Ecological economics

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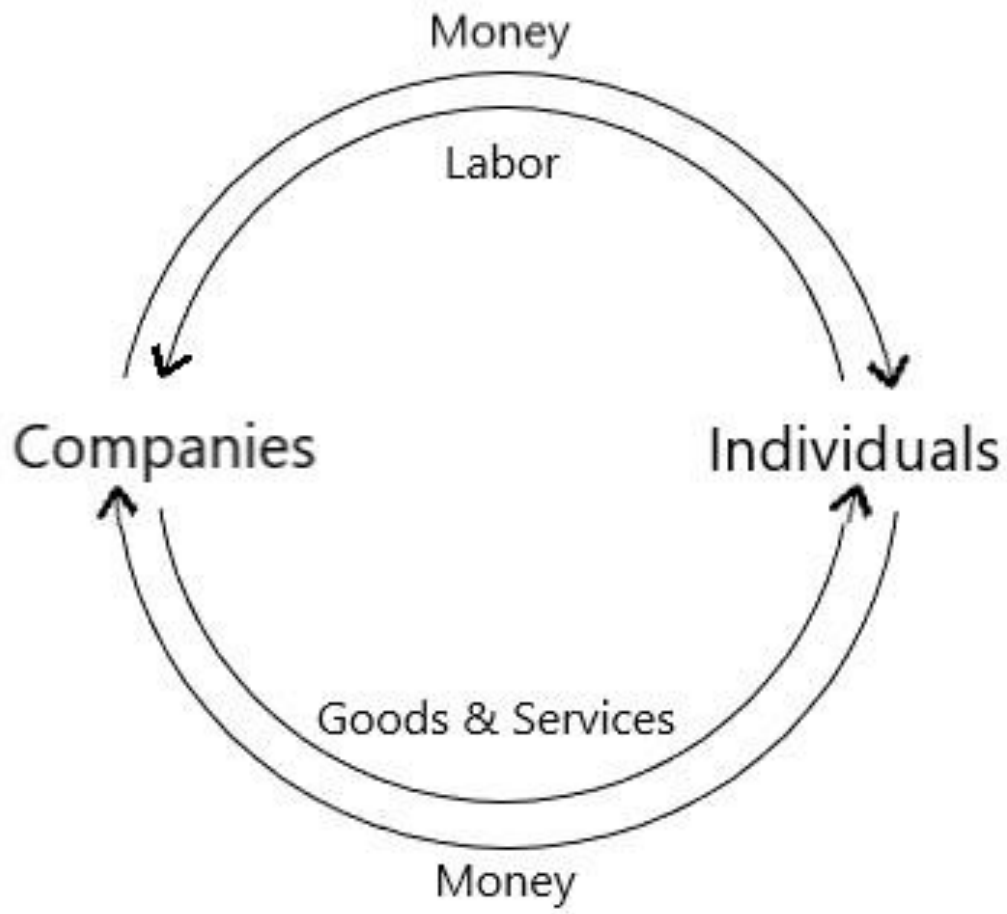
Circular model of neoclassical economics



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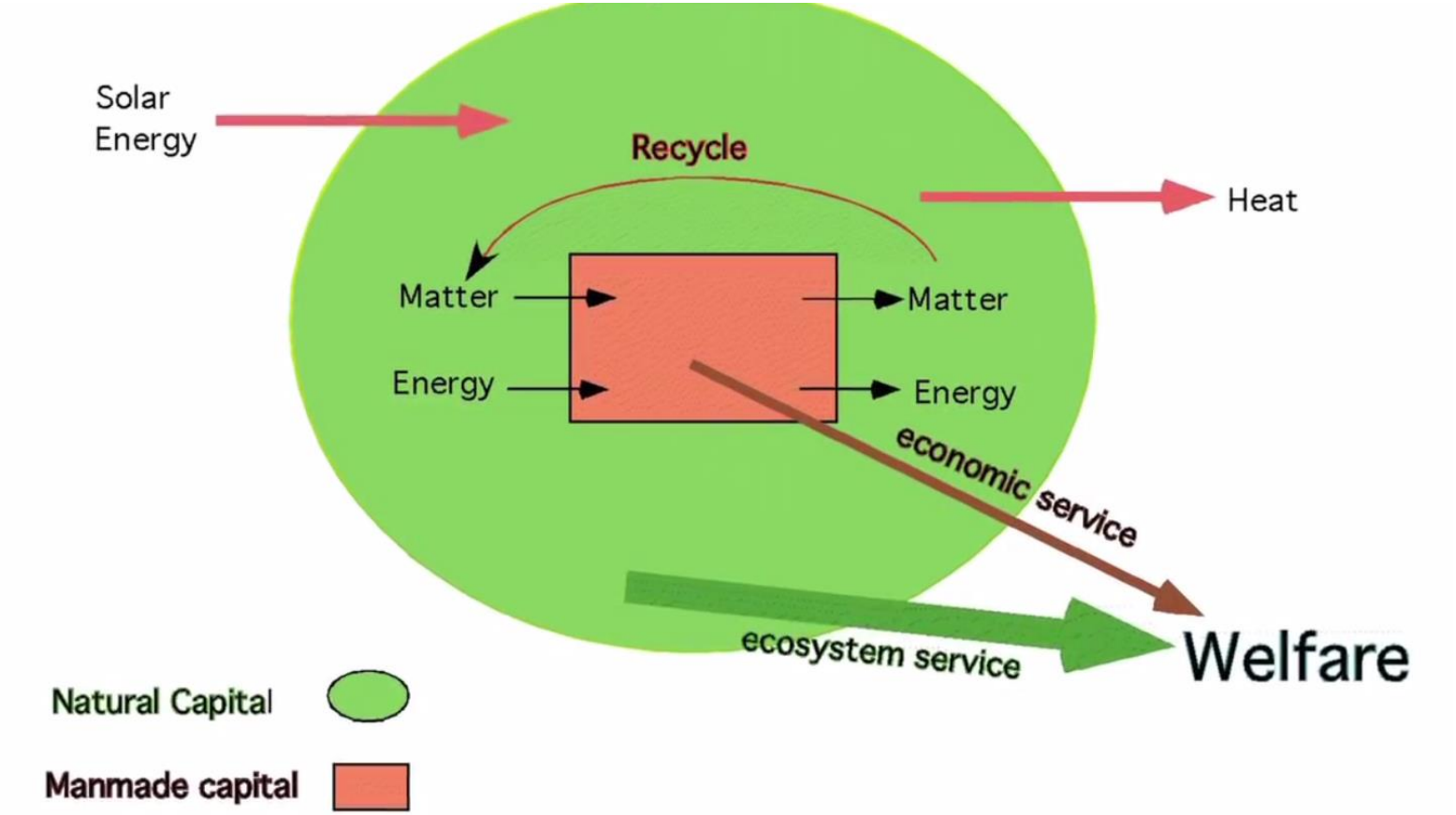
Mindset of traditional economics



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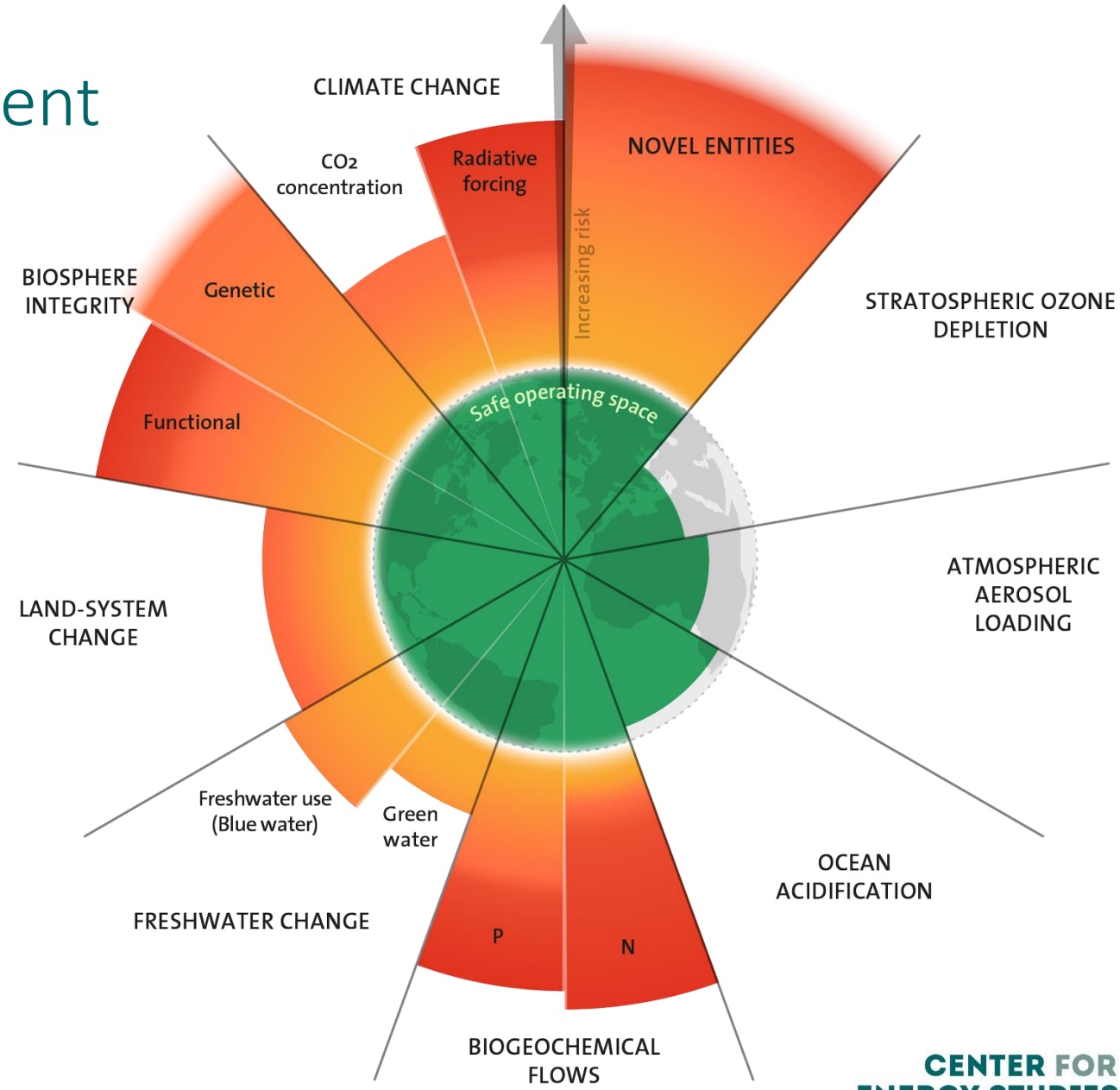
Environment



Holocene as a reference state

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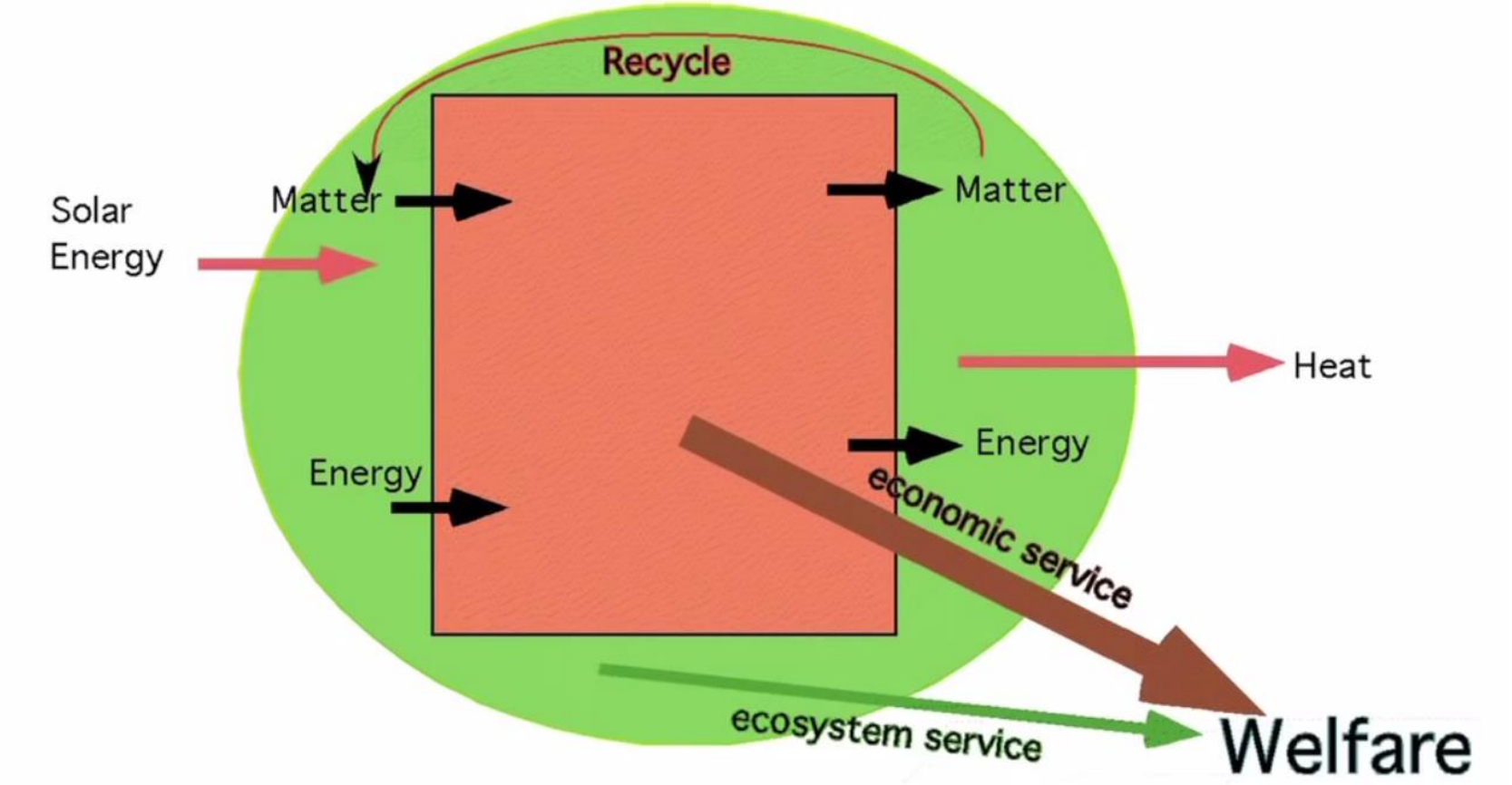
Modern 7bn people world



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Modern 7bn people world - economy embedded in the nature

- Ecological economics is a less homogeneous interdisciplinary normative approach that integrates the environment and economics, emphasizing the physical limits of our planet.
- Natural resources and solar energy provide essential inputs to economic processes. Society is ultimately dependent on these resources.
- The laws of thermodynamics override economic laws.
- The economic system is not unbounded and cannot grow indefinitely; it is limited by the availability of natural resources and the environment's ability to assimilate waste.
- The need and necessity for unending economic growth is questioned.

Sustainability instead of growth

- Rather than prioritizing infinite growth, ecological economists focus on defining a sustainable scale of economic activity that respects ecological limits.
- They are concerned about the overshoot of humanity's ecological footprint, driven in part by energy consumption.

Law of thermodynamics

- The conservation of energy principle states that the total energy of an isolated system remains constant, and energy (as well as matter) can be transformed but not created nor destroyed.
- As energy is transferred or transformed, an increasing amount of it is wasted, leading to an increase in entropy.

1) Technology will compensate for resource depletion

- Man-made capital can replace all types of natural capital (weak sustainability view) vs.
- Natural resources and services are irreplaceable (strong sustainability).

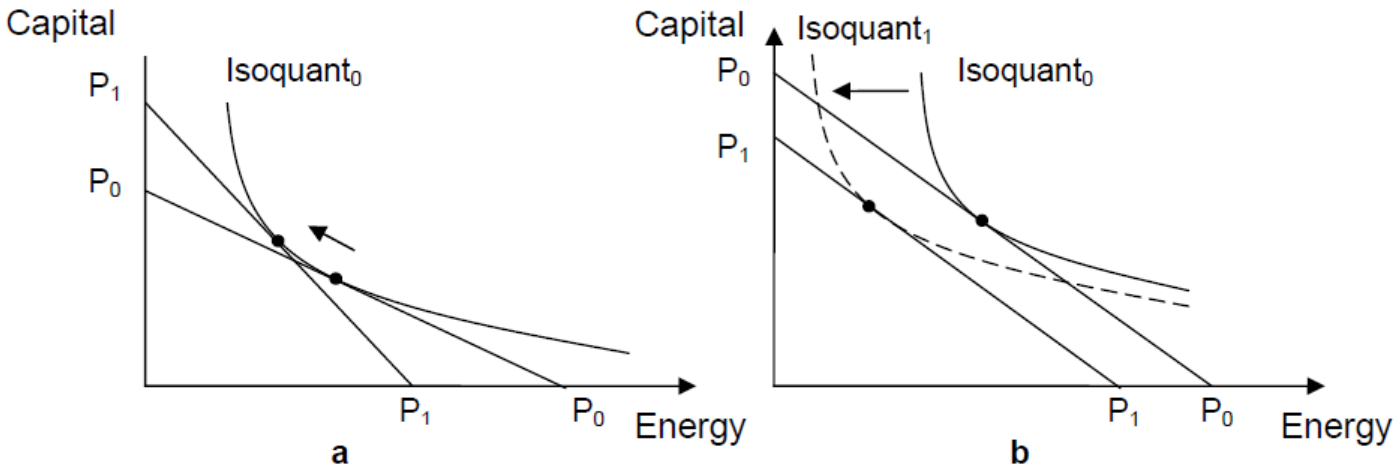

Figure 1 (*a*) Energy efficiency–improving substitution versus (*b*) energy-saving technological change.

Energy efficiency of engines

- ICE – gasoline around 50%, diesel 55-60%.
- Steam turbine - up to 60%.

- Modern thermal power plants – coal up to 50%, NGCC up to 60%, nuclear up to 35%.

2) New energy discoveries will satisfy increasing demand

- New (unconventional) sources of energy.

vs.

- EROEI = usable energy output/energy consumed. Global EROEI is declining (= you need to produce more gross energy to satisfy the same consumption).

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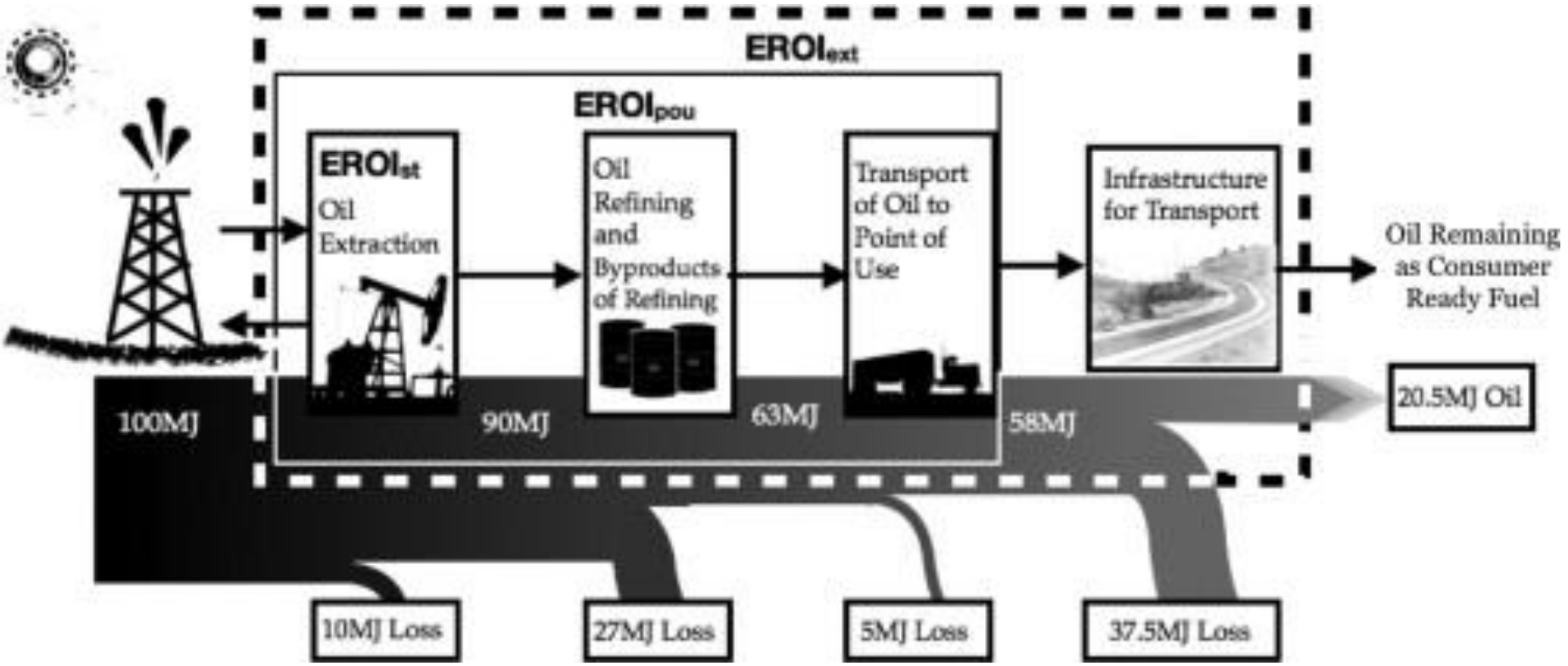
ERoEI

- Energy returned on energy invested – ratio of the amount of usable energy delivered from a particular energy resource to the amount of energy used to obtain that energy resource.
- Less then one – energy sink, net energy loss.

ERoEI


EROIext
EROIpou
EROIst
Oil Extraction
Oil Refining and Byproducts of Refining
Transport of Oil to Point of Use
Infrastructure for Transport
Oil Remaining as Consumer Ready Fuel
100MJ
90MJ
63MJ
58MJ
20.5MJ Oil
10MJ Loss
27MJ Loss
5MJ Loss
37.5MJ Loss

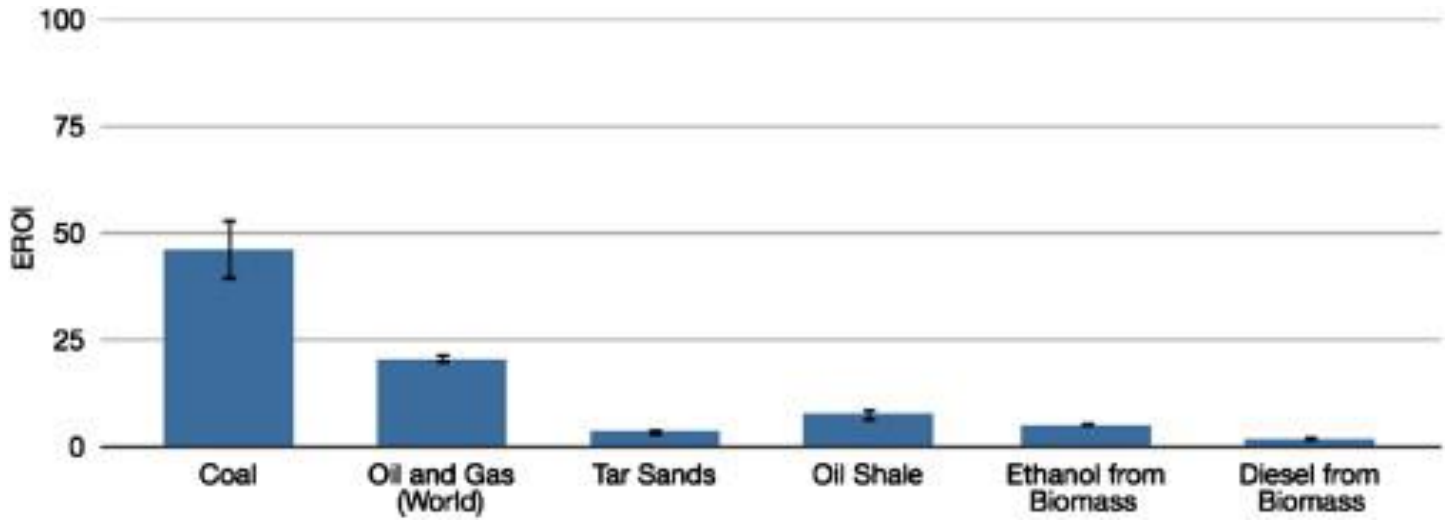
ERoEI

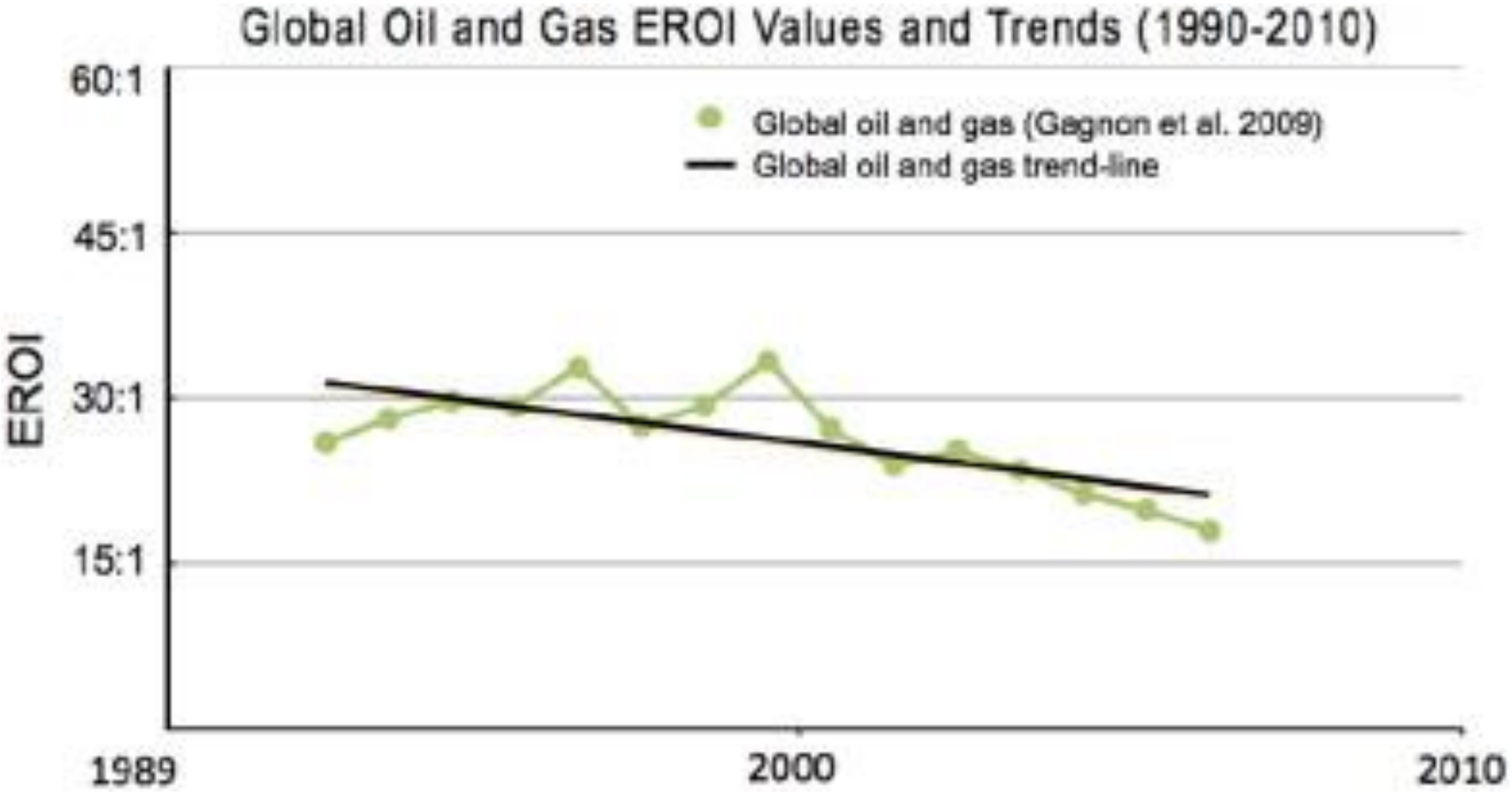
- Standard ERoEI – divides the energy output for a project (region, country) by the sum of the direct and indirect energy used to generate that output.
- Point of use ERoEI – includes additionally the costs associated with refining and transporting the fuel
- Extended ERoEI – considers the energy required not only to get but also to use a unit of energy.
- Societal ERoEI – all gains from fuels and all costs of obtaining these fuels.

EROEI of different sources of energy

Oil in the beginning of oil business	100
Oil in Texas around 1930	60
Oil in the Middle East	30
Other oil	10-35
Natural gas	20
High quality coal	10-20
Low quality coal	4-10
Water power plants	10-40
Wind power plants	5-10
Shale oil	5
PV power plants	2-5
Nuclear energy	4-5
Oil sands	max. 3
Shale oil	max. 1,5
Biofuels (in Europe)	0,9 - 4

EROEI of different sources of energy





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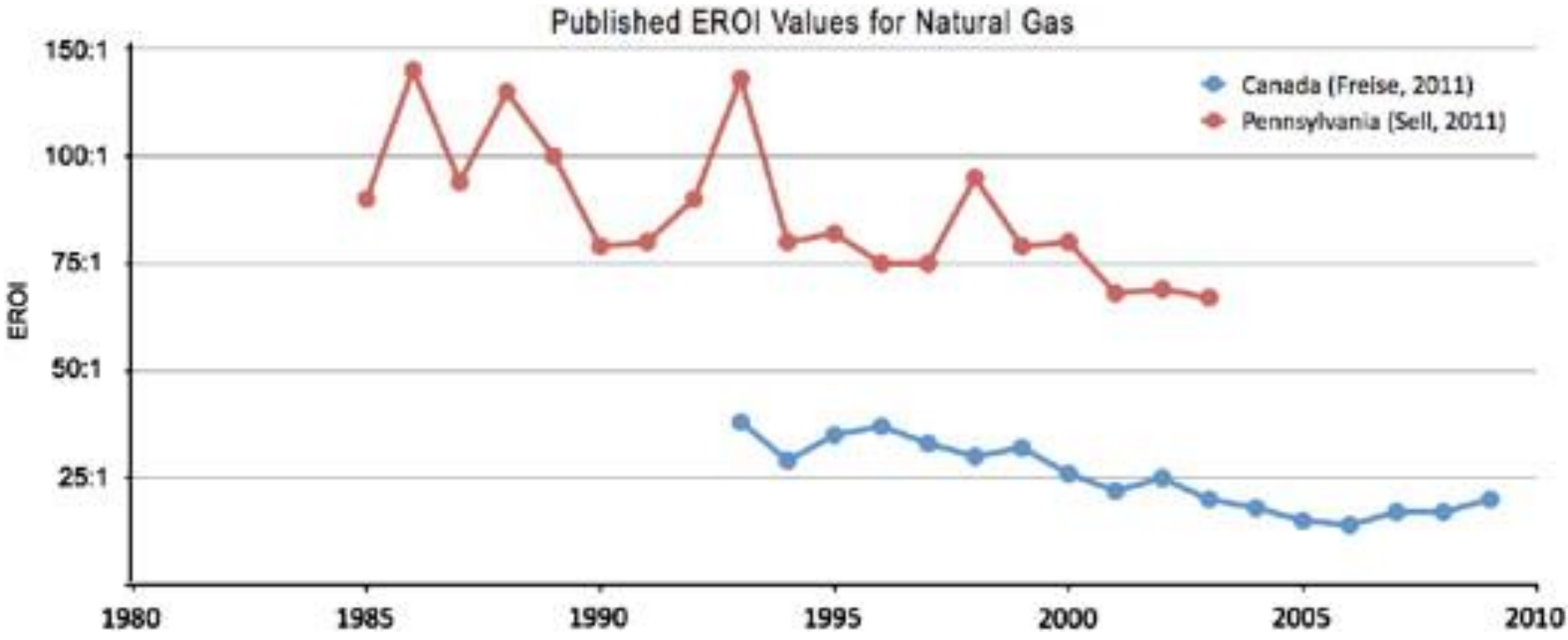

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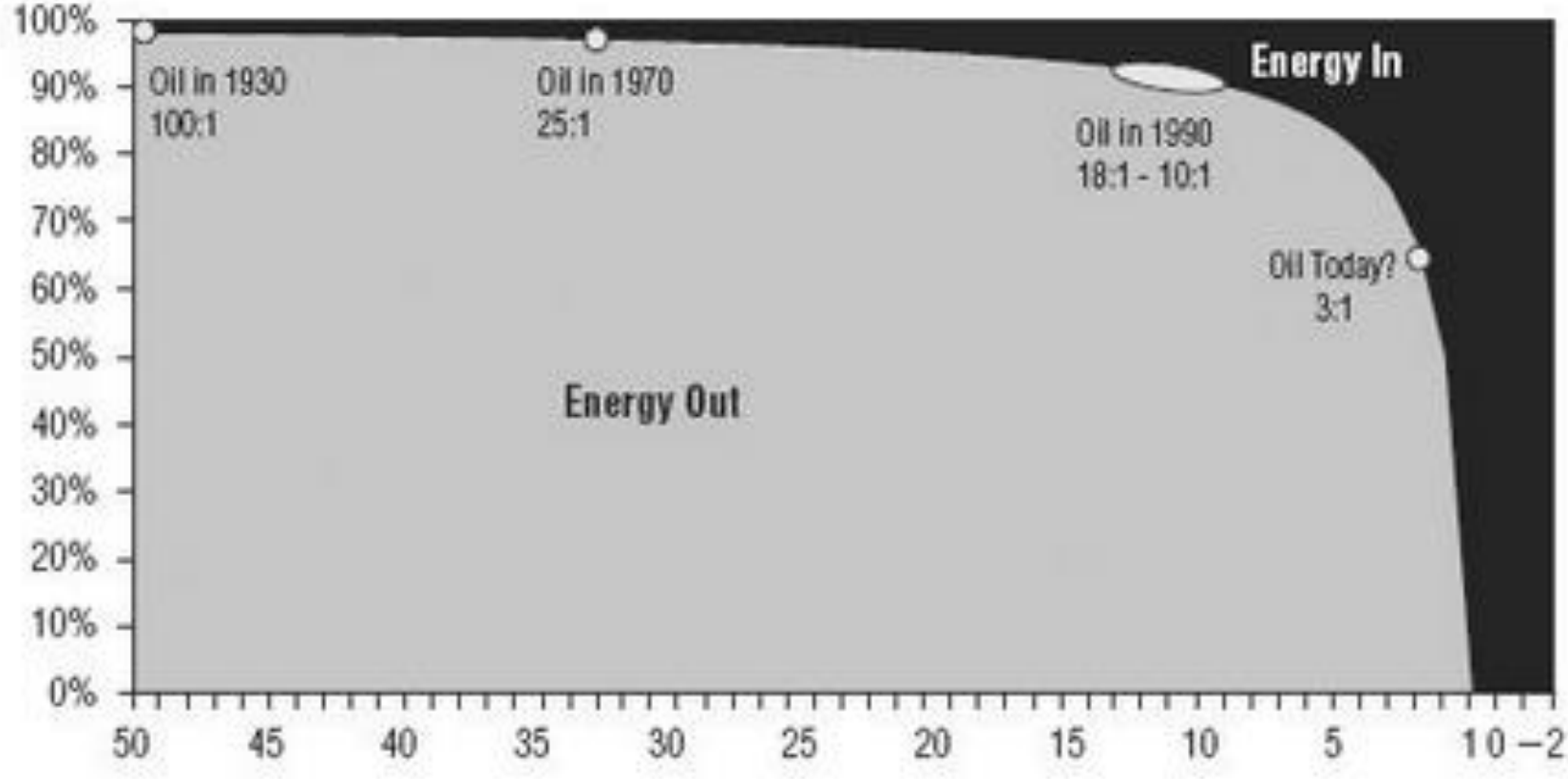

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3) Energy efficiency solution vs. Jevons paradox

- Originated in the 19th century, named after economist William Stanley Jevons (1865).
- Early steam engines were inefficient but improvements in efficiency led to more widespread use, increasing coal consumption.
- Increasing the efficiency of a resource's use can lead to higher, not lower, consumption of that resource.
- Efficiency improvements may encourage more extensive use or new applications, offsetting conservation efforts.

4) Substitutability of energy resources

- Different energy resources possesses different characteristics determining their utility in various applications (energy density, storability, intermitency).
- Infrastructure compatibility.
- EROEI.
- Different social impact.

- Ecological economists stress the need to understand resources not just in terms of their market value or energy content, but also in terms of their broader ecological, social, and qualitative context.
- Intrinsic characteristics of resources, their roles in ecosystems, and their unique contributions to human well-being cannot always be captured by market prices alone.
- Not all forms of capital are perfectly substituatable.

5) New technologies are the solution

- New energy sources/technologies.

VS

- „Are there any?“

- Beginning of modern petroleum industry in 1859 (E. Drake in Pennsylvania).
- Beginning of modern natural gas industry around 1820s in Ohio and Pennsylvania.
- Nuclear energy – 1930s (E. Fermi).

- Combustion engine 1872, steam engine 1698, electric engine 1832, solar panel 1883.

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Ecological economics

- Emphasis on nature, justice, time (sustainability). Highly normative (prescriptive).
- Technological scepticism (vs. mainstream economists optimism).
- Economy is contained within the ecosystem of the planet; boundaries of the economy must remain within the boundaries of the ecosystem.
- Carrying capacity of the environment.
- Scarcity of resources, limited supply of environmental services. Firstly to focus on maintaing the environment, then assesing its costs in dolar terms.
- Laws of thermodynamics apply (we cannot create the matter or energy, we need to work with what is available).
- Claimed to be more appropriate framework for today´s world.

Main differences between environmental and ecological economics

Question	Viewpoint of Environmental Economics	Viewpoint of Ecological Economics
How is the value of the environment determined?	Using economic value, based on people's willingness to pay.	Economic value may be useful, but also recognizes inherent values.
How are values measured?	Convert all values to monetary terms if possible.	Some values, particularly inherent value, cannot be expressed in monetary terms.
Advocate market-based solutions to market failures?	Yes, in the majority of cases.	Perhaps, but micro-level market solutions may fail to address macro-level issues.
Consideration given to future generations?	Some, with weights inferred from market activity.	More weight given to future generations based on ethical considerations.
Is value neutrality desirable?	Economics aims to be value neutral (objective).	Values are acceptable in a pluralistic framework.
What is sustainable development?	Maintaining the well-being of humans across time.	Maintaining ecological functions across time.
Are there ultimate limits to economic growth?	Perhaps not, at least in the foreseeable future.	Very likely, based on the limited availability of natural resources.

Sources

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Is steady-state economics/degrowth possible? (Polemic)

- People would never voluntarily walk away from competitive consumerism.

VS

- People over-consume not because of their inner values but because they feel compelled to do so and because our economy is structured to incentivize consumption.
- Our political system defends the interests of capital.
- There is an increasing demand for change.

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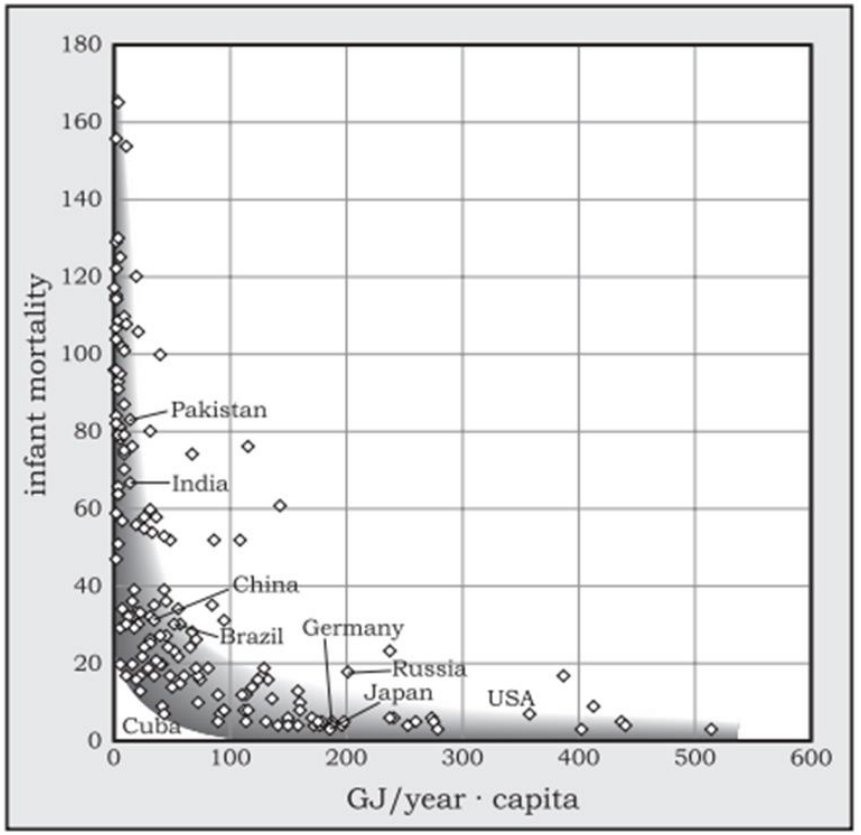
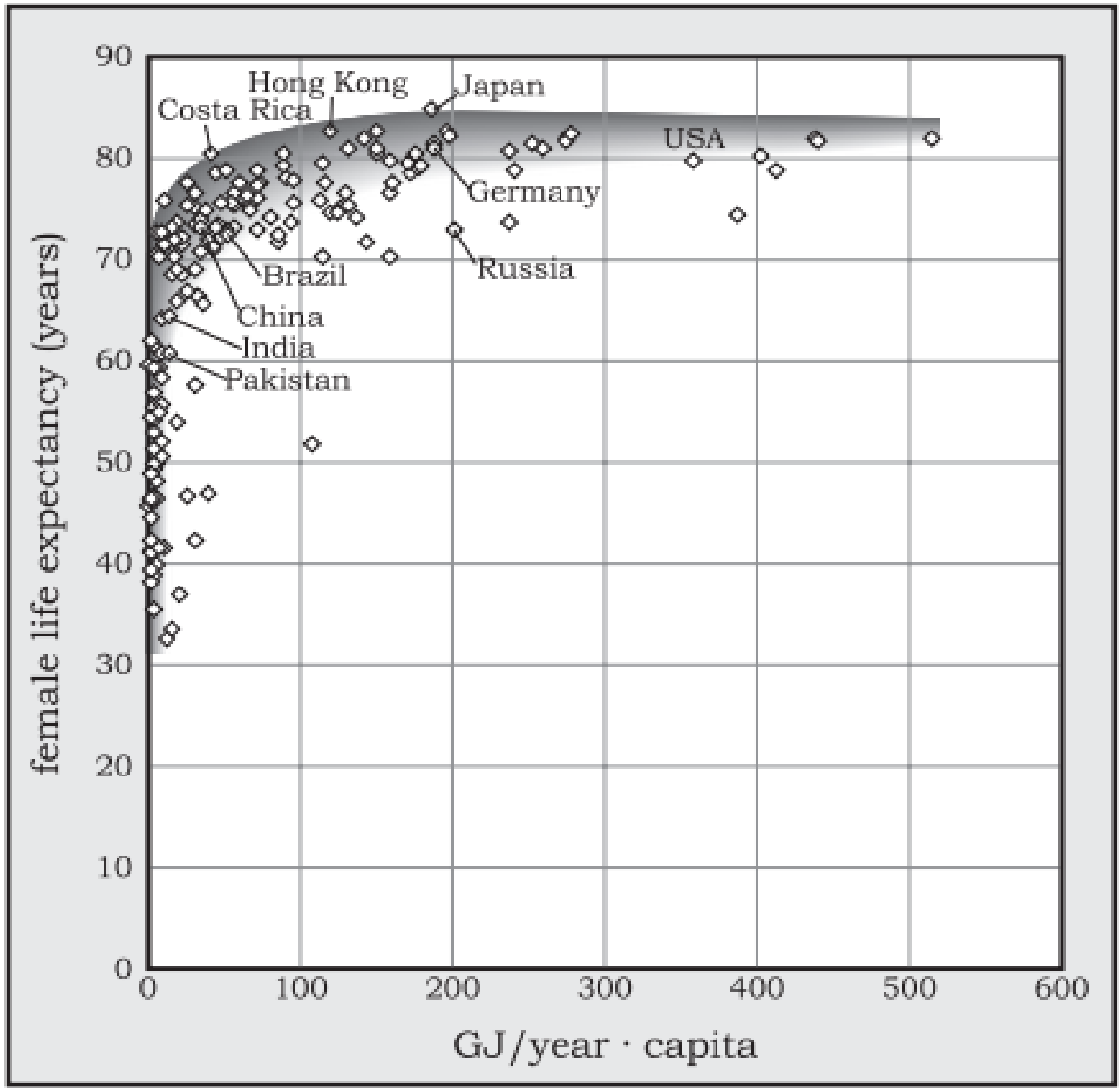
- Simple growth (increase in output, GDP) vs. development (improvement of the quality of life).



Per capita energy use and infant mortality.



Per capita energy use and female life expectancy at birth.

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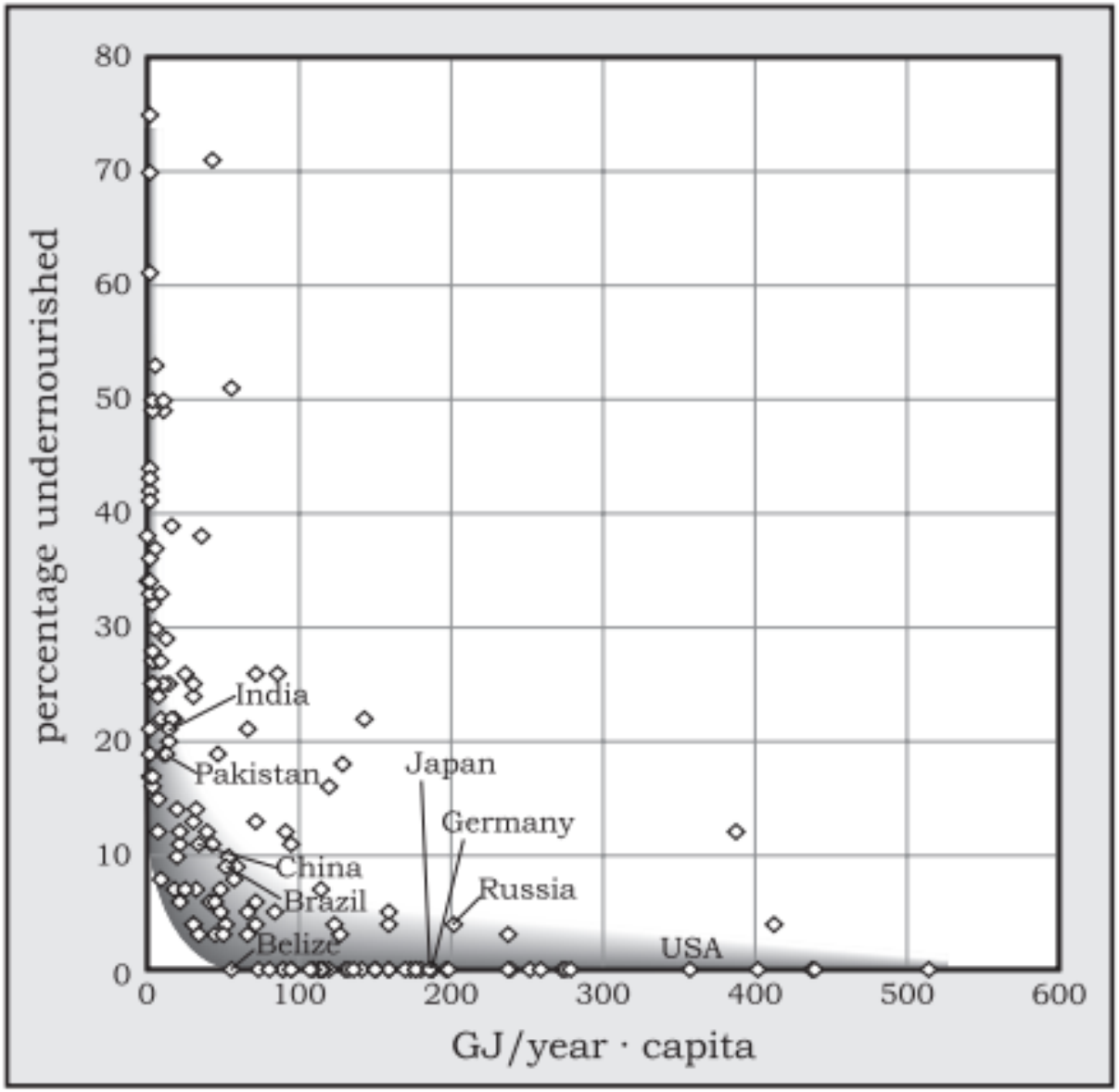

Per capita energy use and malnutrition.

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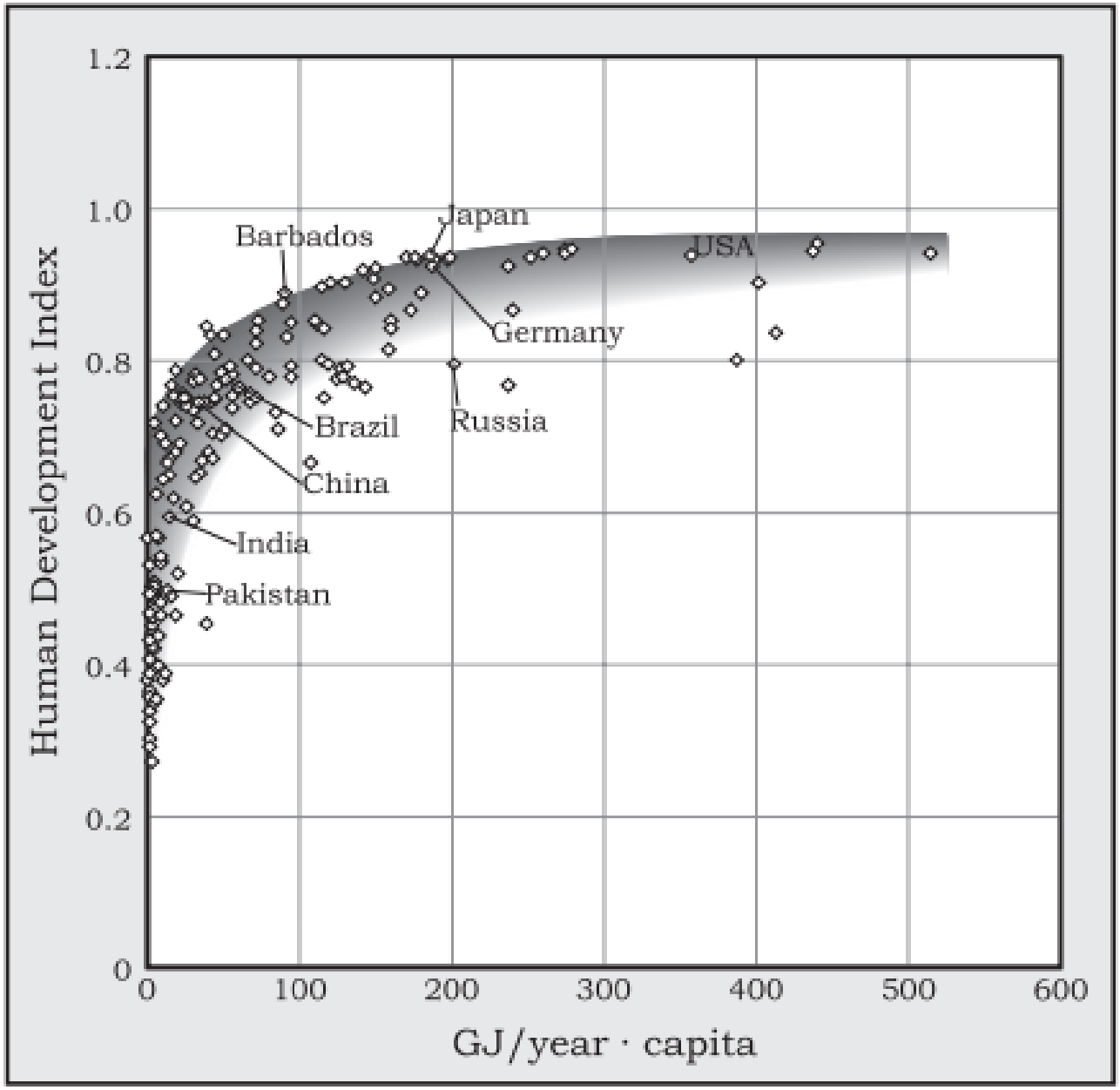

Per capita energy use and HDI.

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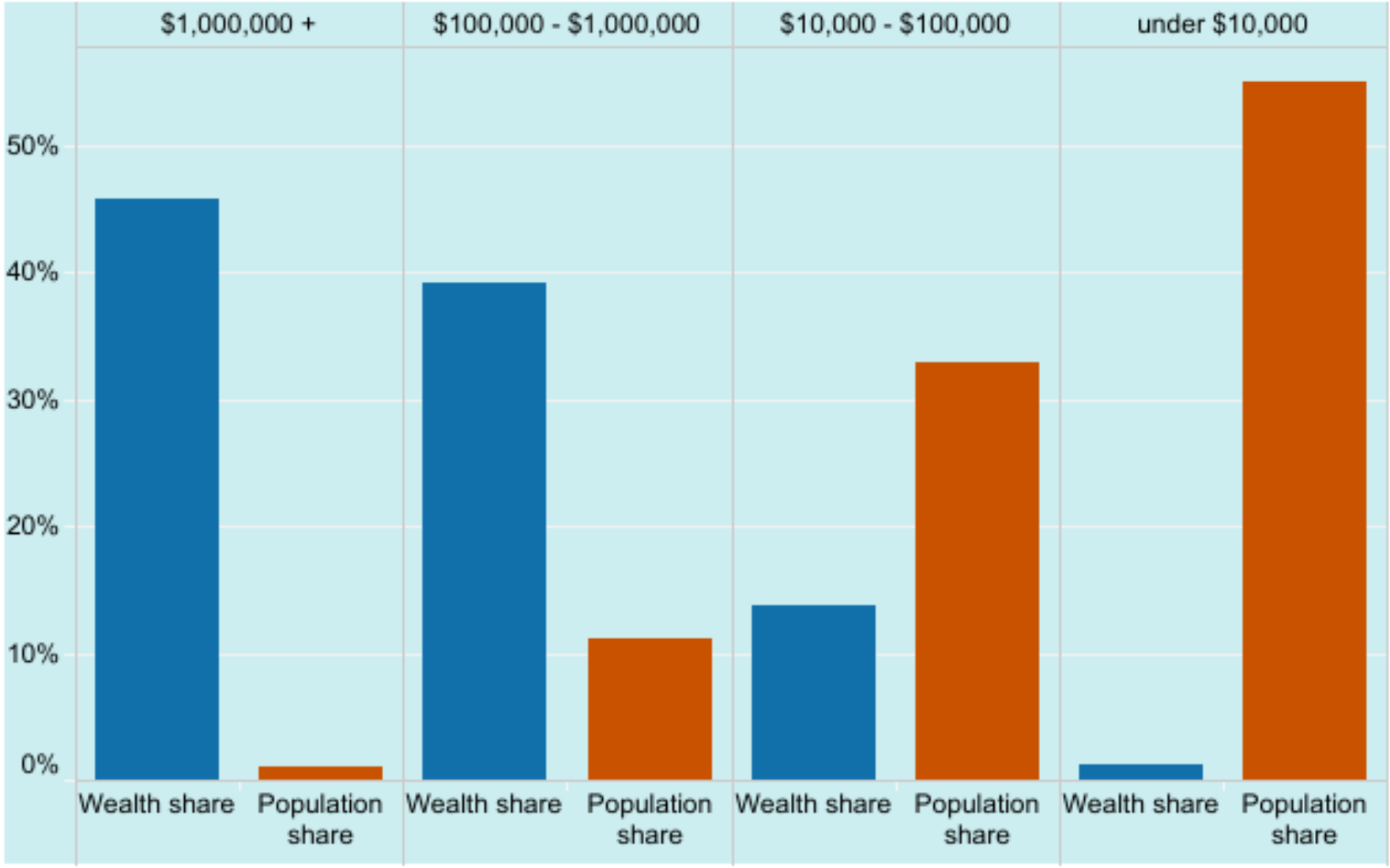
The Richest 1% Own Almost 46% of the World's Wealth

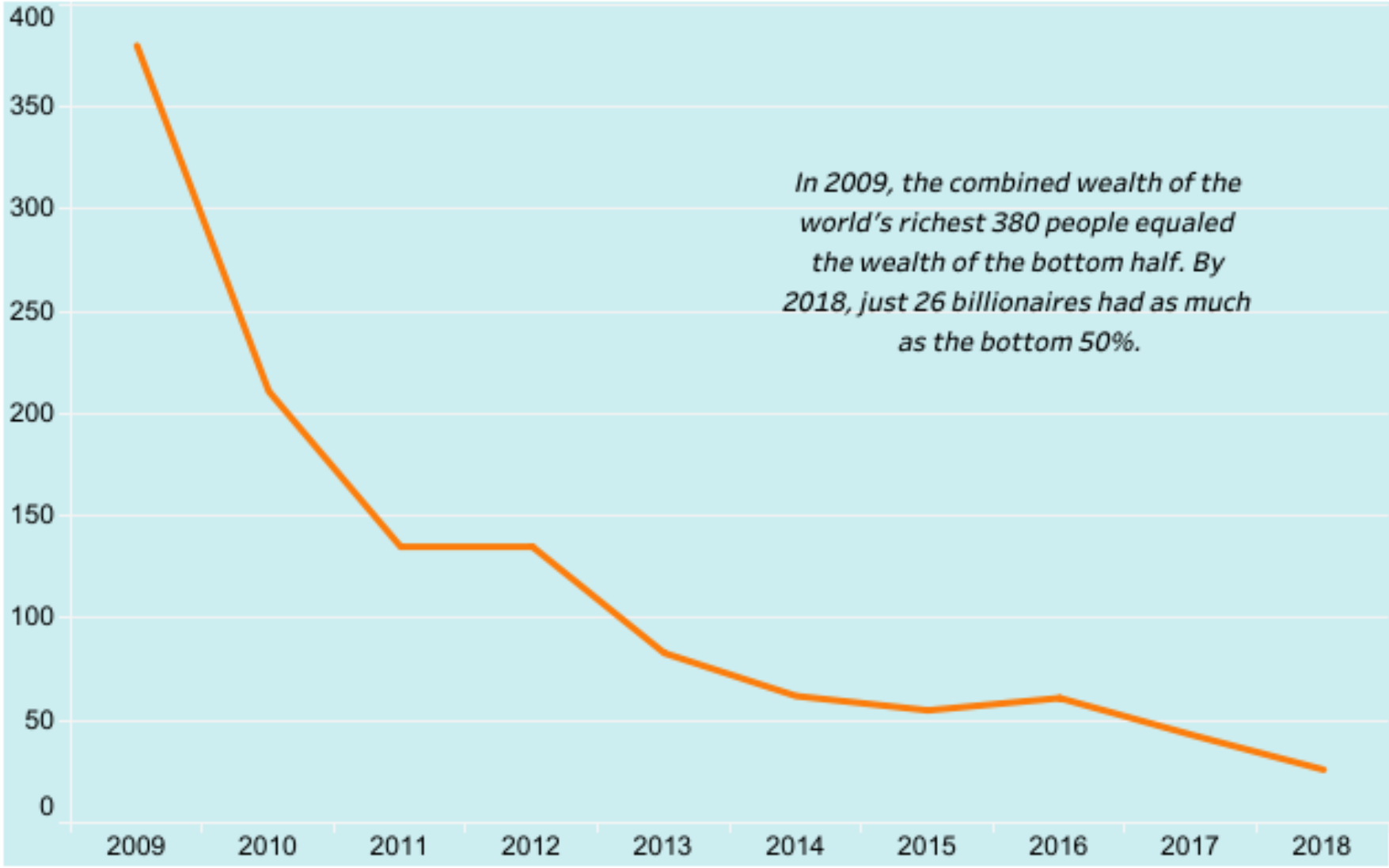
Global adult population and share of total wealth by wealth group, 2020



Source: Credit Suisse Global Wealth Databook, 2021

Wealth of the World's Poorest Shrinks Relative to Billionaires

Number of billionaires it takes to equal the wealth of bottom 50% of the global population



Source: Oxfam, 2019

Green growth as a response?

- Green growth (2012, more efficient technology + right incentives = continuous economic growth while reducing environmental impact) vs. empirical evidence.
- Hard cap on resources use, different measurement of improvement (DP replaced by other tools).