ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

Fare i conti con l'ambiente
Rifiuti acqua energia
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RESOURCES DEPLETION AND RECYCLING

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Introduction

In 1987 World Commission on Environment and Development Brundtland Report 1987:

"**Our common future**"

It marked the beginning of modern environmental policy.

The report highlighted the impossibility of sustaining exponential economic growth and its associated Resource Depletion.

Many of natural resources are limited and will therefore one day be exhausted, if we continue to use them at current rates.

Just an economist can think that it’s possible to have an infinite growth using finite resources

(Kenneth Boulding“ Economic Development as an Evolutionary System, 1981”)

The main assumption is that

natural resources are limited

It’s impossible to think to a system with an infinite growth

the term "**sustainable growth**" is an **oxymoron**

The improvement of the life conditions must be achieved without increasing consumption

Sustainable development

- The velocity of extraction and consumption has to be lower than the velocity of resources regeneration

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Renewable raw material and energy

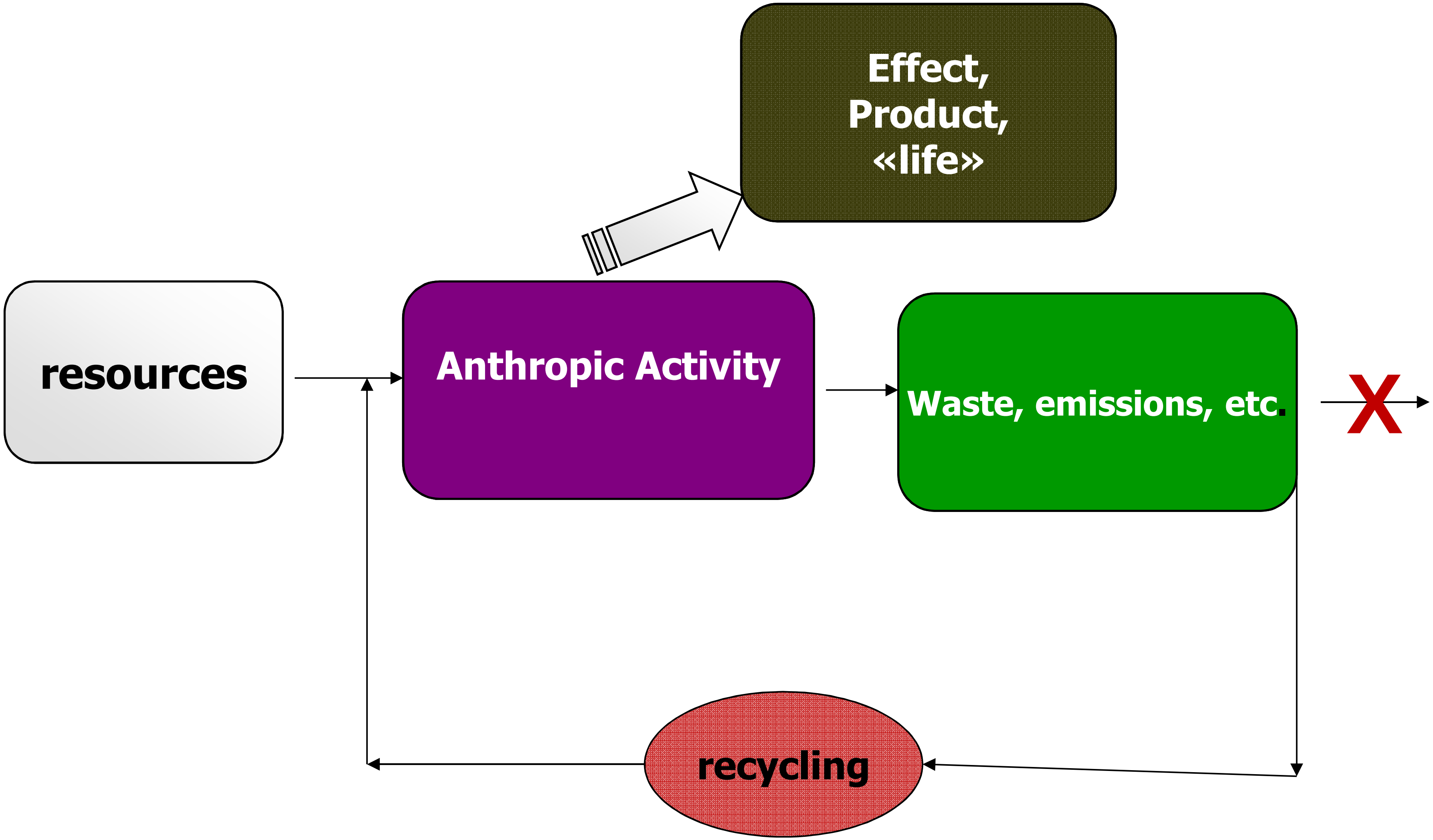
- The velocity of waste production has to be lower than the natural efficiency of the natural ecosystems to absorb it and remove it

↓

Minimization of waste production.

Reuse and recycling

Close system



Natural Resources Depletion Indicator

indicator calculates the depletion of natural resources, taking into account

- **An economical approach:**

as a percentage of total gross national income (% GNI)

- **A quantitative approach:**

the size of the resource reserve in ground and the consumption rate

Both

fraction of reserve disappearing per year (indeed the consumption rate is expressed as a quantity per year)

(World Bank definition)

Natural resource depletion is the sum of net

forest depletion,

energy depletion

mineral depletion

Net **forest depletion** is unit resource rents times the excess of roundwood harvest over natural growth.

Energy depletion is the ratio of the value of the stock of energy resources to the remaining reserve lifetime (capped at 25 years). It covers coal, crude oil, and natural gas.

Mineral depletion is the ratio of the value of the stock of mineral resources to the remaining reserve lifetime (capped at 25 years). It covers tin, gold, lead, zinc, iron, copper, nickel, silver, bauxite, and phosphate.

International Human Development Indicators Natural resource depletion (% of GNI)

economic indicators, with a monetary expression of energy, mineral and forest depletion expressed as a percentage of **total gross national income (%GNI)**, as proposed in the International Human Development Indicators, United Nations Development Programme (UNDP), based on World Bank data (2011).

HDI Rank	Country	1980	1990	2000	2005	2006	2007	2008	2009
1	Norway	9.3	8.0	15.3	15.4	15.2	13.8	17.1	10.6
2	Australia	4.6	2.2	2.3	4.0	4.9	5.6	7.5	5.1
3	Netherlands	2.6	0.8	1.1	1.6	1.4	1.3	2.0	0.8
4	United States	4.5	0.8	0.7	1.1	1.1	1.2	2.0	0.7
20	France	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0
21	Slovenia	0.0	0.0	0.2	0.2	0.2	0.2	0.3	0.2
22	Finland	0.1	0.0	0.0	0.0	0.1	0.1	0.1	0.1
23	Spain	0.2	0.0	0.0	0.0	0.0	0.0	0.1	0.0
24	Italy	0.2	0.1	0.2	0.2	0.2	0.2	0.2	0.1

LCA Approach Bureau Veritas (EIME)

- A quantitative approach calculates the depletion of natural resources, taking into account the size of the resource reserve in ground and the consumption rate of today's economy.

- **Natural Resource Depletion indicator is expressed in the fraction of the reserve disappearing per year**

Total Reserve based Indicators

directly assess the extracted mass of a given resource, usually in relation to its deposits.

Both the CML (Guinee/Heijungs 1995; van Oers et al. 2002) and EDIP methods (Hauschild/Wenzel 1998)

Exergy loss

Exergy has been described as “the upper limit of the portion of a resource that can be converted into work” (Dewulf et al. 2007). Conversely, **exergy extraction represents extracted potential for entropy production from the natural environment**, since a resource is usually concentrated following extraction:

the amount of energy necessary to bring the resource back into the state before extraction can be described exergy loss (Lindeijer et al 2002)

Surplus energy

- The surplus energy approach, as adopted in the Eco-Indicator 99 (Goedkoop/Spriensma 2001) and IMPACT 2002+ (Jolliet et al 2003), is based on the assumption that

as more of a resource is extracted over time, quality of deposits still available tends to decrease.

- **Each extraction of a certain amount of a resource from a deposit in the present will require an earlier move to more energy-intensive extraction from lower-quality, less accessible deposits in the future.**

Marginal cost

It may be argued that as energy demand increases if a resource is to be extracted from less concentrated, lower-quality deposits over time,

extraction costs increase as well.

an **economic perspective for measuring resource depletion as energy demand for extraction or concentration**

Monetizing the energy requirements of resource extraction, provides a more universally applicable indicator;

Willingness-to-pay models

- **Willingness to pay** models aim to capture the costs of an environmental intervention that stakeholders are willing to accept. The EPS 2000 method (Steen 1999) assesses resource depletion using this approach.

- A market model is used for abiotic resource depletion, assumptions differing depending on the substance or material (different groups of metals and minerals, fossil oil, coal, natural gas): **the cost of substituting a substance by a sustainable alternative** is used as a WTP value for future generations affected by present-day depletion.
- In case of biotic resources or ecosystem capacity, including fish, meat, wood, and land use, a survey-based contingent valuation method is used to determine WTP, i.e. the value of a resource to stakeholders.

Natural resources depletion

+

Waste production

=

Environmental Impact

Resources valorization

+

Waste minimization, recycling and recovery

=

Sustainability

In Western Europe, 15% of the raw materials (in euros) used for building work and consumer products is obtained by recycling.
This means that recycling has become a player in the raw materials sector.
In the coming 15 years, the contribution of recycling in the supply of raw materials in Western Europe must be doubled to 30%, For this purpose, breakthrough technologies must be developed.

The time of expiration of nonrenewable resources can be postponed, possibly for a very long time, by

- technological improvements in the exploitation and processing efficiency
- using the resources in accord with a program of "sustained availability"
- minimize raw material consumption by dematerialization of products
- optimization of raw material recover and use
- utilization of substitute resources
- improve and maximize recycling processes

A new approach: Transition Engineering

Working on changing existing systems to manage un-sustainability was the only way to transition through the next 50 years or so with a prosperous outcome. (Susan Krumdieck)

Every generation faces problems that challenge their technology, creativity and humanity. Facing and finding solutions to problems is how we adapt, develop and improve. **Nature has always been a challenge**.

Transition approach is the work of change for a strategic purpose with a long-term perspective:

Holistic or Whole System Perspectives

Change of existing systems to reduce:

- energy intensity
- fossil fuel demand
- resource and material intensity

Change of existing systems to increase resilience

Synergies of Scale: Long-term = Short-term; Local = Global; Individual = Population

Engage participation at all levels, Active engagement and communication, Strategic decision-making

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Thank You for Your Attention

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