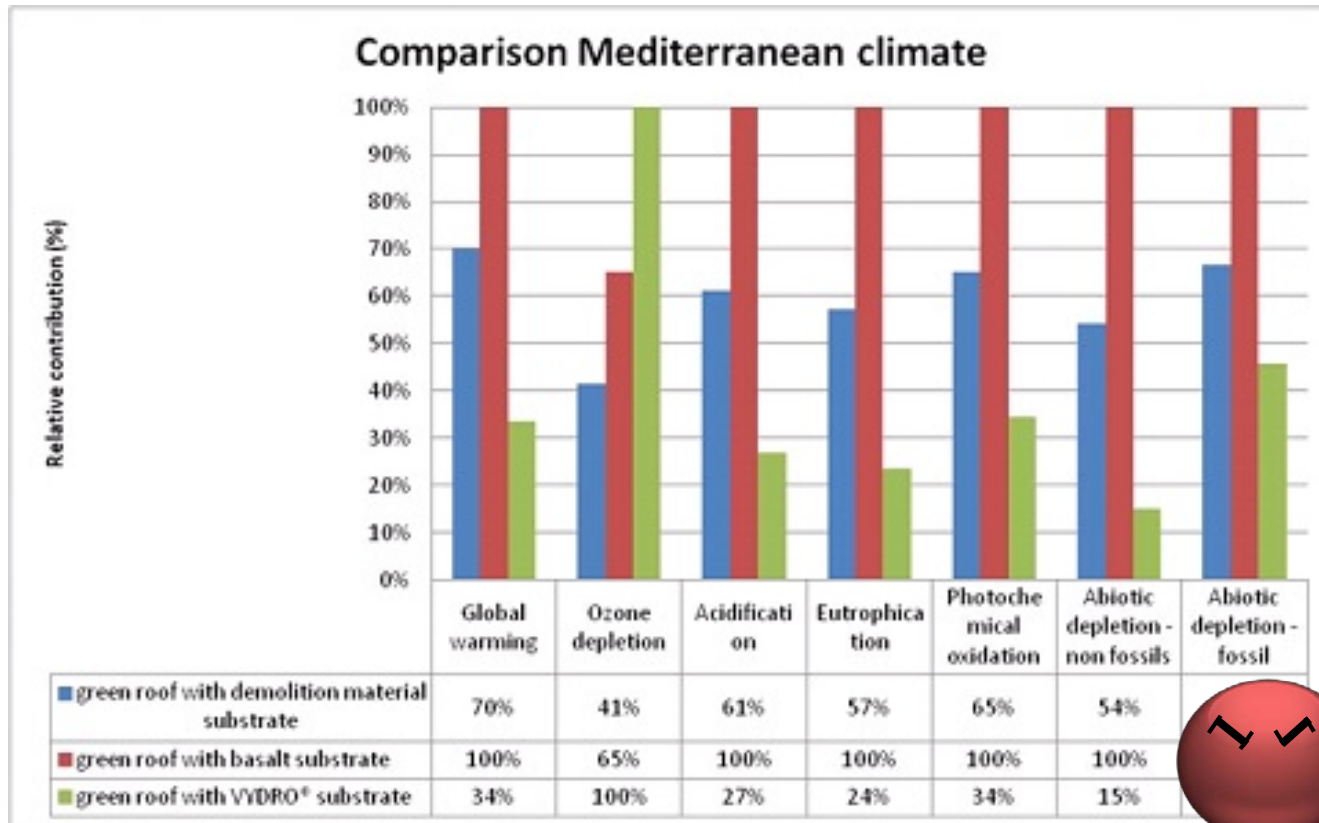


This is OK for a LCA practitioner but these results may be difficult to be understood by a non-expert on LCA!

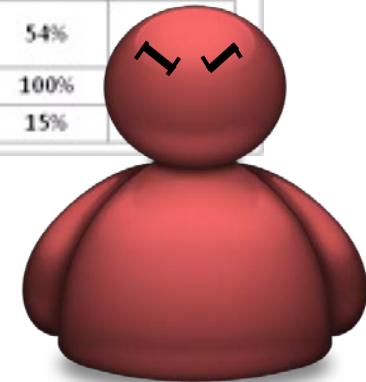


# LIFE CYCLE SUSTAINABILITY ASSESSMENT

Expressing results...



This is OK for a LCA practitioner but these results may be difficult to be understood by a non-expert on LCA!



# LIFE CYCLE SUSTAINABILITY ASSESSMENT

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Expressing results...

$$50 > 10$$

*“...Well so from an environmental point of view, Process A leads to a value of 50 which almost 5 times the value of Process B so Process B is clearly a better option from an environmental point of view...”*

Maybe in order to be able to express the results in a simplified way, you need to reach this level of simplification!



**TARGET AUDIENCE IS CRITICAL!**

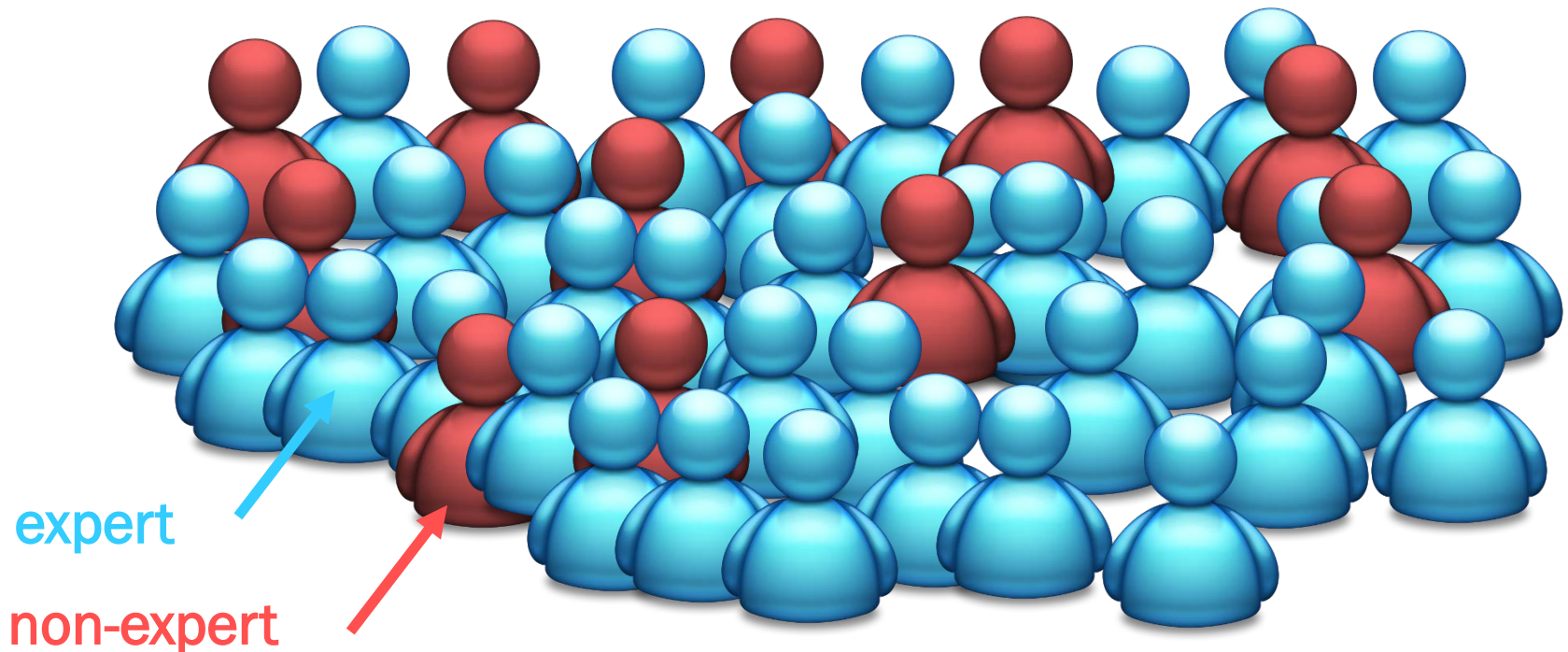
# LIFE CYCLE SUSTAINABILITY ASSESSMENT

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However is it a good option to simplify the results to just one score?

What a LCA practitioner can do?

## TARGET AUDIENCE IS CRITICAL!



# LIFE CYCLE SUSTAINABILITY ASSESSMENT

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Are the 3 Sustainability components truly independent?

In fact, *“the combined impacts, positive and negative, of the sets of measures as a whole, are likely to be more than the simple sum of the impacts of their constituent measures because of synergistic effects”*

*(Lee and Kirkpatrick 2001).*



# LIFE CYCLE SUSTAINABILITY ASSESSMENT

Are the 3 Sustainability components truly independent?

It seems difficult that environmental, economic and social issues can be independently assessed...



INDUSTRY

Saving \$\$\$ from not installing a new filter



Losing \$\$\$ from health expenses



CITIZEN

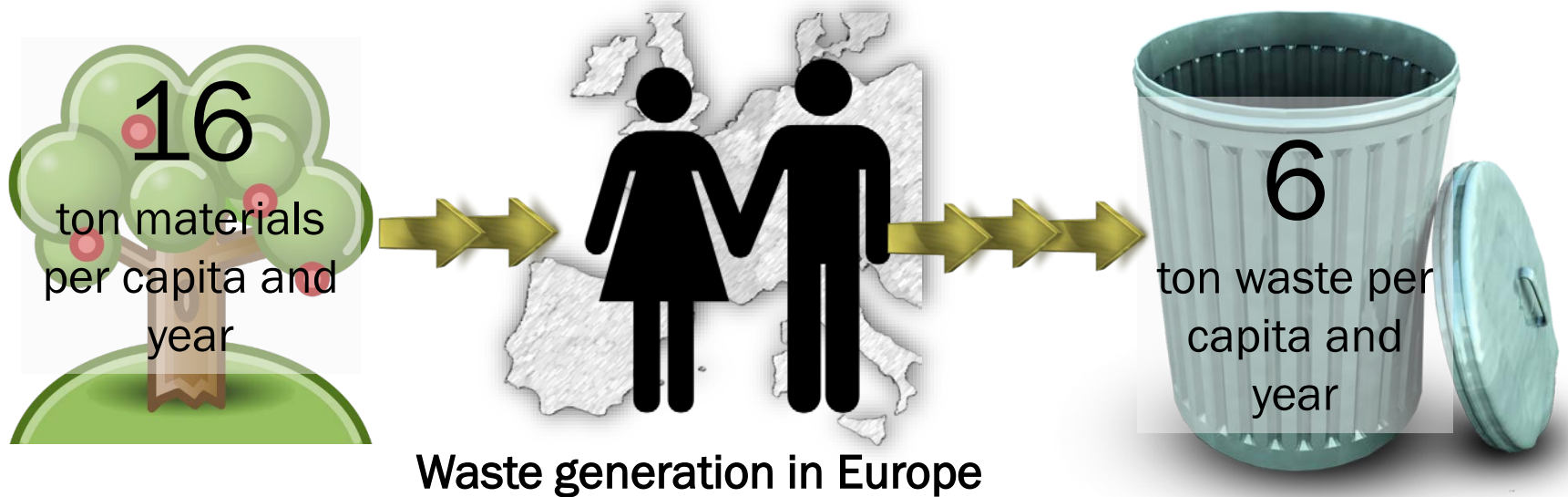
# 1.4. EUROPE 2020



# EUROPE 2020

## Moving towards a circular economy

Since the industrial revolution, waste has constantly grown. This is because our economies have used a “take-make-consume and dispose” pattern of growth – a linear model which assumes that resources are abundant, available and cheap to dispose of.



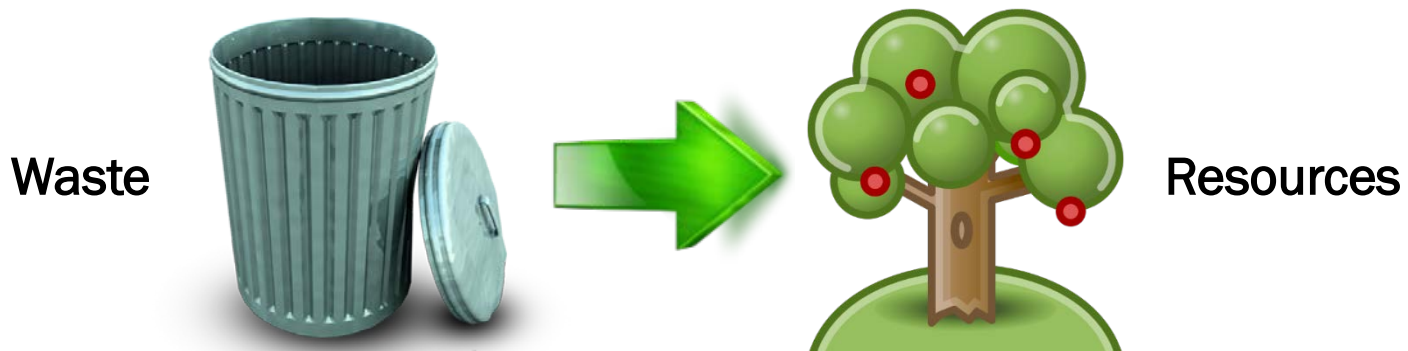
# EUROPE 2020

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## Moving towards a circular economy

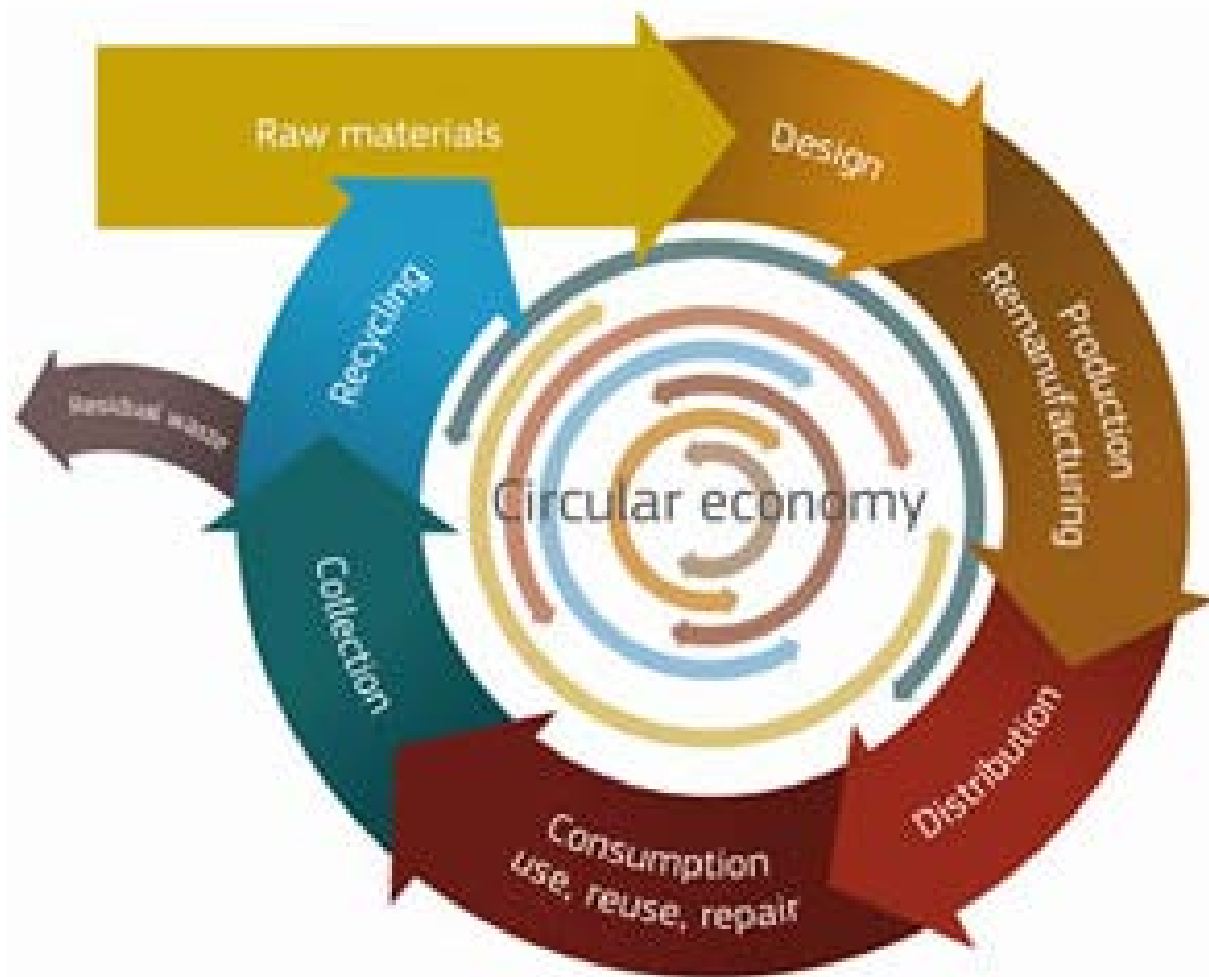
What we need is a more circular economy. This means re-using, repairing, refurbishing and recycling existing materials and products. What used to be regarded as 'waste' can be turned into a resource. All resources need to be managed more efficiently throughout their life cycle.

...Net savings up to EUR 600 billion, ...GDP by nearly 1%, while creating 2 million additional jobs.



# EUROPE 2020

## Moving towards a circular economy





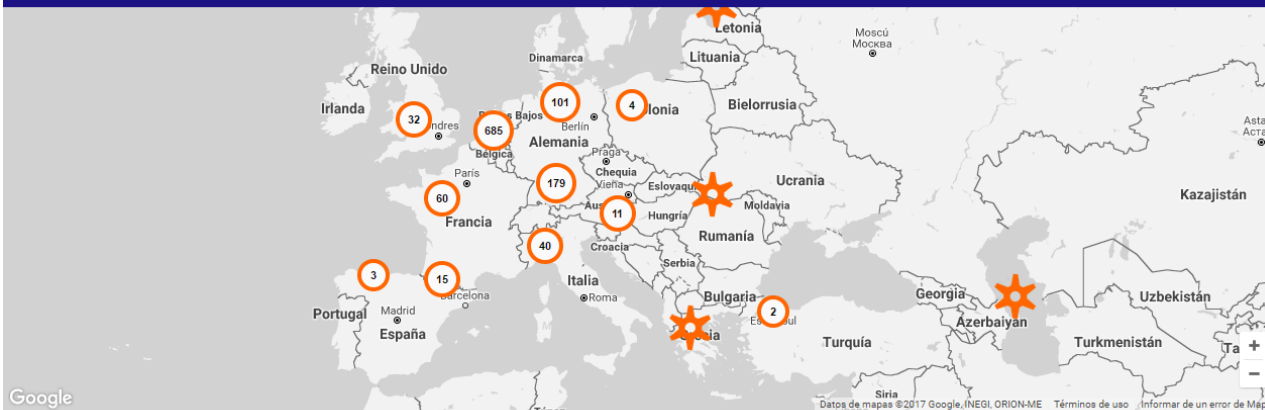
Toss it? No way!

FIND A REPAIR CAFÉ

START A REPAIR CAFÉ

## Visit a Repair Café

[Home](#) / [Visit a Repair Café](#)



VISIT ONE OF OUR 1208 REPAIR CAFÉS

Enter the name of your hometown





Conviértete en anfitrión

Ayuda

Regístrate

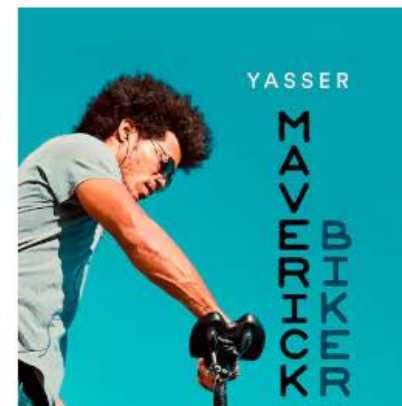
Inicia sesión

# Descubre viajes para recordar en Airbnb.

Reserva experiencias y alojamientos únicos en más de 191 países.

Dónde Destino, ciudad, dirección	Cuándo Llegada → Salida	Huéspedes 1 huésped	Buscar
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## Las experiencias más populares





Find the *perfect* pet sitter near you.

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Sitting

Check-Ins

Daycare

Dog Walking

 Camargo, 39

 Start date

 End date

**FIND A SITTER**

Millions of nights • 60,000 sitters • 8,000 cities

# 1.5. LIFE CYCLE THINKING



# LIFE CYCLE THINKING

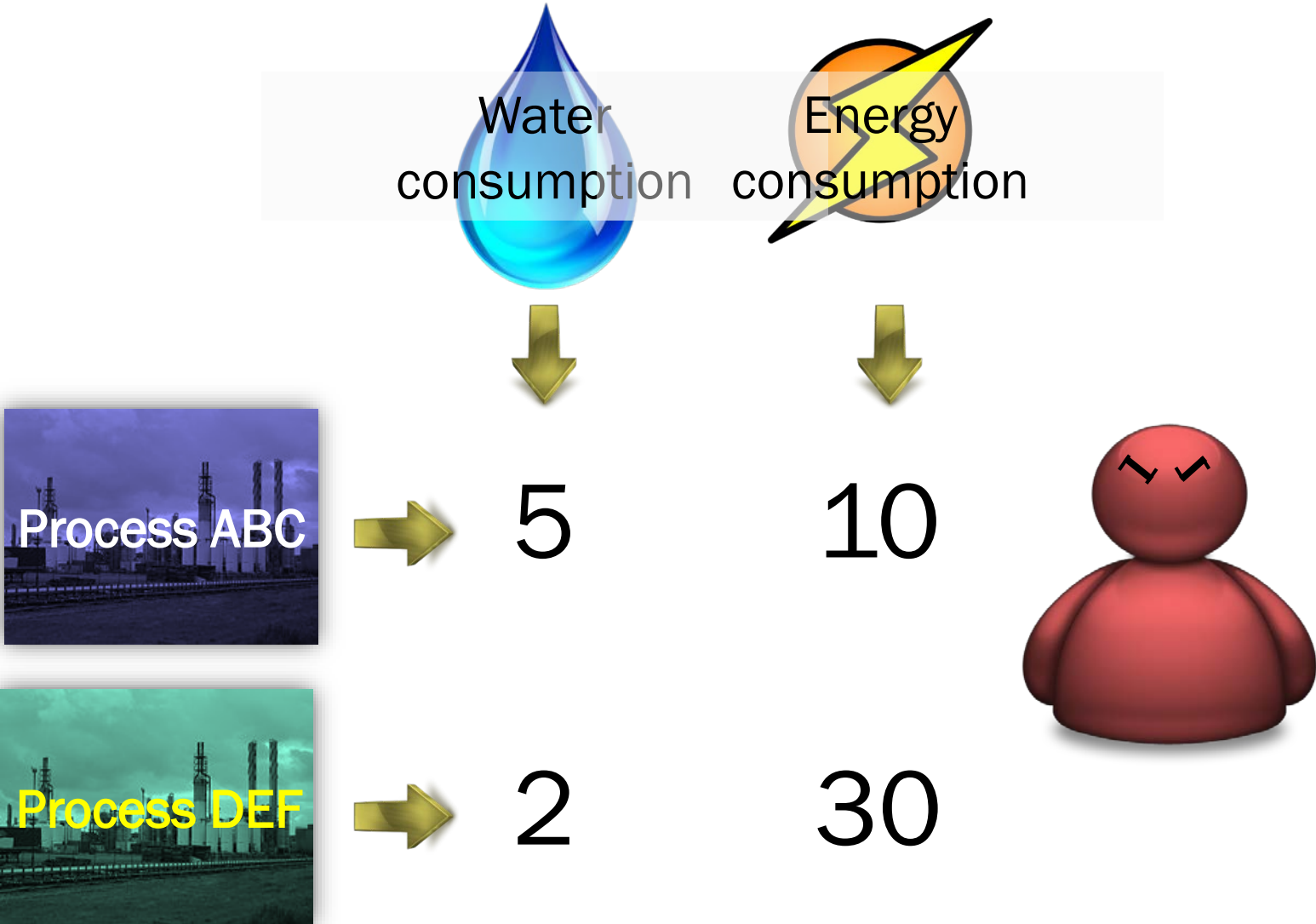
## Life Cycle Thinking: a definition



“The key aim of **Life Cycle Thinking** is to **avoid burden shifting**. This means minimizing impacts at one stage of the life cycle, or in a geographic region, or in a particular impact category, while helping to avoid increases elsewhere”

# LIFE CYCLE THINKING

Avoiding burdens shifting



# LIFE CYCLE THINKING

## Avoiding burdens shifting

### Carbon Footprint of Nations

