

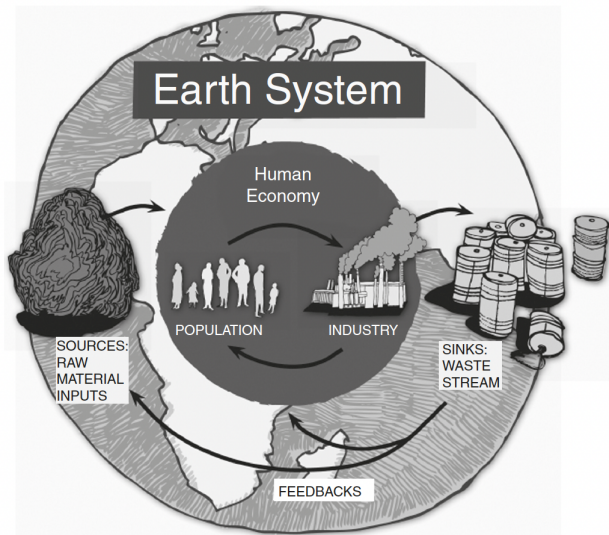
Macroeconomics and the Environment

The Environmental Kuznets Curve

November 27, 2024



Economy-Nature interactions



Source: Scot Cato (2021, p.74)

Evolution of Pollution

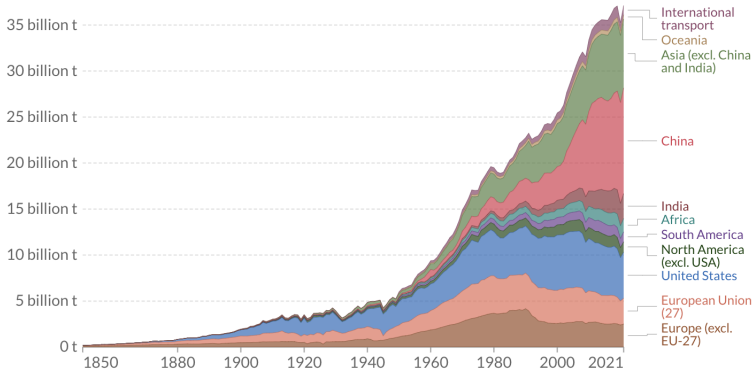
Annual CO₂ emissions by world region

This measures fossil fuel and industry emissions. Land use change is not included.



All together ▾

Relative



Source: Our World in Data based on the Global Carbon Project (2023)

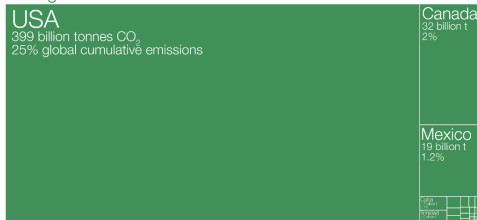
OurWorldInData.org/co2-and-greenhouse-gas-emissions • CC BY



Pollution today

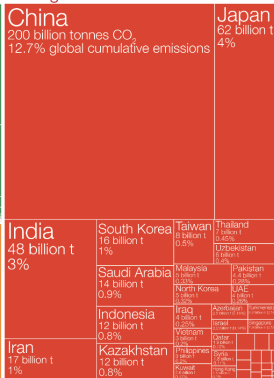
North America

457 billion tonnes CO₂
29% global cumulative emissions



Asia

457 billion tonnes CO₂
29% global cumulative emissions



EU-28

353 billion tonnes CO₂
22% global cumulative emissions



Russia

101 billion tonnes
6% global emissions



India

48 billion t
3%



South Korea

16 billion t
1%



Taiwan

8 billion t
0.5%



Thailand

7 billion t
0.45%



Europe

514 billion tonnes CO₂
33% global cumulative emissions



Africa South America

43 billion tonnes CO₂ 3% global emissions
40 billion tonnes CO₂ 3% global emissions



Oceania

20 billion tonnes CO₂
1.2% global emissions



Economy-Nature interactions - The Kaya identity

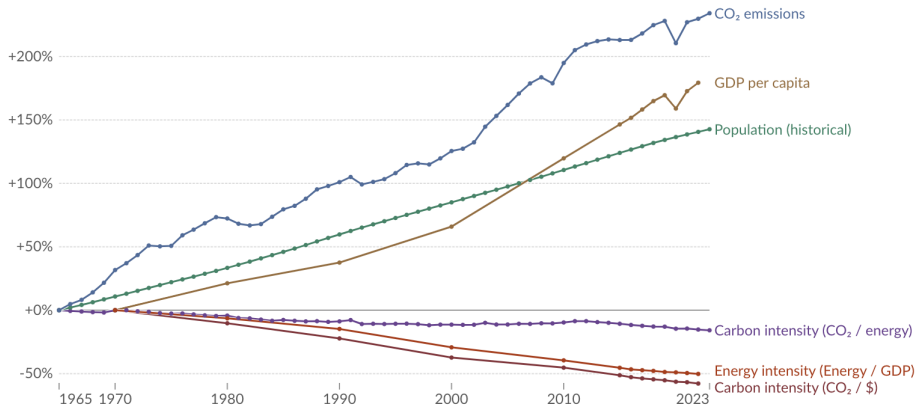
- Yoichi Kaya (1993): At every point of time emissions are given by:

$$M = N \frac{Y}{N} \frac{E}{Y} \frac{M}{E} \quad (\text{Kaya Identity})$$

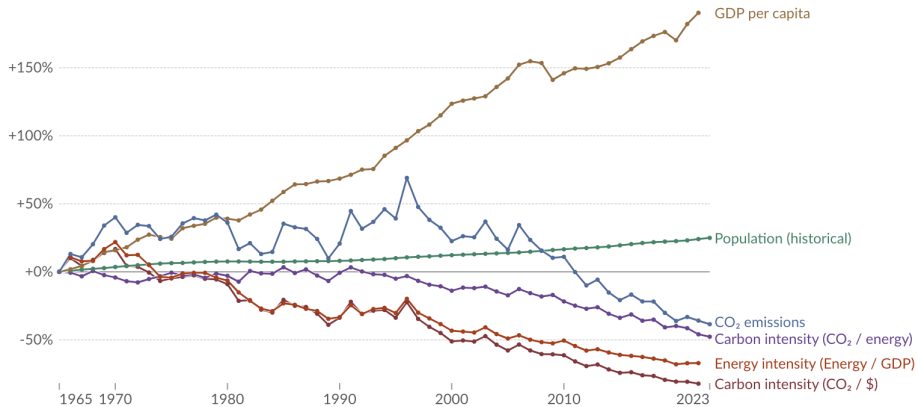
- Determinants of GHG emissions:
 - ▶ Population (N)
 - ▶ Income (Y) per capita.
 - ▶ Energy intensity (Energy (E) per unit of output (Y)).
 - ▶ Carbon intensity (Emissions (M) per unit of energy use (E)).
- It is an identity because we can cancel out N, Y and E on the right-hand side to obtain $M = M$.



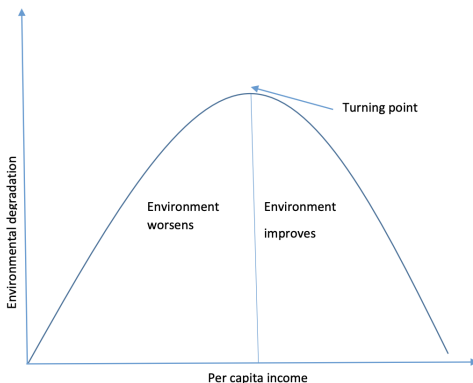
Kaya identity for the World



Kaya identity for Denmark



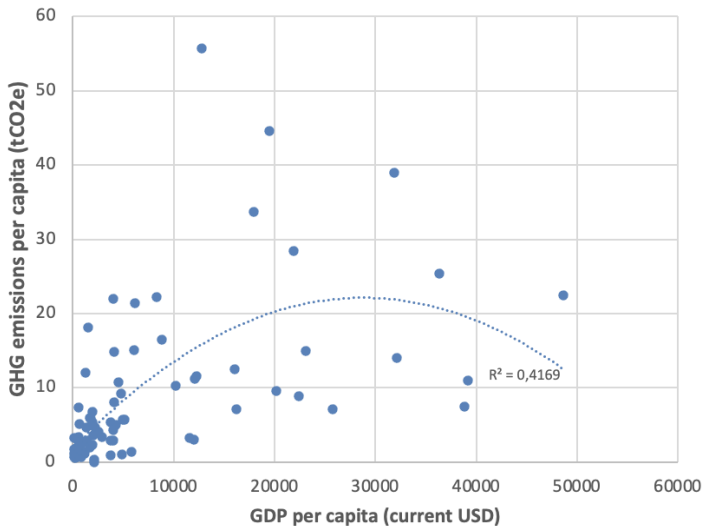
Environmental Kuznets Curve



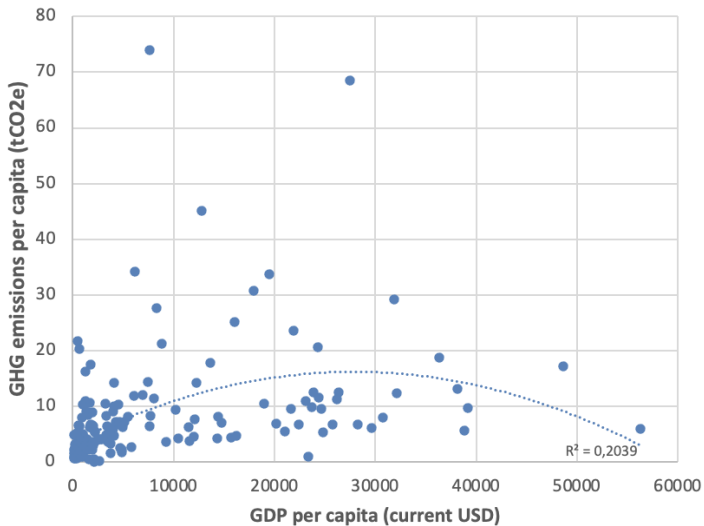
Key drivers

- Scale effect (how much growth)
- Composition effect (what sectors drive growth)
- Technology effect (how clean growth is)

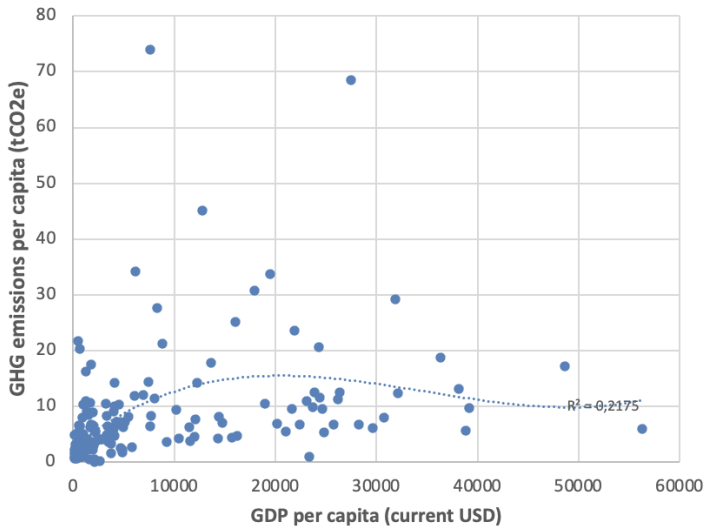
Kuznets curve (2000)



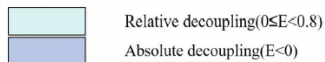
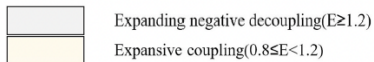
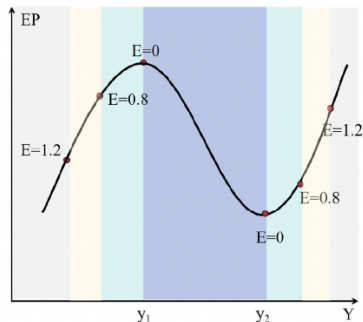
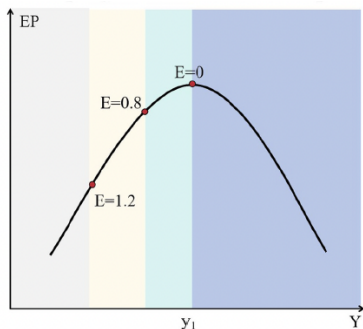
Kuznets curve (today)



Kuznets curve (today)



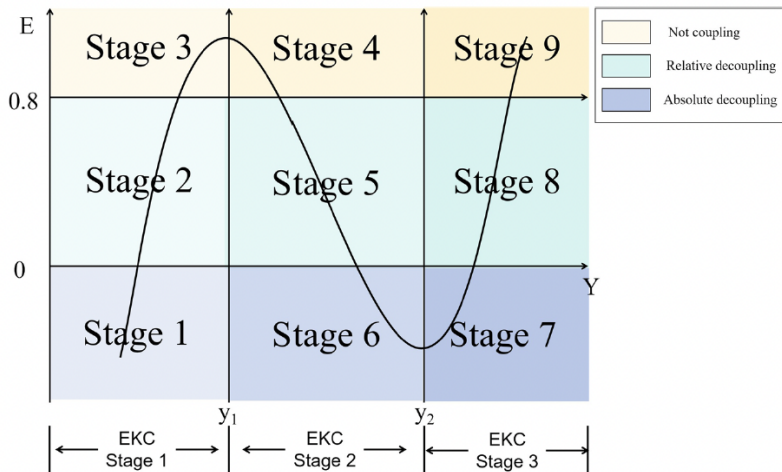
Kuznets curve: U-shaped or N-shaped?



Source: Wang et al. (2024)

Technological obsolescence effect: economic growth is faster than technology growth.

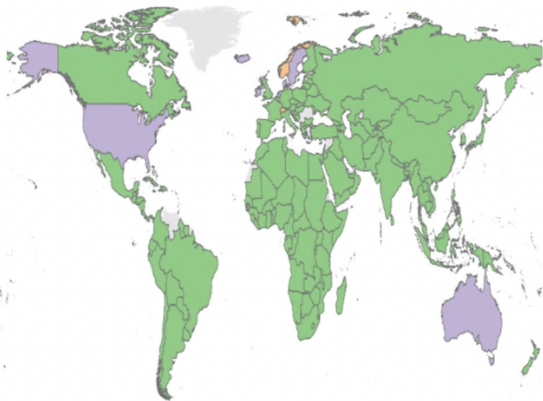
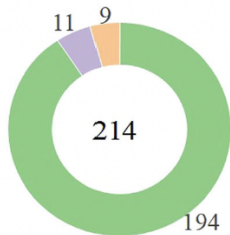
Kuznets curve: U-shaped or N-shaped?



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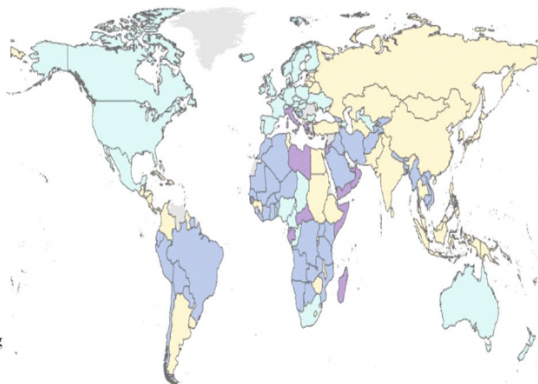
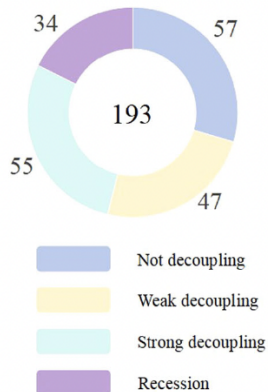
N-shaped EKC: the economic dimension

(a) Divide countries according to EKC turning points



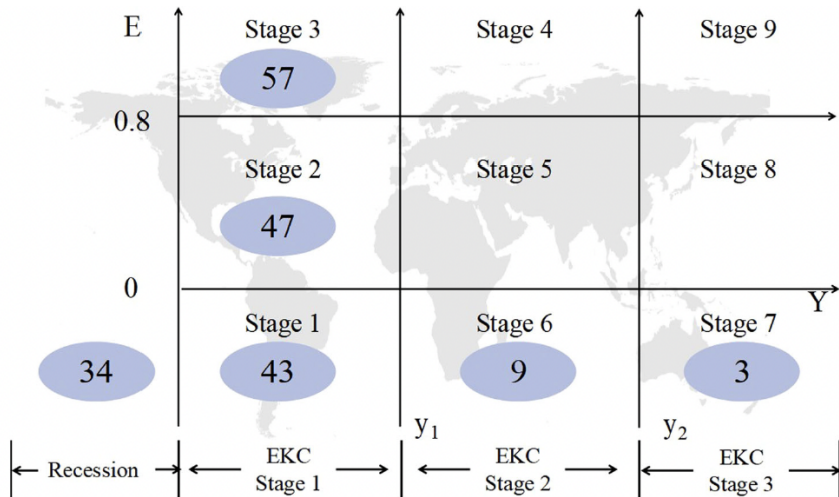
Source: Wang et al. (2024)

N-shaped EKC: the environmental dimension



Source: Wang et al. (2024)

N-shaped EKC: results



Source: Wang et al. (2024)

Policy Questions

How can we help developing countries increase their living standards without going through the polluting pathway that the current developed countries went through?

Will technological progress be enough to address the challenges entailed by climate change?

Are developed countries willing to downgrade their consumption pattern to attain a more sounder balance between the economy and the environment?

Will it be possible to reach the required international cooperation in the context of the current geopolitical fragmentation?



Time is running...

Limiting warming to 1.5°C and 2°C involves rapid, deep and in most cases immediate greenhouse gas emission reductions

Net zero CO₂ and net zero GHG emissions can be achieved through strong reductions across all sectors

