Technology Dynamics and Transition Management in China

Sustainable Development

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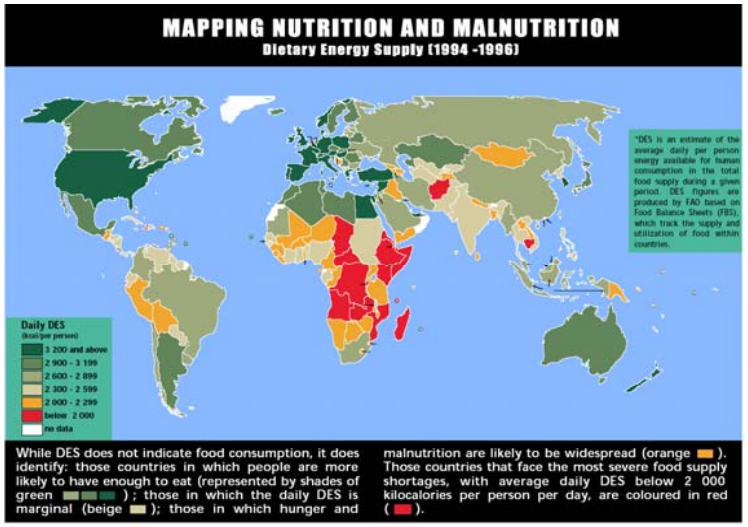

http://www.fao.org/NEWS/1998/981204-e.htm

January 8, 2010

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Development in such a way that the present generation supports itself without endangering the living conditions of the next generation

Strikes a bridge between development and environment, the needs of North and South and the needs of this and future generations

It connects ecology, economy and social rights

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Global approach

Broad development

Politics? Besides governments, groups in the market market and in society are addressed: firms, trade unions, citizens, women, youth, cultural organizations, churches

However: ‘stretched beyond credibility’

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Urgency (physical threats)
Sense of urgency (actor perceptions)

Assignment of meaning:

- Welfare problem in rich countries
- Health problem in rich and poor countries
- Economic or development problem in rich and poor countries
- Survival problem in poor countries

N.B.

- In the long term: survival problem for the whole world population
- Match between possibilities and needs

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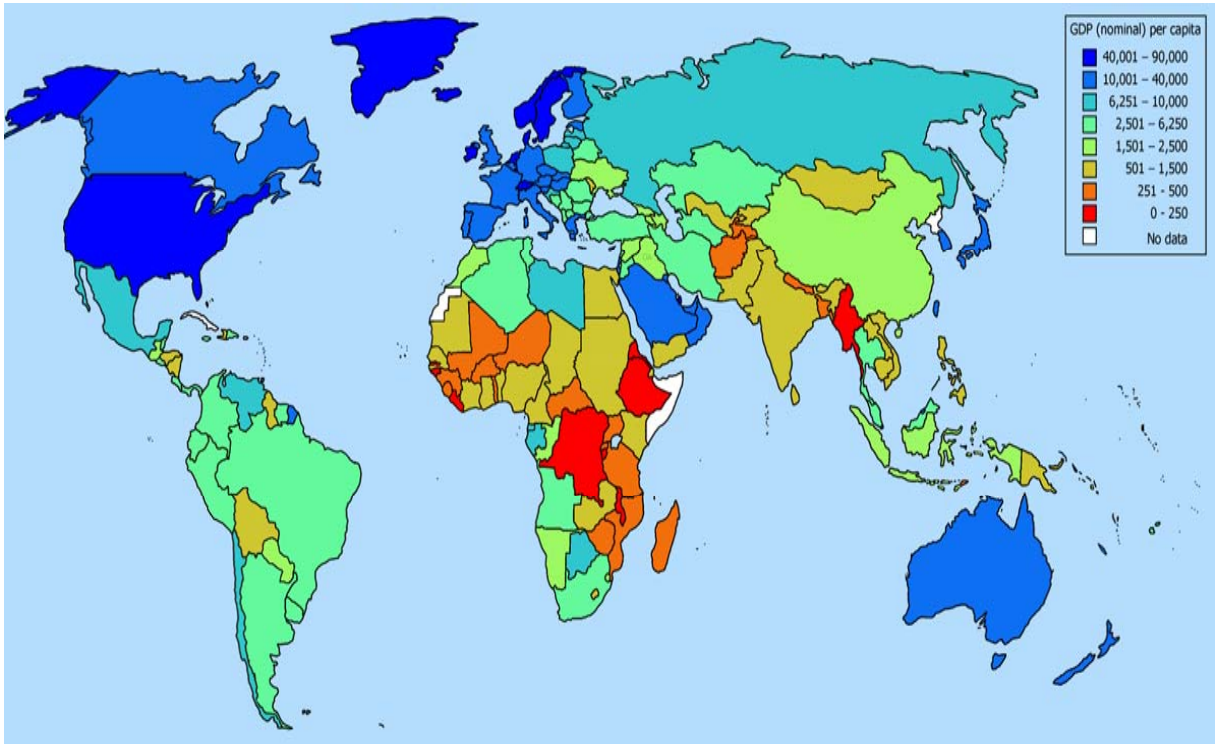
Devlopment Problem: Difference in Gross Domestic Product per Capita

GDP as an indication of the standard of living in an economy.

20% world population

gets 75% world income;

20% gets 2%



http://upload.wikimedia.org/wikipedia/commons/0/09/GDP_nominal_per_capita_world_map_IMF_figures_for_year_2006.png

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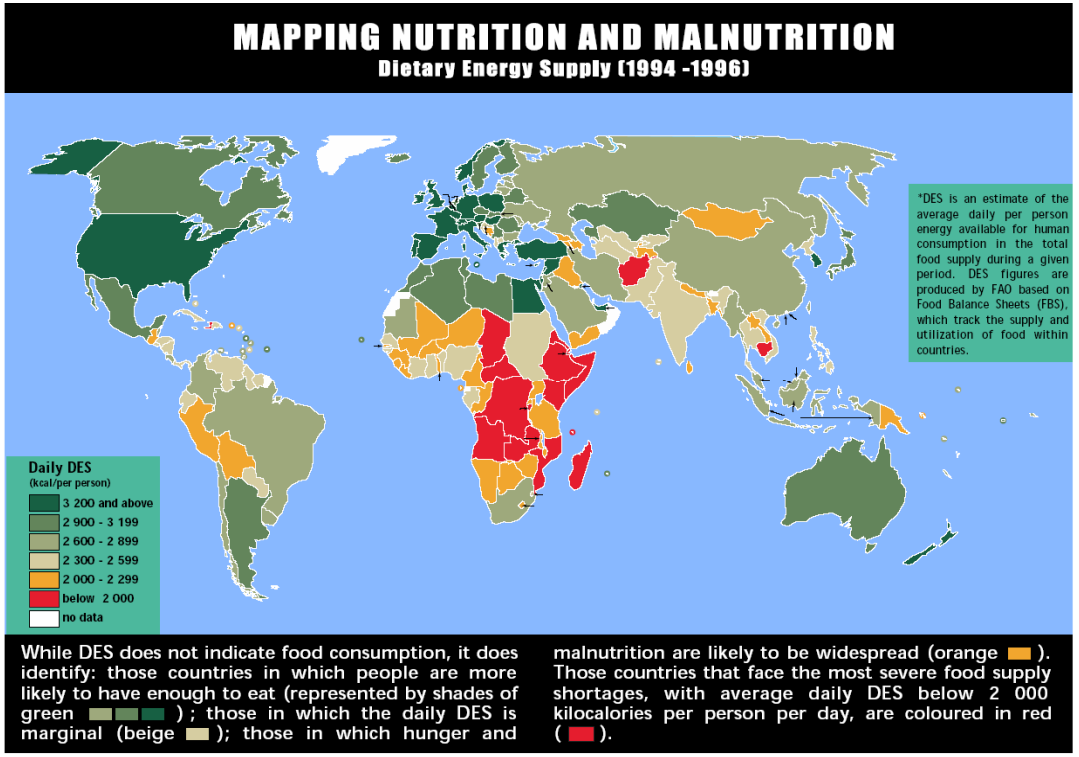
Food Inequality

73% world population receives 28% world cereal production

27% world population uses food made with 83% of the world quantity of artificial fertilizer



http://www.fao.org/NEWS/1998/981204-e.htm

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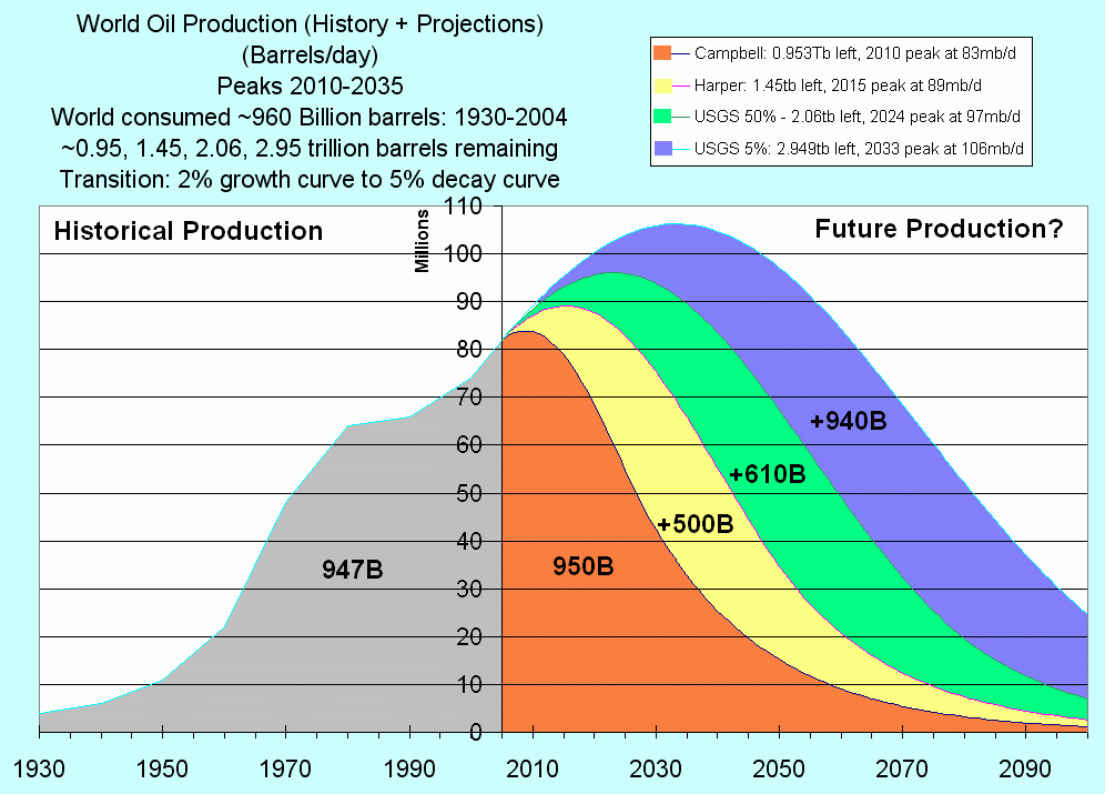
Hubbert Curve 'Peak oil'



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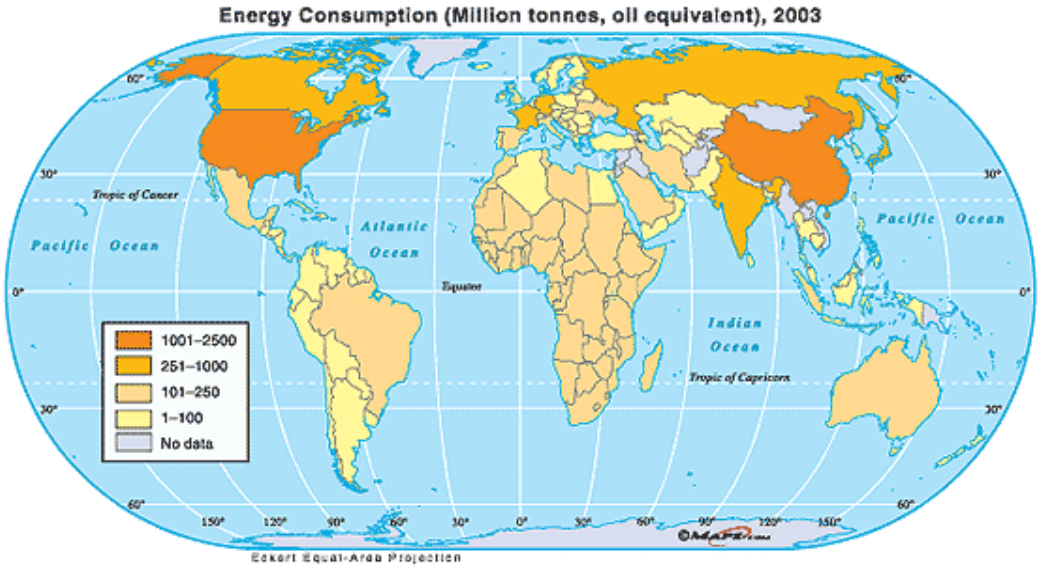
80-20 rule



http://media.maps.com/magellan/images/energycons.gif

20 % of the world population uses 80 % of the resources (fossil fuels, mineral and metal ores)

resource use rich countries 16 times higher than poor countries

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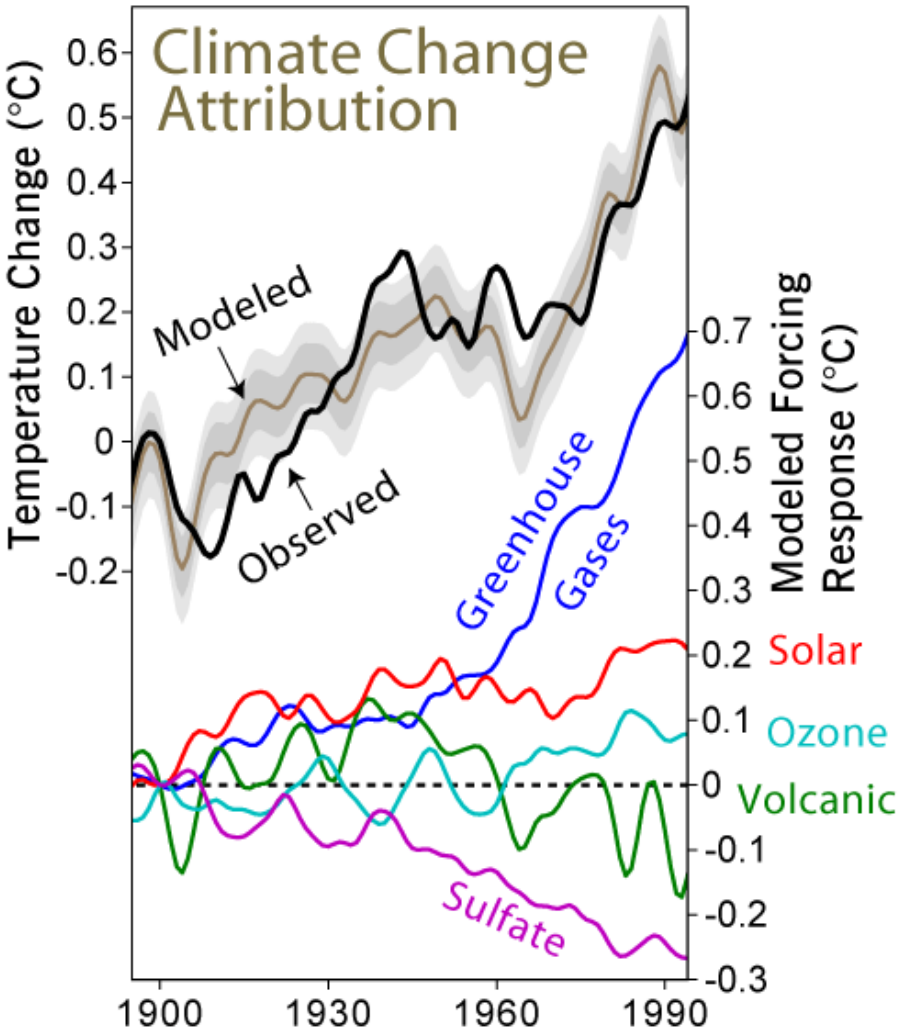
Emissions and Climate



http://en.wikipedia.org/wiki/Image:Climate_Change_Attribution.png

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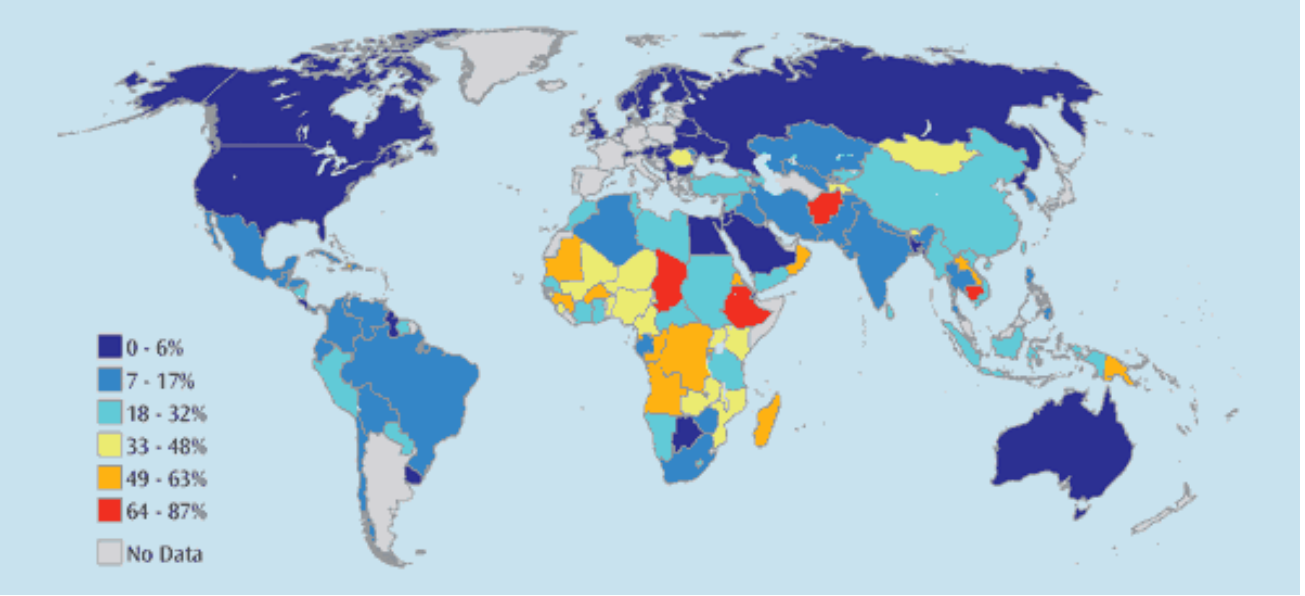
Safe Drinking Water

2/3 world population has no access to safe drinking water



http://www.theglobaleducationproject.org/earth/images/final-images/access-safe-water-map.gif

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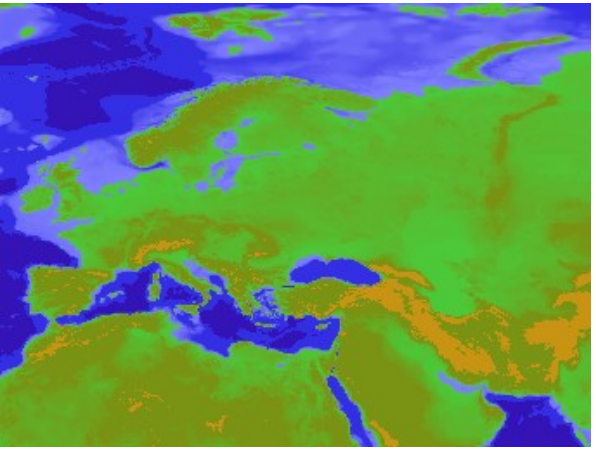
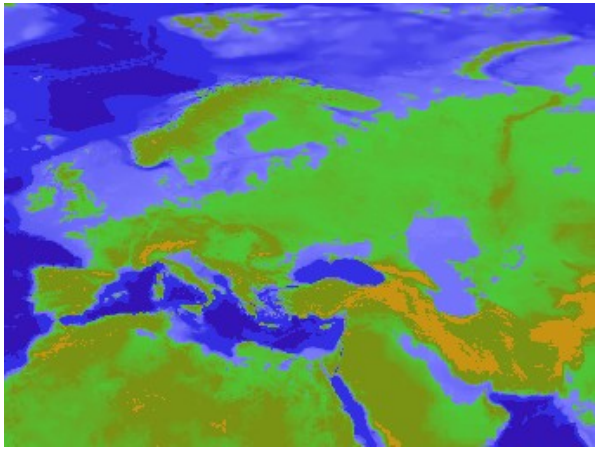
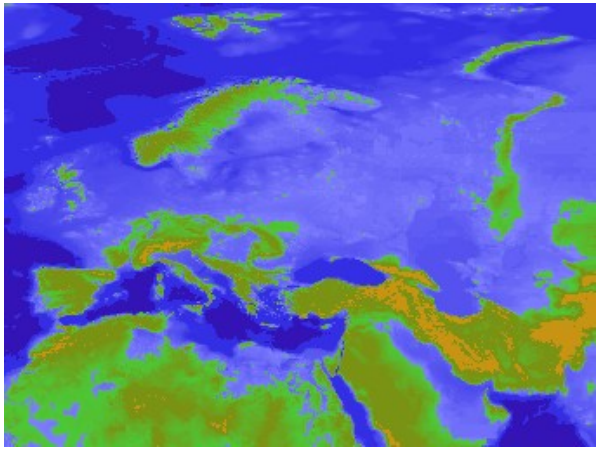
Sea Level Rise



- 50 meters



+50 meters



+250 meters

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Water Stress

Pressure on the quantity and quality of water resources resulting from competing and conflicting water uses

→ Intense droughts, serious water shortages, large-scale flooding and ecosystem damages

→ Social conflicts including war

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Water

2.5% of the Earth's water resources is freshwater; less than 1% can be used for human use

No substitute available for water

Access to water deteriorates because of excessive water use, pollution, population and economic growth: 600% increase over last 100 years

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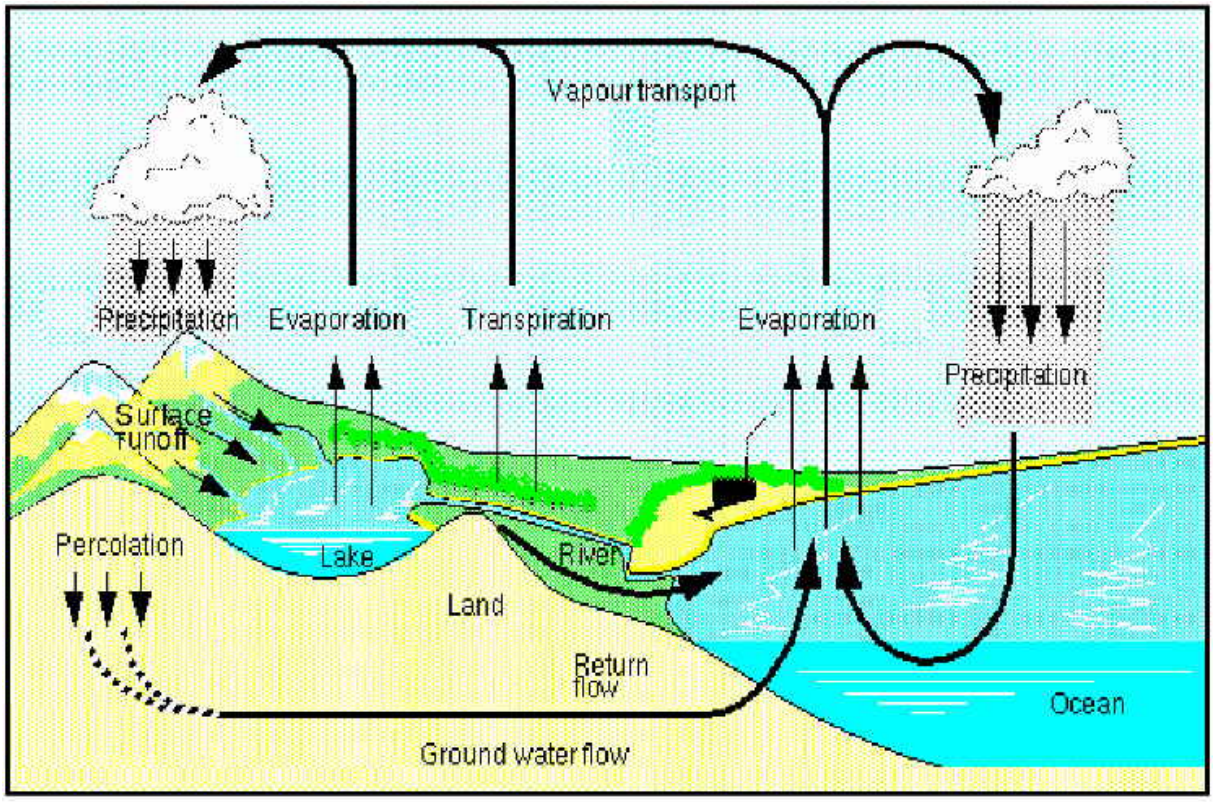
Hydrological Cycle



http://www.euwfd.com/assets/images/autogen/a_Image-050202.jpg

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Water Use

Households 10%

Industry 20%

- Hydropower and nuclear power 70%
- Industrial processes 30-40%
- Thermal generation 0.5-3%

Agriculture 70% → 120% increase over the next 20 years

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Water Distribution

First World 500 litres per person / per day

Third World 60-150 litres ppd

400 children die daily from water-born deceases

Sub-Saharan Africa 10-20 litres ppd

World population growth of 50% over the next 40 years mostly in Third World

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Water Problems

Too little or too much

Management problem

Global environmental degradation

- Nature cause → adaptation
- Human induced → sense of urgency to eliminate causes

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Sustainability: 10 Key Notions

1. Brundtland report
2. North South (and East West) relations
3. IPAT formula
4. 3P's people, planet, profit
5. Sustainable entrepreneurship
6. Systems thinking
7. Limited resources and limited emissions
8. Tools: EIA (MER), MET, LCA, LIDS-wheel, EF, WF, VWT
9. The human factor: unintended use of technology, rebound effect, prisoners dilemma
10. Transition management

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Brundtland, Our Common Future 1987 (WCED)

Sustainable development meets the needs of the present without compromising the ability of future generations to meet their own needs

Point of departure, goal and assumption: socio-economic development, the rise of living standards, is necessary, should be realized and is possible

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North-South, East-West

Needs: overriding priority should be given to the **world's poor**

Inequity is the largest environmental problem in the world; it is also a fundamental development problem

'Justice sustainability': improving the living conditions of the poor

Sustainable solutions meet the demands of the poor or –
at least – do not harm the interests of the poor

Ethics on a base level; e.g. forced migrations could be unsustainable

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Brundtland

Sustainable development does not aim at reaching a fixed state of harmony; it is a continued **process of change** in which the exploitation of resources, the direction of investments, the orientation of technological development and institutional change are made consistent with future as well as present needs

Technology and organization could be 'reverse salients': **state of technology and organization** impose limits on the environment's ability to meet present and future needs

→ Technical and organizational innovations

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I = P x A x T

I = P x A x T

I = total **Impact** of mankind on the environment (resource use + pollution)

P = **Population**

A = **Affluence** (quantity of products / services consumed per person; e.g. GNP per capita)

T = **Technology-efficiency** /effectivity (environmental impact per unit of product / service; includes product re-use and organization of the production)

Source: Mulder, K. *Sustainable development for engineers: a handbook and resource guide.* Sheffield: Greenleaf, 2006

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Reducing the environmental impact by 50% in 2050

I = P x A x T

Population	1	1.5 - 2.5
Affluence	1	4 - 8
Environmental impact	1	0.5

Consequently, technology efficiency should be 12 to 40 times higher

N.B. Calculating with IPAT usually occurs with increases / decreases in percentages

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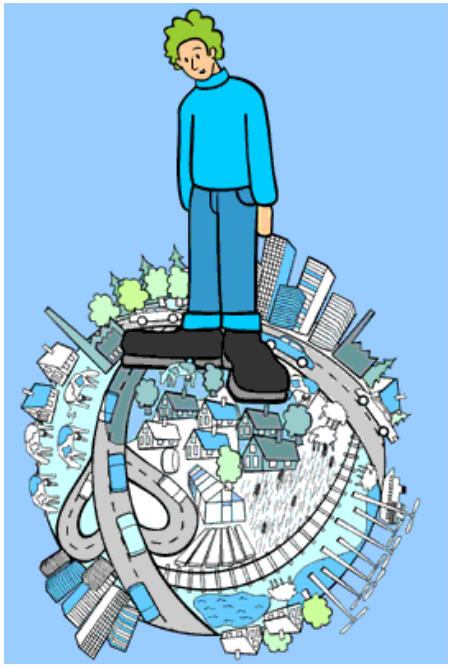
Ecological Footprint



Indicates *how much land and water area (in hectares) a population (or one person) requires* to produce the resources it/he consumes and to absorb its/his wastes under the prevailing technology

It is a specification of ‘IPAT-Impact’;
fair share is 1.8 hectares

Resource management tool:
Global Ecological Footprint Calculator

www.voetenbank.nl/home.htm

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Water Footprint

Total volume of water that is used to produce the goods and services consumed by the inhabitants of the nation (I in terms of water use)

The water footprint in cubic meter per year per capita:

China	700
Japan	1150
USA	2500
Fair share (1997)	1700

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Virtual Water

Virtual water is the volume of water required to produce a commodity or service; 90 % of the total water use.

To produce one kilogram of wheat we need about 1,000 litres of water, i.e. the virtual water of this kilogram of wheat is 1,000 litres.

For meat, we need about five to twenty times more. The production of one kilogram of beef requires 16 thousand litres of water.

To produce one cup of coffee we need 140 litres of water.

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Domestic water use?

Use of domestic water sources
vs
use of water outside the country borders

Only about 7% of the Chinese water footprint falls outside China.

Japan has about 65% of its total water footprint outside the borders of the country.

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How to Improve the Technology of Water Use

Increasing availability: extra wells, more rainwater harvesting or measures that reduce evaporation losses.

Increasing technical efficiency, e.g. improved farming or production methods.

Increasing management efficiency: optimal organisation of production (e.g. logistics) and ‘virtual water trade’.

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Using Virtual Water Trade

Efficient trade can be driven by comparative advantage: it is more efficient to produce goods that one can produce at lower cost and trade it for goods that are more costly for oneself, but (apparently) less for the other party.

For agriculture, in many countries the main contributor to its water demand, this could imply production for the market instead of for subsistence.

VWT is especially important for countries with scarce water resources, like Middle East countries

Source: VIRTUAL WATER IN THE VOLTA BASIN: Socio-technical modelling for efficient water use in Burkina Faso / P. Blinde, D. Busser, M., Korenstra, C. Meijer, S. Schwab, W. Ravesteijn, M. Smoorenburg and T. Van der Voorn

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Limited resources and limited emissions

Modern windmill in Sweden

http://upload.wikimedia.org/wikipedia/commons/5/56/Windmill_02.JPG

In general: less technology and more organization?

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Large Scale Interventions?

Nagarjuna dam

+ hydro-electric plant

India

http://frostatmidnite.files.wordpress.com/2007/08/300px-nagarjunasagardam.jpg

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3 P's

People, planet, *profit* (Shell) → entrepreneurship

People, planet, *prosperity* → societal management

Polluter pays principle

Prevention pays principle

4 P's: + politics → government steers or helps steering

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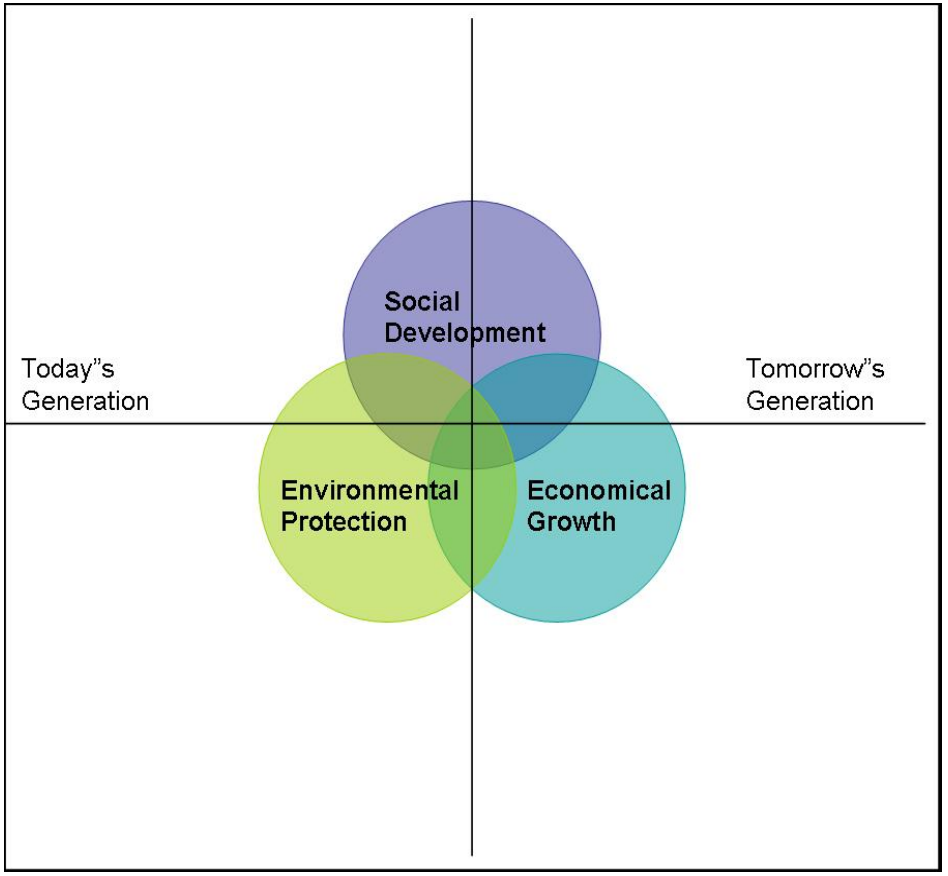
Three Dimension Concept

Rio Declaration
1992



www.unngocsd.org

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Sustainable Entrepreneurship

Creation of value in three fields: Profit, People and Planet; thus contributing to long term social welfare (SER 2000)

→ Corporate responsibility

- Entrepreneurship is necessary to sustain a society
- Sustainable enterpreneurship is a long term strategy
- Identifying opportunities, assessing risks and taking the smartest action

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Whole System Design

Optimizing not just parts, but entire systems

Designers and decision-makers **too often define problems narrowly,** without identifying their causes or connections. This merely shifts or multiplies problems.

Systems thinking—the opposite of that des-integrated approach—typically reveals lasting, elegantly frugal solutions with multiple benefits, which enable us to transcend ideological battles and unite all parties around shared goals.

www.rmi.org
(Rocky Mountains Institute)

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Socio Technical System

Artefacts/technical systems + actors + institutions

Boundary: systems contain everything which is being controlled by a central actor (management) / specific technological (engineers') regime

Environment: other systems, society (actors and institutions not directly involved), natural environment

E.g. river engineering system

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Engineerial irrigation development in Indonesia

	Stage	Actor/(s)	Regime	Mechanism
1832	Invention & Introduction	Engineers, civil & servants	Irrigation for exploitation	
-1885	Pioneering works, research & preparation	Engineers & civil servants	Irrigation for exploitation and welfare	Separate works: reverse salient
-1900	Growth	Engineers	Same	Load factor

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Engineerial irrigation development in Indonesia

-1920	Innovations	Engineers, civil servants & agriculturalists	Irrigation for Welfare	Momentum Large-scale management: reverse salient
-1940	Consolidation	Same	Irrigation for welfare	Load factor
	Transfer	Engineers		

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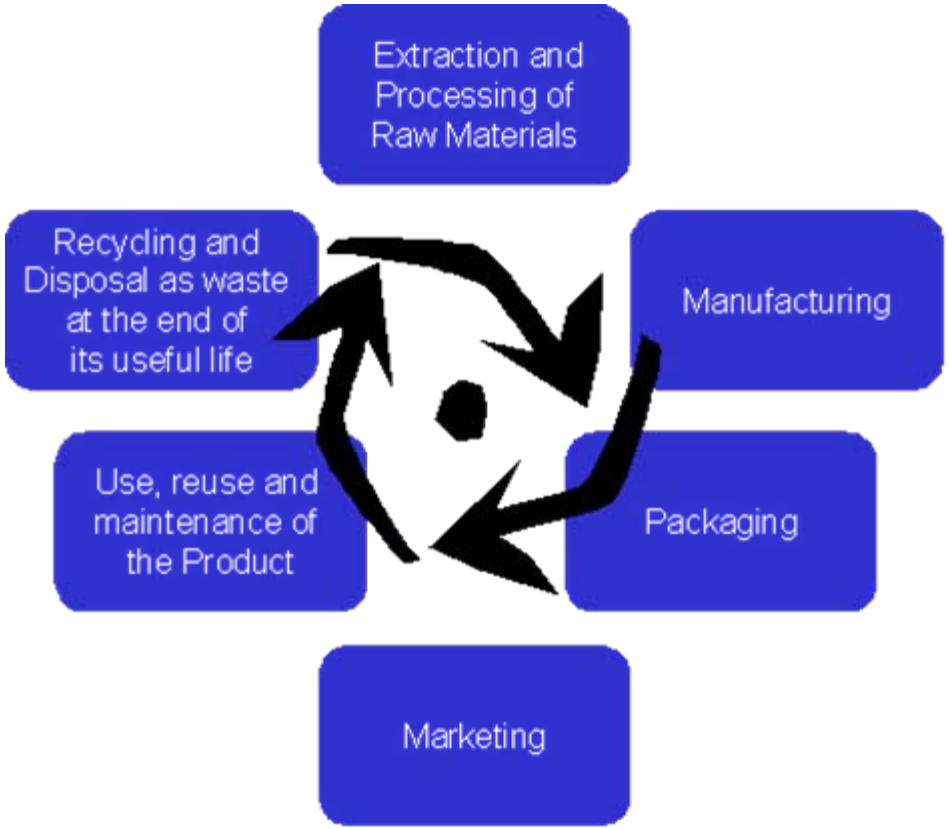
Life Cycle Assessment

Assessment of the environmental impact of a given product or service during its lifespan



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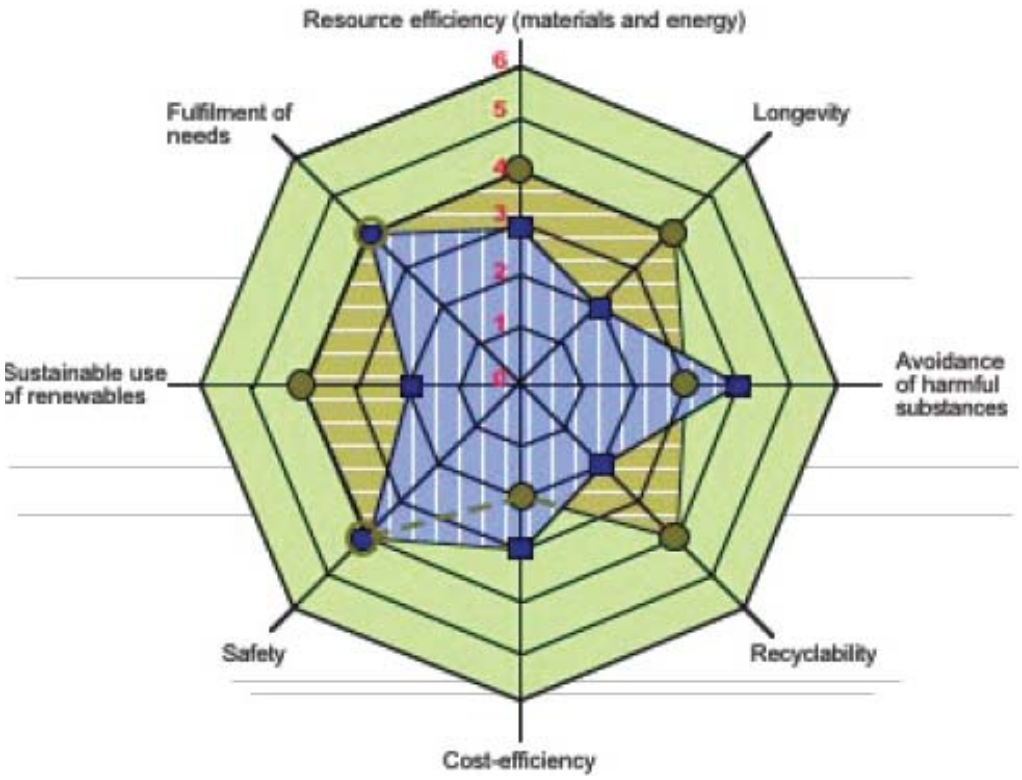
Life Design Strategies



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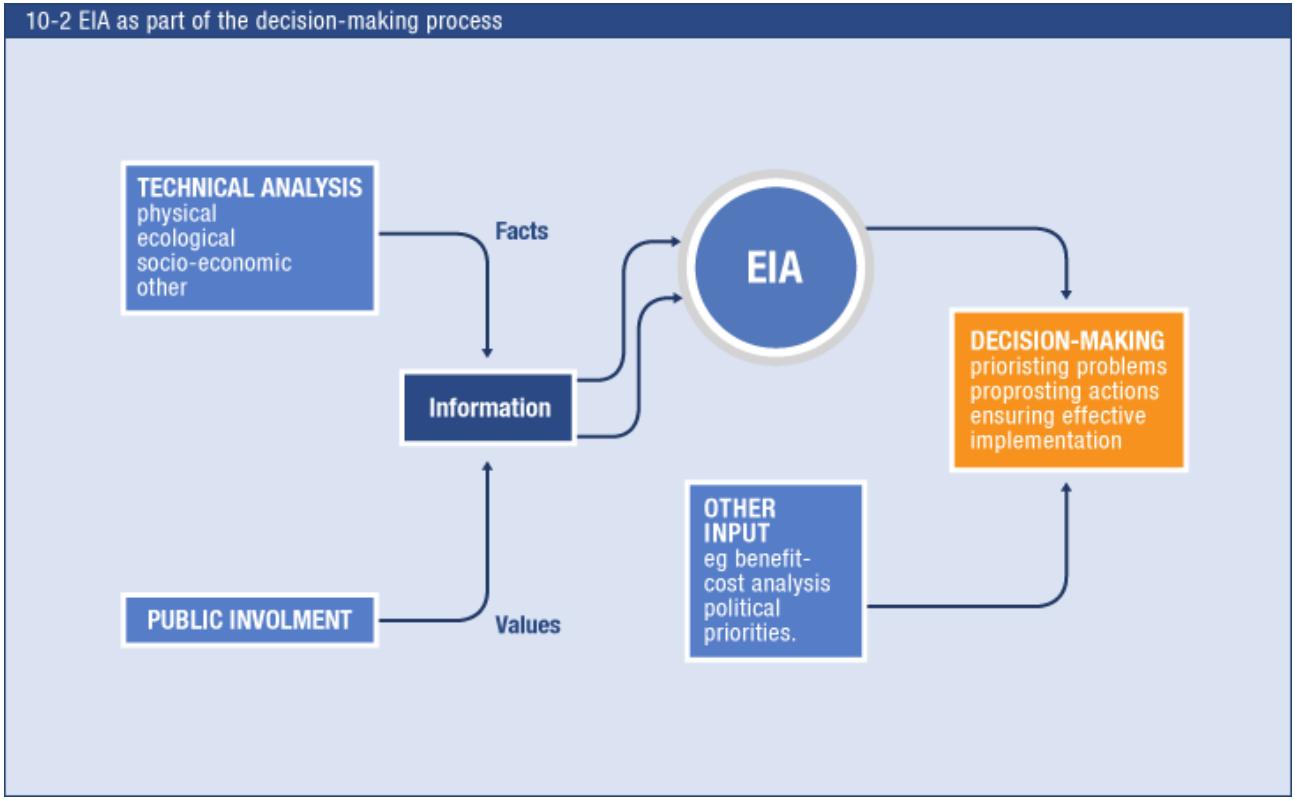
Environmental Impact Analysis



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Materials Energy and Toxicity Matrix

	Materials	Energy	Toxicity
Production	Plastics, metal for wiring and element	Electricity, gas, fuel oil....	Pollution from metals extraction and refining. Pollution from oil extraction and from petrochemical plants. Pollution from energy sources.
Use	Water	Electricity	Pollution from power generation and distribution (SO2, NO2, CO2 etc...)
Disposal		Diesel (fuel for transport to tip)	Possible pollution associated with landfills in general

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Unintended Use of Technology

E.g.

- use of internet for a variety of purpose, including coordinating fights between soccer fans or protest campaigns
- 9/11 (2001) use of civil airplanes for death and destruction
- using irrigation canals for washing

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Rebound Effect

Increase in consumption as a result of an increase in efficiency, e.g.

- increase in distance driven resulting from improved fuel economy of cars
- growth in garden lighting after introduction energy saving compact fluorescent lamp

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Prisoners Dilemma

	Prisoner B Stays Silent	**Prisoner B Betrays**
Prisoner A Stays Silent	Each serves six months	Prisoner A serves ten years Prisoner B goes free
Prisoner A Betrays	Prisoner A goes free Prisoner B serves ten years	Each serves five years

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Transition Management

Transition to sustainable development is a complex process of technology development and societal change; new socio-technical system, new technological regime

Process is largely autonomous; a variety of actors has influence, including the government

Evolutionary steering: adjusting processes

Creating conditions under which societal innovation can take place, esp by the government influenced by ‘conscious actors’

Source: Jan Rotmans / Drift

Group Assignment

Make a sustainability analysis of you problem and solutions.

Use (one of) the tools from this lecture.