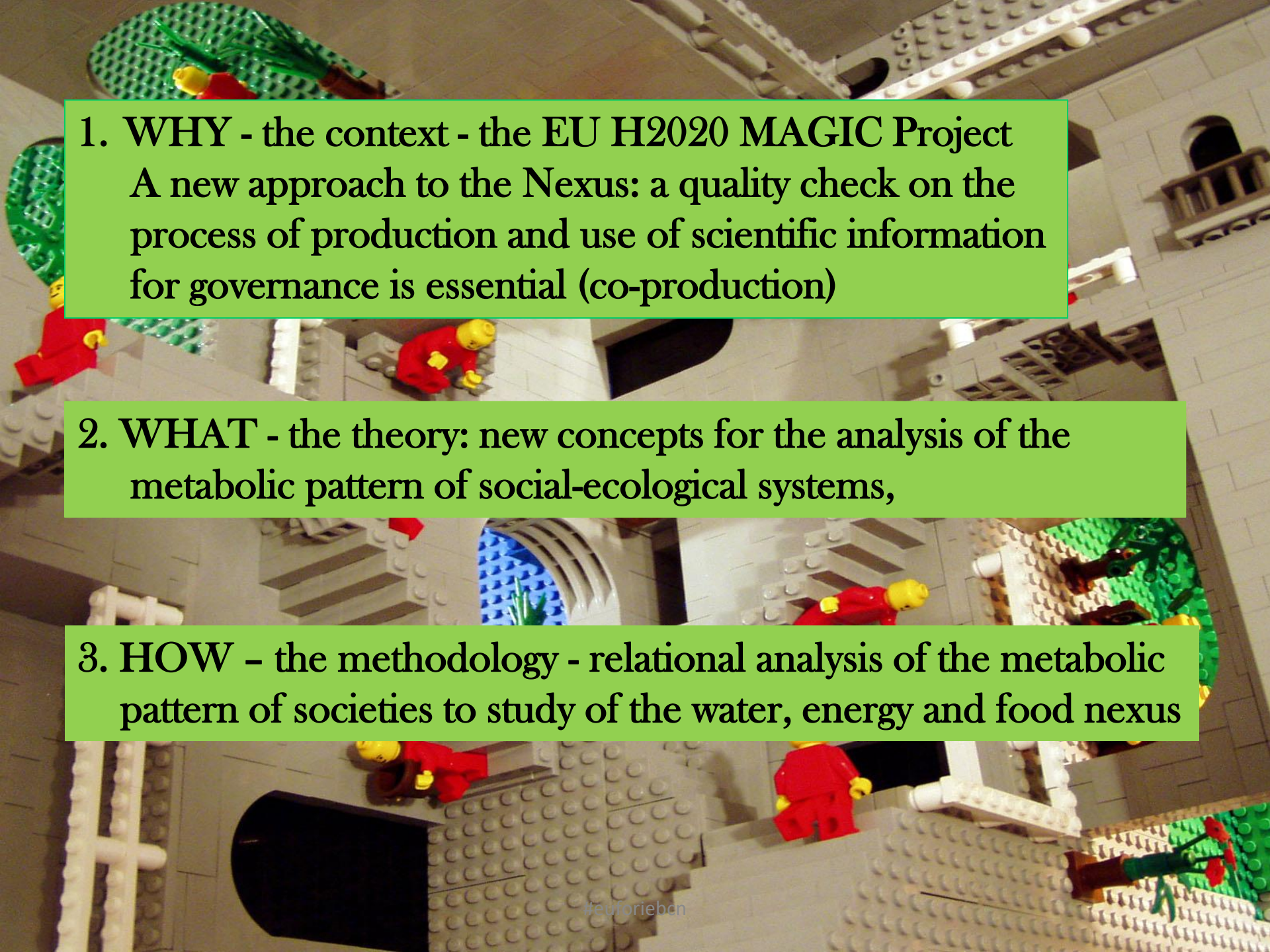
ICREA Mario GIAMPIETRO

icta Institute of Environmental Science and Technology • UAB
Research Group on Integrated Assessment

Implementing more effective tools to analyze the sustainability of social-ecological systems in relation to the water-energy-food nexus



1. WHY - the context - the EU H2020 MAGIC Project
   A new approach to the Nexus: a quality check on the process of production and use of scientific information for governance is essential (co-production)

2. WHAT - the theory: new concepts for the analysis of the metabolic pattern of social-ecological systems,

3. HOW – the methodology - relational analysis of the metabolic pattern of societies to study of the water, energy and food nexus

The new approach to the nexus proposed by the MAGIC project – co-production of knowledge about the nexus.

It implies:

1. a quality check on the pre-analytical choice of narratives; and
2. a quality check on the analytical choice of formal representations used for the integrated assessment

The nexus as a biophysical problem

nature climate change

PERSPECTIVE

PUBLISHED ONLINE: 25 JUNE 2013 | DOI: 10.1038/NCLIMATE1789

Integrated analysis of climate change, land-use, energy and water strategies

Mark Howells[1]*, Sebastian Hermann[1]*, Manuel Welsch[1], Morgan Bazilian[1], Rebecka Segerström[1], Thomas Alfstad[2], Dolf Gielen[3], Holger Rogner[4], Guenther Fischer[4], Harrij van Velthuizen[4], David Wiberg[4], Charles Young[5], R. Alexander Roehrl[6], Alexander Mueller[7], Pasquale Steduto[7] and Indoomatee Ramma[8]

Contents lists available a

Journal of Hydrolc
Studie

journal homepage: www.elsevier.com/locate/ejrh

A key element in management of the land, water and energy systems is that they are inextricably linked. Agriculture alone

A review of the current state of research on the water, energy, and food nexus

Aiko Endo[a,*], Izumi Tsurita[b], Kimberly Burnett[c], Pedcris M. Orencio[d]

[a] Research Department, Research Institute for Humanity and Nature, 457-4 Kamigamo-motoyama, Kita-ku, Kyoto 603-8047, Japan
[b] Department of Cultural Anthropology, Graduate School of Arts and Sciences, The University of Tokyo, 3-8-1 Komaba, Meguro-ku, Tokyo 153-8902, Japan
[c] University of Hawaii Economic Research Organization, University of Hawaii at Manoa, 2424 Maile Way Saunders Hall 540 Honolulu, HI 96822, USA
[d] Catholic Relief Service Philippines (Manila Office) Urban Disaster Risk Reduction Department, CBCP Building 470 Gen Luna Street, Intramuros, Manila 1002, Philippines

water, energy and food resources, presenting communities with an increasing number of trade offs and potential con
among these resources which have complex interactions. For example, demands for water, energy and food are estimat
way. In addition, the relationships of all three resources such as water–energy, water–food and/or water–energy–
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A key element in management of the land, water and energy systems is that they are inextricably linked. Agriculture alone

g the Nexus. Background Paper for the Bonn2011
ecurity Nexus. Stockholm Environment Institute,

urity Nexus. Stockholm Environment Institute,

products. The nexus approach can boost this potential by addressing externalities

For example, nexus thinking would

ergy intensity of desalination (also

l electricity'), or water demands in re-

newable energy production (e.g. biofuels and some hydropower schemes) or water demands of affores-

tation for carbon storage. Also, action to avoid or

nberly Burnett[c], Pedcris M. Orer

y and Nature, 457-4 Kamigamo-motoyama, Kita-ku, Ky

l of Arts and Sciences, The University of Tokyo, 3-8-1 Ko

newable energy production (e.g. biofuels and some hydropower schemes) or water demands of affores-

torage. Also, action to avoid or

otential conflicts are estimated to

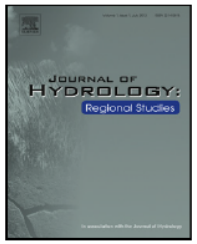
er–energy–food

The nexus as a scientific challenge

Contents lists available at ScienceDirect

Journal of Hydrology: Regional Studies

journal homepage: www.elsevier.com/locate/ejrh



A review of the current state of research on the water, energy, and food nexus

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HI 96822, USA
[d] Catholic Relief Service Philippines (Manila Office) Urban Disaster Risk Reduction Department, CBCP Building 4
Intramuros, Manila 1002, Philippines

Furthermore, there seems to be very few reviews on the nexus, as the concept consists of multiple disciplines, as well as interdisciplinary and transdisciplinary research results.

United Nations. However, the WEFN is so expansive and its connections so important, that detailed process systems models for it do not yet exist at a level satisfactory for important decisions. While PSE has largely applied to industrial processes and systems, the

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PSE has largely applied to industrial processes and systems, the

The nexus as a problem of governance

J Environ Stud Sci (2016) 6:192–199
DOI 10.1007/s13412-016-0378-5

CrossMark

Present and future of the water-energy-food nexus and the role of the community of practice

Rabi H. Mohtar[1] · Richard Lawford[2]

[a]United Na

Framing the water-energy nexus for

enda

understand and manage "the complex interactions between water, energy, and food" (FAO 2014a, b). This nexus serves *

to balance the different goals and interests of the parties using

WEF reso

i2, A- 1400, Vienna, Austria

J Environ Stud Sci (2016) 6:192–199
DOI 10.1007/s13412-016-0378-5

CrossMark

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Sustainable development and
A perspective on livelihoods

Eloise M. Biggs[a,*], Eleanor Bruce[b], B
Natasha Pauli[c], Kellie McNeill[d], Andre
Billy Haworth[b], Stephanie Duce[b], Yuk

[a] Geography and Environment, University of Southampton, Univer
[b] Geocoastal Research Group, School of Geosciences, University of
[c] School of Earth and Environment, University of Western Australi
[d] School of Social Sciences, University of Auckland, Private Bag 92
[e] Department of Environmental Sciences, University of Sydney, Suite
2015, NSW, Australia
[f] International Water Management Institute, 127 Sunil Mawatha,
[g] Asia-Pacific Network for Global Change Research, East Building

Increasingly, the international de
useful as a major policy and manage
global acceptance of its value in leve
Goals (SDGs) and even for their sub
targets and indicators; to support the
between competing needs; to make
coordination between international development partners; and to reduce the risk that actions to achieve SDG targets could later undermine one another.

land–water–energ
is advocated as an advance on current and often sector-specific governance of natural resource use.

is

nexus is

surge in

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on goals,

resources

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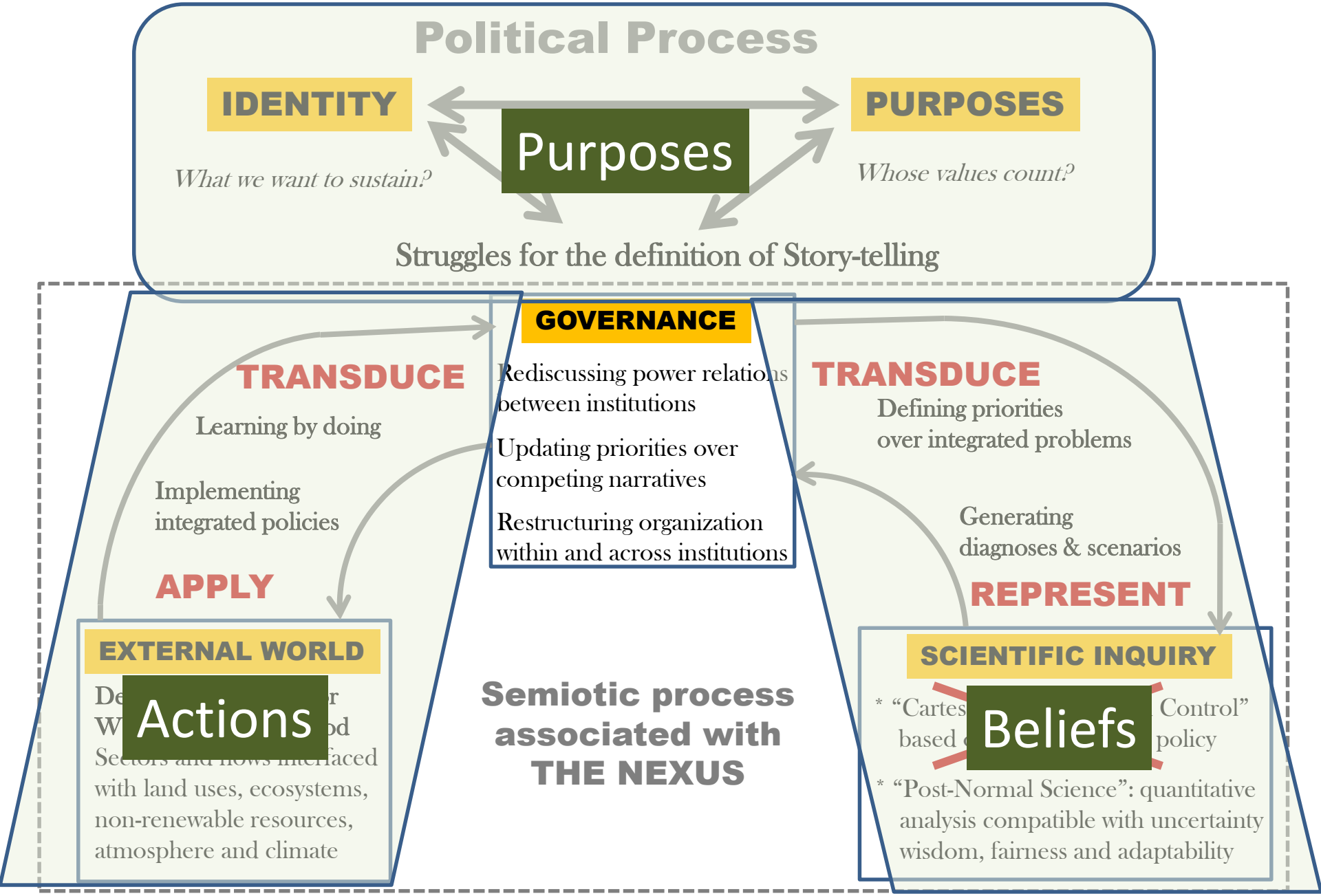
G targets

Present and future of the water-energy-food nexus and the role of the community of practice

Rabi H. Mohtar[1] · Richard Lawford[2]

understand and manage "the complex interactions between water, energy, and food" (FAO 2014a, b). This nexus serves to balance the different goals and interests of the parties using WEF resources, while maintaining the ecosystem integrity



What is generating the entanglement

Handling non-equivalent descriptive domains, non-reducible models and large doses of uncertainty

The NEXUS represents a challenge to the conventional system of governance because it requires considering simultaneously:

- different purposes (WHY do we need action);
- different narratives (HOW can we solve the problem), and
- different representations (WHAT is the problem and WHICH targets should be used)

When discussing the text of EU directives any decision about targets (WHAT to achieve) and problems to be solved (WHAT has to be fixed) reflects/depends on a given choice of narratives about of the issue (HOW to eliminate the problem).
But what if by eliminating a problem defined using a given narrative reflected in models referring to a given scale we will generate another Problem defined in a different narrative referring to a different scale?

Narratives as explanations of causality

Challenge #1

how to identify “the right” narrative
for “the right” story teller?

Event to be dealt with: THE POSSIBLE DEATH OF A PARTICULAR INDIVIDUAL

NARRATIVE	Story-Teller
EXPLANATION 1 --> “no oxygen supply in the brain” *Space-time scale*: VERY SMALL *Example*: EMERGENCY ROOM	**Doctor in the emergency room**
EXPLANATION 2 --> “affected by lung canc *Space-time scale*: SMALL *Example*: MEDICA	**Pharmaceutical researcher**
EXPLANATION *Space-tim* *Example*: MEETING AT HEALTH MINISTRY	**Tax expert**
EXPLANATION 4 --> “humans must die” *Space-time scale*: VERY LARGE *Example*: SUSTAINABILITY ISSUES	**Philosopher**

FOUR USEFUL STORY-TELLINGs

Event to be dealt with: THE POSSIBLE DEATH OF A PARTICULAR INDIVIDUAL

NARRATIVE	Story-Teller
EXPLANATION 1 --> “no oxygen supply in the brain” *Space-time scale*: VERY SMALL *Example*: EMERGENCY ROOM	**expert**
EXPLANATION 2 --> “affected by lung ca *Space-time scale*: SMALL *Example*: MED NT	**Philosopher**
EXPLANATI ividual is a heavy smoker” *Space* UM *Example*: MEETING AT HEALTH MINISTRY	**Doctor in the emergency room**
EXPLANATION 4 --> “humans must die” *Space-time scale*: VERY LARGE *Example*: SUSTAINABILITY ISSUES	**Pharmaceutical researcher**

FOUR USELESS STORY-TELLINGs

Scale as a lens through which observe the world

Challenge #2

how to identify “the right” scale
for “the right” purpose?

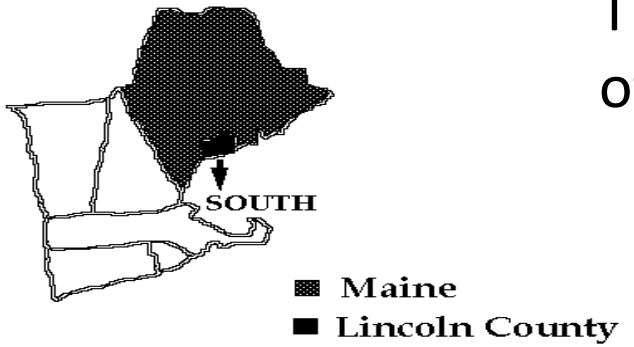
The issue of scale

WHY you have chosen HOW to see WHAT you see . . .

Right perce n when checking the local time before calling Los Angeles

Hierarchical Levels:

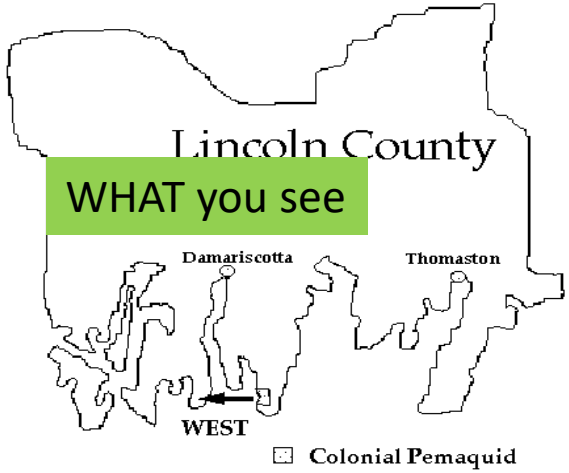
Federation (whole country)/State



Hierarchical Levels:

State/County

HOW to see



WHAT you see

HOW to see

Hierarchical Levels:

County/Village

WHAT you see

Right perception when looking for a house with a sunset view

WHY you have chosen HOW to see WHAT you see . . .

Hierarchical Levels:

Village/specific beach

If you want to solve this problem . . .

Right narrative when checking the local time before calling Los Angeles

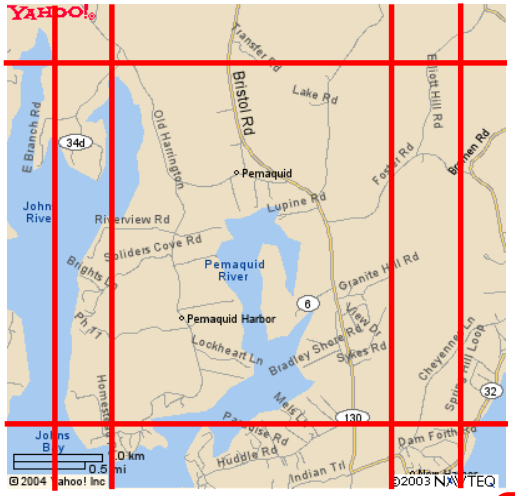
Hierarchical Levels:

Federation (whole country)/State

Perception/Representation of space = globe

You see a space which is the surface of a sphere

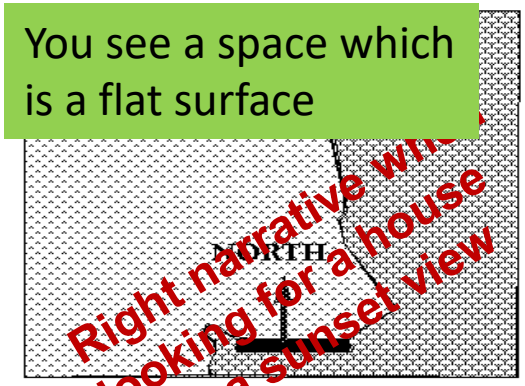
The validity of "evidence based policy" depends on the choice of story-telling



Perception/Representation of space = plane

If you want to solve this problema

You see a space which is a flat surface



Right narrative when looking for a house with a sunset view

Colonial Pemaquid

Polly's beach

Hierarchical Levels:

Village/specific beach

Which one of these two cars will generate more harm to the atmosphere in terms of emissions?

Willliam Stanley Jevons
The coal question - 1865

The Jevons' Paradox

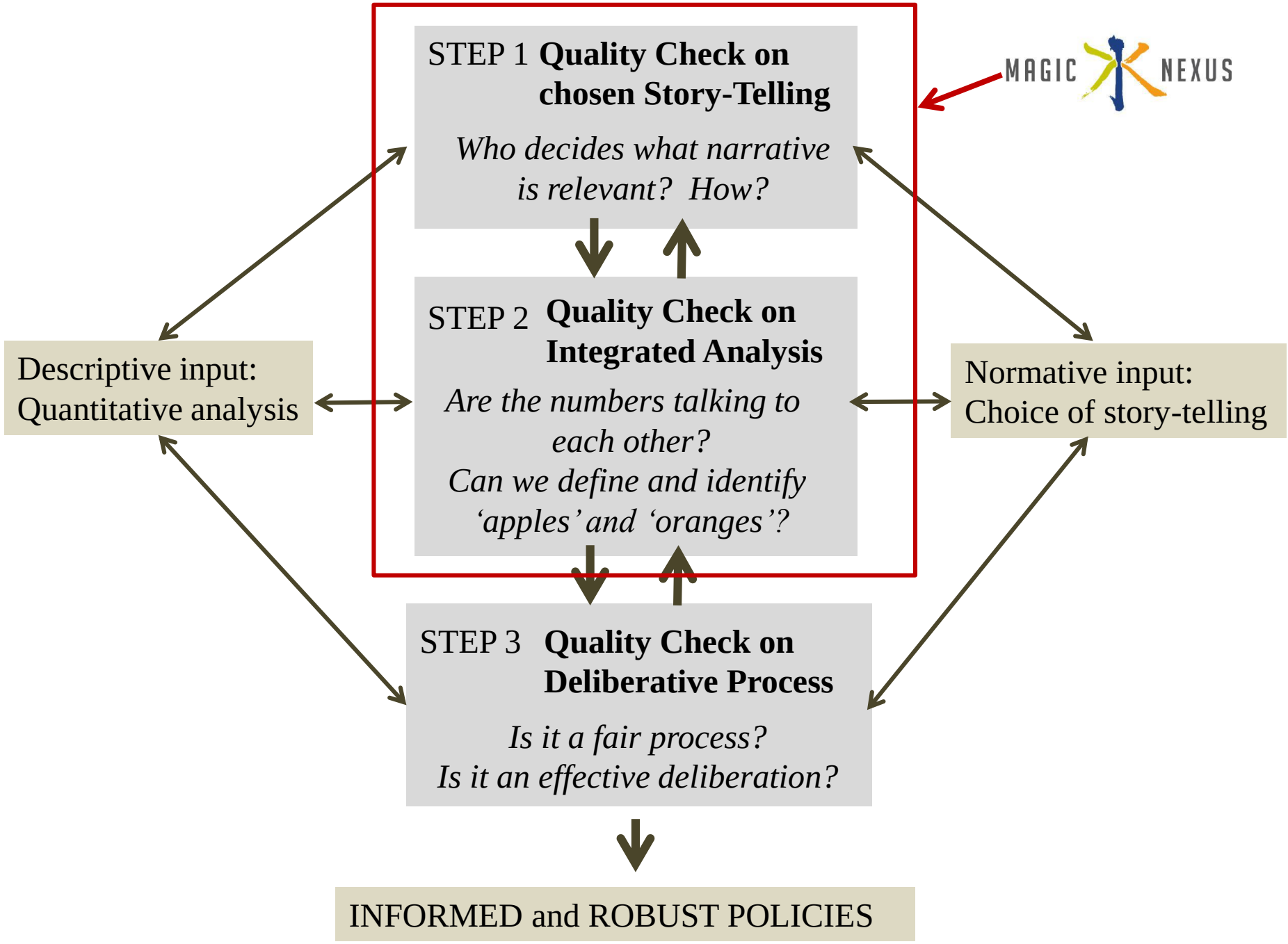
More efficient cars will imply more consumption of gasoline!

HUMMER: 45,000 US$
Fuel economy: 6 km/liter

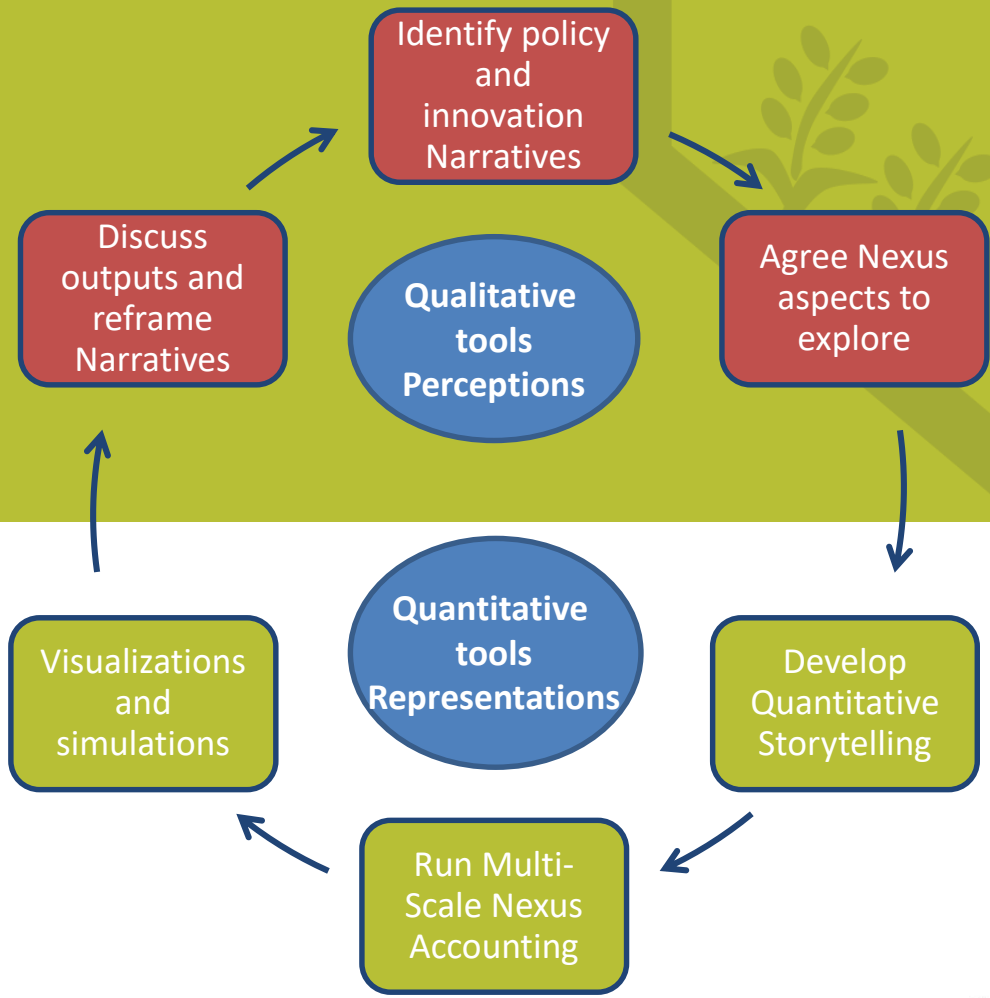
Out of production since May 2010

SMART: 10,000 US$
Fuel economy: 14 km/liter

More than 1.6 million and counting


STEP 1 Quality Check on chosen Story-Telling
Who decides what narrative is relevant? How?
STEP 2 Quality Check on Integrated Analysis
Are the numbers talking to each other?
Can we define and identify 'apples' and 'oranges'?
STEP 3 Quality Check on Deliberative Process
Is it a fair process?
Is it an effective deliberation?
Descriptive input: Quantitative analysis
Normative input: Choice of story-telling
INFORMED and ROBUST POLICIES
MAGIC NEXUS

The challenge for MAGIC: would it be possible to move from “policy based evidence” to “quantitative story-telling”?



2. WHAT - the theory: new concepts for the analysis of the metabolic pattern of social-ecological systems,

Definition of a societal-economic system

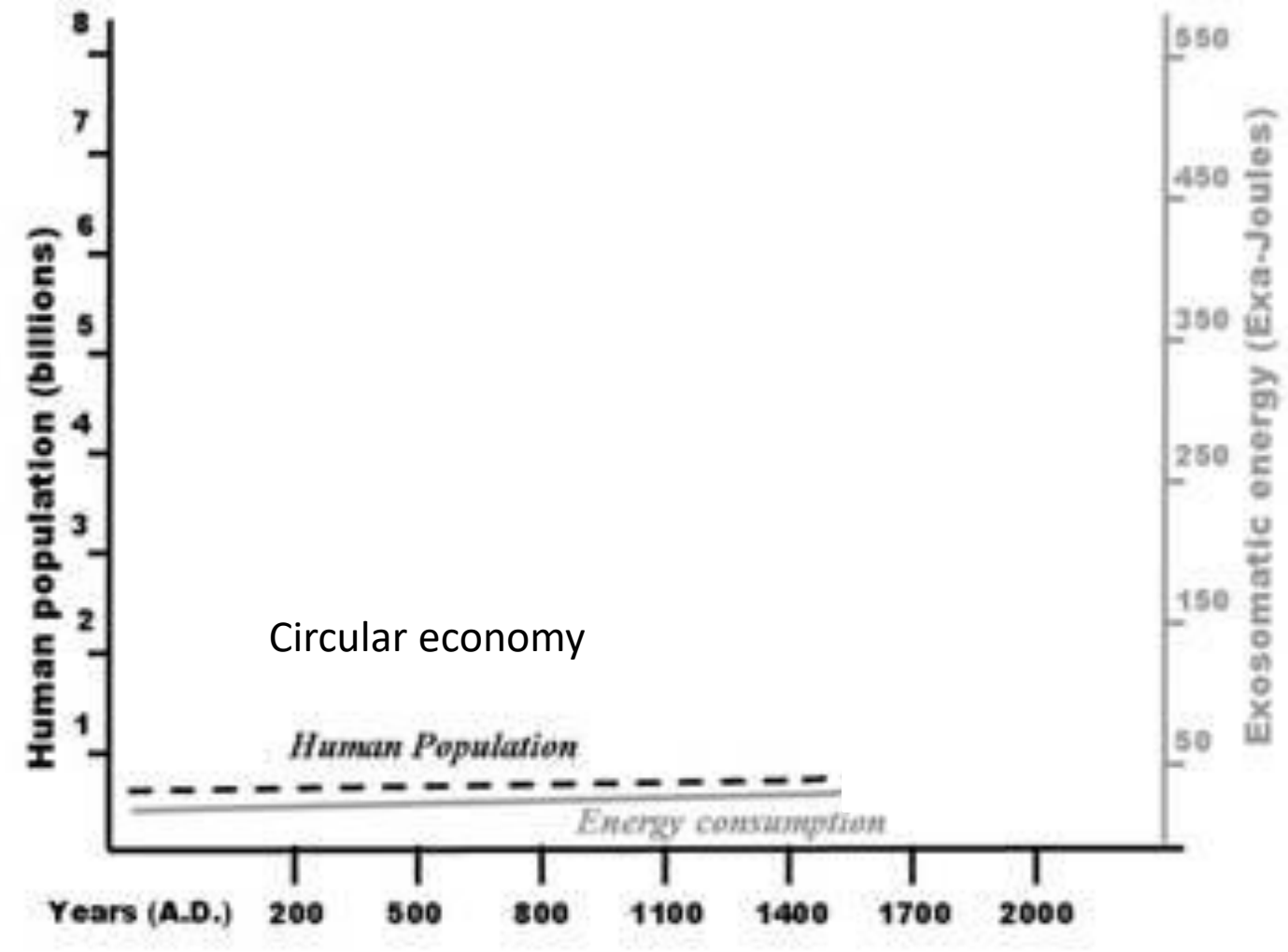
A set of functional and structural components operating in the technosphere (processes under human control) within a prescribed boundary. The components are linked through a pattern of expected interactions determining a dynamic interdependence over their identities.

The goal of a societal-economic system is that of reproducing and maintaining its identity while learning how to become more adaptable.

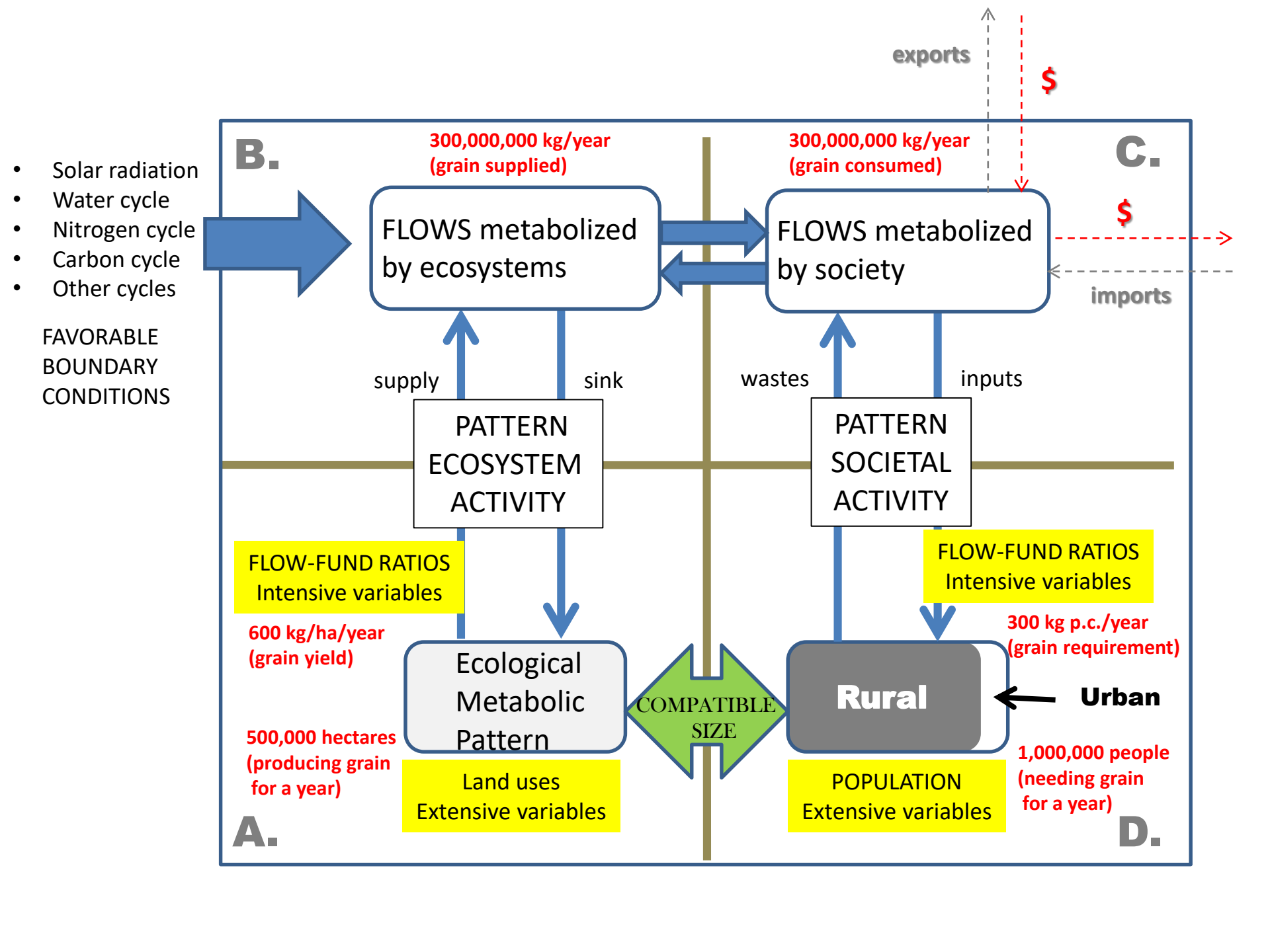
Definition of a societal-ecological system

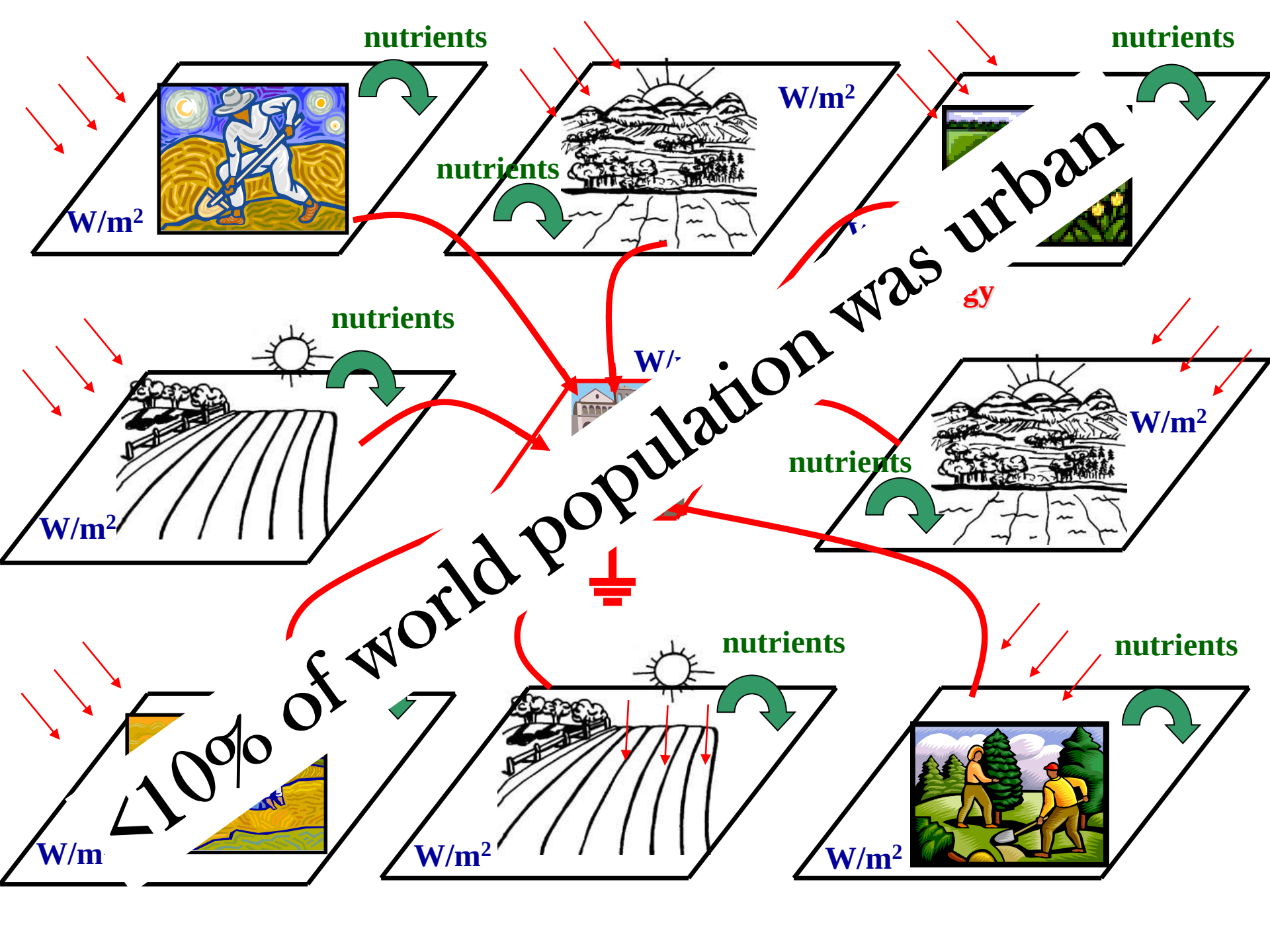
A set of functional and structural components operating both in the *technosphere* (societal processes) and in the *biosphere* (ecological processes) within a prescribed boundary.

The components are linked because of a pattern of expected interactions determining a dynamic interdependence over their identities.



The situation in the past


exports
$
B.
300,000,000 kg/year
(grain supplied)
300,000,000 kg/year
(grain consumed)
C.
Solar radiation
Water cycle
Nitrogen cycle
Carbon cycle
Other cycles
FAVORABLE
BOUNDARY
CONDITIONS
FLOWS metabolized
by ecosystems
FLOWS metabolized
by society
$
imports
supply
sink
wastes
inputs
PATTERN
ECOSYSTEM
ACTIVITY
PATTERN
SOCIETAL
ACTIVITY
FLOW-FUND RATIOS
Intensive variables
FLOW-FUND RATIOS
Intensive variables
600 kg/ha/year
(grain yield)
300 kg p.c./year
(grain requirement)
Ecological
Metabolic
Pattern
COMPATIBLE
SIZE
Rural
Urban
500,000 hectares
(producing grain
for a year)
1,000,000 people
(needing grain
for a year)
Land uses
Extensive variables
POPULATION
Extensive variables
A.
D.


nutrients
W/m²
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nutrients
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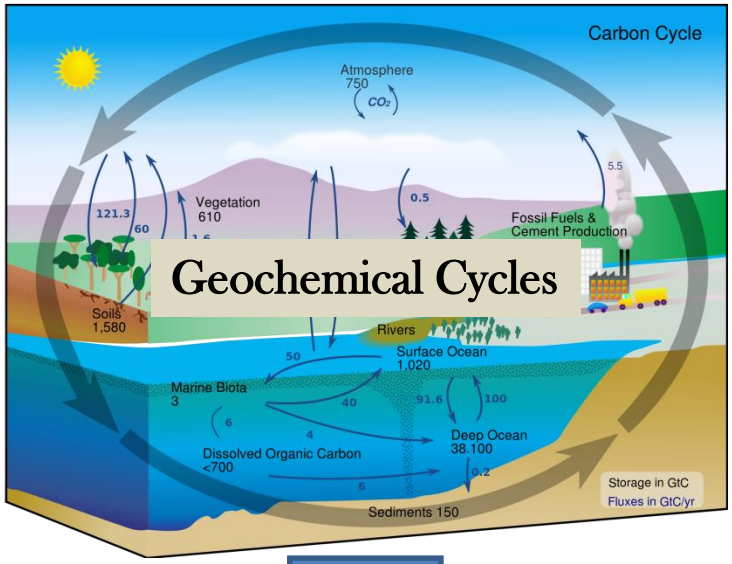
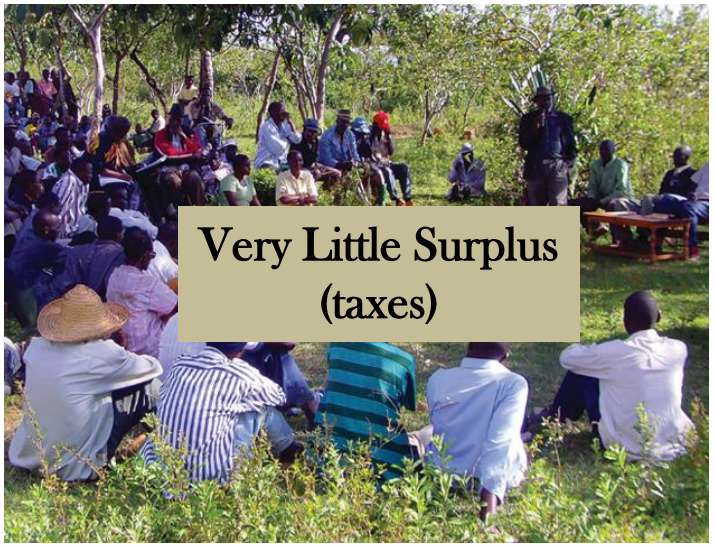
nutrients
W/m²
<10% of world population was urban
nutrients
W/m²
nutrients
W/m²



Geochemical Cycles



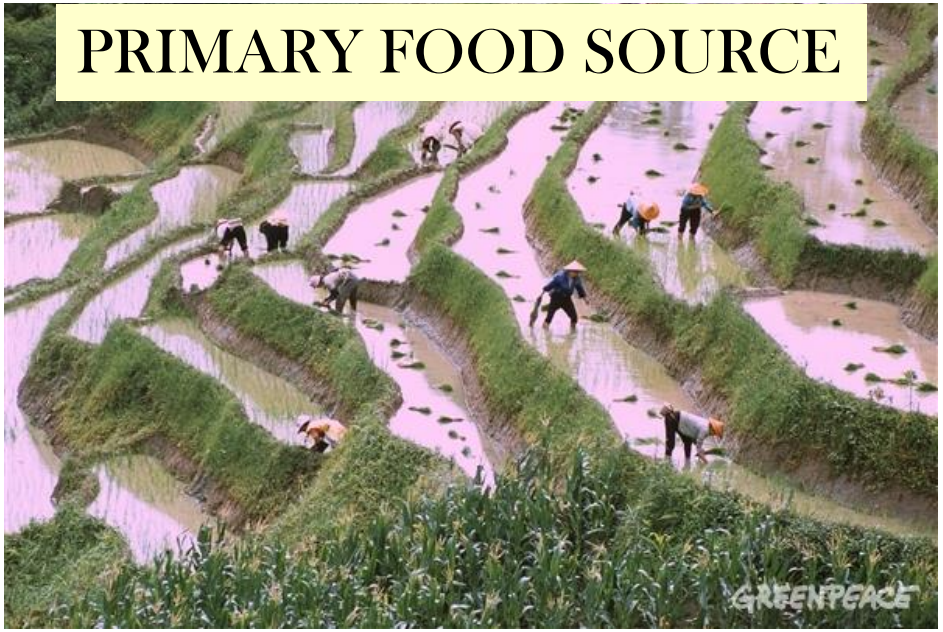
Very Little Surplus
(taxes)

Key elements to
be reproduced

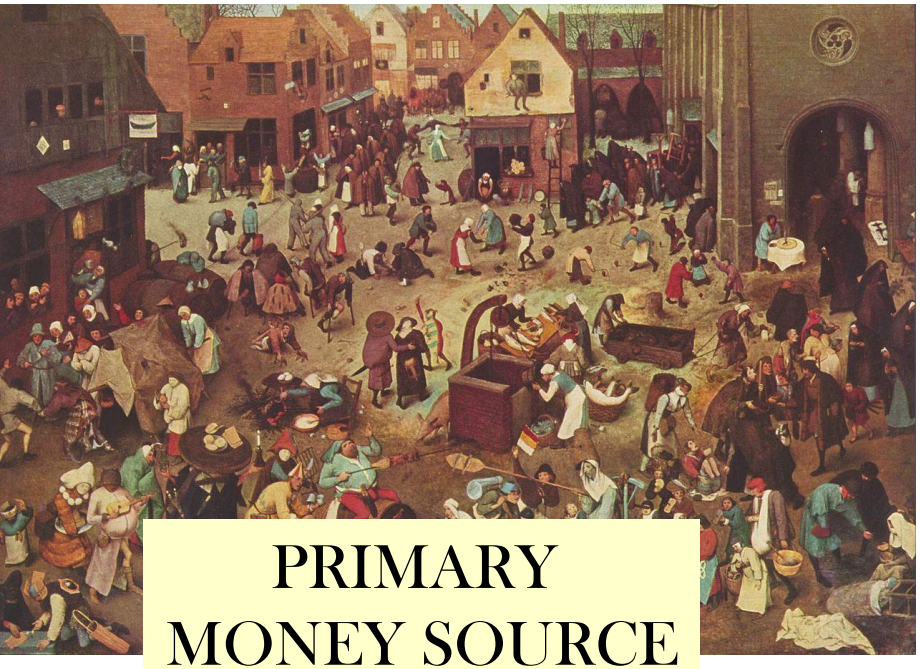
Agro-ecosystems

Rural Communities

The social perception of primary sources of relevant flows **before the industrial revolution**

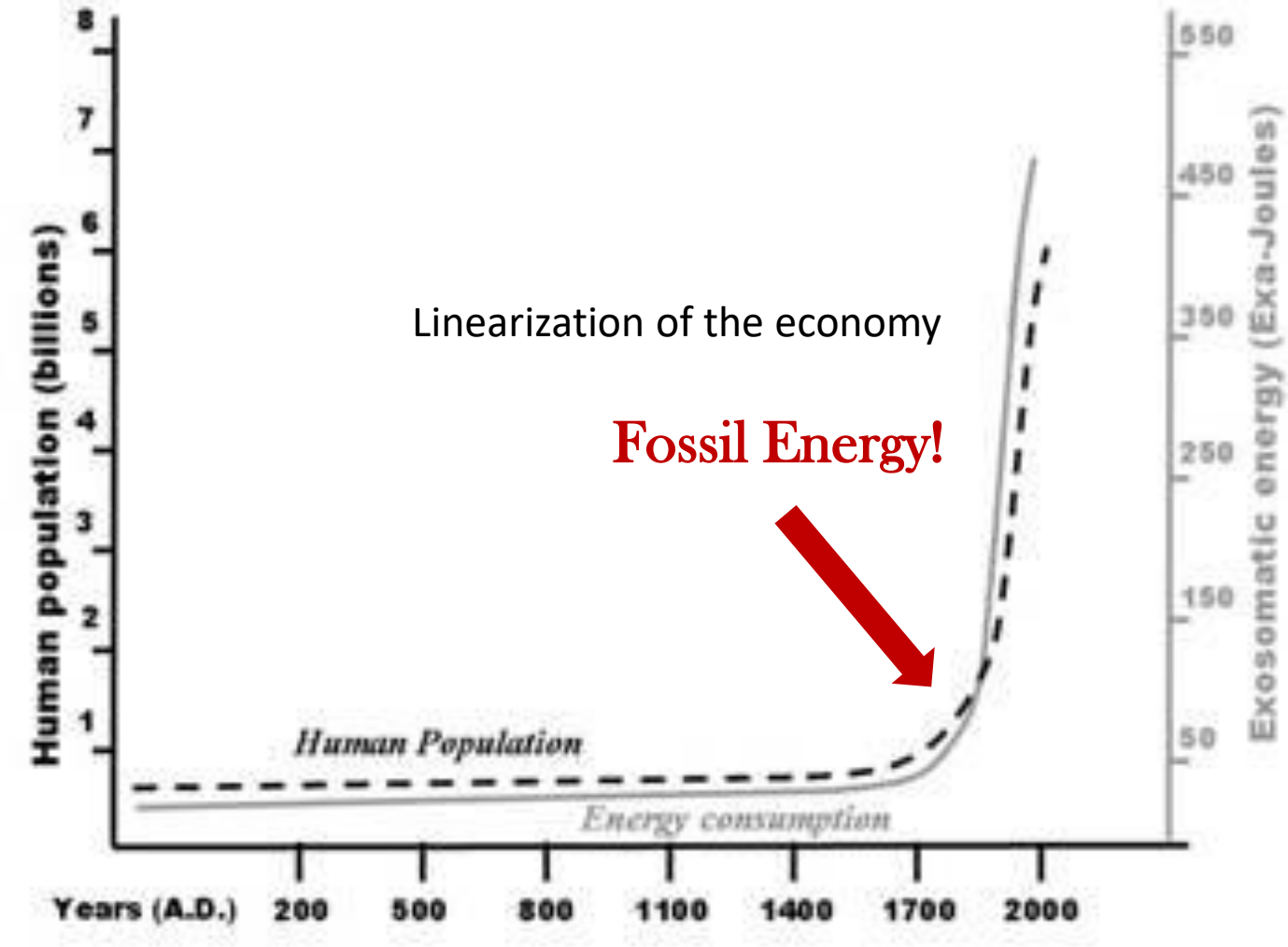


PRIMARY FOOD SOURCE

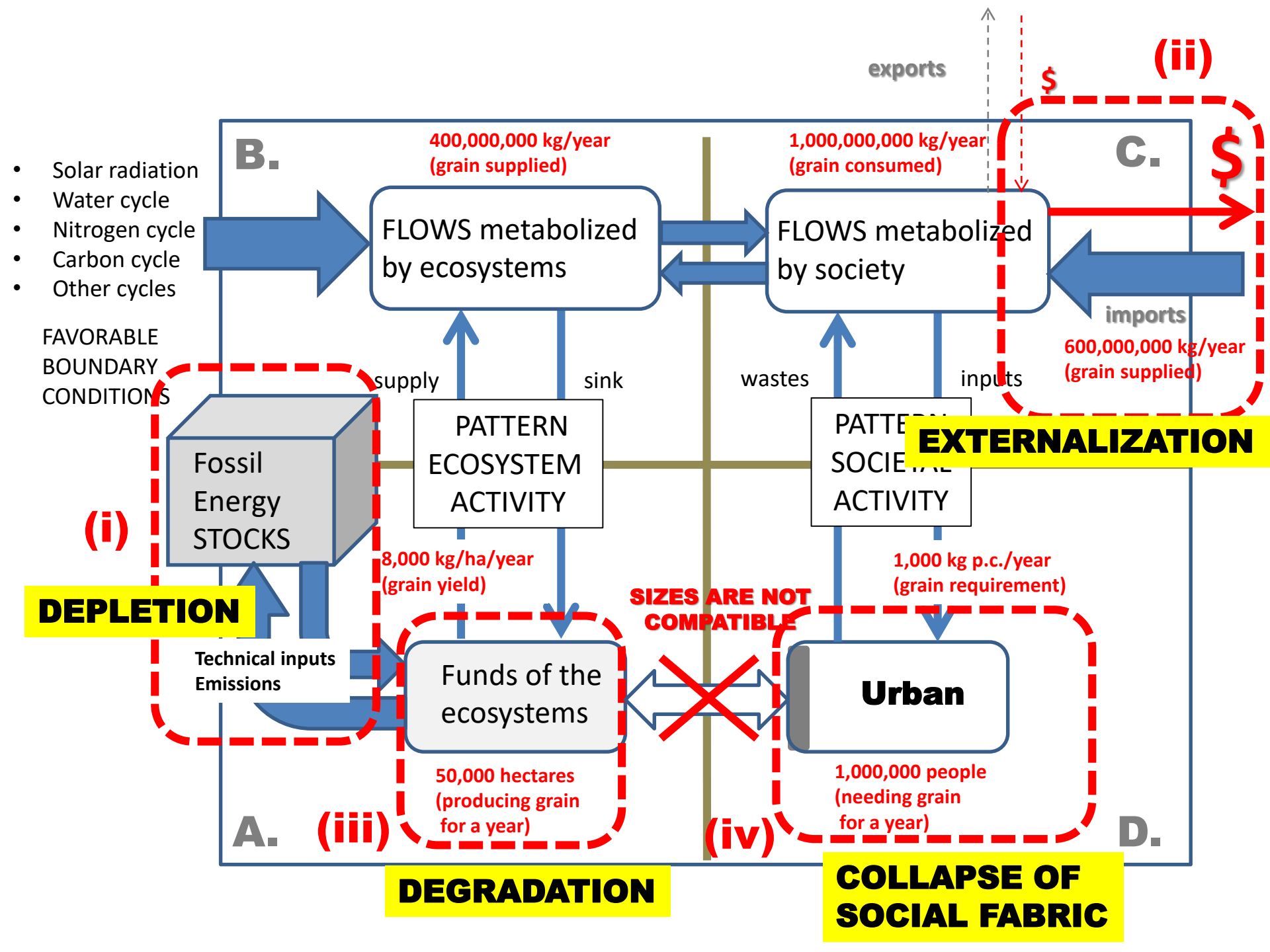


PRIMARY MONEY SOURCE

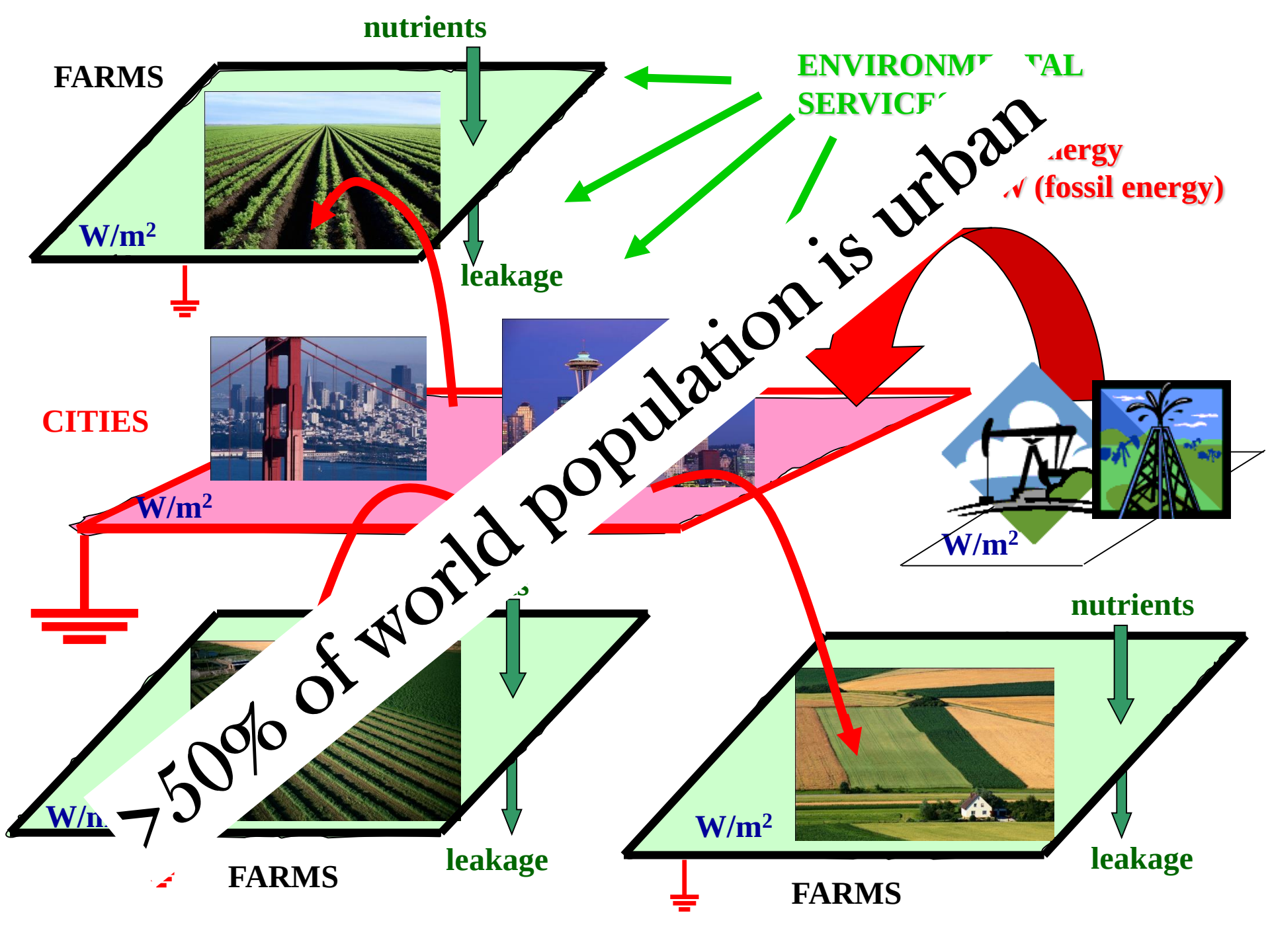
PRIMARY ENERGY SOURCE

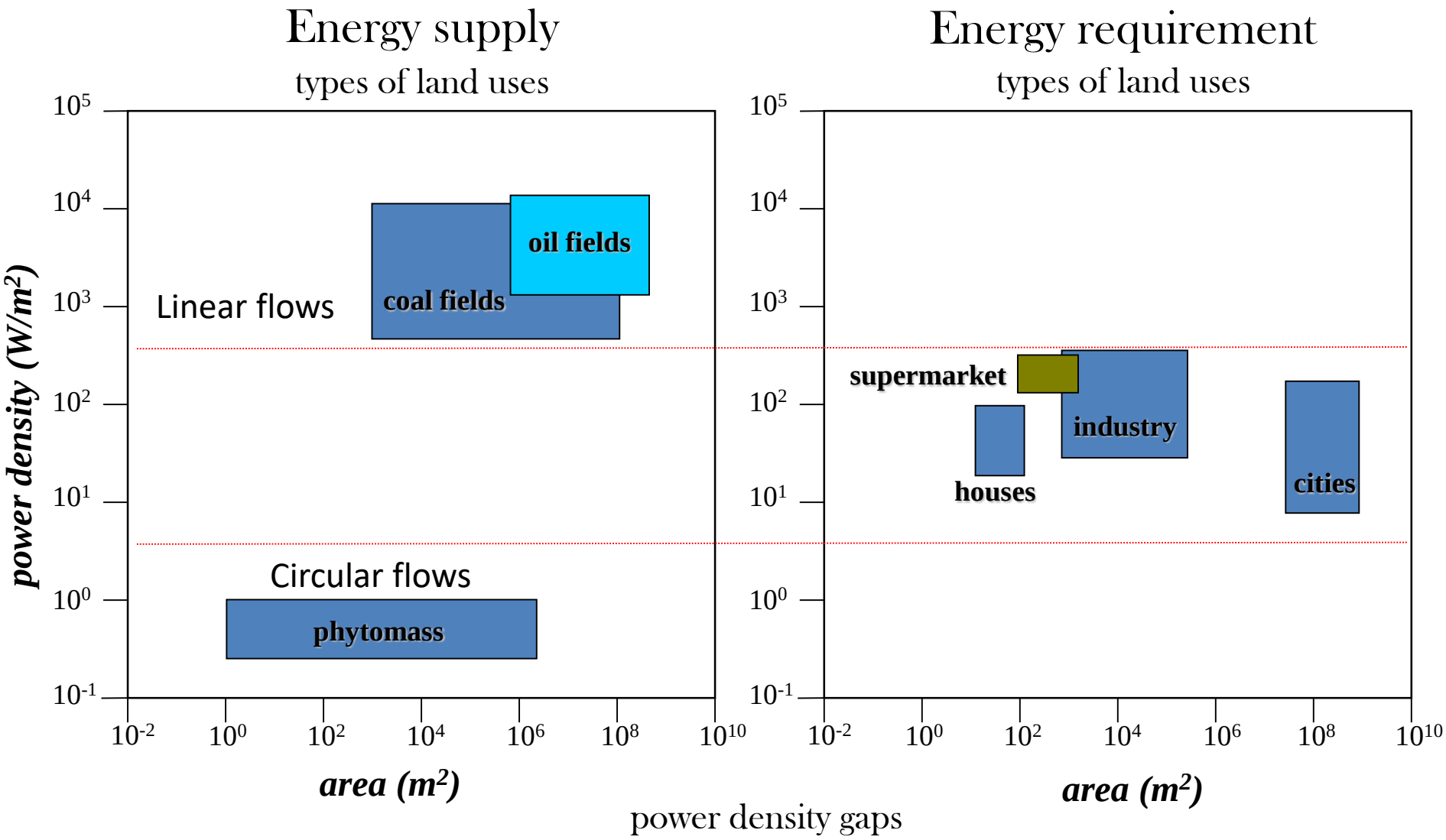


The situation after the industrial revolution


exports
$
(ii)
B.
400,000,000 kg/year
(grain supplied)
1,000,000,000 kg/year
(grain consumed)
C.
$
Solar radiation
Water cycle
Nitrogen cycle
Carbon cycle
Other cycles
FLOWS metabolized by ecosystems
FLOWS metabolized by society
imports
600,000,000 kg/year
(grain supplied)
FAVORABLE BOUNDARY CONDITIONS
supply
sink
wastes
inputs
EXTERNALIZATION
Fossil Energy STOCKS
PATTERN ECOSYSTEM ACTIVITY
PATTERN SOCIETAL ACTIVITY
(i)
8,000 kg/ha/year
(grain yield)
1,000 kg p.c./year
(grain requirement)
DEPLETION
SIZES ARE NOT COMPATIBLE
Technical inputs
Emissions
Funds of the ecosystems
Urban
50,000 hectares
(producing grain for a year)
1,000,000 people
(needing grain for a year)
A.
(iii)
(iv)
D.
DEGRADATION
COLLAPSE OF SOCIAL FABRIC


- Oil consumption
- Oil production
Meet the world
Grande Reportagem
Magazine


nutrients
FARMS
W/m²
leakage
ENVIRONMENTAL
SERVICES
energy
N (fossil energy)
CITIES
W/m²
>50% of world population is urban
W/m²
nutrients
W/m²
FARMS
leakage
W/m²
leakage
FARMS



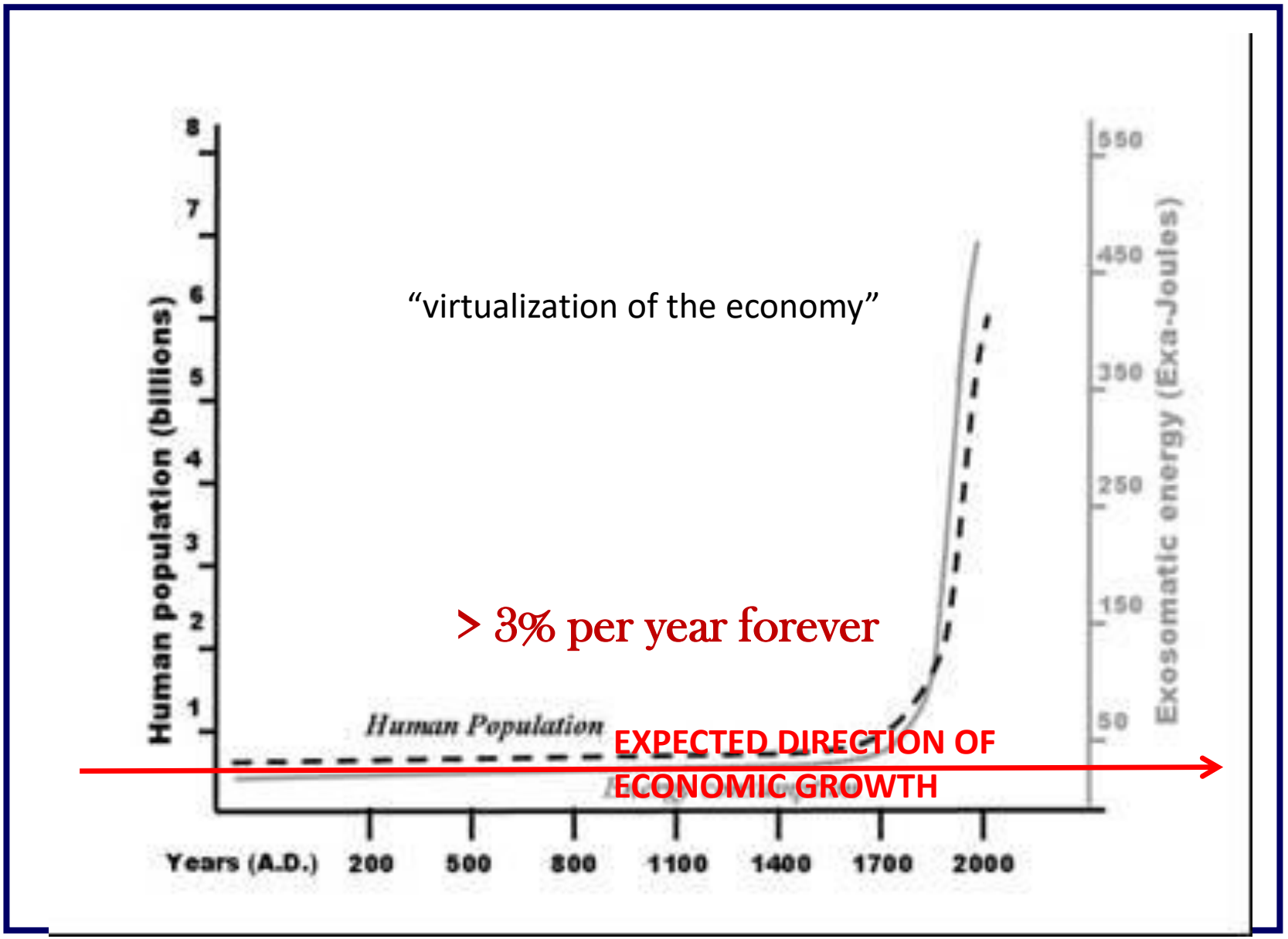
after Vaclav Smil 2003 Energy at the Crossroads, The MIT press
(Fig. 5.2 and Fig. 5.3)

The social perception of primary sources of relevant flows **after the industrial revolution**

PRIMARY MONEY SOURCE

PRIMARY FOOD SOURCE

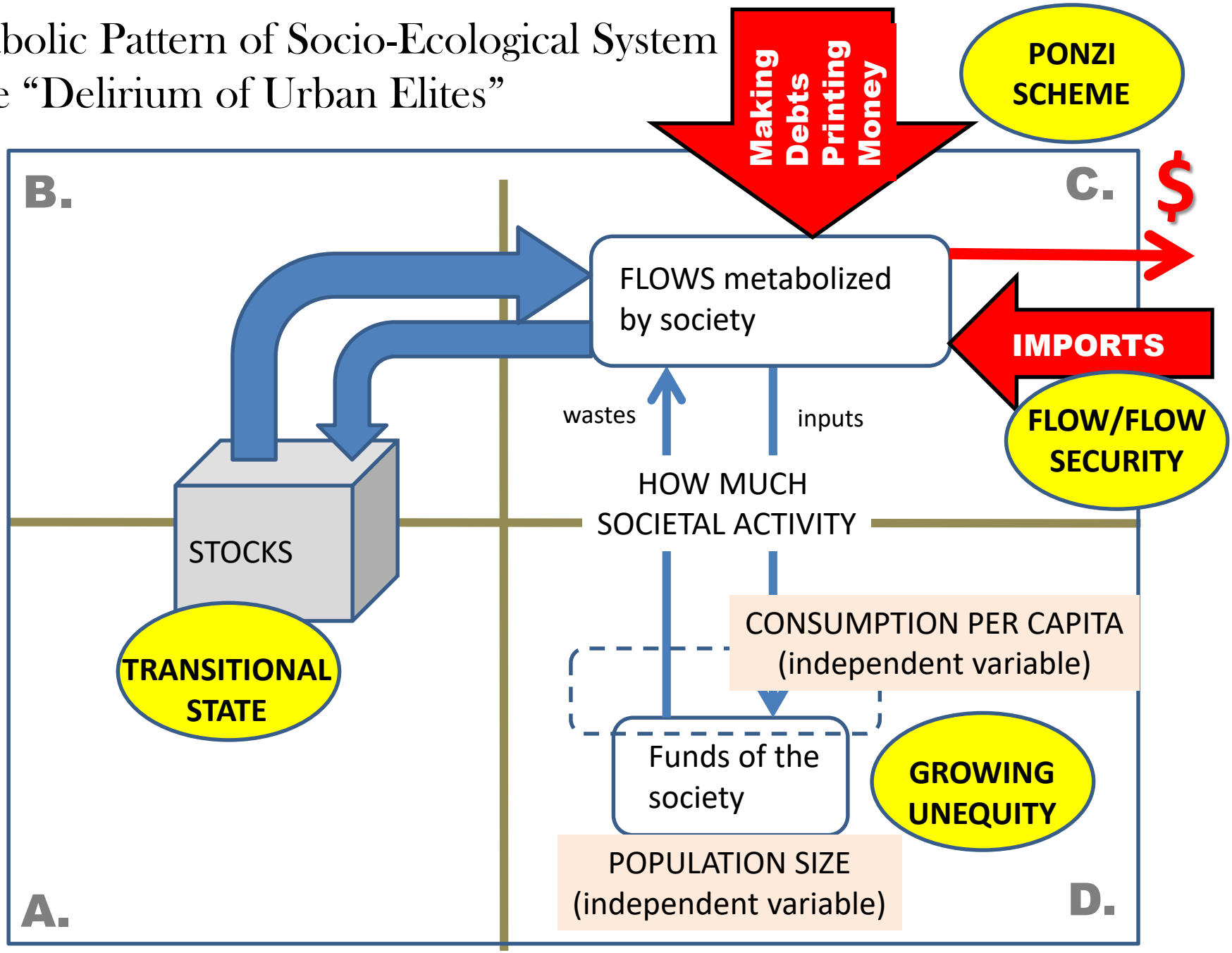
PRIMARY ENERGY SOURCE

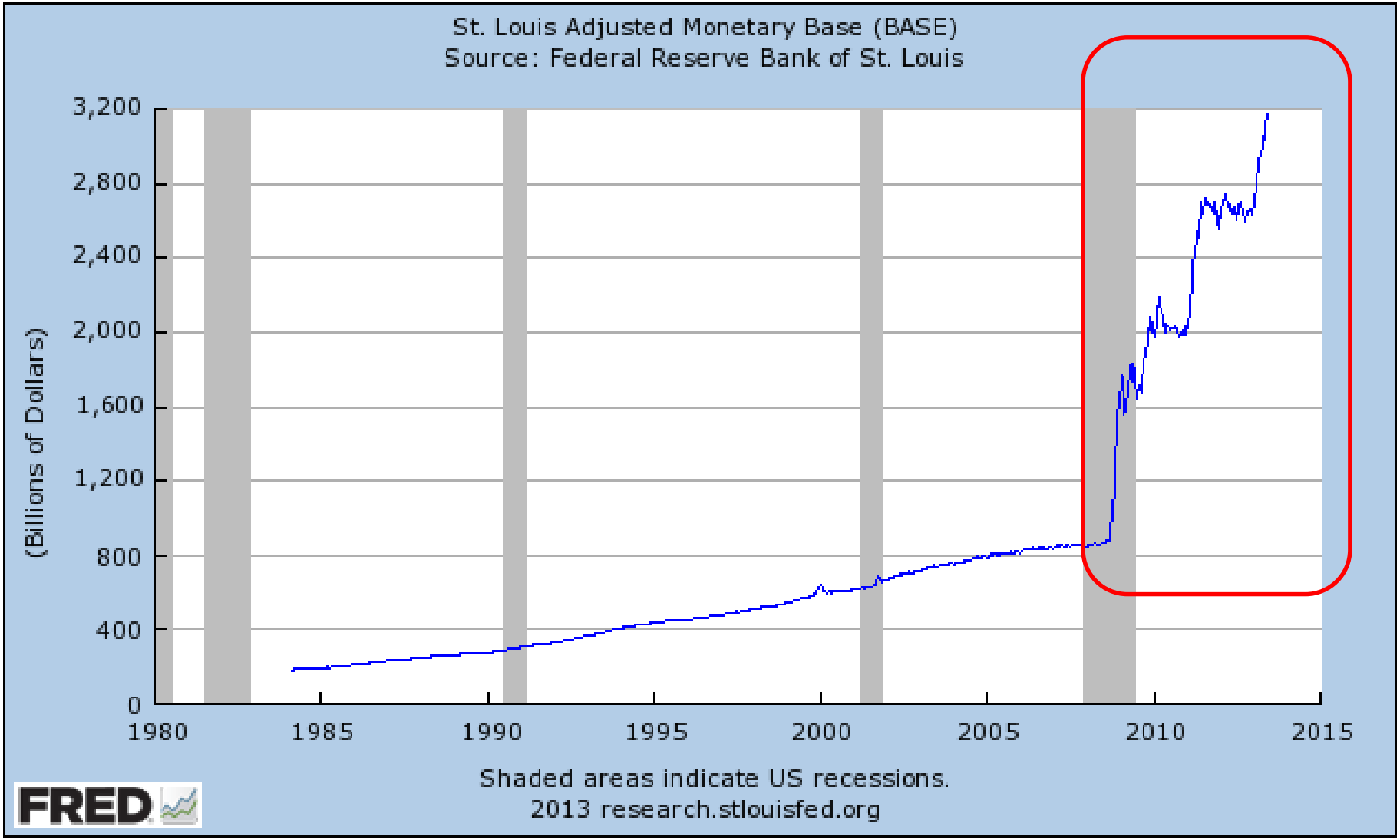


The narrative about economic growth in the post-truth world

The dangerous attractor of "Ponzi Scheme Economics"!

Metabolic Pattern of Socio-Ecological System in the "Delirium of Urban Elites"





Printing money in the USA . . .

search dating more International

theguardian

ball opinion culture business lifestyle fashion environment tech travel browse all sections

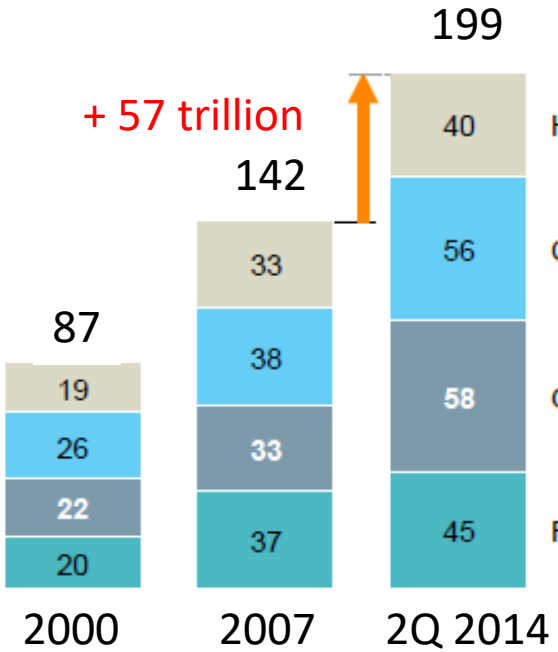
s banking retail markets eurozone

Quantitative easing ain't so easy to quantify

The EU bank is going for 1.1 Trillion € just to start

Global debt has increased by $57 trillion since 2007, outpacing world GDP growth

Gloobal stock of debt outstanding by type
US$ trillion, constant 2013 exchange rate



	Compound annual growth rate (%)	
	2000–07	2007–14[1]
	7.3	5.3
Household	8.5	2.8
Corporate	5.7	5.9
Government	5.8	9.3
Financial	9.4	2.9

199 trillion =
286% world GDP

Total debt
as % of GDP

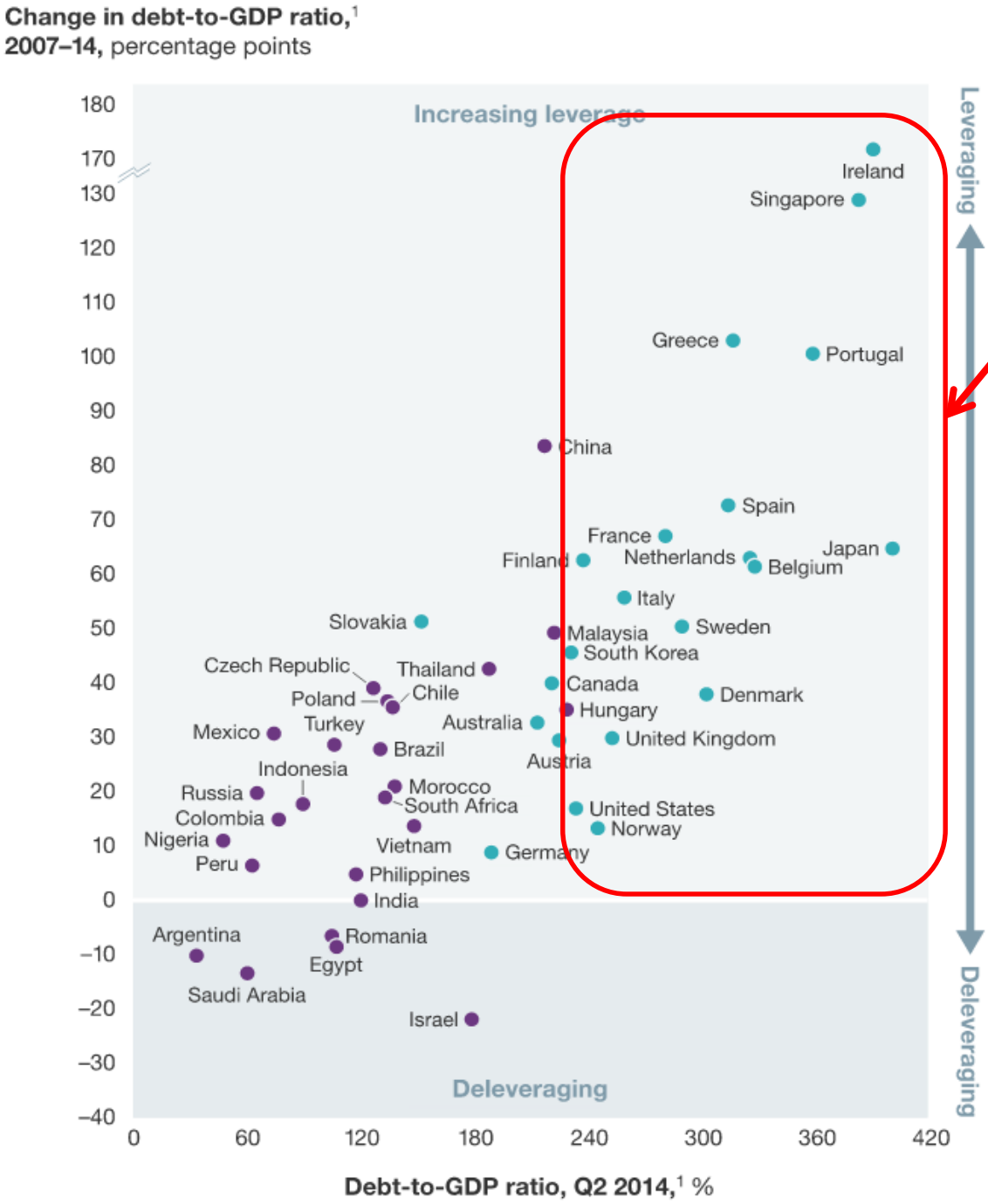
2000	2007	2Q 2014
246	269	286

MCKINSEY GLOBAL INSTITUTE

DEBT AND (NOT MUCH) DELEVERAGING

February 2015

http://www.mckinsey.com/insights/economic_studies/debt_and_not_much_deleveraging



Only the rich can go into debt!

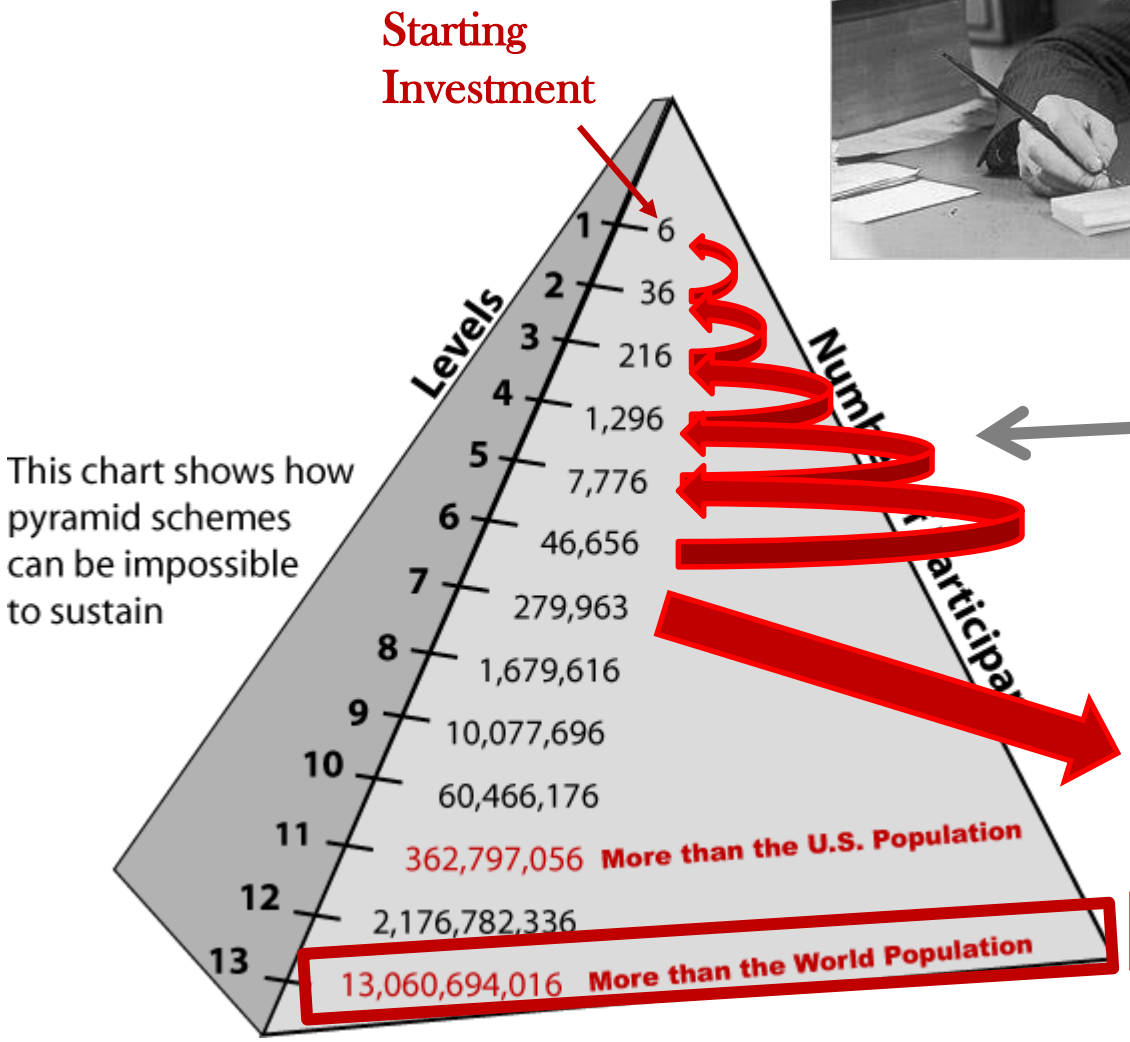
Taking from the poor giving to the rich . . .

MCKINSEY GLOBAL INSTITUTE

DEBT AND (NOT MUCH) DELEVERAGING

February 2015

Why is oil below 60 US$/barrel?



When the scheme is operating at this point, it is the best of the possible investments!!!!!

TAKE THE MONEY AND RUN!

NO PLACE WHERE TO RUN!

The social perception of primary sources of relevant flows **among urban elites . . .**

PRIMARY MONEY SOURCE

!

PRIMARY FOOD SOURCE

PRIMARY ENERGY SOURCE

MIT Technology Review

VOL. 115 NO. 6 | $5.99 US

HAS QUANTUM COMPUTING FINALLY ARRIVED?
Upfront p24

HOW TOMORROW'S STARTUPS WILL BE FUNDED
Business Report p75

TECH TRANSFORMS MUSIC, ART, AND PROSE
Reviews p87

Buzz Aldrin, *Apollo 11* moonwalker, would like a word with you.

You Promised Me Mars Colonies. Instead, I Got Facebook.

We've stopped solving big problems.
Meet the technologists who refuse to give up. p26

LIKE US ON facebook

Market capitalization: 300 billion US$

12,700 jobs

24 MUS$ ←→ 1 job

In 2015

0.4 MUS$ ←→ 1 job

Market capitalization: 150 billion US$

344,000 jobs

TOYOTA

http://www.vaclavsmil.com/wp-content/uploads/Spectrum.manuf_.pdf

3. HOW – the methodology - relational analysis of the metabolic pattern of societies to study of the water, energy and food nexus

EXAMPLE #1

A quantitative characterization of the nexus requires a different approach to quantitative analysis . . .

It is not about handling individual numbers one at the time

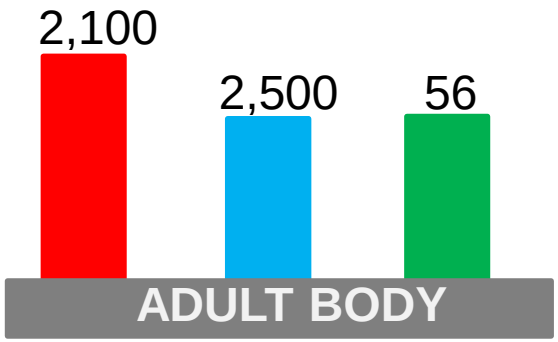
BUT

it is about handling relations over profiles of numbers (patterns) across scales

Illustrating the entanglement over flows: the example of the diet

3 flows considered: **Energy (kcal)** **Water (grams)** **Protein** (grams)

These 3 flows are entangled in an expected patterns associated with the dietary requirement of a person – a profile of quantities per day needed by an adult



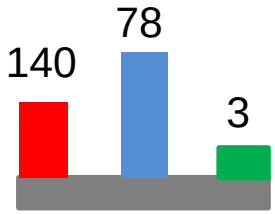
Dietary intake per day

Characteristics of the requirement

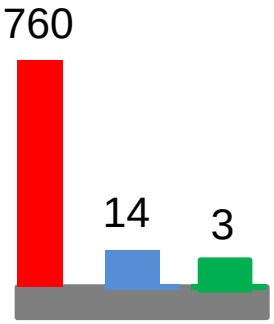
Illustrating the entanglement over flows in metabolic patterns: the example of the diet

3 flows considered: **Energy (kcal)** **Water (grams)** **Protein (grams)**

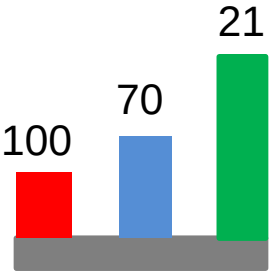
These 3 flows are entangled in expected patterns associated with the typologies of food inputs in the diet – a profile of quantities per 100 grams of food type



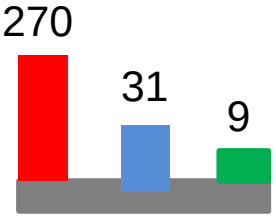
A. Milk (100 gr)



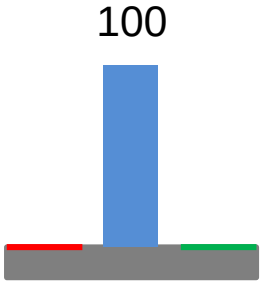
B. Butter (100 gr)



C. Beef (100 gr)



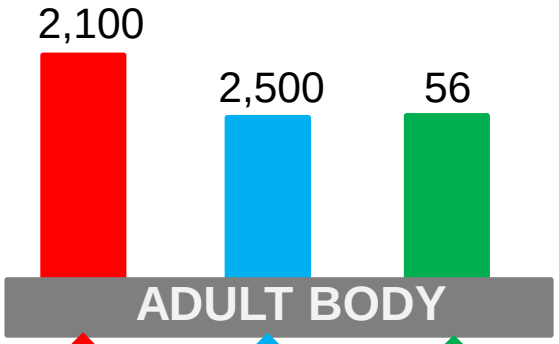
D. Bread (100 gr)



E. Drinking water (100 gr)

Characteristics of typologies of inputs

Extensive variables
measuring the flows as
"total quantities per day"



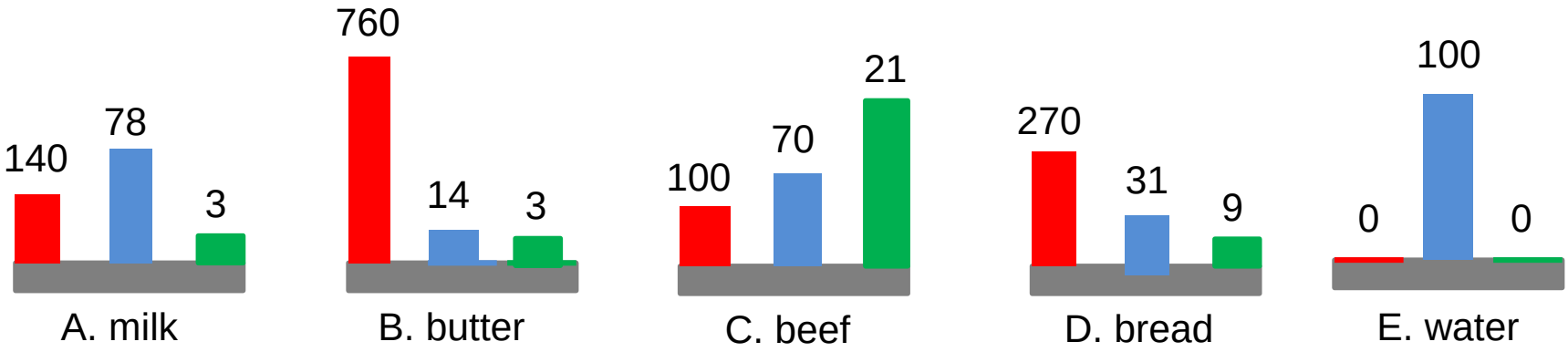
REQUIRED PATTERN
OF NUTRIENT FLOWS
PER DAY PER ADULT
(SCALED)

Unused Surplus 170 gr/day

18 gr/day *Unused Surplus*

A. Milk **50 gr**	70	40	2
B. Butter **150 gr**	1,140	25	5
C. Beef **150 gr**	150	105	40
D. Bread **300 gr**	810	90	27
E. Water **2,250 gr**	0	2,250	0

SCALING
across the two
sets of patterns



Intensive variables measuring patterns as profiles of "quantities per 100 grams"

When preparing a diet you cannot use models looking at:

(i) the requirement and supply of energy;
(ii) the requirement and supply of water; and
(iii) the requirement and supply of proteins;

one at the time!

You have to study the implication of the entanglement of these flows across non-equivalent descriptions of processes referring to different scales

EXAMPLE #2

A quantitative characterization of the nexus must consider different aspects of sustainability of the metabolic pattern

FEASIBILITY – what are the external limits determined by processes outside human control (e.g. available resources)

VIABILITY – what are the internal limits determined by process under human control (e.g. affordability)

DESIRABILITY – compatibility with normative values and stability of institutions

LEVEL OF EXTERNALIZATION – how much are we exploiting the activity of other Societal-Ecological-Systems?

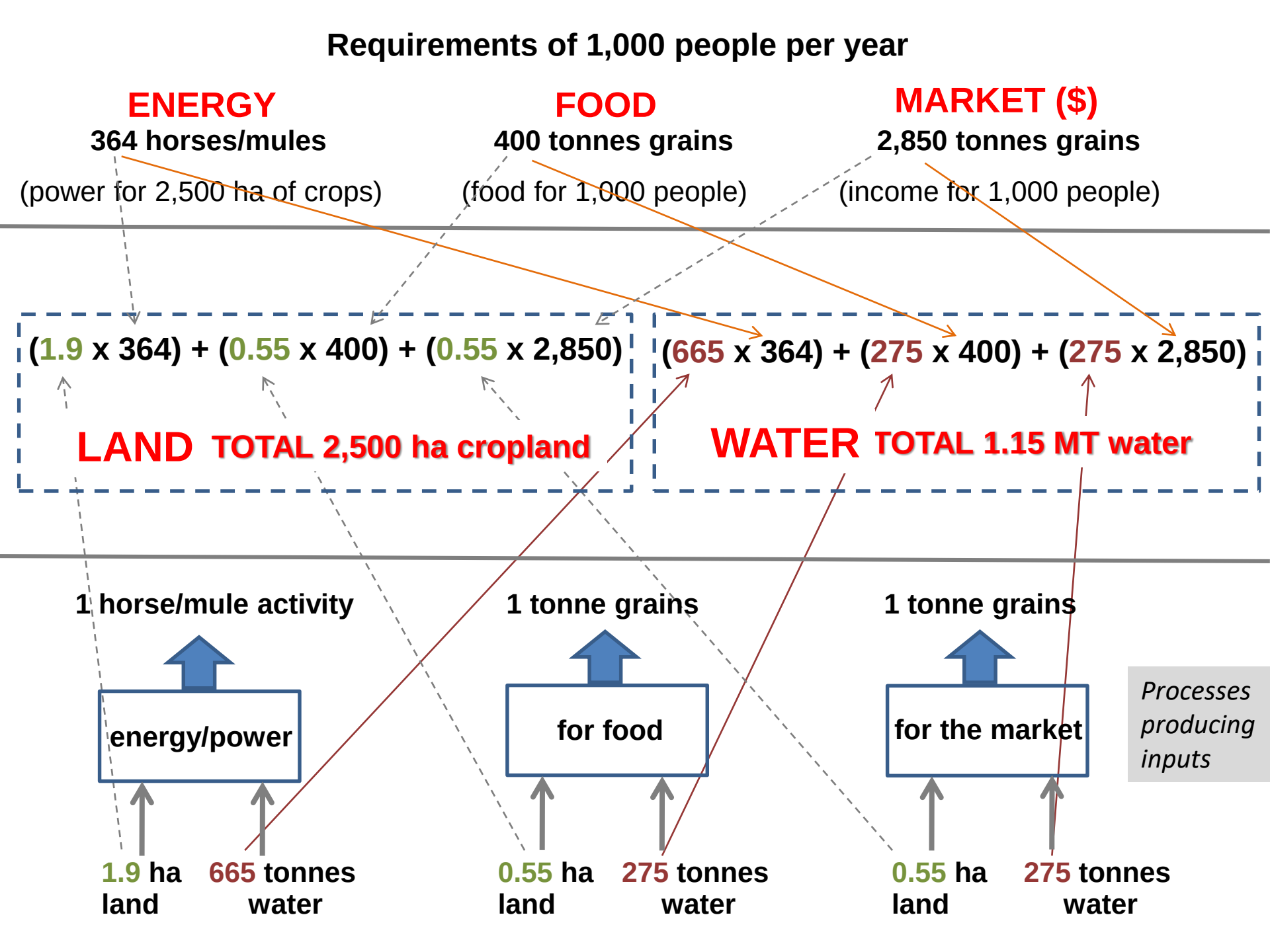
The nexus between water, energy, food, money and land in agricultural production in the great plains, USA, in 1930

A 33 HP animal powered harvester (controlled by 5 workers)

Integrating data across dimensions and scales: agricultural production in the great plains US in 1930

Quantities required per year by 1,000 people cultivating 2,500 ha

GRAINS (for FOOD)	400 tonnes for the diet	→	200 ha	– for grains
GRAINS (for CASH)	2,850 tonnes for the market	→	1,600 ha	– for grains
ENERGY	activity of 364 horses/mules (required power for cultivating 2,500 ha)	→	700 ha	– for oats
			TOTAL **2,500 ha**	- cropped land


Requirements of 1,000 people per year
ENERGY
364 horses/mules
(power for 2,500 ha of crops)
FOOD
400 tonnes grains
(food for 1,000 people)
MARKET ($)
2,850 tonnes grains
(income for 1,000 people)
(1.9 x 364) + (0.55 x 400) + (0.55 x 2,850)
LAND TOTAL 2,500 ha cropland
(665 x 364) + (275 x 400) + (275 x 2,850)
WATER TOTAL 1.15 MT water
1 horse/mule activity
energy/power
1.9 ha land
665 tonnes water
1 tonne grains
for food
0.55 ha land
275 tonnes water
1 tonne grains
for the market
0.55 ha land
275 tonnes water
Processes producing inputs

The metabolic pattern of a social-ecological system describe how a society is producing and using the flows of food, water and energy required to express its functions:

In human societies this pattern is determined by different factors that can be studied only by adopting different scales and dimensions of analysis: economic analysis, social and institutional analysis, technical analysis, ecological analysis

Rather than trying to collapse such a rich characterization into a single model, it is wiser to establish relations across different levels and dimensions of analysis

A quantitative characterization of the nexus requires the ability to handle **impredicativity** (chicken-egg paradoxes)

It is not about determining unique directions of causality and deterministic relations such as “A because of B” . . .

When studying complex systems self-organizing across different levels and scales it is impossible to identify a simple direction of causality: it depends on the special circumstances, the history, the relations with the context

Compatibility with institutions
and normative values

Is it acceptable according
to our values?

Do we like it?

DESIRABILITY

Good soil?

Enough land?

Appropriate climate?

Enough water?

Is the profit OK?

Are the costs affordable?

Do we have the required know-how
and the appropriate tecnology?

FEASIBILITY

VIABILITY

Compatibility with processes
outside human control

Compatibility with processes
under human control

EXTERNAL BIOPHYSICAL
CONSTRAINTS

INTERNAL BIOPHYSICAL
ECONOMIC CONSTRAINTS

CASE #1

Intensive farming
US plains 1930

Compatibility with institutions and normative values

DESIRABILITY

MAXIMIZING ECONOMIC RETURN

> 3 tonnes of grain per capita

40% of land used for feeding animals!!!

DECREASING RETURN TO SCALE

Increasing production costs

VIABILITY

Compatibility with processes **under human control**

INTERNAL BIOPHYSICAL AND ECONOMIC CONSTRAINTS

INTERNAL CONSTRAINT

CASE #2

Subsistence society in Nepal

Compatibility with institutions and normative values

DESIRABILITY

SUBSISTENCE ECONOMY

400 kg of grain per capita

SHORTAGE OF AGRICULTURAL

< 0.2 ha of arable land p

FEASIBILITY

Compatibility with processes **outside human control**

EXTERNAL BIOPHYSICAL CONSTRAINTS

ECONOMIC CONSTRAINTS

EXTERNAL CONSTRAINT

CASE #3

Buddhist community

Compatibility with institutions and normative values

RELIGIOUS COMMUNITY

DESIRABILITY

400 of grain p.c./year

CULTURAL CONSTRAINTS

PLENTY

> 2.5 h

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CAL AND
RAINTS

CASE #4

Hong Kong

SHORTAGE OF
WATER AND E

< 0.01 ha c

ong
ng

FEASIB

Compatibility with processes **outside human control**

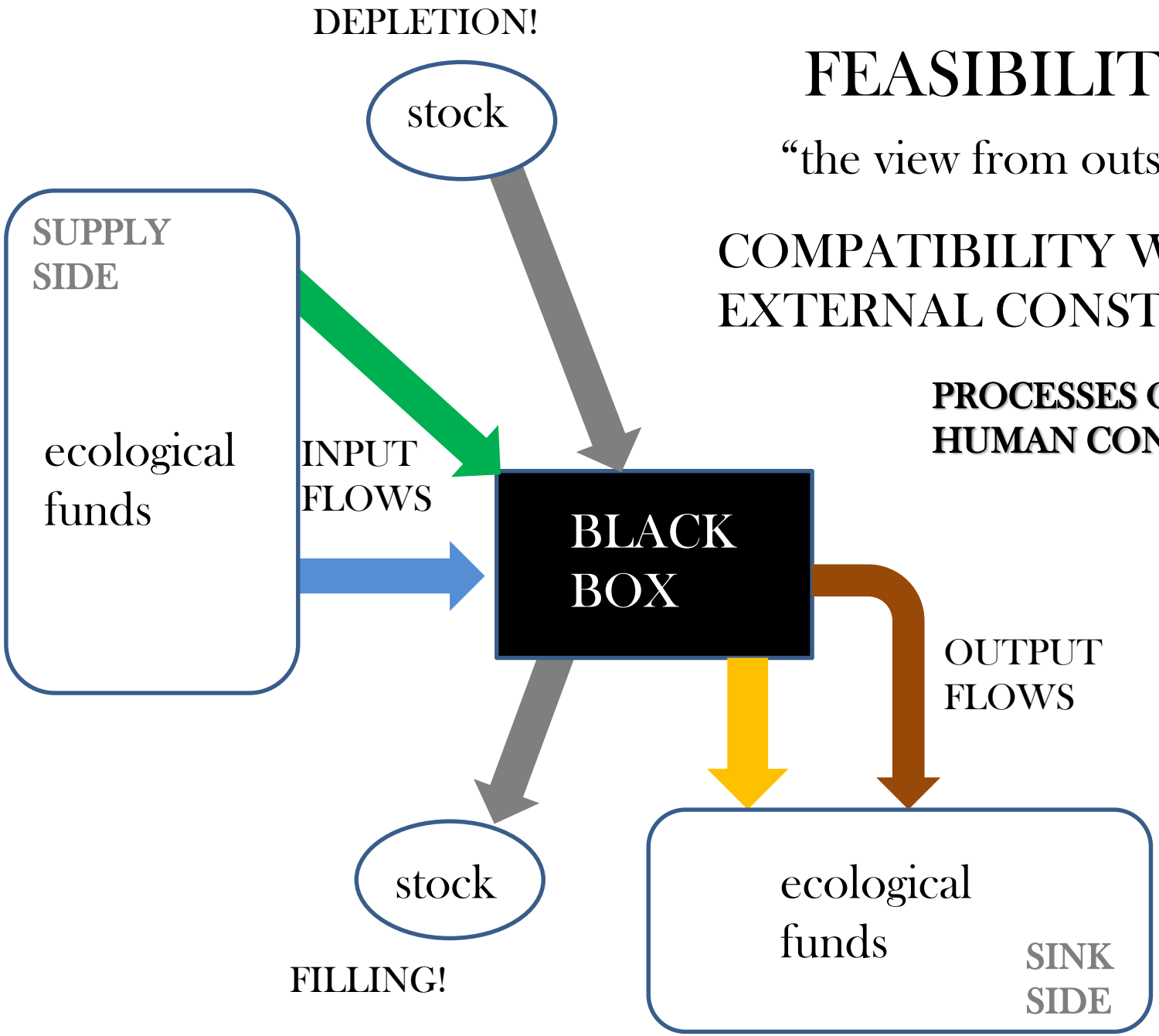
EXTERNAL BIOPHYSICAL CONSTRAINTS

IMPORTS!

Compatibility with processes **under human control**

INTERNAL BIOPHYSICAL & ECONOMIC CONSTRAINTS

EXTERNALIZATION



FEASIBILITY

"the view from outside"

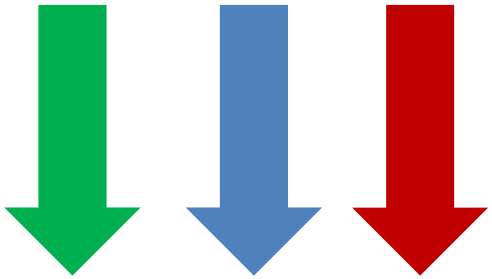
COMPATIBILITY WITH EXTERNAL CONSTRAINTS

PROCESSES OUTSIDE HUMAN CONTROL !

VIABILITY

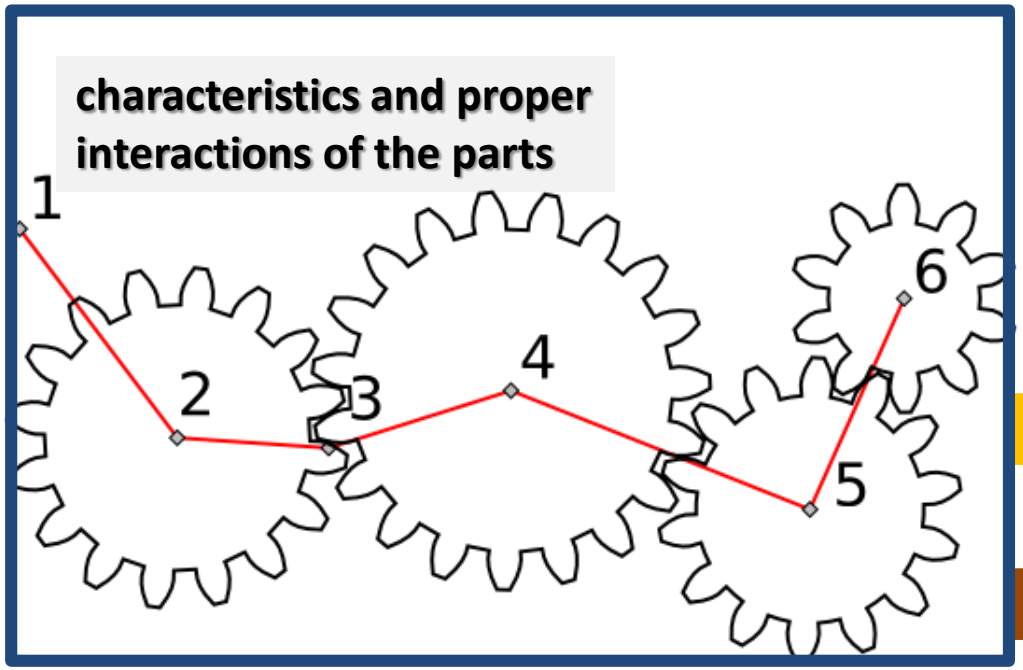
"the view from inside"

ASSUMING THAT THE SUPPLY OF NEEDED INFLOWS IS AVAILABLE "BY DEFAULT"

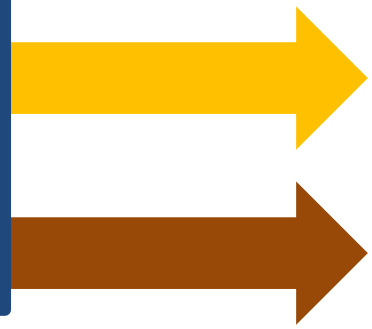


COMPATIBILITY WITH INTERNAL CONSTRAINTS

PROCESSES UNDER HUMAN CONTROL



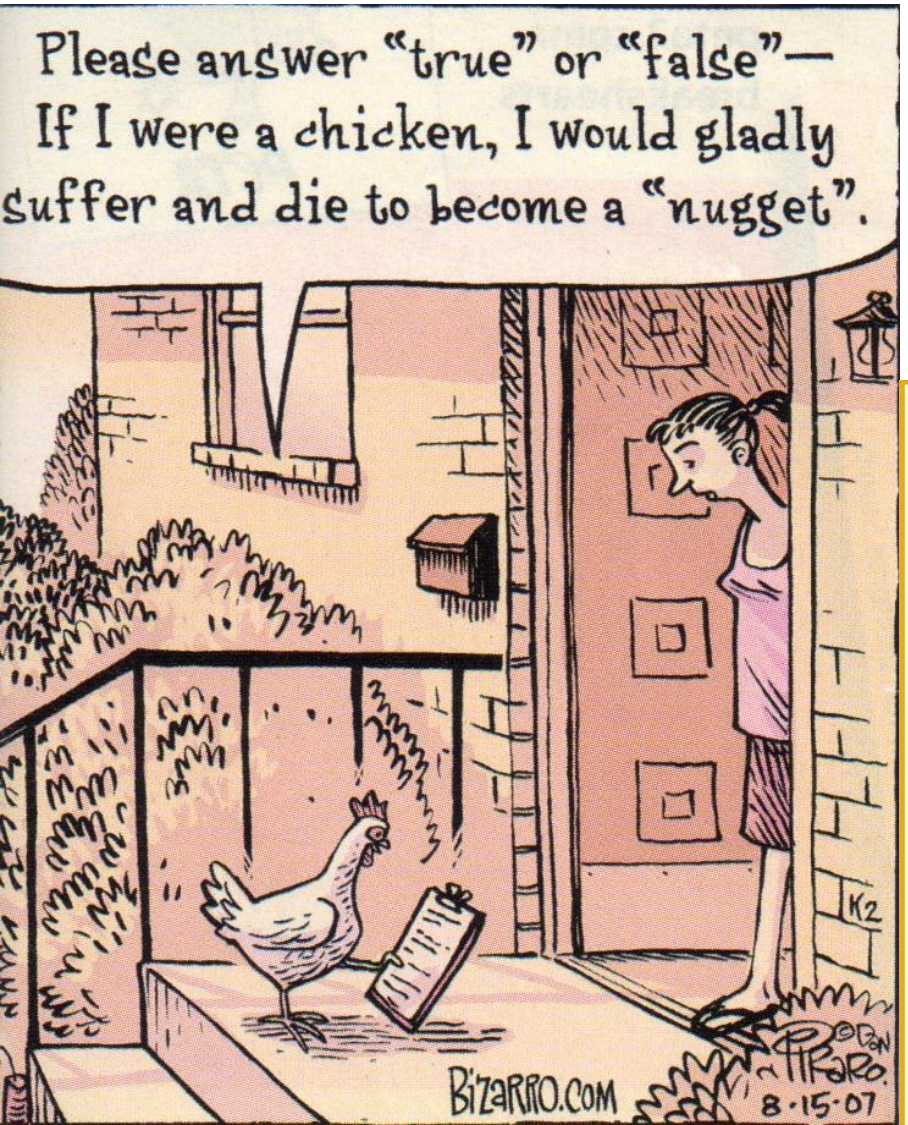
ASSUMING THAT THE NEEDED SINK CAPACITY FOR OUTFLOWS IS AVAILABLE "BY DEFAULT"



Values, Taboos, Cultural Identity
Path Dependence (history matters . . .)

DESIRABILITY

"whose view counts?"



COMPATIBILITY WITH
NORMATIVE VALUES
KEEPING TOGETHER
SOCIAL INSTITUTIONS

EXTERNALIZATION

In relation to the missing parts of the presentation . . .

Coursera: Massive Open On-line Course (MOOC)

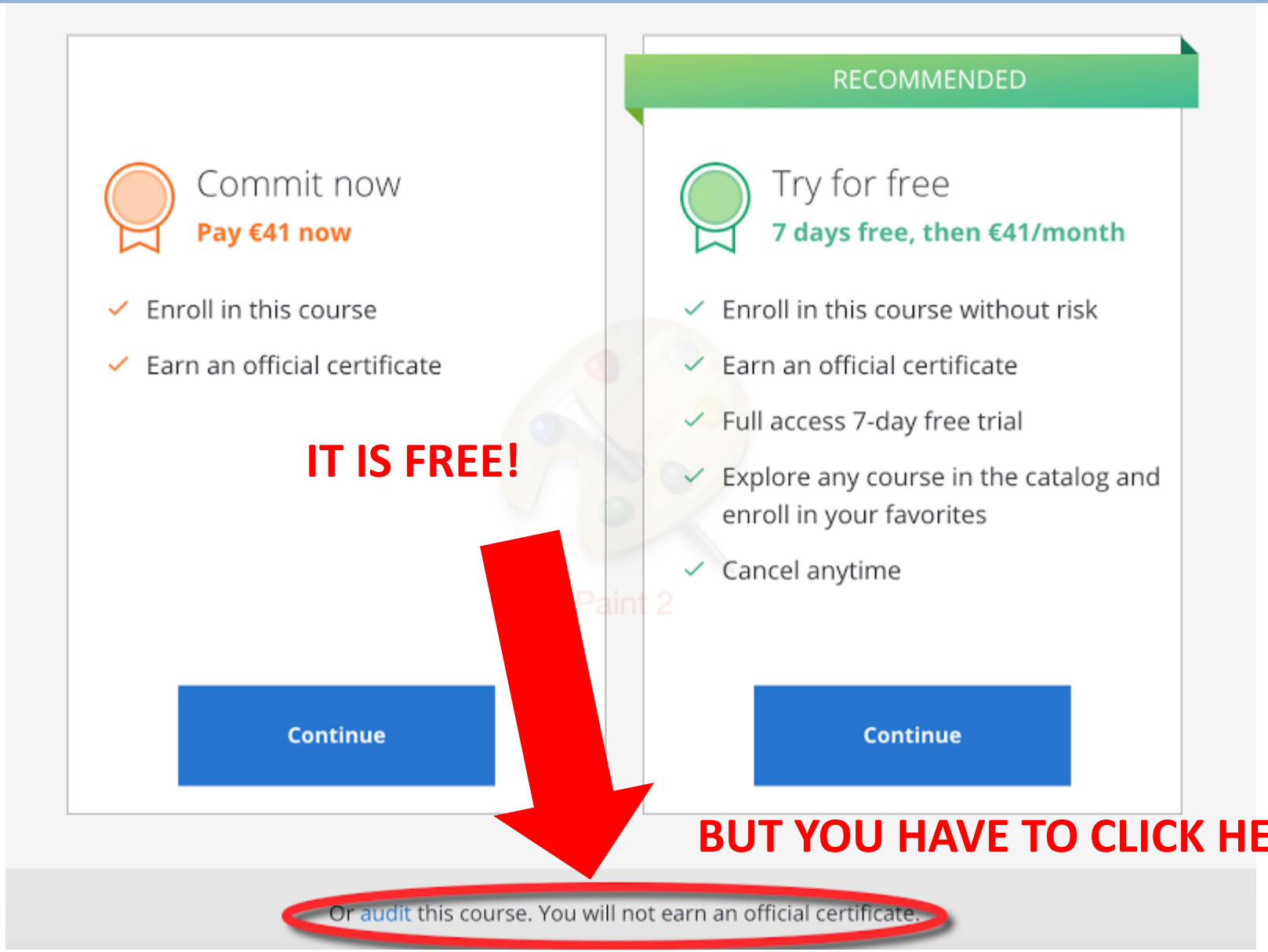
https://www.youtube.com/watch?v=0orXZnJ2Djo

The teaser on youtube

- Launched July 2017
- 872 learners as of 30 September 2017
- Course of 8 weeks – 3 lessons/wk – 3 videos/lesson → 72 videos

https://www.coursera.org/learn/sustainability-social-ecological-systems

https://www.coursera.org/learn/sustainability-social-ecological-systems



The deliverable 4.1 of MAGIC (300 pages!) provides:

1. A critical appraisal of narratives used right now in sustainability science;
2. An illustration of the analytical tool-kit for analyzing the metabolic pattern of SES;
3. A detailed illustration of six case studies in which the method is applied

http://www.magic-nexus.eu/documents/d41-report-nexus-security-using-quantitative-story-telling

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No. 689669.

Moving towards Adaptive Governance In Complexity

THANKS FOR YOUR ATTENTION

http://magic-nexus.eu

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