UNIVERSITÉ Clermont Auvergne

ERASME Jean Monnet Excellence Center on Sustainability

Climate change is not the problem, the problems are our economic system and the demography : Manifesto for strong sustainability

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The Fable of the Elephant, the Rabbit and the Black Bird

The Fable of the Elephant, the Rabbit and the Black Bird

(The Elephant : Economy)

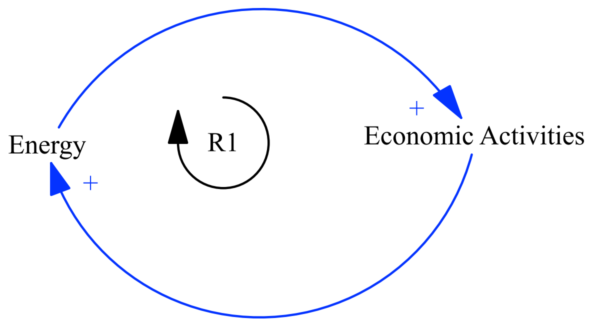
(The Rabbit : Energy)

(The Black Bird : Climate)

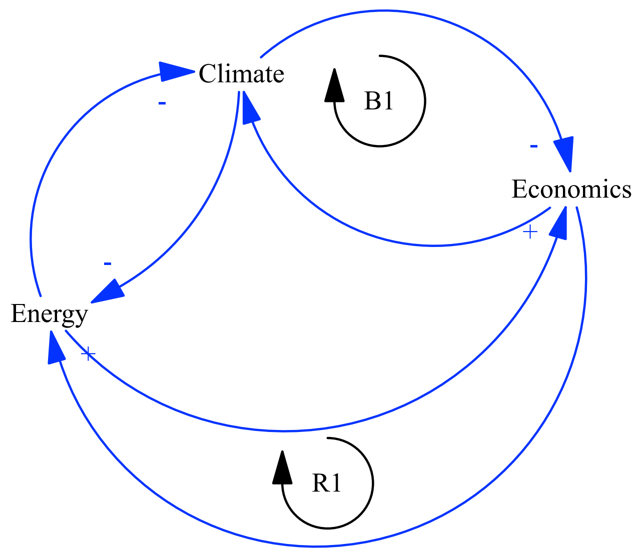
In 1977, Charles Hitch edited a book untitled " Modeling Energy – Economy Interactions : Five Approachs
One of the five articles has been written by W. Hogan and Manne S., "The Fable of Elephant and the Rabbit"

<u>The statement :</u> "*In most energy policy studies, the energy sector is viewed in isolation from the remainder of the economy, and the analysis is performed without consideration of the broader impacts. Typically, the GDP and other macro-economic indices are taken as given – as though they were unaffected by the energy sector*" (1977, p. 247).

In 1977, the conclusion was clear : the two way linkages between energy and GDP are significant - we can not threat the energy sector in isolation, but we must consider the full interdependence effects

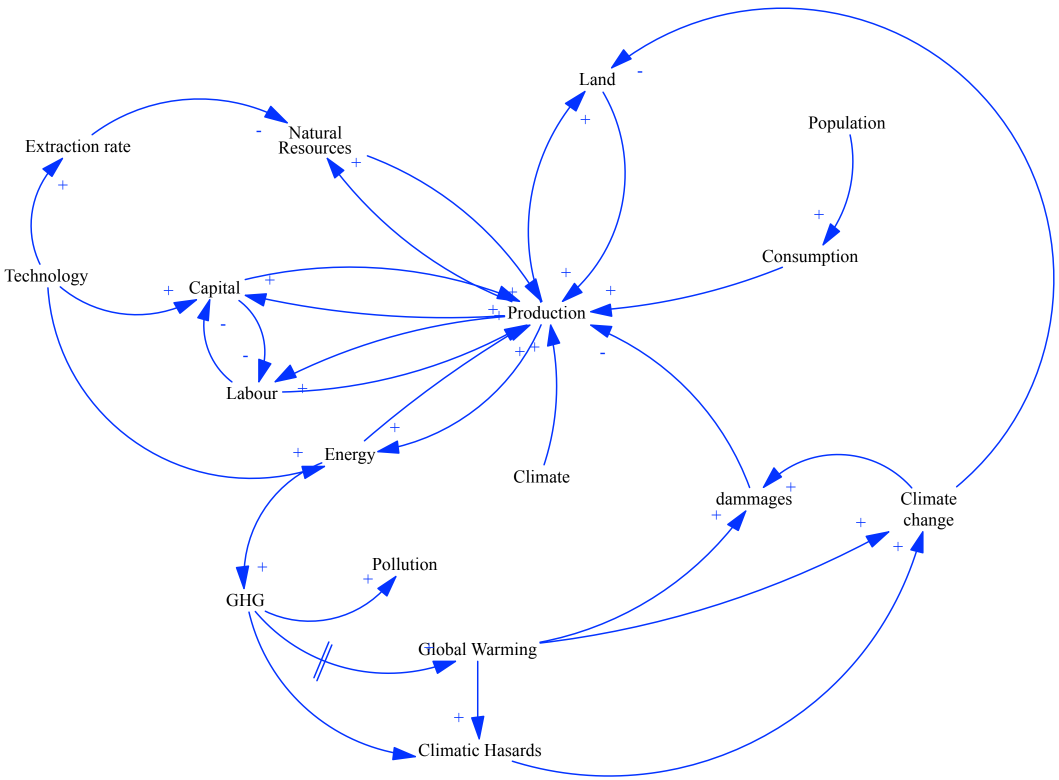


Today, Energy is an input for the economic activities (more GDP = more energy) but generates damages to economic activities (GHG) and jeopardizes life on earth. Climate as an input, may produce more economic activities but also creates some damages.



Conclusion : we can threat Economy – Energy and Climate in isolation –> causalities and interlinkages (Diemer, 2009)

Climate as Energy are inputs for production....



The Long Term Growth Model of the World Bank ????

Long Term Growth Model (LTGM v4.1) - Model Description

Steven Pennings (spennings@worldbank.org)

27 June 2018

- **NEW** in LTGM v4: effect of growth on poverty (via log-normal income distribution, Section 5)
- The neoclassical growth model is based on Solow (1956), Swan (1956) and Hevia and Loayza (2012)
  - There are only two key parts: the production function and capital accumulation.
- Model 1: assume a path for the investment share of GDP $(I/Y) \to$ implied per-capita GDP growth.
- Model 2: assume a path of growth in GDP per capita $\to$ required investment share of GDP (I/Y).
- Model 3: assume a path for the savings share of GDP $(S/Y) \to$ implied per-capita GDP growth.
- A Current Account Balance or External Debt constraint converts savings (S/Y) into (I/Y) in Model 3. The constraint also allows savings to be calculated as residual in Model 1 and 2 (see Section 3 for details).
- Section 4 summarizes the drivers of per-capita GDP growth in one equation (and compares to the ICOR).

1 Model 1: Growth given investment

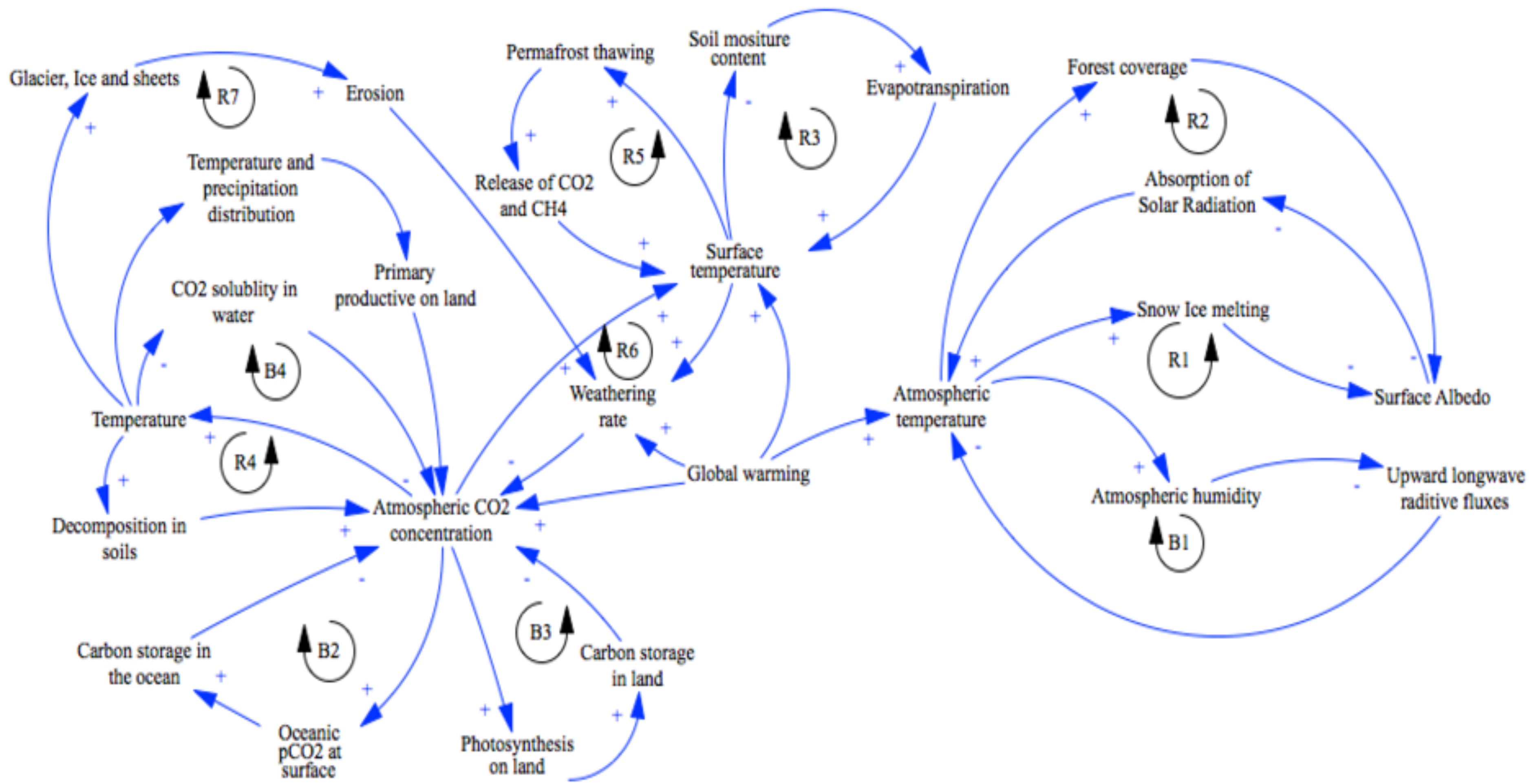
1.1 The production function

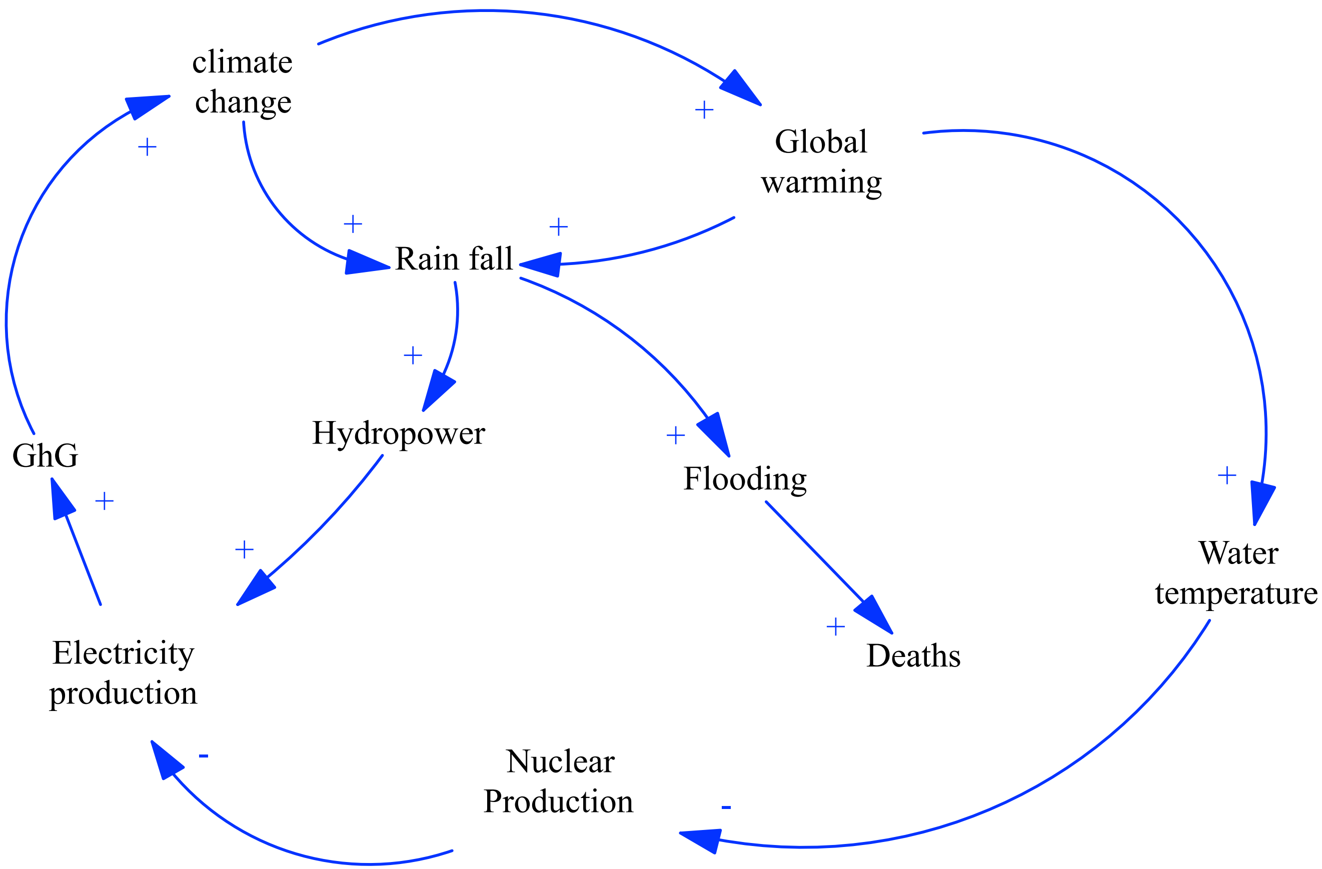
I assume a standard production function where Y_t is GDP, A_t is the total factor productivity, K_t is the capital stock, and $h_t L_t$ is *effective* labor used in production, which can be further decomposed as h_t human capital *per worker*, and L_t is the number of workers. β is the labor share.

$$Y_t = A_t K_t^{1-\beta}(h_t L_t)^{\beta} \tag{1}$$

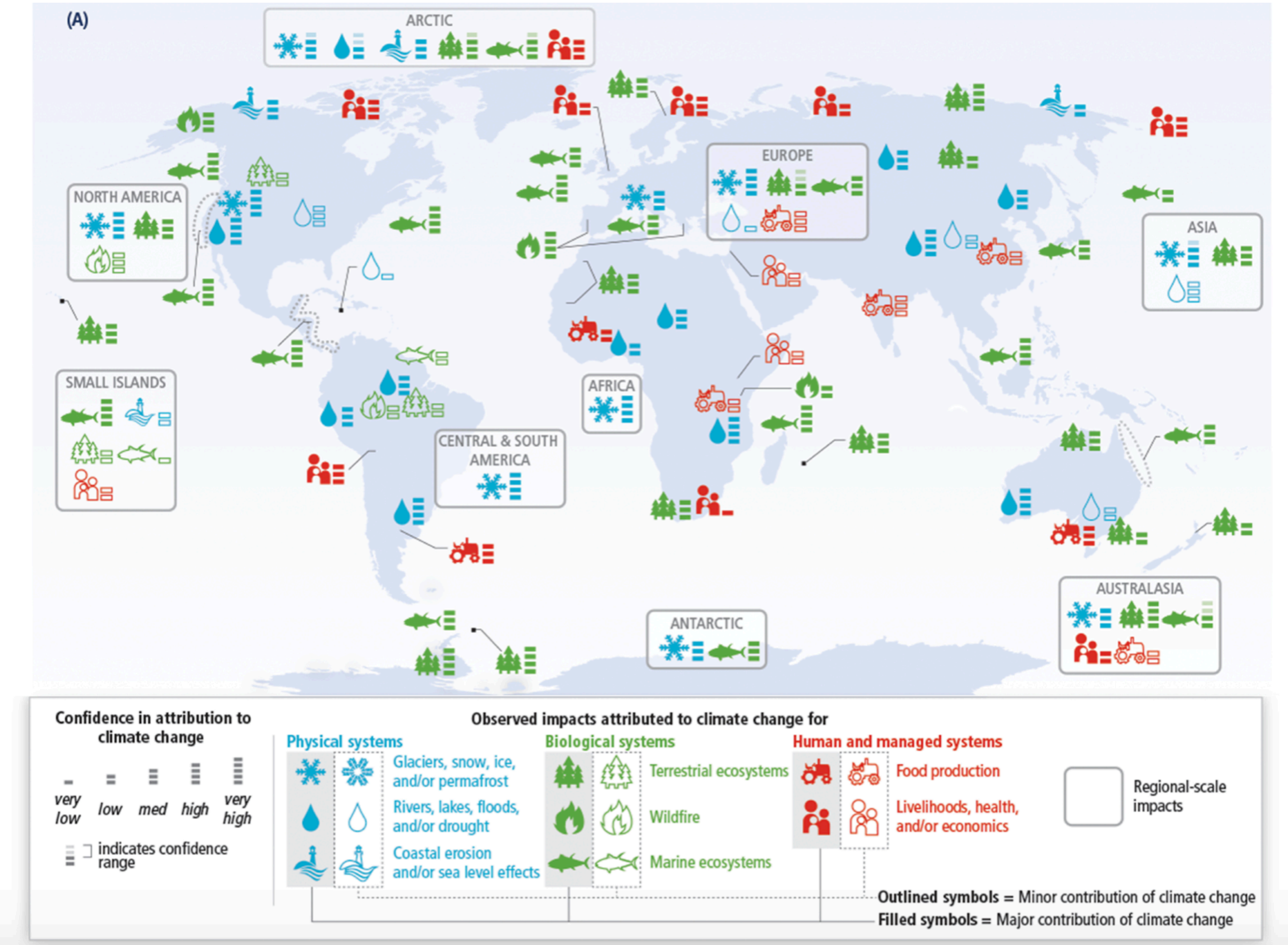
The Climate System

The Climate System

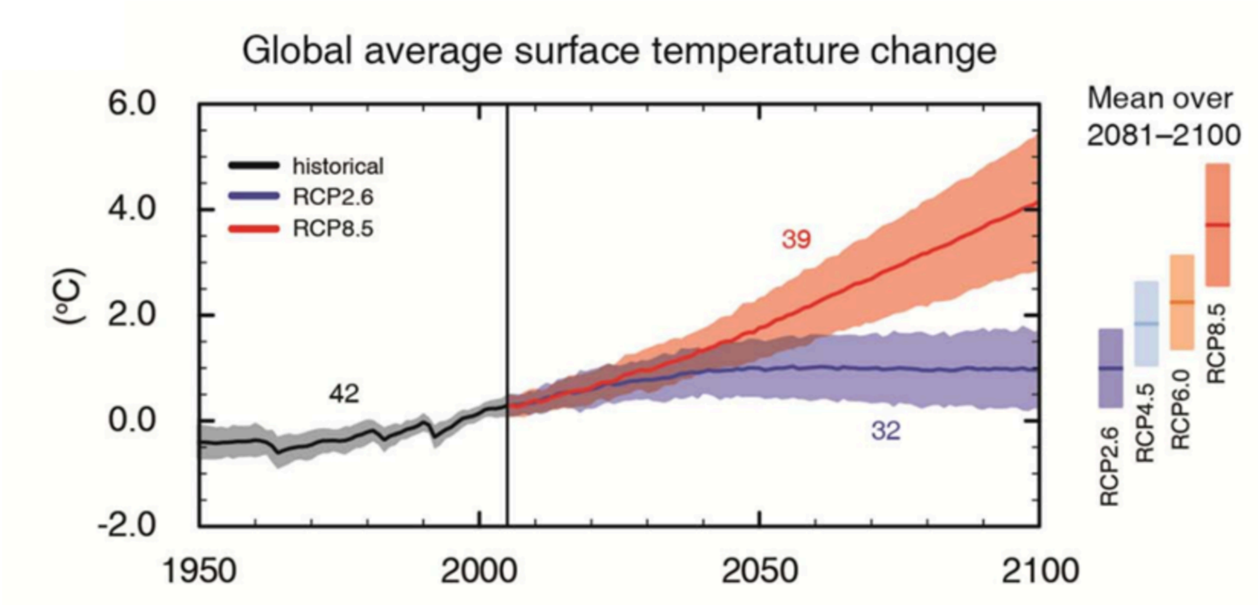



climate change
Global warming
Rain fall
Hydropower
Flooding
GhG
Water temperature
Deaths
Electricity production
Nuclear Production
+
-

Impacts Attributed to Climate Change (+ confidence in attribution)



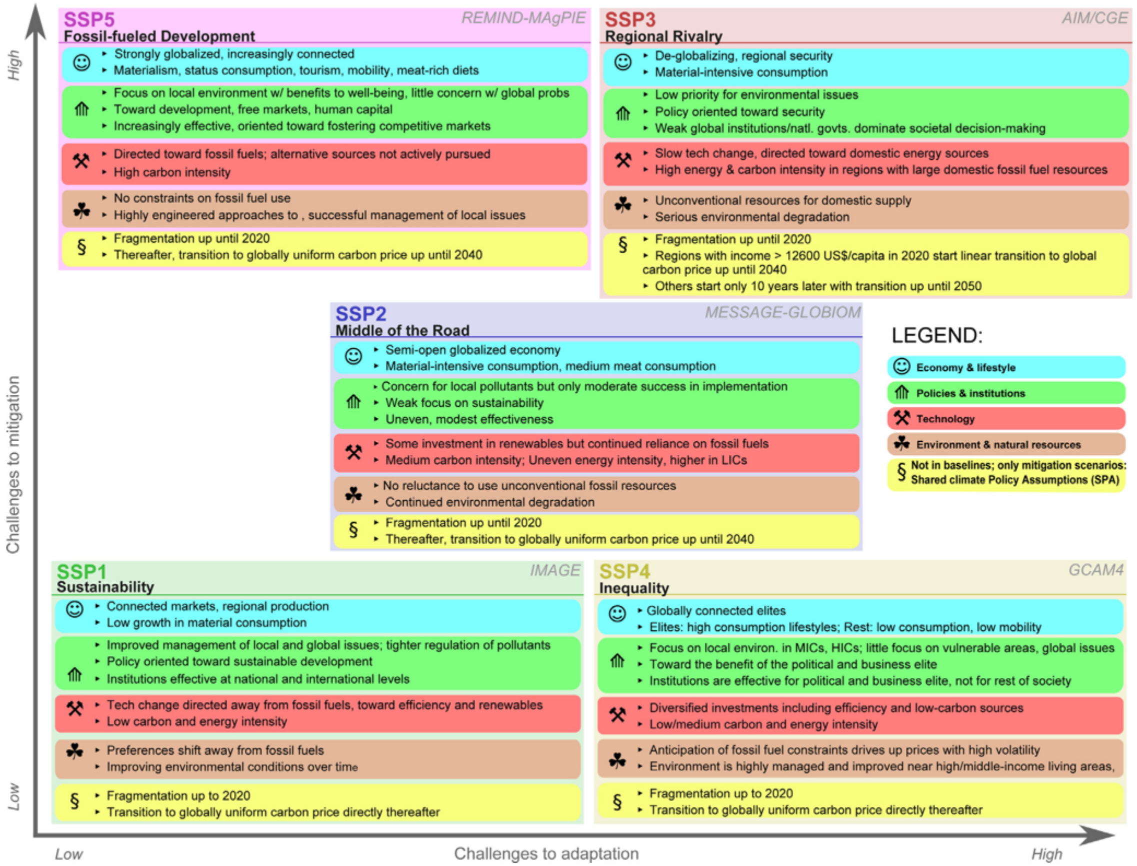
Temperature predictions to the year 2100 with different Representative Concentration Pathways RCP scenarios



Governments, policy makers and climate scientists have all resolved four different representative concentration pathway (RCP) scenarios to predict the average global temperature leading up to 2100. These four RCP values relate to what the radiative forcing could be by 2100 and are 2.6, 4.5, 6.0 and 8.5 respectively. For example, the RCP 2.6 has a radiative forcing of 2.6 (very similar to today's values – see graph below) whereas a RCP value of 8.5 has over 3 times the amount of warming by 2100. The figure above shows that there could be a huge difference in global average temperature depending of which RCP scenario the world adopts.

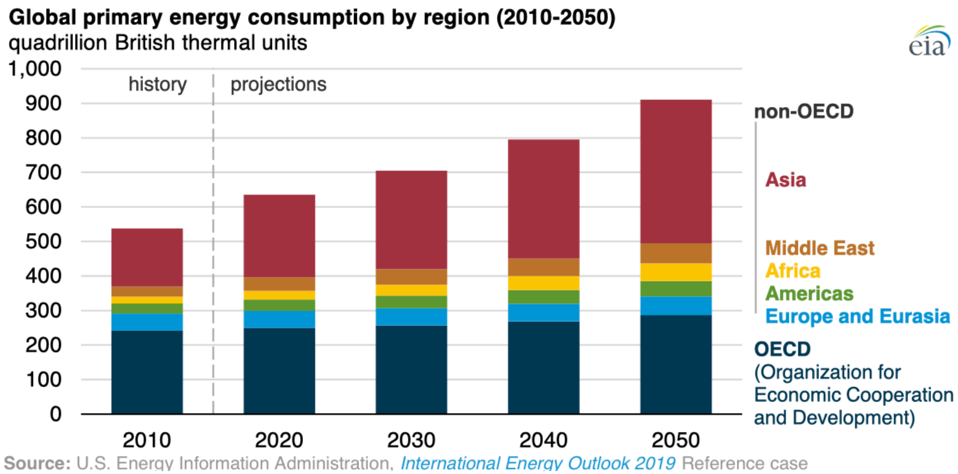
Scenarios for Mitigation / Adaptation

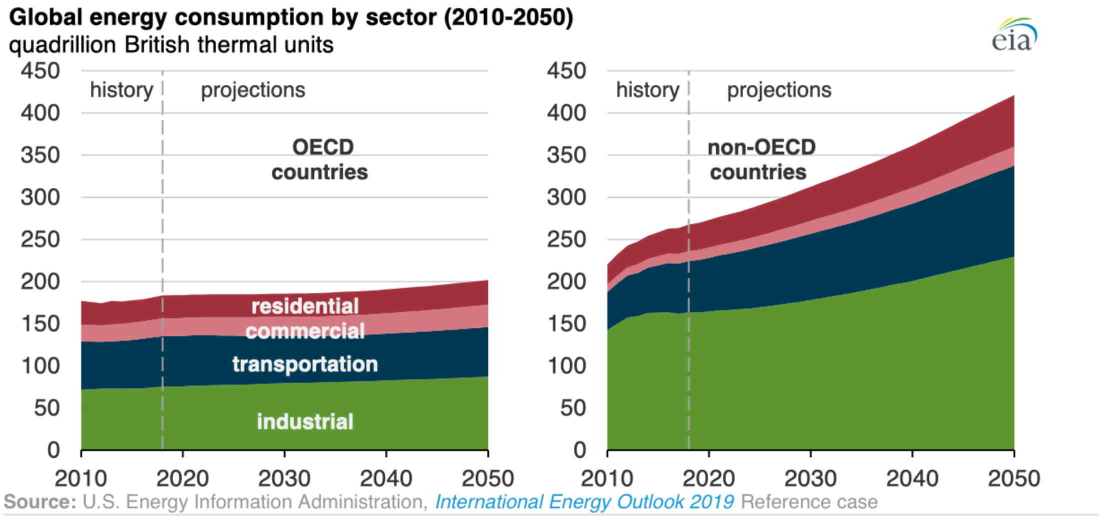
Source: O'Neill et al. (2014, p. 391; 2015, p. 2)



Source : bauer and al. (2017)

Our need of Energy is growing and will keep growing, Climate Mitigation is over, Climate Adaptation is on the way





So Climate is not the problem, the problems is the size of the economic system and the growth of population !!!!

Economists ' Land

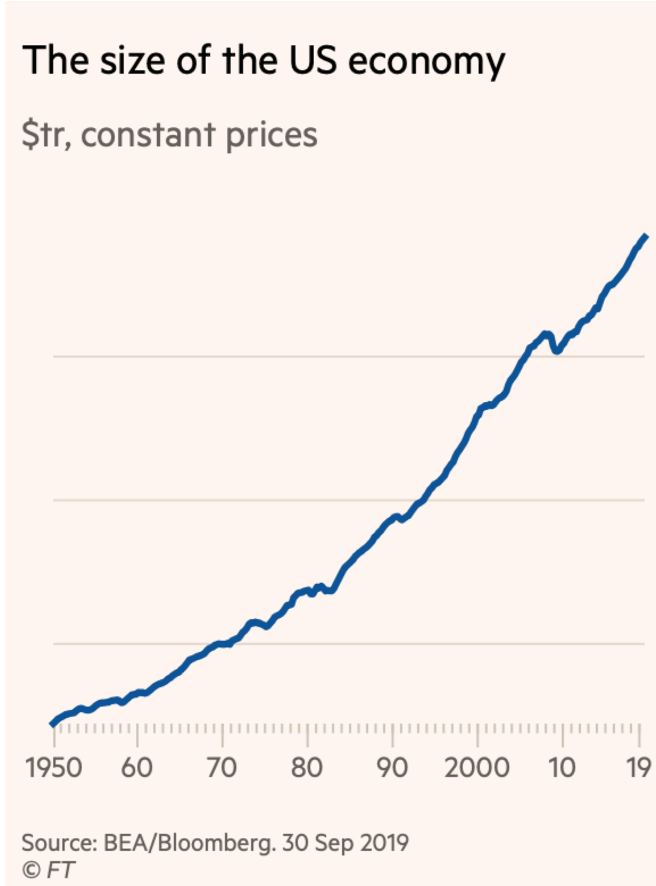
Wrong reprentation !
GDP = Activity level (Sum of Added Values), is not a well-being indicator
Let's see the drivers of GDP
GDP = C + I + X – IMP + G +- Stocks

Problem and Challenge

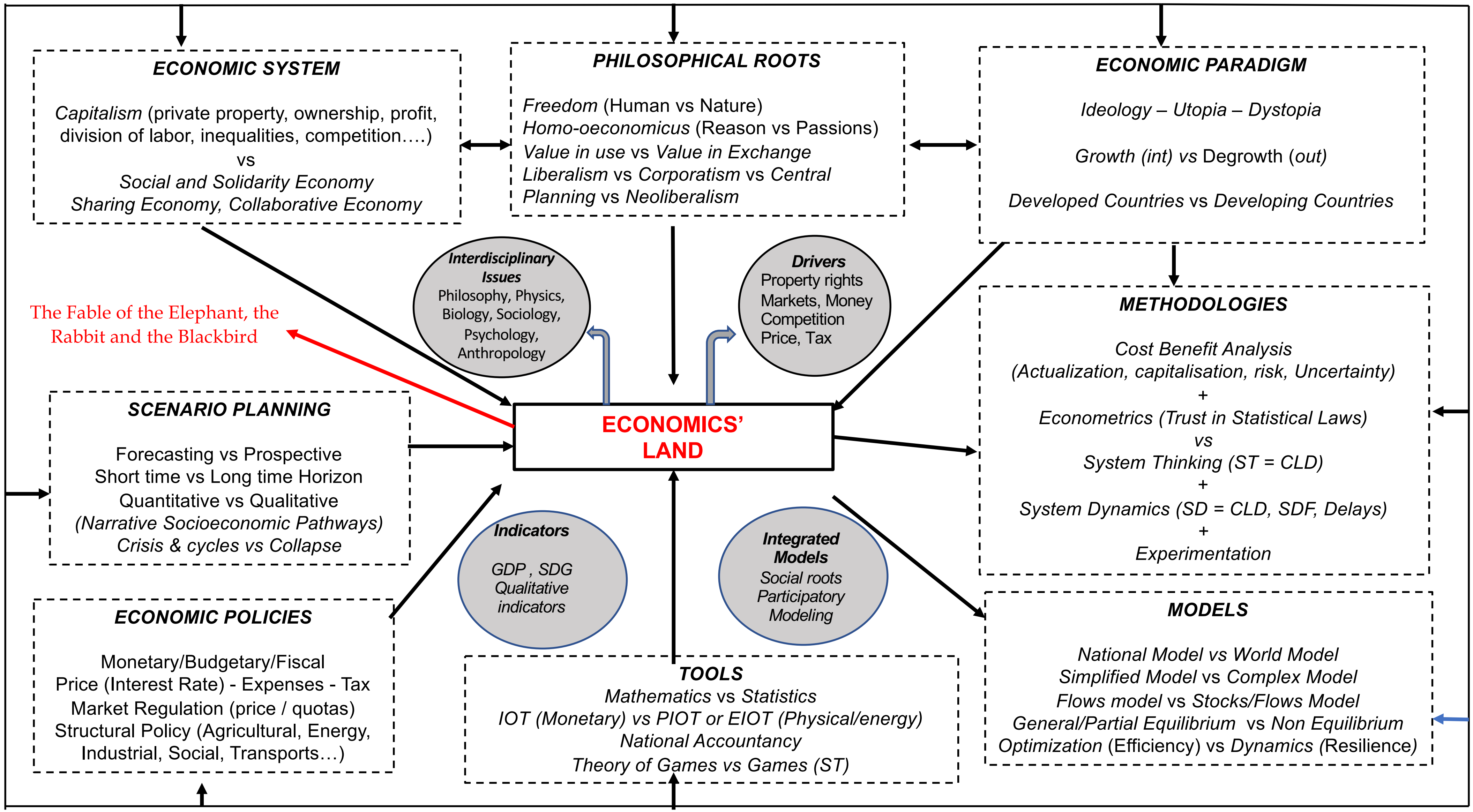
The problem is not the GDP (flows) but the size of the economy (stocks)

Challenge : How to reduce the size of the economy ?

Welcome to the No Men Land



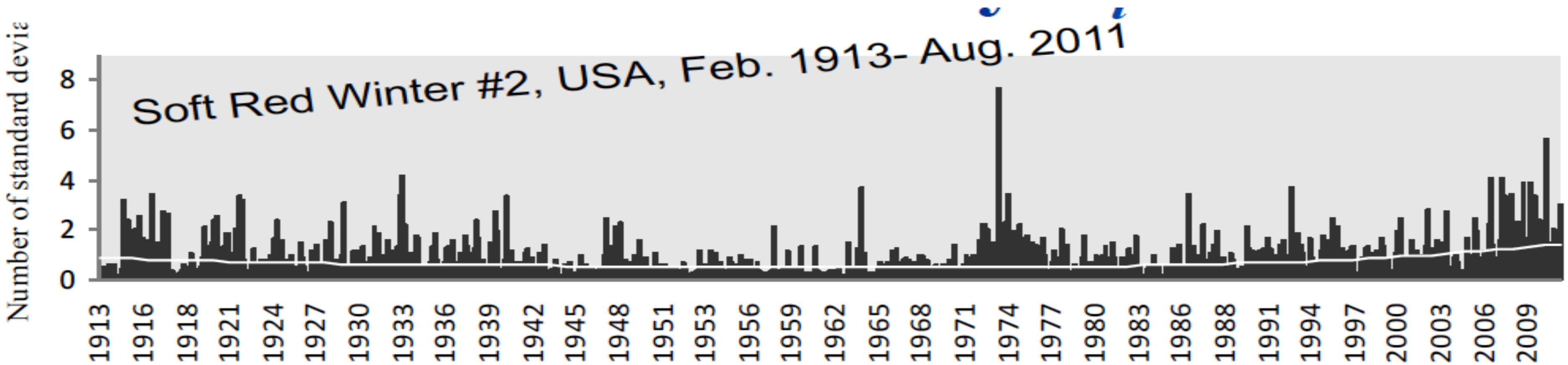
Good representation
Size = Commodification process (exchange value – price – market)
Education, Health…

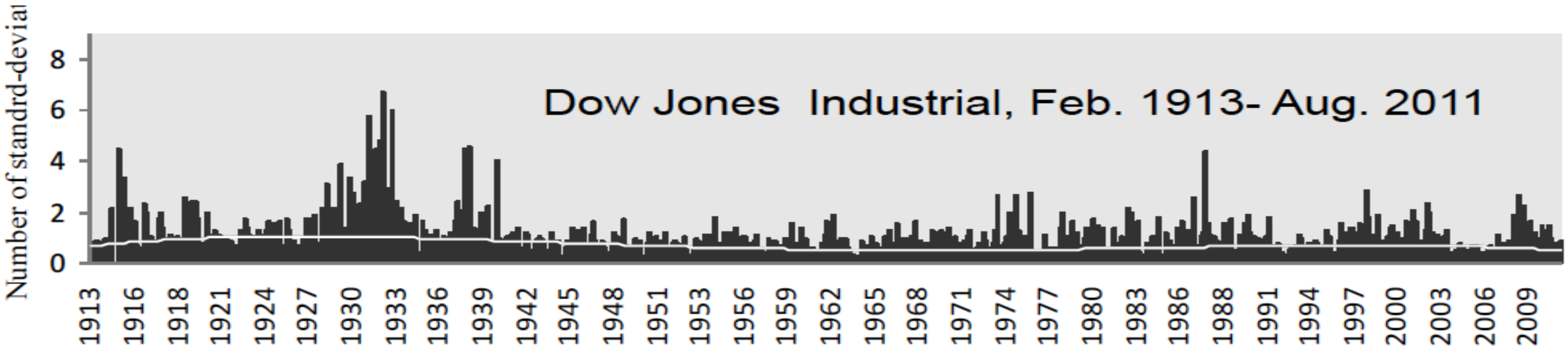

ECONOMIC SYSTEM
Capitalism (private property, ownership, profit, division of labor, inequalities, competition….)
vs
Social and Solidarity Economy
Sharing Economy, Collaborative Economy
PHILOSOPHICAL ROOTS
Freedom (Human vs Nature)
Homo-oeconomicus (Reason vs Passions)
Value in use vs Value in Exchange
Liberalism vs Corporatism vs Central Planning vs Neoliberalism
ECONOMIC PARADIGM
Ideology – Utopia – Dystopia
Growth (int) vs Degrowth (out)
Developed Countries vs Developing Countries
Interdisciplinary Issues
Philosophy, Physics, Biology, Sociology, Psychology, Anthropology
Drivers
Property rights
Markets, Money
Competition
Price, Tax
The Fable of the Elephant, the Rabbit and the Blackbird
METHODOLOGIES
Cost Benefit Analysis
(Actualization, capitalisation, risk, Uncertainty)
+
Econometrics (Trust in Statistical Laws)
vs
System Thinking (ST = CLD)
+
System Dynamics (SD = CLD, SDF, Delays)
+
Experimentation
SCENARIO PLANNING
Forecasting vs Prospective
Short time vs Long time Horizon
Quantitative vs Qualitative
(Narrative Socioeconomic Pathways)
Crisis & cycles vs Collapse
ECONOMICS' LAND
Indicators
GDP , SDG
Qualitative indicators
Integrated Models
Social roots
Participatory Modeling
ECONOMIC POLICIES
Monetary/Budgetary/Fiscal
Price (Interest Rate) - Expenses - Tax
Market Regulation (price / quotas)
Structural Policy (Agricultural, Energy, Industrial, Social, Transports…)
TOOLS
Mathematics vs Statistics
IOT (Monetary) vs PIOT or EIOT (Physical/energy)
National Accountancy
Theory of Games vs Games (ST)
MODELS
National Model vs World Model
Simplified Model vs Complex Model
Flows model vs Stocks/Flows Model
General/Partial Equilibrium vs Non Equilibrium
Optimization (Efficiency) vs Dynamics (Resilience)

Representation 1 : Methodology

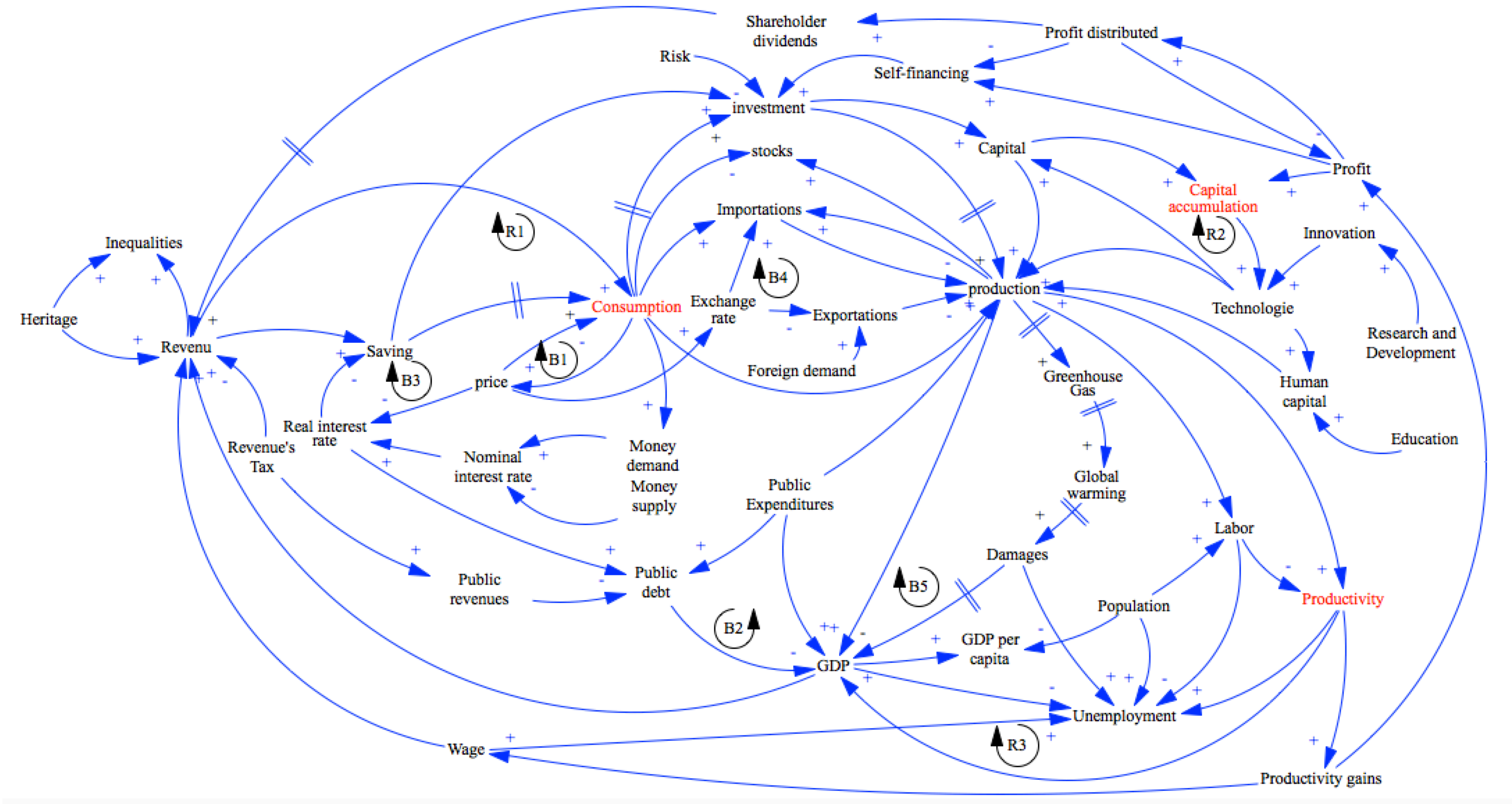
Econometrics – Linear System – Law of Large Numbers

Correlation vs Causality (System Dynamics) … (need much investigation)

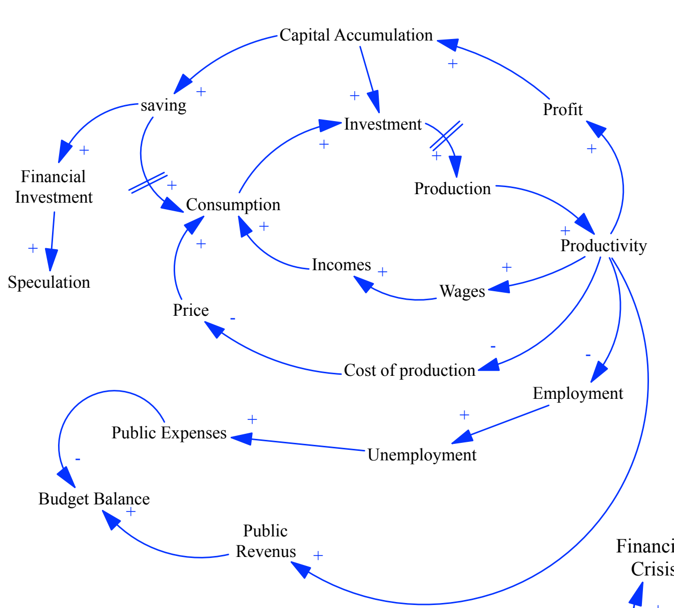




Representation 2
Economics Dynamics

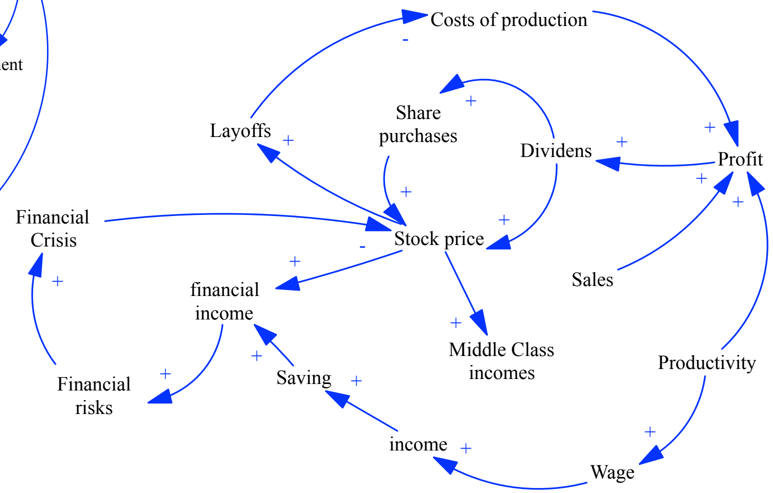


Three Loops of the Economic Dynamic



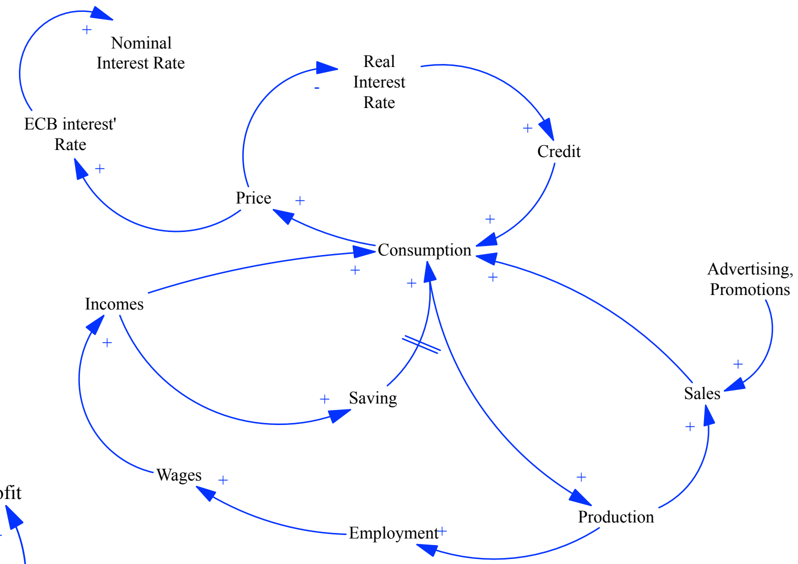
Productivity Loop

To reduce working time, at the same salary, you have to be more productive. 40 hours per week 35 hours per week + Hourly productivity



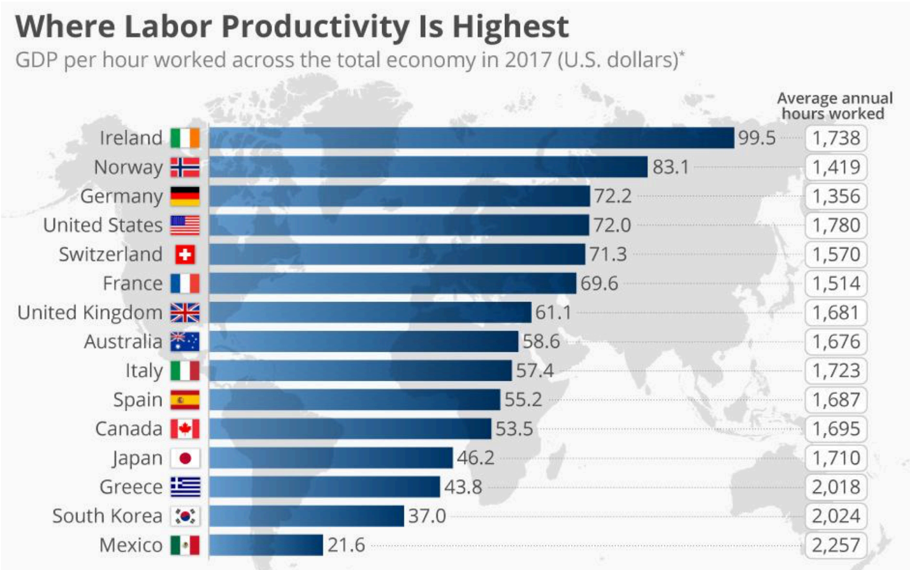
Capital Accumulation Loop

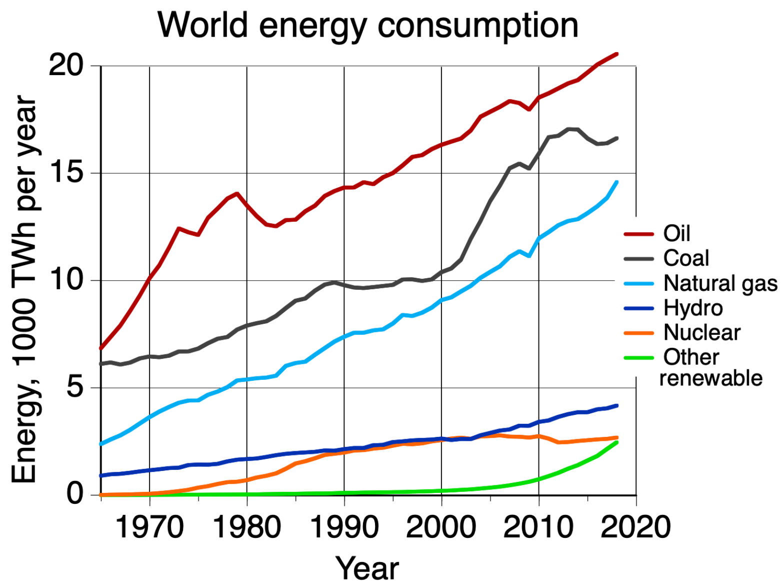
The French have savings equal to 5,000 billion euros = 2 times France's GDP

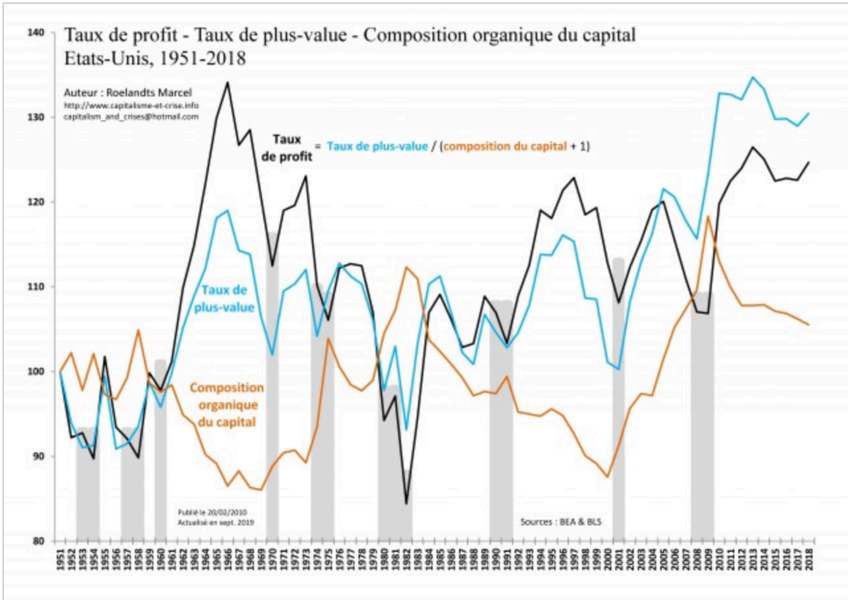


Consumption Loop

A Frenchman consumes 84% of his income, an American consumes 98% of his income

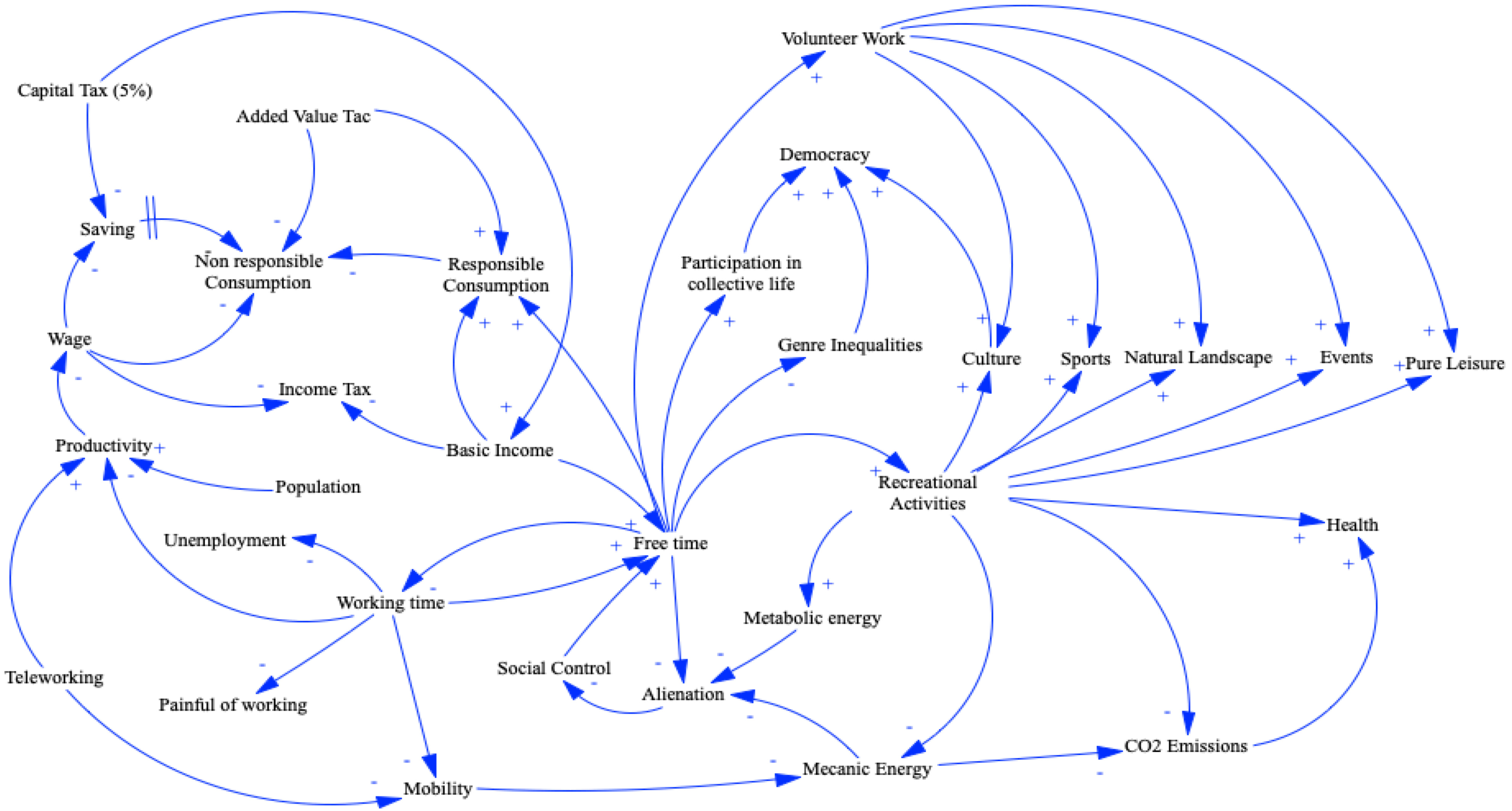

Where Labor Productivity Is Highest
GDP per hour worked across the total economy in 2017 (U.S. dollars)*
Average annual hours worked
Ireland 99.5 1,738
Norway 83.1 1,419
Germany 72.2 1,356
United States 72.0 1,780
Switzerland 71.3 1,570
France 69.6 1,514
United Kingdom 61.1 1,681
Australia 58.6 1,676
Italy 57.4 1,723
Spain 55.2 1,687
Canada 53.5 1,695
Japan 46.2 1,710
Greece 43.8 2,018
South Korea 37.0 2,024
Mexico 21.6 2,257


World energy consumption
Energy, 1000 TWh per year
0
5
10
15
20
1970
1980
1990
2000
2010
2020
Year
Oil
Coal
Natural gas
Hydro
Nuclear
Other renewable


Taux de profit - Taux de plus-value - Composition organique du capital
Etats-Unis, 1951-2018
Auteur : Roelandts Marcel
http://www.capitalisme-et-crise.info
capitalism_and_crises@hotmail.com
Taux de profit = Taux de plus-value / (composition du capital + 1)
Taux de plus-value
Composition organique du capital
Publié le 20/02/2010
Actualisé en sept. 2019
Sources : BEA & BLS
140
130
120
110
100
90
80

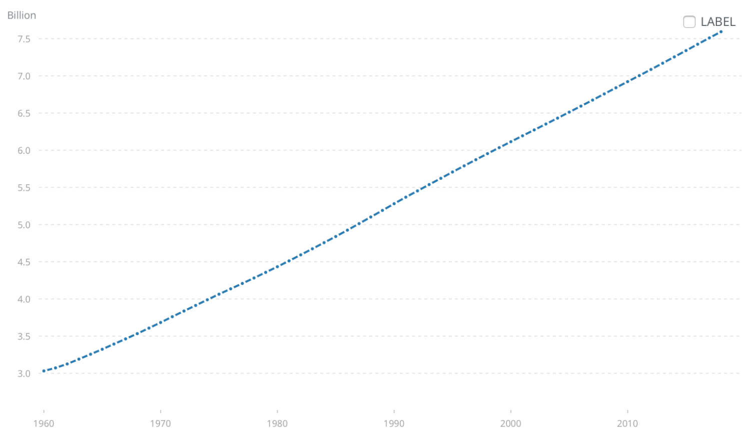
Challenge : How to reduce the size of the economy ?

Economic Diet = Reducing Working Time (strong sustainability)

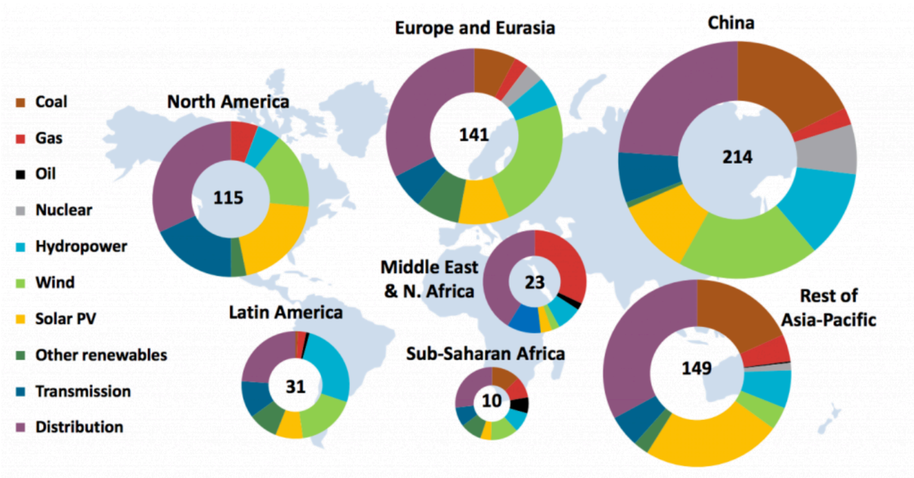


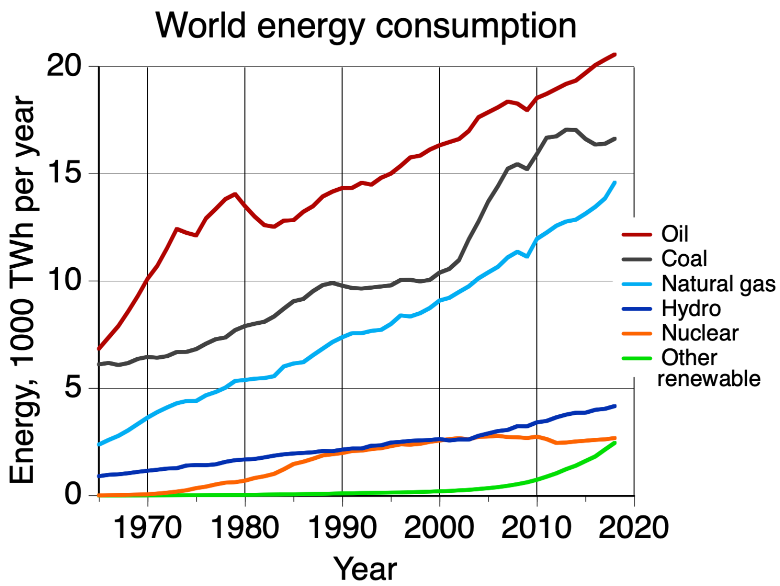
Touch the consumption, and so one the population, with renewable energy (weak sustainability, Mix Energetic)

Let's see the drivers of GDP = C + I + X – IMP + G +- Stocks



High income	2018	1,210,312.15
Low & middle income	2018	6,383,958.21
Low income	2018	705,417.32
Lower middle income	2018	3,022,905.17
Middle income	2018	5,678,540.89
Upper middle income	2018	2,655,635.72





IPAT Equation to Carbon Card

The IPAT equation was formulated during a controversy between Ehrlich - Holdren (1971, 1972) and Barry Commoner (1972) on the role of population growth in the degradation of the natural environment.

I = P x A x T represents the amount of emissions of a considered pollutant (GHG), P the population, Wealth (affluence) formalized by (GDP/capita), T the pollutant emissions per unit produced, depending on the technology

Kaya's identity (1990, 1993) used in the IPCC's Report (Rogner et al., 2007) takes up the IPAT equation by considering the environmental impact of CO_2 emissions. In addition, it divides the technological component into two factors, energy intensity (EI) and carbon intensity (CI). Energy intensity is the consumption of primary energy (PE) per unit of gross domestic product (GDP), which is the inverse of the productivity of the energy factor. Carbon intensity is the fossil energy content of a unit of primary energy

The Kaya equation is therefore as follows: $CO_2 = P \times GDP/P \times EI \times CI$

$$\text{Emissions de CO2} = \underbrace{\frac{\text{Emissions de CO2}}{\text{Energie consommée}}}_{\text{Contenu en carbone de l'énergie}} \times \underbrace{\frac{\text{Energie consommée}}{\text{PIB}}}_{\text{Intensité énergétique du PIB}} \times \underbrace{\frac{\text{PIB}}{\text{Population}}}_{\text{PIB par personne}} \times \text{Population}$$

From the Kaya equation, it is possible to analyze the consequences of an increase in consumption. For example, the increase in the number of cars in the global fleet.

$$\text{Emissions de CO2} = \underbrace{\frac{\text{Emissions de CO2}}{\text{Energie consommée}}}_{\text{Contenu en carbone de l'énergie}} \times \underbrace{\frac{\text{Energie consommée}}{\text{Distance parcourue}}}_{\text{Intensité énergétique par kilomètre}} \times \underbrace{\frac{\text{Distance parcourue}}{\text{Nombre de véhicules}}}_{\text{Distance moyenne par véhicule}} \times \text{Nombre de véhicules}$$

In 2010, CO2 emissions from car was 225 g/km, average distance per car : 15 000 km and number of cars : 1 billon. Such a scenario gave for 2020 global CO2 emissions for cars of about 3.3 Gigatonnes

In 2018, CO2 emissions from car is 110g, average distance per car : 8900km and number of cars : 1.2 billon. Today such a scenario gives for 2020 global CO2 emissions for cars about : 1.17 Gigatones…

Technology compensates for the increase in the number of cars on the market.

Closed Loop Diagram :
Urbanization – Energy – Global Warming –Air Conditioning

The fable of the Elephant, the Rabbit and the Black flycatcher.

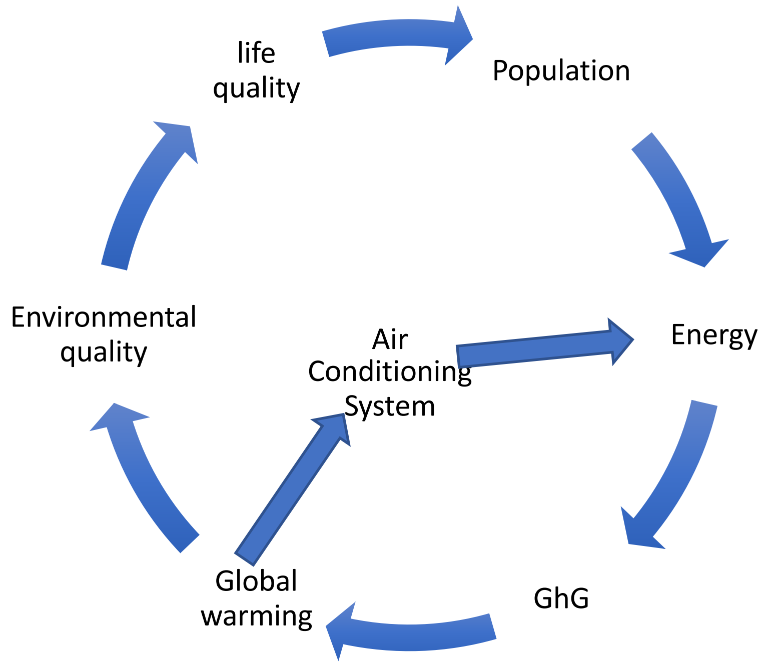
More growth and more population mean more energy, more GHG, more global warming… more air conditioning system… more energy…

USA: 45% of energy come from Air conditioning.
France : 3% of french people has air conditioning system
If 50% of french people would have air conditioning = it would be the equivalent of 20 nuclear plants.

Renewable energy is necessary but not sufficient :
Wind plant (2 MW) produce 4 GWh/year, equivalent of 1200 people… For a city of 150 000 people = 125 wind plants
Wind Plant (3 MW) with much wind produce 8 GWh/year, equivalent of 2300 people, For a city of 150 000 people = 65 wind plants

Mitigation policy is no more realistic → Adaption policy will be the target.

One solution : reduce our consumption



Drivers of Urban Dynamics