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MEASURING METABOLISM OF AN AREA

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WHY ???

...Urban metabolism...

...Sustainable Development...

...Circular economy...

...Ecological footprint...

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STATISTICS

- The world's population it is growing by **1.10% per year**, yielding an additional *83 million people annually*.

- The population is predicted to increase more than one billion people over the next 13 years, reaching 8.6 billion in 2030, to 9.8 billion in 2050 and 11.2 billion by 2100

- Cities allocate about **50%** of world's population, and it is expected that this number will increase up to 66% by 2050

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STATISTICS

- Although urban areas account for **<u>only four percent</u>** of the Earth's land surface area they are responsible *<u>for 60% of water consumption and 80% of carbon emissions and</u>* (with 25% attributed to urban transportation, 32% to urban built environment, and an additional 5% to municipal solid waste)

- In 2015 the '<u>ecological overshoot</u>' was estimated to be **54% above the planet's biocapacity' meaning we need 1.5 planets to live sustainably**

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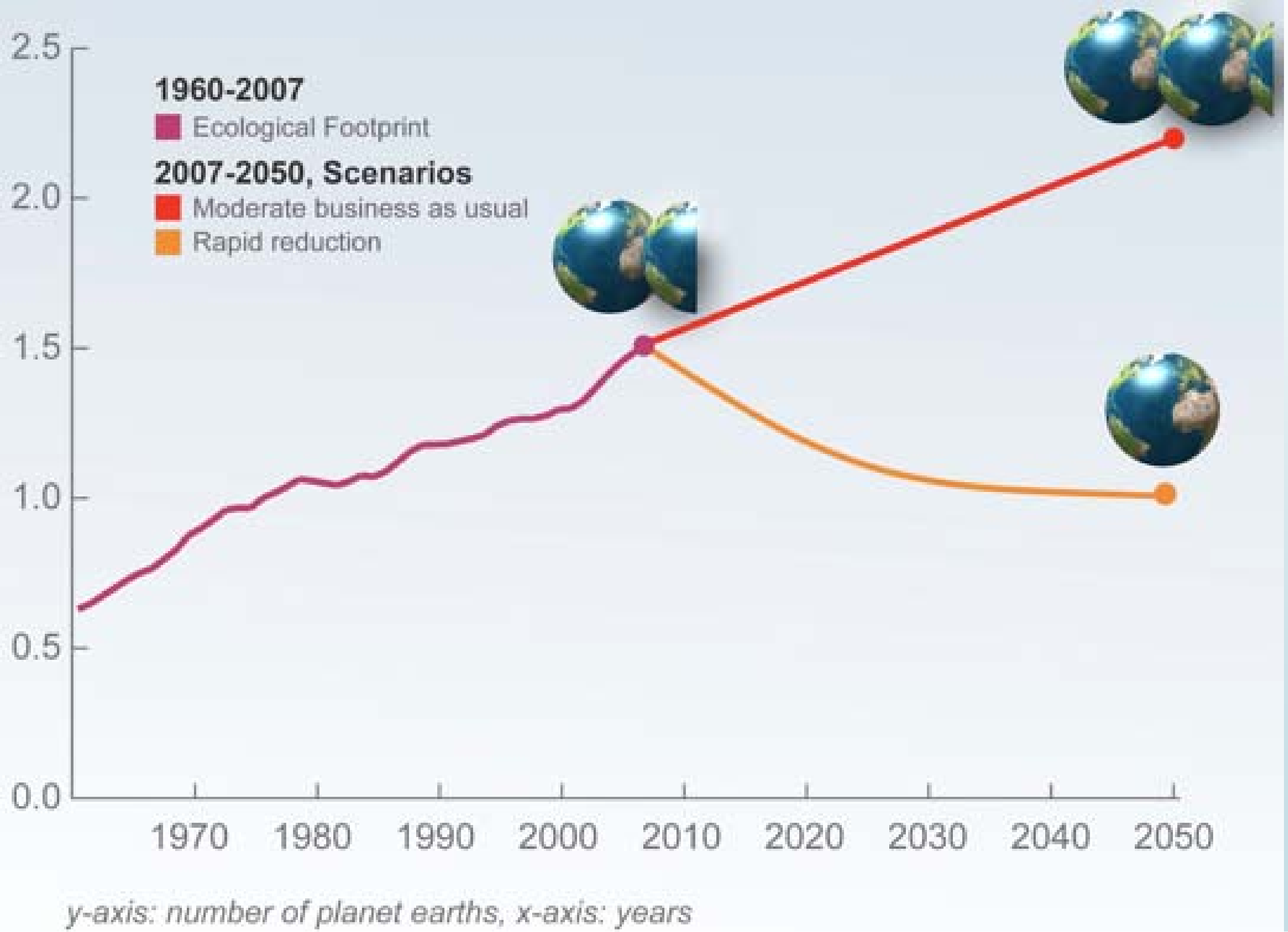
STATISTICS



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URBAN METABOLISM CONCEPT

- **Karl Max** first discussed urban metabolism in **1883**, and used the conception of metabolism to *describe the material and energy exchanges between nature and society in his critique of industrialization*

- **Abel Wolman** (**1965**) re-launched the urban metabolism concept as *a method of analyzing cities and communities through the quantification <u>of inputs</u> – water, food and fuel, <u>outputs</u> – sewage, solid refuse and air pollutants and tracking their respective transformations and flows.*

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URBAN METABOLISM CONCEPT

- **Kennedy (2007)**: the sum total of the technical and socio-economic processes that occur in cities, resulting in growth, production of energy, and elimination of waste

- Urban Metabolism is a framework for modeling complex urban systems' flows – water, energy, food, people, etc – as if the city were an ecosystem. It can be used to analyze how urban areas function with regard to resource use and the underlying infrastructures, and the relationship between human activities and the (natural) environment.

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URBAN METABOLISM ANALYSIS

The advantages of using an urban metabolism framework are :

- 1. explicitly identifies of the system's boundaries;
- 2. accounts for inputs and outputs to the system;
- 3. allows for a hierarchical approach to research;
- 4. includes decomposable elements for targeted, sectoral research;
- 5. necessitates analysis of policy and technology outcomes with respect to sustainability goals;
- 6. is an adaptive approach to solutions and their consequences;
- 7. integrates social science and biophysical science/technology

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Urban Metabolism Analysis - Methodologies

EMERGY ANALYSIS

is defined as the amount of energy of one type (usually solar) that is directly or indirectly required to provide a given flow or storage of energy or matter

The urban metabolism emergy system has the component:

- *of renewable resource emergy (R),*
- *non-renewable resource emergy (N),*
- *imported emergy (IM),*
- *waste emergy (W)*
- *and exported emergy (EX) of material, energy and labour*

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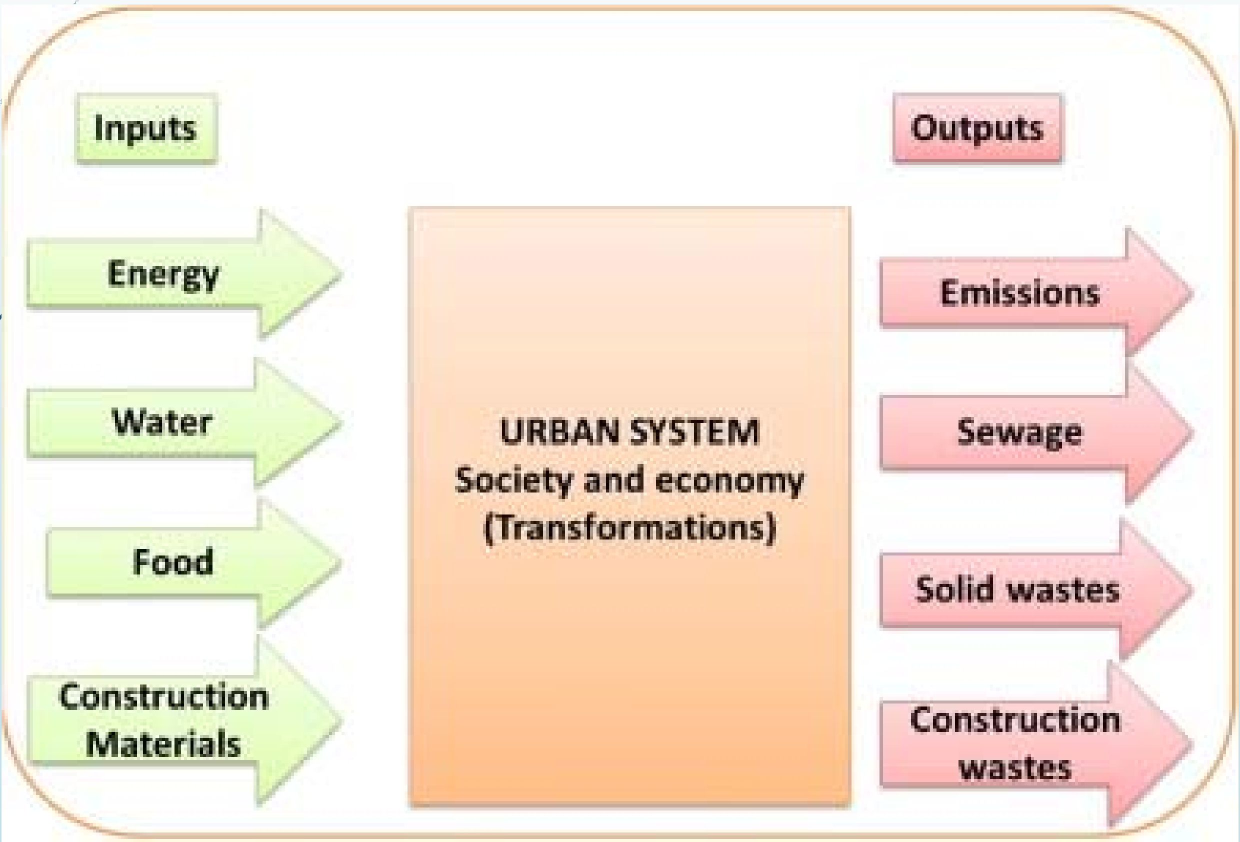
URBAN METABOLISM ANALYSIS - METHODOLOGIES

MATERIAL FLOW ANALYSIS (MFA)

- is based on two fundamental and well-established scientific principles, the systems approach and mass balance
- Refers to the analysis of the throughput of process chains comprising extraction or harvest, chemical transformation, manufacturing, consumption, recycling and disposal of materials.

URBAN METABOLISM ANALYSIS - METHODOLOGIES



MATERIAL

FLOW ANALYSIS

(MFA)

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URBAN METABOLISM ANALYSIS - METHODOLOGIES

ECOLOGICAL FOOTPRINT

- measures the ecological assets that a given population requires to produce the natural resources it consumes and to absorb its waste, especially carbon emissions.

- is measured in ***global hectares***, an indication of the proportion of the earth's surface required to support a particular activity.

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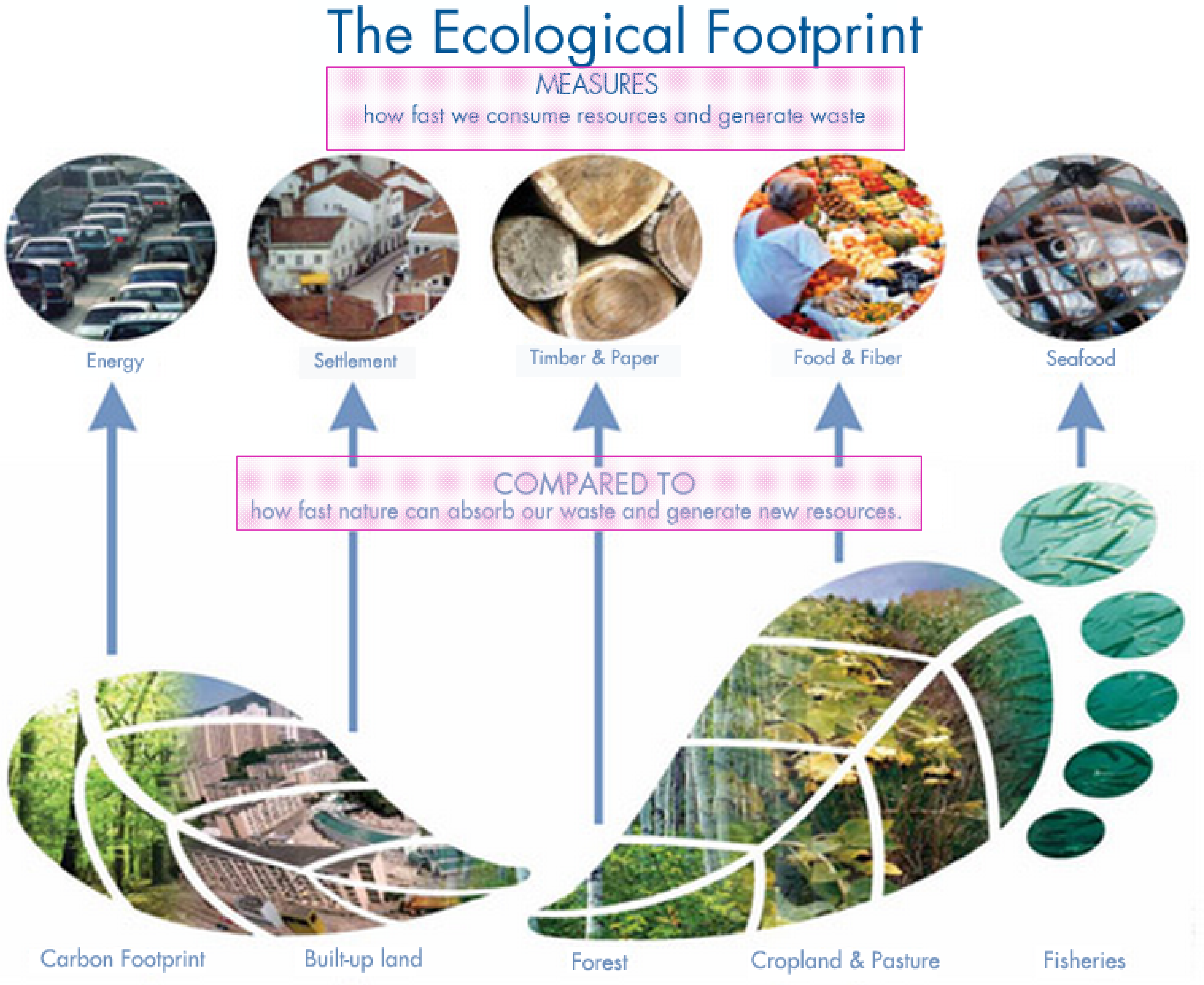

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INDICATORS DEVELOPMENT

- ✓Water supply;
- ✓Wastewater treatment;
- ✓Solid waste management;
- ✓Energy consumption;
- ✓Food supply;
- ✓Transportation;

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URBAN METABOLISM ANALYSIS

Purposes of UM ANALYSIS

***1. Assessment of materials and energy flows throughout a city*.**

The resultant evaluation shows:

- the efficiency in resource use and its future need,
- the existence of any environmental burden,
- the contribution of recycling and the capacity of waste treatment,
- enabling a better awareness of how much impact human activity (social, economic and political) is causing in the natural environment

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URBAN METABOLISM ANALYSIS

2. Aims to quantify greenhouse gas (GHG) emissions

3,4. Use material and energy evaluation to support decisions concerning public policy

In order to deal with problems such as pollution, sewage treatment, resource scarcity, water shortage and the formation of heat islands, different options in urban design are assessed with the aid of mathematical models, which shows the choices that best balance greater social and economic advancements with lower ecological effects

DIFFICULTIES IN URBAN METABOLISM ANALYSIS

1. data scarcity at the city level
2. difficulty in tracking informal, unregulated, illegal or decentralized systems, which in most of the world includes flows of food, material and informal goods,
3. a lack of standardized method for examining urban metabolism, making comparison of cities' metabolisms quite difficult
4. the fluid nature of urban metabolisms, which are difficult to express in static quantifications,
5. the nature of cities as open systems, which extends the cities' ecological footprint beyond its point of political or administrative control

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CONCLUSION

There is **an urgent need** to improve the understanding of cities and their metabolism, however is pressed not only by the social relevance of urban environments, but also by the availability of new strategies for city-scale interventions that are enabled by emerging technologies.

Urban planning **is crucial** to address resilience and climate change adaptation. In this sense, a comprehensive strategy for urban planning should be based on intersectorial interventions.

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THANKS FOR YOUR ATTENTION!!!

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