# The Road towards Sustainability

*A historical perspective*

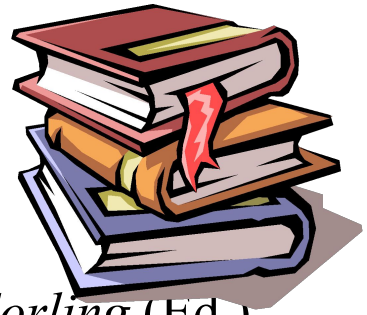
*Lecture 2. Continuation*

*Sustainable Baltic Region course.*
*Baltic University Program*

# The Road towards Sustainability

1. Islands – global lessons from micro-worlds
2. The environmental dilemma – a history of scientists and social constructions
3. **Baltic region eco-strategies**
4. **What we live on?**
5. **Paradigms of sustainability**
6. **The road to sustainability**

# Literature




1. **The Road towards Sustainability.** A historical perspective. *S.Sorling* (Ed.) – Uppsala: BUP, 1997. – 48 p.
2. **Программа действий.** Повестка дня на 21 век и другие документы конференции в Рио-де-Жанейро в популярном изложении / Сост.: М. Китинг. – Женева: Центр «За наше общее будущее», 1993. – 70 с.
3. **Дейлі Г.** Поза зростанням. Економічна теорія сталого розвитку. – К.: Інтелсфера, 2002. – 312 с.
4. **Daly, H. and Farley J.** Ecological Economics. Principles and applications. – Washington: Island Press, 2004. – 454 p.
5. WEF, 2012. More with Less: Scaling Sustainable Consumption and Resource Efficiency Report. Industry agenda
6. **Meadows D.** et al. Limits to Growth, - 1972.

# 4. What we live on?

***Natural resources and exergy***

# General comments

- Each ecosystem has to be supplied with energy & matter;
- Without such a supply there is **a dead matter;**
- Societal systems are supplied **according to the same principles** as a natural systems;
- There is demand for  water, food, metals, oil, fuels, etc.

# 4.1. Criteria of natural resources assessment

In order for a quantity of matter in the ecosystem to be classified as natural resource such **five criteria** must be fulfilled:

1. Availability;
2. Technology;
3. Access;
4. Economic efficiency;
5. Environment (ecology).

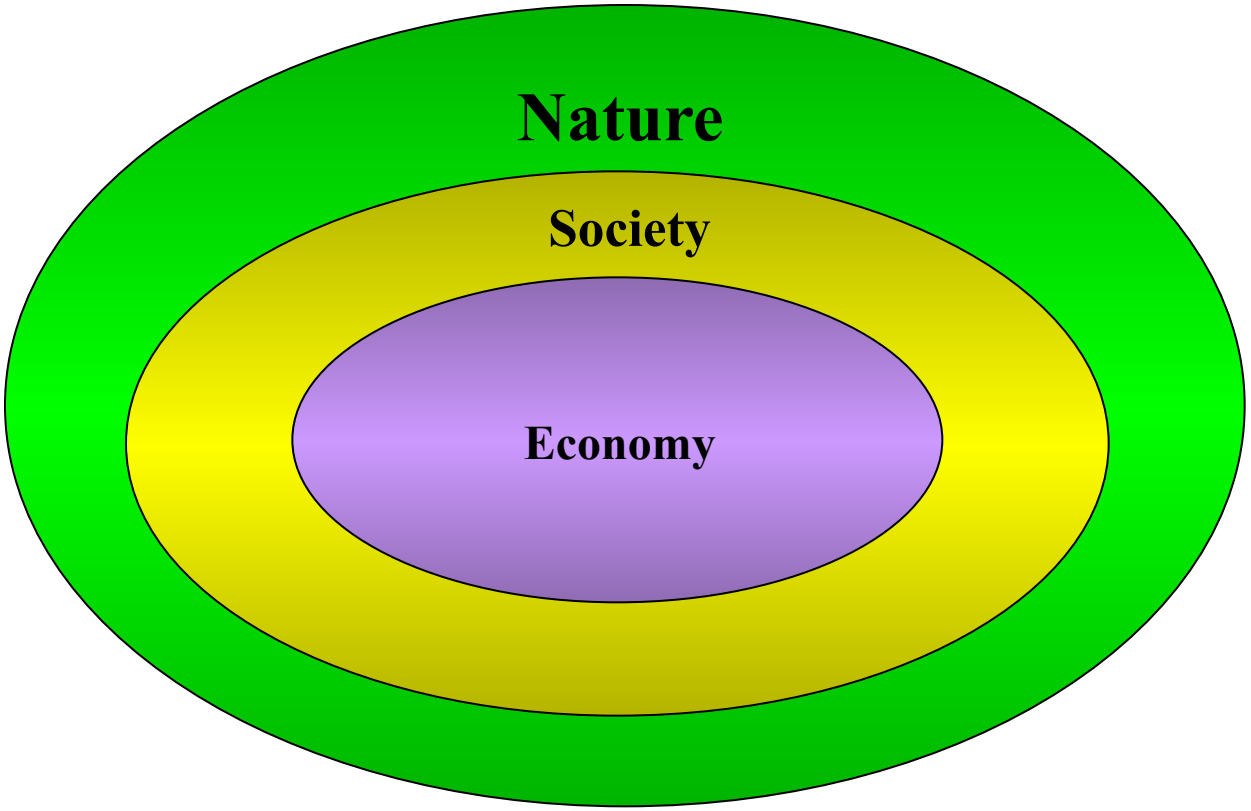
# 4.2. Political and social conditions as a further criteria

- Knowledge;
- Public opinion;
- Scale (World Economic Forum, 2012: we leave in era of scaling) .

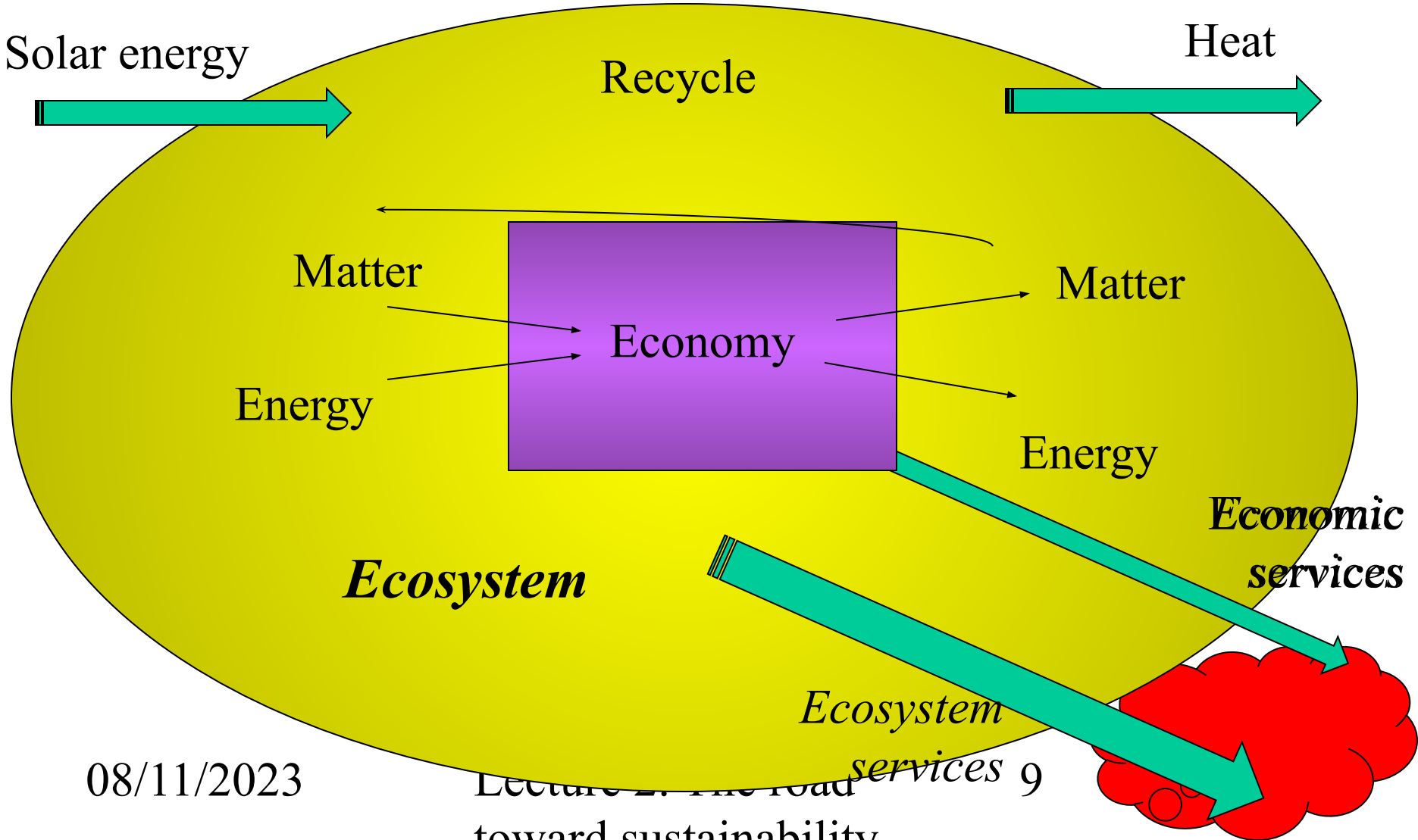
We must all think ***globally*** and act ***locally.***

# Pre-analytical View of Ecological Economics

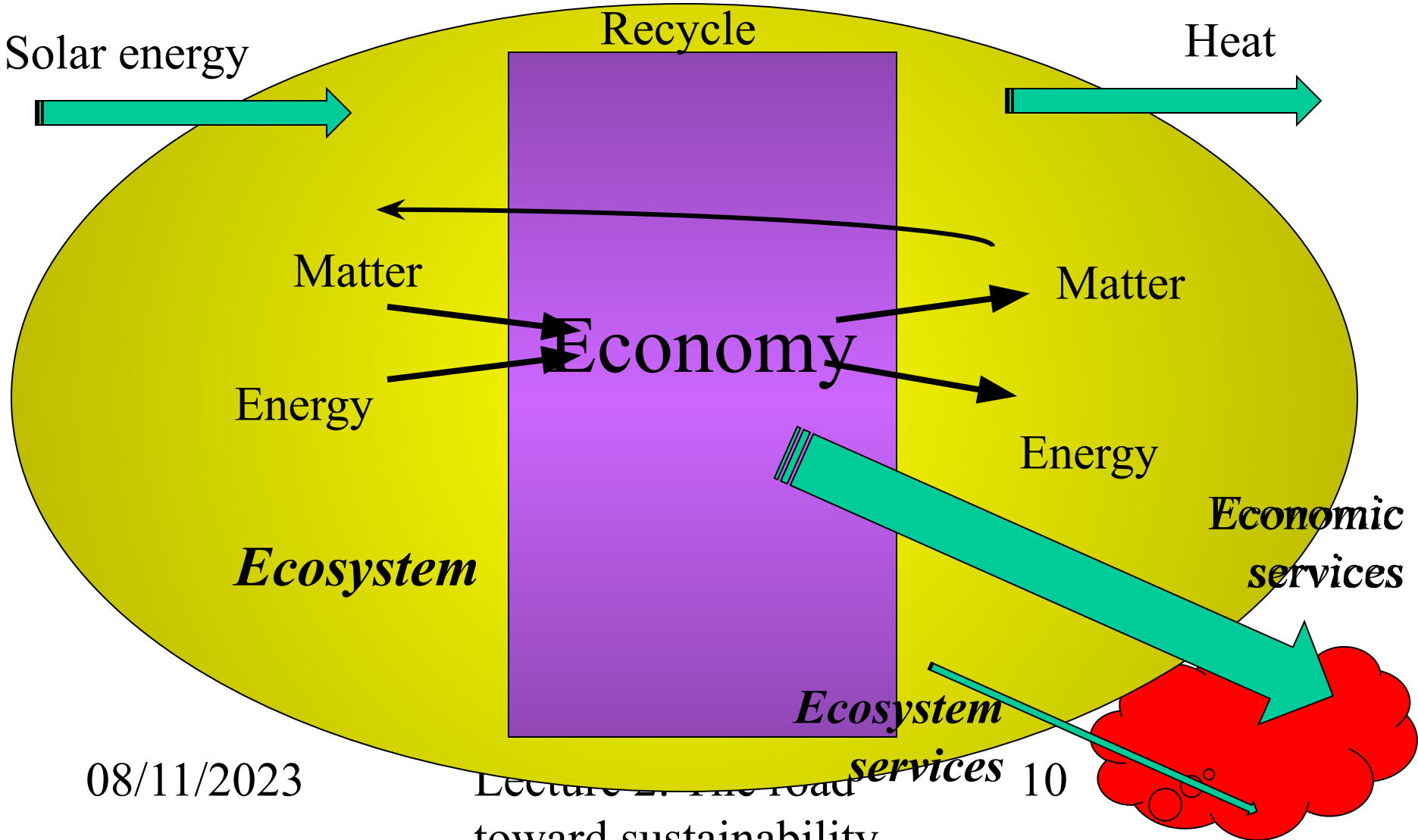
*(Farley et al, 2005)*



# Optimal Scale (1)
# Empty World



# Optimal Scale (2)
# Full World



# 4.3. The complexity of the energy realm *(sphere)*

- Holistic fashion for considering

  (sources, production, distribution, use, impacts)

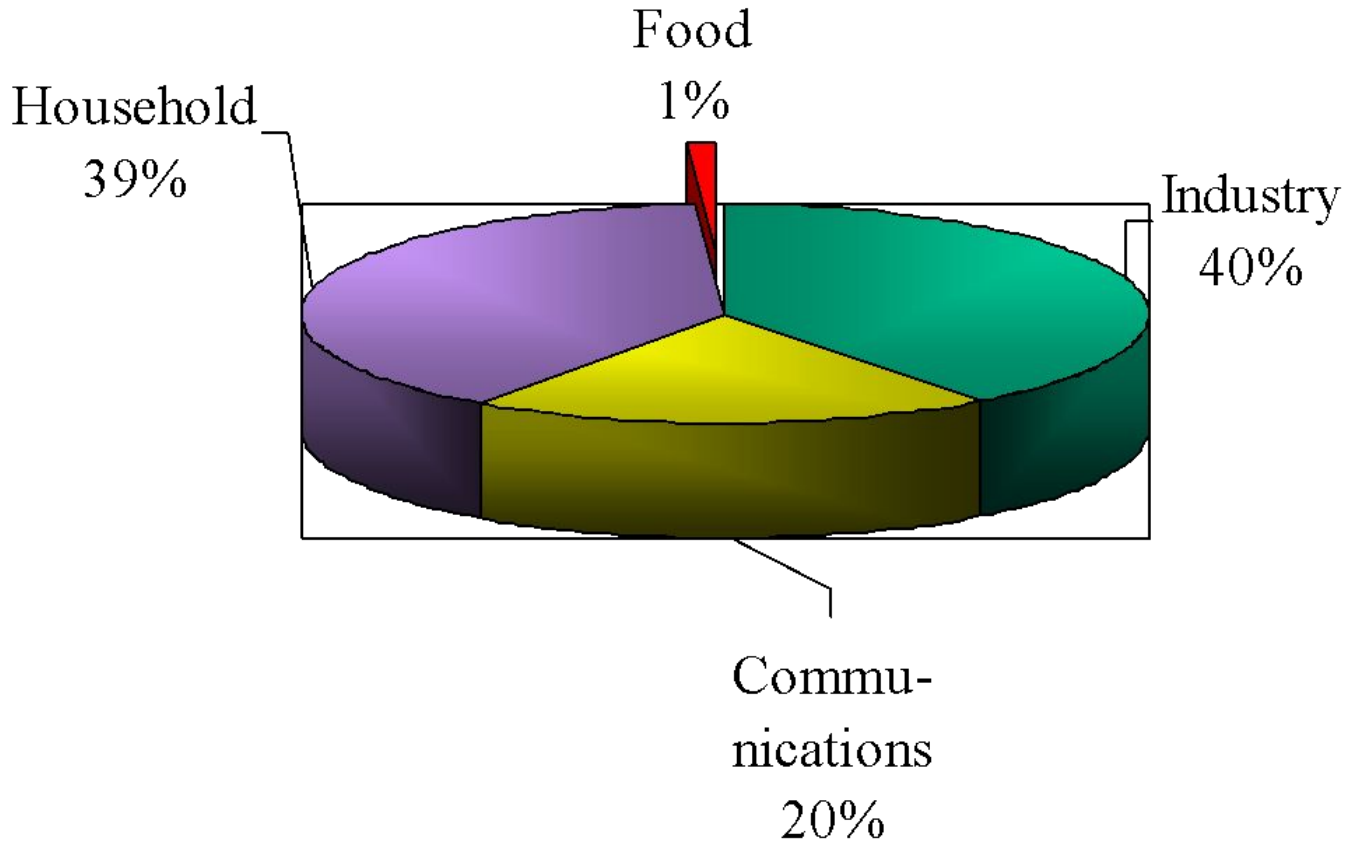
  Human ecology: multidimensional point of view;
- Study of energy as a clue (розгадка) to measures for conservation
- Complexity, caused by:
  - humans themselves, their knowledge, attitudes and habits;
  - Differences between individuals and groups.

# 4.3. The complexity of the energy realm *(sphere) (2)*

- Every living species has own model for obtaining matter and energy from the surrounding system;
- Struggle for life is basically a struggle for matter and energy;
- Food supply to humans is a part of the energy supply to whole society!??
- Affluent societies are full of ‘energy slaves’ (100 per person);

# 4.3. The complexity of the energy realm (3)

***Baltic region: structure of energy consumption (1997)***



# 4.4. Energy Growth in Scandinavia

- 5 % per year over a period of 200 years;
- Exponential growth – a doubling time of **15 years**;
- A remarkable changes in the growth patterns:
  - 1973 - world oil market price raised by a factor of four;
  - 1979 - world oil market price raised by a factor of three;
  - **Oil consumption** per person drastically **DECREASE** from **four** $m^3$ in 1973 to **two** $m^3$ now (**nuclear** power);
  - Industrialized countries reduced oil consumption;
  - Instead poor countries have some increment.

# 4.5. The Principles of Energy Supply

- The energy concept was discovered by **J.P.Joule** and others in 1840;
- Basic laws in thermodynamics in the following decades;
- Energy was defined as a **quantity** concept;
- Without attention to the **quality** of energy;
- But only **high** enough quality energy makes an **'energy source'!**

# 4.5. The Principles of Energy Supply (2)

The first law in thermodynamics:

**the quantity of energy is always preserved!**

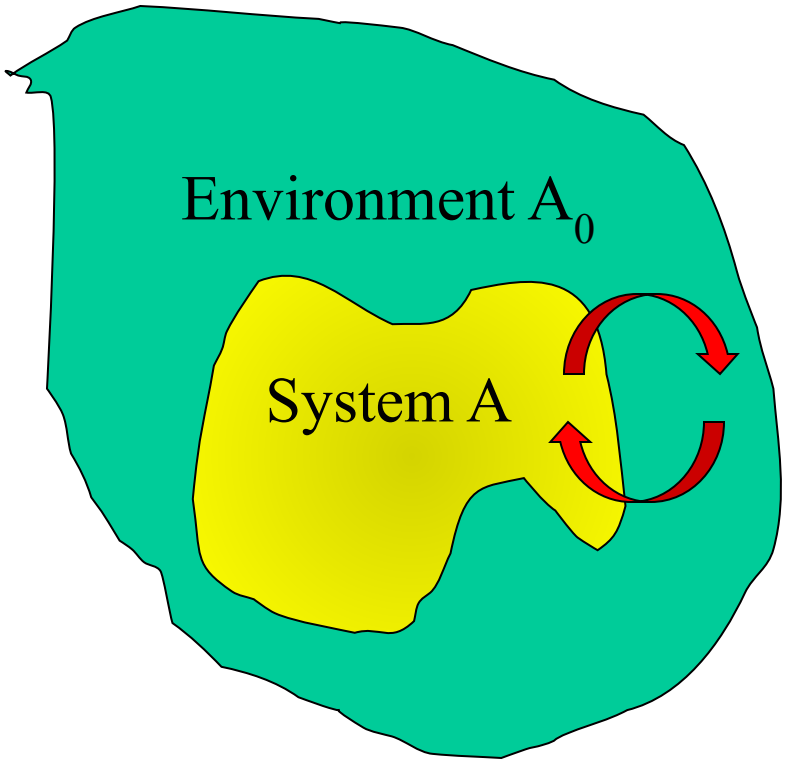
# 4.5. The Principles of Energy Supply (3)

- The high quality energy makes an ‘energy source’, meet the system’s demand;
- All processes in the system are maintained at the cost of degradation of the quality of energy;
- In the end there is only low-temperature heat left. It appears as ***background energy*** which is engulfed in the surrounding ecosystem (поглинута);
- All ecosystems are loaded by ***background energy,*** even in dead state.

# 4.6. Exergy

- The word was created in 1953 by German engineer **Z.Rant;**
- reflect **quality** of energy as well as **quantity;**
- It can be defined only with reference to a **system** in question and its **environment;**
- Hence this is ideal model for environmental energy discussion.

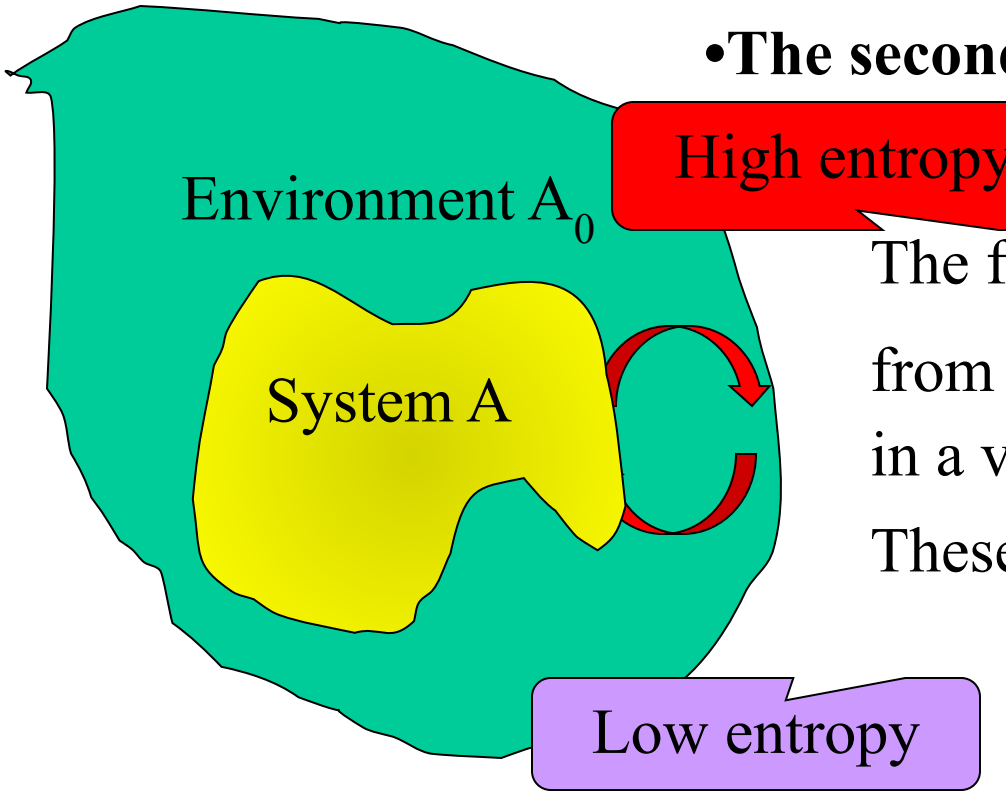
# 4.6. Exergy (2)
# The maintenance theory




- The system A contains some agent (both living species or working machine)
- It is in perpetual interaction with its environment $A_0$;
- If the two systems can be distinguished, e.g. by having different temperatures, there can be a dynamic change, **co-evolution**;

Without maintenance, the processes in system A will cease – '**heat death**' or **'thermodynamic equilibrium'** of system A and environment $A_0$.

# 4.6. Exergy (3)
# The maintenance theory




- **The second law in thermodynamics:**

The flow **from** the system differs from the flow **to the system** in a very essential property.

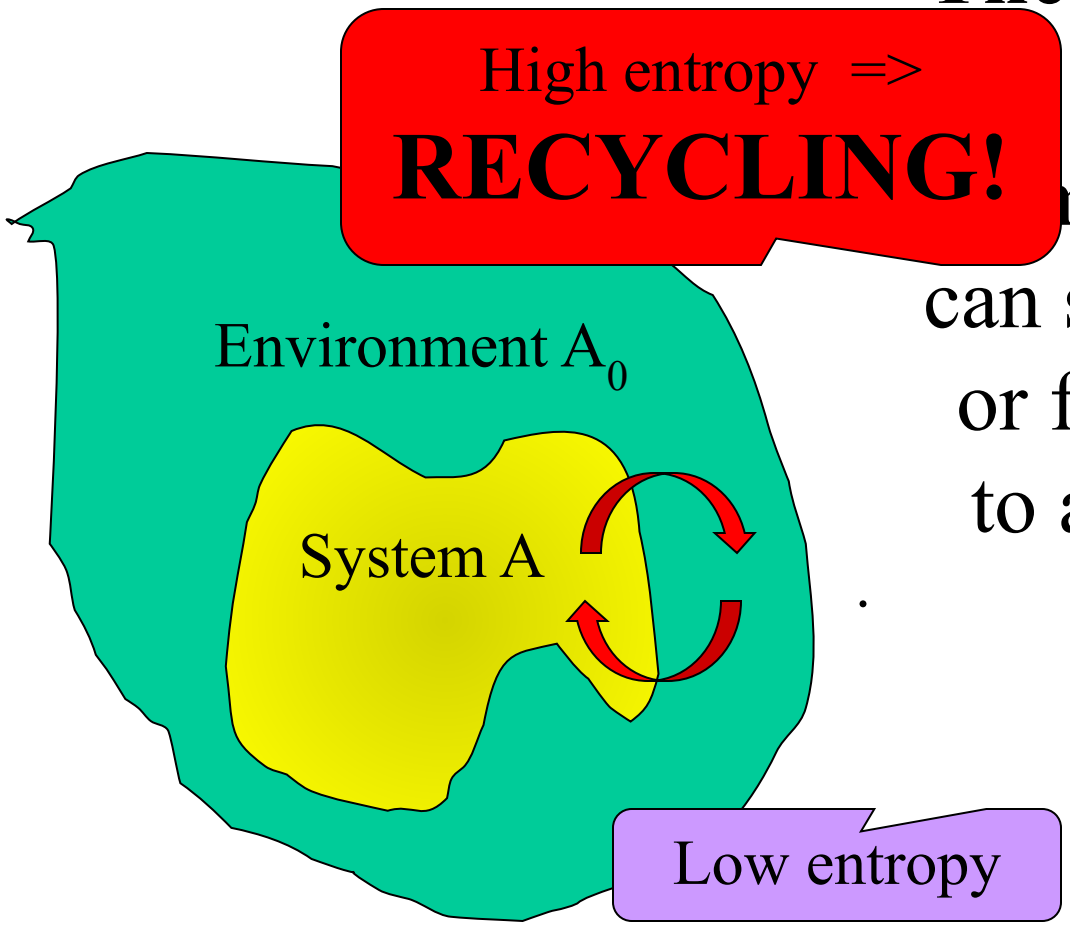
These changes are **irreversible:**

**Exegy** is consumed,
**Energy** is dissipated.

# 4.6. Exergy (4)

- Exergy is the name of such energy that can be utilized as an energy source;
- Exergy is the most important ingredient in the supply flow to a system;
- Exergy defines a content of structure and structuring capability that can cause growth, organization, development, evolution, sustenance or maintenance of life or other activities.

# 4.7. The principle of recycling




**The conservation law of thermodynamics:**

nic matter and energy can stay in their locations or flow from one system to another but can never disappear.

# 5. Paradigms of sustainability

# Essence of Sustainable Development

"**Sustainable Development** meets the needs of present without compromising the ability of future generations to meet their needs".

**(***Brundtland Report, 1987)*

- **Development –** is **a qualitative** concept incorporating ideas about improvement and including cultural, social as well as economic dimensions (getting 'better').
- **Growth** implying **quantitative** expansion only (getting 'bigger').
- Inter- and intra-generational equity. Resource distribution.

# Sustainable Development aimed

"To maximize simultaneously the **biological systems** goals (generic diversity, resistance, biological productivity), **economic systems** goals (satisfaction of basic needs, enhancement of equity, increasing useful goods and services), and **social system** goals (cultural diversity, institutional sustainability, social justice, participation)".

*(Barbier, 1987)*

# Sustainable Development involves

- Economic efficiency;
- Environmental integrity;
- Social justice.

# **Subsystems** (pillars) **of sustainability:**

## ***Biological, economic, and social***

Sustainability is a ***relationship*** between dynamic human economic systems and dynamic but slower ecological systems, in which:

- Human life can develop ***indefinitely***;
- Human individuals can ***flourish***;
- Human culture can ***develop*** and
- Effects of human activities ***remain within bounds*** so as not to destroy the diversity, complexity and functioning of the ecological life-support system.

*Robert Constanza (1992)*

# 5.2. Paradigms of Sustainability

*(example, pattern)*

- Uncertainties are fundamental to policy decisions;
- Causal relations unknown;
- Hence, two type of uncertainty in decision-making:
  - Incomplete knowledge of dose-effect relations;
  - Differing appraisals of the natural environment or robustness and fragility of nature.

# 5.2. Paradigms of Sustainability (2)

*'define the corners of the playing field' (Latestein, 1994)*

1. **Utilizing paradigm** – impacts of human activity on the environment can be absorbed, risks are small, technology is self-regulatory and will change within certain limits;
2. **Saving paradigm** – the environment has a limited absorbing capacity hence mankind must adjust to lower level of consumption;
3. **Managing paradigm** – nature is vulnerable and solution is technologies that adapt to the environmental conditions, as consumption levels cannot be drastically altered;
4. **Preserving paradigm** – nature is very fragile; society is very flexible hence behavioral changes should be made.

# 5.2. Paradigms of Sustainability (3)

*(Orr, 1992)*

1. **Technological sustainability**:
   - Each problem has a **technological answer** or **market solution**;
   - Understanding and manipulating of environmental processes;
   - Economic growth is essential;
2. **Ecological sustainability**:
   - Transition to post-modern world;
   - Acquire skills to live much more poorly then we do;
   - Moral improvement;
   - 'a systematic effort to restore and preserve traditional knowledge of the land and its function' *(Orr, 1994)*

# 5.3. Carrying capacity, ecological equilibrium and Plimsoll lines

1. **Carrying capacity** (of an area of land in connection with human populations and societies) is usually expressed as the **largest population** which can be maintained on it in ecological equilibrium (given the prevailing method of resource exploitation);

   *(Wilkinson, 1973)*

2. **Plimsoll lines** 'helps us to keep the economic scale within ecological carrying capacity' *(Daly, 1988).*

   Plimsoll lines (painted on the hull) indicate the maximum loading capacity of a ship. Depend on salinity of water, weather conditions etc.

# Headline Indicators of Sustainability

- Ecological footprint;
- Green GDP (gross domestic product);
- Genuine Savings Index;
- Living planet index.

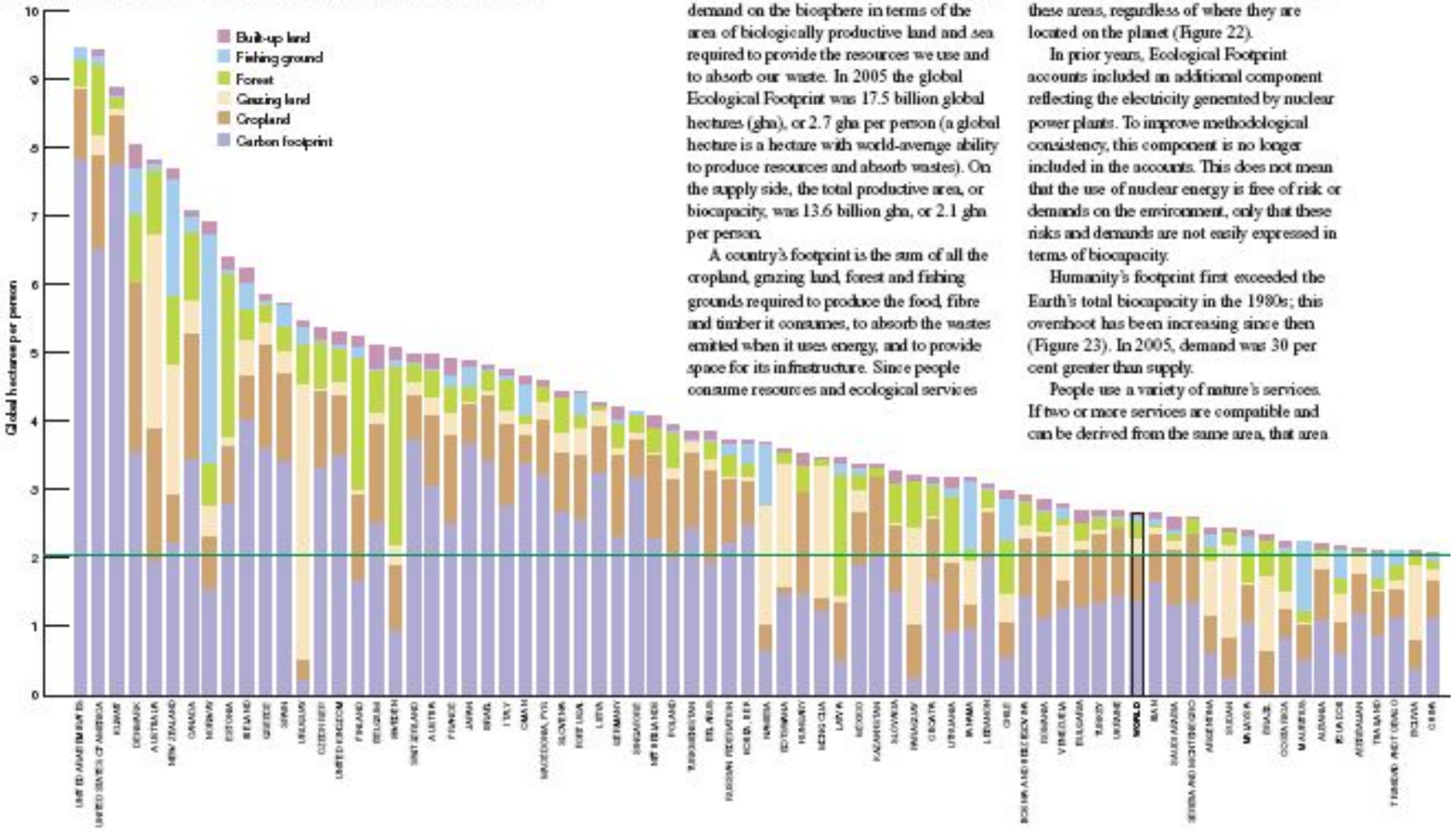
# 5.4. Ecological footprint

the total area that each population uses for all categories of consumption and waste discharge.

Reflect the **ecological deficit** or **global overshoot** (excessive use of land or and water areas).

Ecological footprint of industrialized countries many times greater then in developing countries.

Fig. 22: ECOLOGICAL FOOTPRINT PER PERSON, BY COUNTRY, 2005




The Ecological Footprint measures humanity's demand on the biosphere in terms of the area of biologically productive land and sea required to provide the resources we use and to absorb our waste. In 2005 the global Ecological Footprint was 17.5 billion global hectares (gha), or 2.7 gha per person (a global hectare is a hectare with world-average ability to produce resources and absorb wastes). On the supply side, the total productive area, or biocapacity, was 13.6 billion gha, or 2.1 gha per person.

A country's footprint is the sum of all the cropland, grazing land, forest and fishing grounds required to produce the food, fibre and timber it consumes, to absorb the wastes emitted when it uses energy, and to provide space for its infrastructure. Since people consume resources and ecological services from all over the world, their footprint sums these areas, regardless of where they are located on the planet (Figure 22).

In prior years, Ecological Footprint accounts included an additional component reflecting the electricity generated by nuclear power plants. To improve methodological consistency, this component is no longer included in the accounts. This does not mean that the use of nuclear energy is free of risk or demands on the environment, only that these risks and demands are not easily expressed in terms of biocapacity.

Humanity's footprint first exceeded the Earth's total biocapacity in the 1980s; this overshoot has been increasing since then (Figure 23). In 2005, demand was 30 per cent greater than supply.

People use a variety of nature's services. If two or more services are compatible and can be derived from the same area, that area

# 5.5. Environmental utilization space (Siebert, 1982)

**the usable dynamic space of the environment bounded by various Plimsoll lines and having three dimensions:**

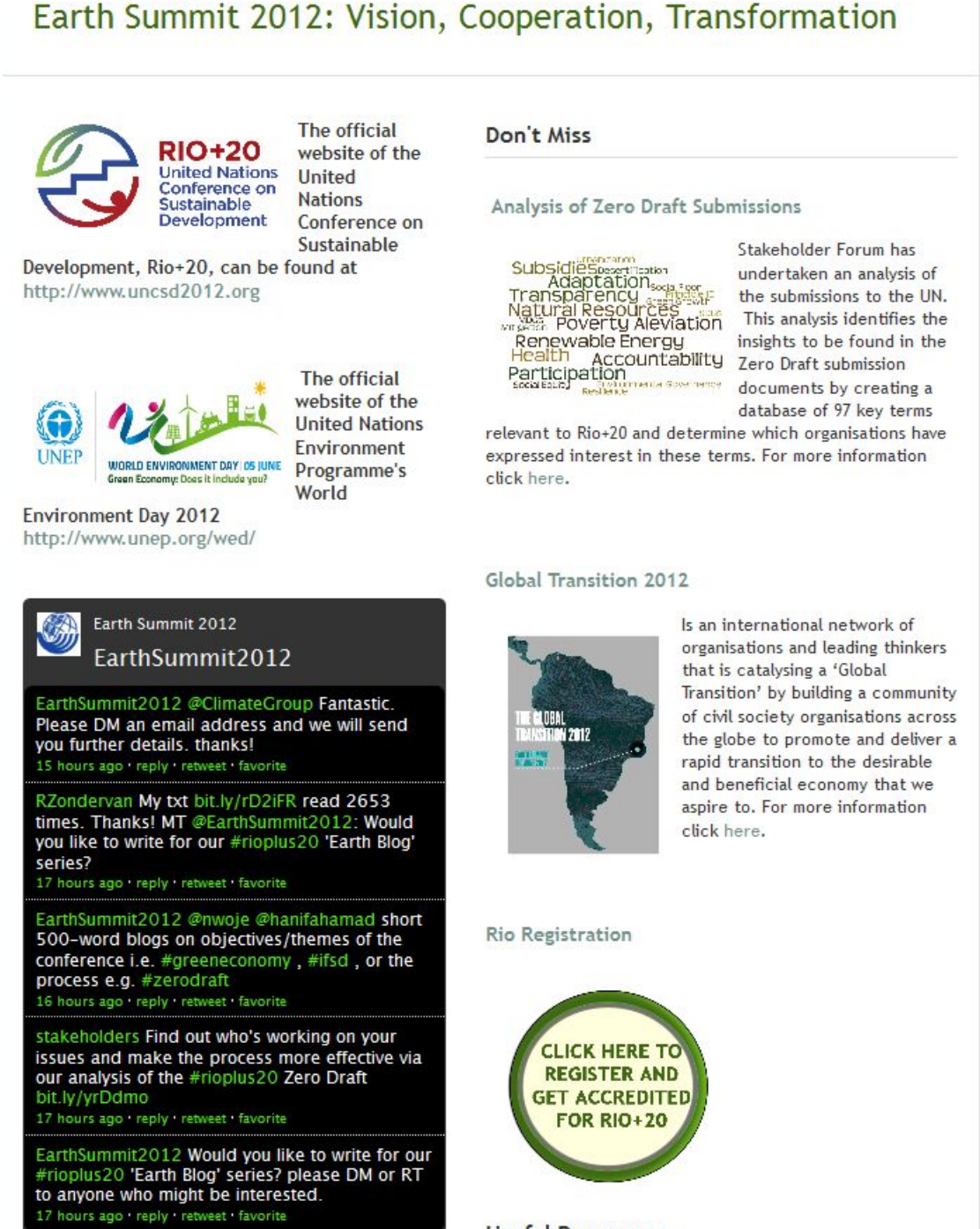
- depletion of resources;
- degree of pollution;
- loss of naturalness in the physical environment.

# 5.6. Co-evolution and the ‘patchwork guilt’ *(Norgaard, 1994)*

- •Co-evolution between cultural and ecological systems;
- •A co-evolutionary paradigm;
- • Restoring and preserving traditional knowledge and natural resources use.

# 6. The road to sustainability

- Establishing an international agenda
- Common sea resources
- Environmental movement and UN (R.Carson (1962), S.Oden (1967) etc.)
- The Club of Rome: “Limits to Growth” by D.Meadows et al, 1972
- UN Conference on Human Environment, Stockholm, 1972;
- UN Conference on Environment and Development, Earth Summit, Rio de Janeiro, 1992;
- UN Johannesburg Summit, 2002;
- Earth Summit 2012: Vision, Cooperation, Transformation




**OBJECTIVES:**

- Securing Political Commitment to Sustainable Development
- Assessing Progress Towards Internationally Agreed Commitments
- New and Emerging Challenges

## THEMES

- Green Economy in the context of Poverty Eradication and Sustainable Development
- Institutional Framework for Sustainable Development

**http://www.earthsummit2012.org**

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