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
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**The statement** : “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 cannot threaten 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 \(\rightarrow\) causalities and interlinkages (Diemer, 2009)
Climate as Energy are inputs for production.

The Long Term Growth Model of the World Bank

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

Steven Pennings (spennings@worldbank.org)
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- **NEW** in LTGM v4: effect of growth on poverty (via log-normal income distribution, Section 6)
- The neoclassical growth model is based on Solow (1956), Swan (1956) and Leca 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 ($I/Y$) → implied per-capita GDP growth.
- Model 2: assume a path of growth in GDP per capita → required investment share of GDP ($I/Y$).
- Model 3: assume a path for the savings share of GDP ($S/Y$) → 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 8 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. $\beta$ is the labor share.

$$Y_t = A_t K_t^{1-\beta} (h_t L_t)^\beta$$  (1)
The Climate System
The Climate System
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
The problem is not the GDP (flows) but the size of the economy (stocks)

Challenge: How to reduce the size of the economy?

Wrong representation!
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

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

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**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

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**ECONOMIC PARADIGM**

Ideology – Utopia – Dystopia

Growth (int) vs Degrowth (out)

Developed Countries vs Developing Countries

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**METHODOLOGIES**

Cost Benefit Analysis

(Evaluation, capitalization, risk, Uncertainty)

+ Econometrics (Trust in Statistical Laws)

vs

System Thinking (ST = CLD)

+ System Dynamics (SD = CLD, SDF, Delays)

+ Experimentation

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**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)

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**ECONOMIC POLICIES**

Monetary/Budgetary/Fiscal

Price (Interest Rate) - Expenses - Tax

Market Regulation (prices / quotas)

Structural Policy (Agricultural, Energy, Industrial, Social, Transports...)

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**SCENARIO PLANNING**

Forecasting vs Prospective

Short time vs Long time Horizon

Quantitative vs Qualitative

(Narrative Socioeconomic Pathways)

Crisis & cycles vs Collapse

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**INTERDISCIPLINARY ISSUES**

Philosophy, Physics, Biology, Sociology, Psychology, Anthropology

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**DRIVERS**

Property rights

Markets, Money

Competition

Price, Tax

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**INDICATORS**

GDP, SDG

Qualitative indicators

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**INTEGRATED MODELS**

Social roots

Participatory Modeling

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**TOOLS**

Mathematics vs Statistics

IOT (Monetary) vs PIOT or EIOT (Physical/energy)

National Accountancy

Theory of Games vs Games (ST)

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**THE FABLE OF THE ELEPHANT, THE RABBIT AND THE BLACKBIRD**
Representation 1: Methodology
Econometrics – Linear System – Law of Large Numbers
Correlation vs Causality (System Dynamics) … (need much investigation)
Representation 2
Economics Dynamics
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.

Three Loops of the Economic Dynamic

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.

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

<table>
<thead>
<tr>
<th>Income Level</th>
<th>Year</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>High income</td>
<td>2018</td>
<td>1,210,312,15</td>
</tr>
<tr>
<td>Low &amp; middle income</td>
<td>2018</td>
<td>6,383,958.21</td>
</tr>
<tr>
<td>Low income</td>
<td>2018</td>
<td>705,417.32</td>
</tr>
<tr>
<td>Lower middle income</td>
<td>2018</td>
<td>3,022,905.17</td>
</tr>
<tr>
<td>Middle income</td>
<td>2018</td>
<td>5,678,540.89</td>
</tr>
<tr>
<td>Upper middle income</td>
<td>2018</td>
<td>2,655,635.72</td>
</tr>
</tbody>
</table>
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.

$I = P \times A \times T$ 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 CO2 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: $CO2 = P \times GDP/P \times EI \times CI$
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.

In 2010, CO2 emissions from car was 225 g/km, average distance per car : 15 000 km and number of cars : 1 billion. 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 billion. 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.
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

- Population
- Urbanization
- Land Use
- Biodiversity
- Water
- Energy
- Health’s Problems
- Food
- Economics
- Employment
- Gender
- Housing Sector
- Transport sector
- Air Quality