Máster Universitario en Administración y Dirección de Empresas

Full Time MBA

Crunching numbers for sustainability

Professor Andrea Saltelli

upf. BARCELONA SCHOOL OF MANAGEMENT

March 2025

Crunching numbers for sustainability

upf. BARCELONA SCHOOL OF MANAGEMENT

Andrea Saltelli

HOME ABOUT ME PUBLICATIONS NEWS & VIDEOS RESOURCES ← Where to find this talk

Latest papers

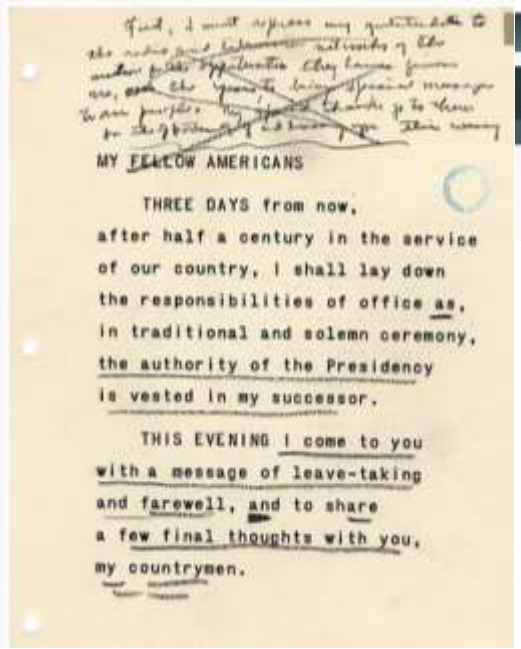
Models and the common good

A short analysis of norms and counter-norms in modelling, discussing how models may misuse their epistemic authority for reasons of occasion, opportunity and interest. Outline:Narratives and counter-narratives,State of exception,Seeking Cinderella,Reformation

Ranking the Rankers

Ranking the Rankers? We investigate using global sensitivity analysis the properties of the science-wide author databases' standardised citation indicators produced since 2015 by a team of researchers led by John P. A. Ioannidis.

Digital twins



MY FELLOW AMERICANS

THREE DAYS from now, after half a century in the service of our country, I shall lay down the responsibilities of office as, in traditional and solemn ceremony, the authority of the Presidency is vested in my successor.

THIS EVENING I come to you with a message of leave-taking and farewell, and to share a few final thoughts with you, my countrymen.

https://www.archives.gov/milestone-documents/president-dwight-d-eisenhowers-farewell-address

If you have read this: how did Eisenhower's hopes and fears stand the test of times

The prospect of domination of the nation's scholars by Federal employment, project allocations, and the power of money is ever present — and is gravely to be regarded.

Yet, in holding scientific research and discovery in respect as we should, we must also be alert to the equal and opposite danger that public policy could itself become the captive of a scientific-technological elite.

➔ p. 112

1.

Energy Ethics

Ethics in crumbs; Golden Rule, Nicomachean ethics; Biophysical economy; Charles A. S. Hall; Odum; Georgescu Roegen; The dialogue on climate; Transitions; Truth or justice? Roger Pielke; Mary Douglas cultural theory of risk; Myths of Nature; Wynne's and Winner's dissent; Vaclav Smil's Energy transitions; The economy of promises; Digital Twins for the transition? Jasanoff; Merton and the CUDOS.

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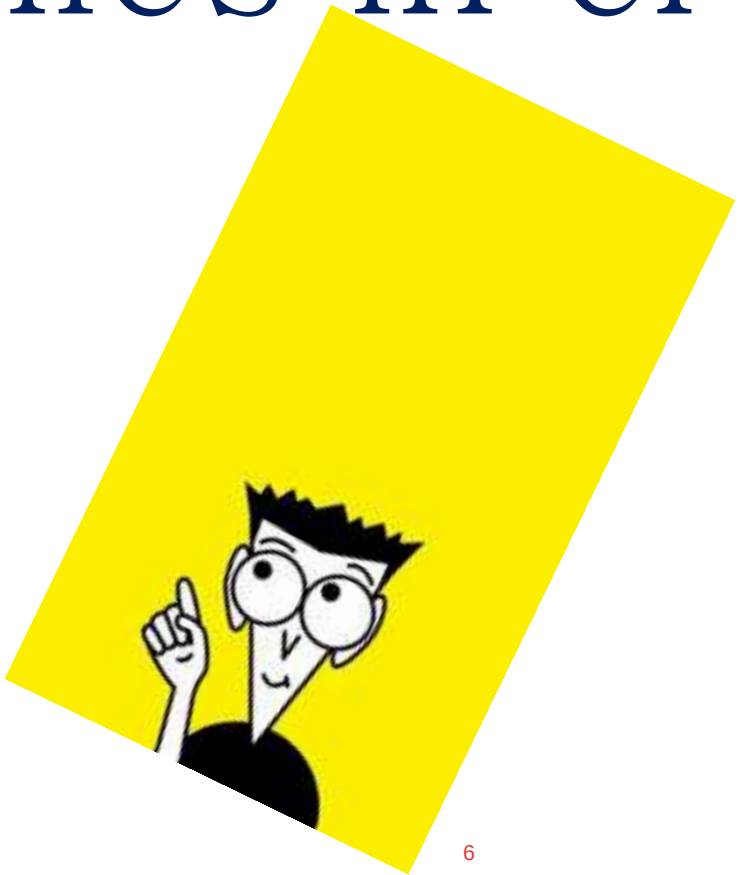
Ethics in crumbs



Philosophical quests:

Ontology: what is
Epistemology: how to know
Ethics: what to do

Question: which comes first?

Golden rule

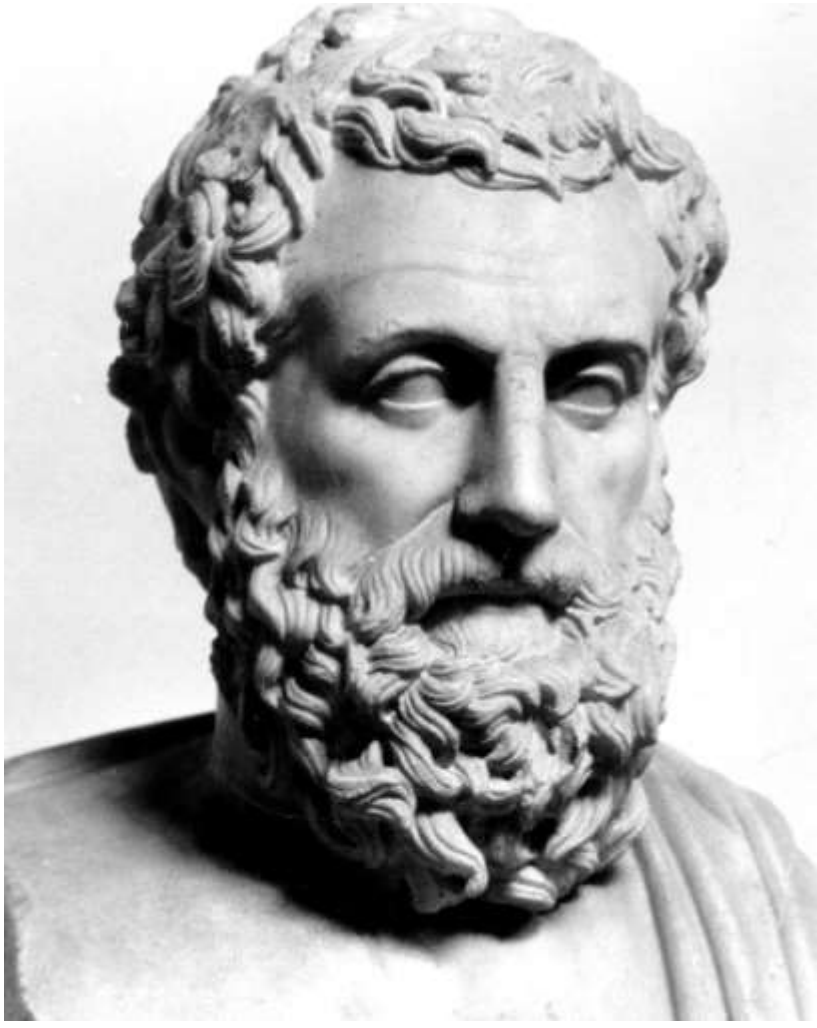
“treat others as you treat yourself” (Mahābhārata, ~IX-V century BCE)

“Avoid doing what you would blame others for doing” (Thales ~624 BC, ~546 BC)

“Treat your inferior as you would wish your superior to treat you” (Seneca, ~4 BC, 65 AD)

“Thou shalt love thy neighbour as thyself”, (Paul the apostle, ~5, ~64 AD)

Aristotle's Nicomachean Ethics



For Aristotle (384, 322 BC) strict relation between ethics and politics

Ethics: How to live a good life (myself)

Politics: How to promote a good life (in the polis)

"...though it is worth while to attain the end merely for one man, it is finer and more godlike to attain it for a nation or for city-states. These, then, are the ends at which our inquiry aims, since it is political science, in one sense of that term", Book 1, Chapter 2

Ethics for educated citizens [Athenians], no children, no *barbaroi* → ?

… no slaves or craftsmen, no *idiotes*, no women, [but their happiness important]
↓
?

Unlike in Plato, there is no universal good (no summum bonum)

As the function of man is intellectual activity, his 'good' must be plural and coincide with the exercise of virtues (aretes), among which justice is key

As the function of man is intellectual activity, his ‘good’ must be plural and coincide with the exercise of virtues (aretes), among which justice is key

Question: which are
the other three virtues?

Prudentia – (Greek Phronēsis)
Iustitia
Fortitudo
Temperantia

Socratic ethos

Is Socrates saying that he knows the truth?

And what kind of man am I? One of those who would gladly be refuted if anything I say is not true, and would gladly refute another who says what is not true, but would be no less happy to be refuted myself than to refute, for I consider that a greater benefit ... I believe there is no worse evil for man than a false opinion about the subject of our present discussion

Slide: courtesy of Kjetil Rommetveit

Biophysical economics

Flow-Fund Theory of Nicholas Georgescu-Roegen

Southern Economic Journal

January 1975 Volume 41 Number 3

ENERGY AND ECONOMIC MYTHS*

NICHOLAS GEORGESCU-ROEGEN

Vanderbilt University

So you can now all go home and sleep peacefully in your beds tonight secure in the knowledge that in the sober and considered opinion of the latest occupant of the second oldest Chair in Political Economy in this country, although life on this Earth is very far from perfect there is no reason to think that continued economic growth will make it any worse.

Wilfred Beckerman

Nicholas Georgescu-Roegen

(1906-1994)

Nicholas Georgescu-Roegen

- Father of ecological economics
- Ante-litteram advocate of degrowth? Inspired the Club of Rome
- The first to note that the laws of thermodynamics, particularly the second law, which emphasizes the irreversibility of natural processes, are ignored in economics

- Defines "flows" (current resources) and "funds" (accumulated resources) to be used in economics ➔ sustainability
- Reintroduces Entropy in economics

Entropy: an index of the amount of unavailable energy in a given thermodynamic system at a given moment of its evolution

Roegen criticizes

"… the viewing of the economic process as a mechanical analogue consisting – as all mechanical analogues do –of a principle of conservation (transformation) and a maximization rule.

…

The economic science itself is thus reduced to a timeless kinematics"


Southern Economic Journal

January 1975

ENERGY AND ECONOMIC MYTHS*

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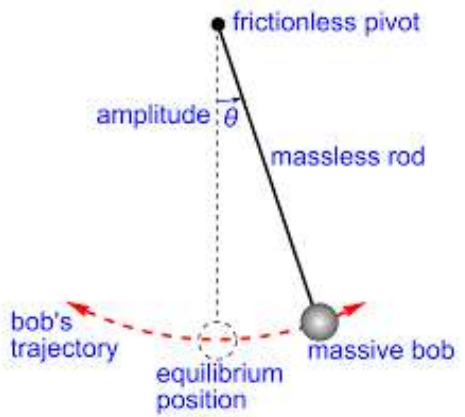
Vanderbilt University

Roegen critique (continued)

"Everything now turns out to be just a pendulum movement. One business "cycle" follows another. The pillar of equilibrium theory is that, if events alter the demand and supply propensities, the economic world always returns to its previous conditions as soon as these events fade out"



Source: Wikipedia Commons


Southern Economic Journal

ENERGY AND ECONOMIC MYTHS*

NICHOLAS GEORGESCU-ROEGEN

Roegen critique (continued)

"An inflation, a catastrophic drought, or a stock-exchange crash leaves absolutely no mark on the economy. Complete reversibility is the general rule, just as in mechanics"

Plastic waste dumping site at Thilafushi, an example of no mark.
Source: https://www.dreamstime.com


Southern Economic Journal

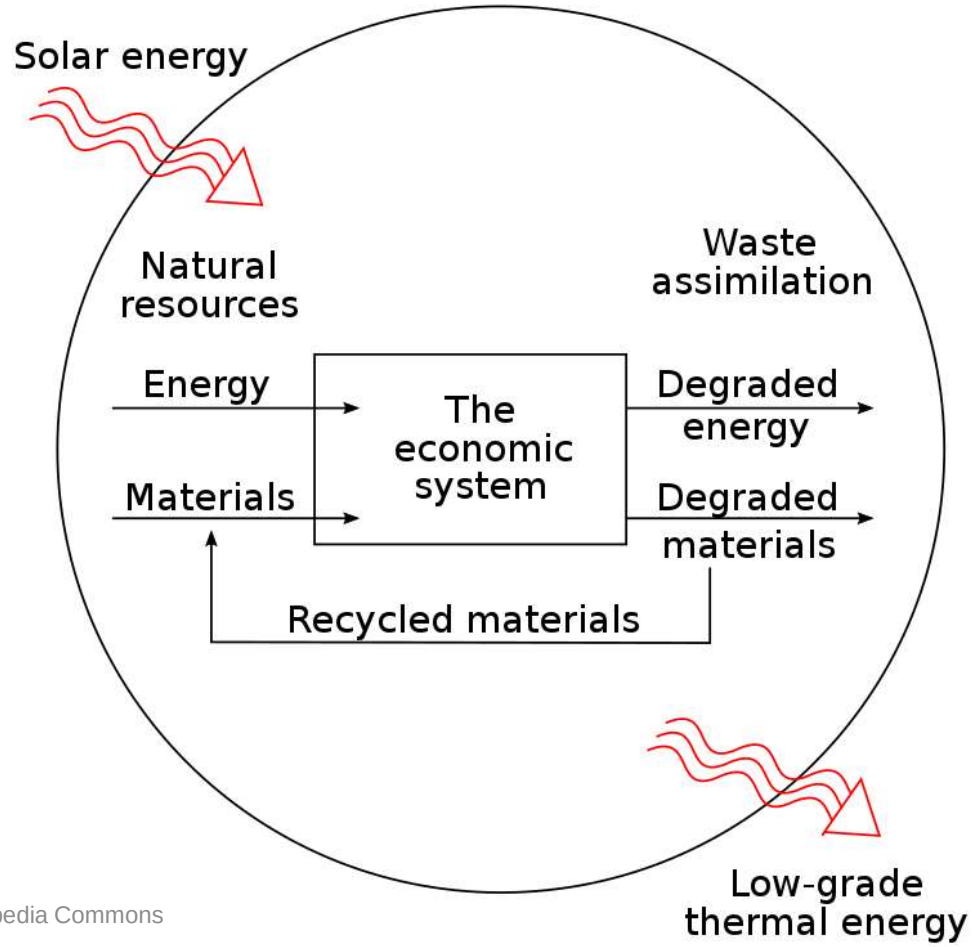
January 1975

ENERGY AND ECONOMIC MYTHS*

NICHOLAS GEORGESCU-ROEGEN

Vanderbilt University

The Earth's biosphere

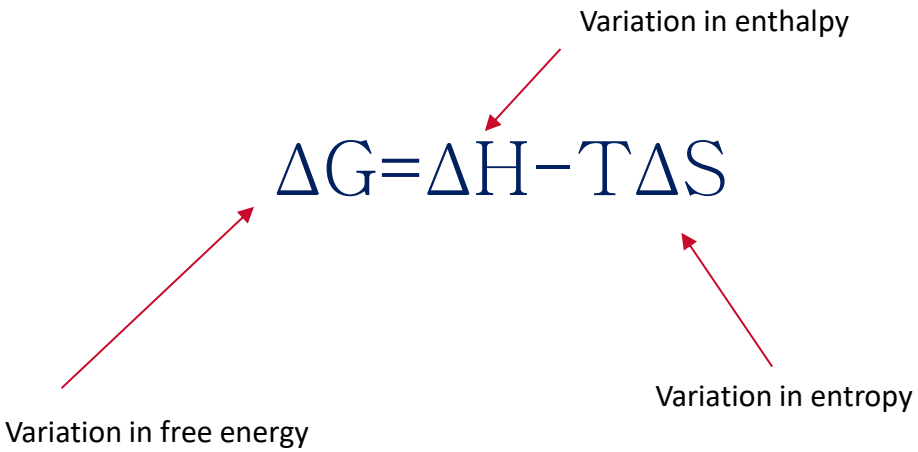


Source: Wikipedia Commons

MECHANICS VERSUS THERMODYNAMICS

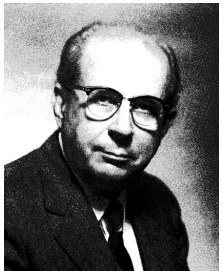
To equate the economic process with a mechanical analogue implies, therefore, the myth that the economic process is a circular merry-go-round which cannot possibly affect the environment of matter and energy in any way

Entropy = “entropy as an index of the amount of unavailable energy in a given thermodynamic system at a given moment of its evolution”

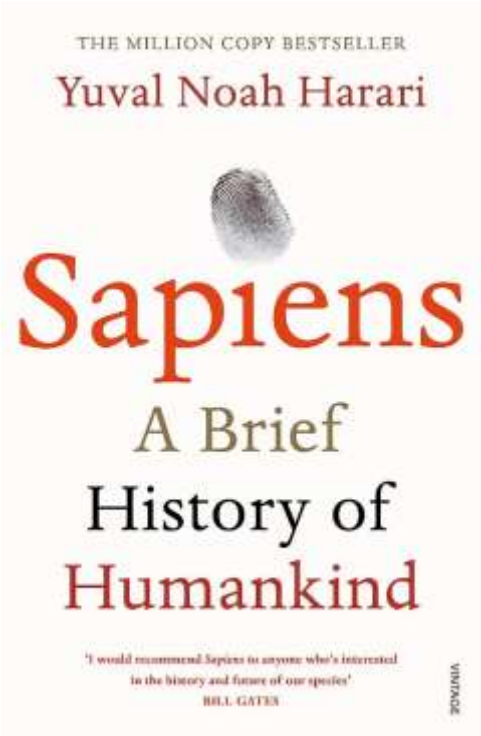


Remember this from college’s thermodynamics?

"… to act in accord with a myth is the distinctive characteristic of man among all living beings"



Digression: Harari's explanation for the success of humans: believing shared stories in large groups



“Thermodynamics a, peculiar branch of physics, so peculiar that purists prefer not to consider it a part of physics because of its anthropomorphic texture”

“Energy thus came to be divided into available or free energy, which can be transformed into work, and unavailable or bound energy, which cannot be so transformed. Clearly, the division of energy according to this criterion is an anthropomorphic distinction like no other in science”

“The myth of perpetual motion of the second kind, which is that we may use the same energy over and over again, still lingers on in various veiled forms”

“Another economic myth is that man will forever succeed in finding new sources of energy and new ways of harnessing them to his benefit”

Wrapping up, Roegen's warnings are about:

Bootlegging entropy

The danger of linear thinking

The myth that the price mechanism can offset any shortages, whether of land, energy or materials

The fallacy of endless substitution

Substitution within a finite stock of accessible low entropy cannot possibly go on forever – Daly's similitude of the perfect empty kitchen that cannot nourish

Southern Economic Journal

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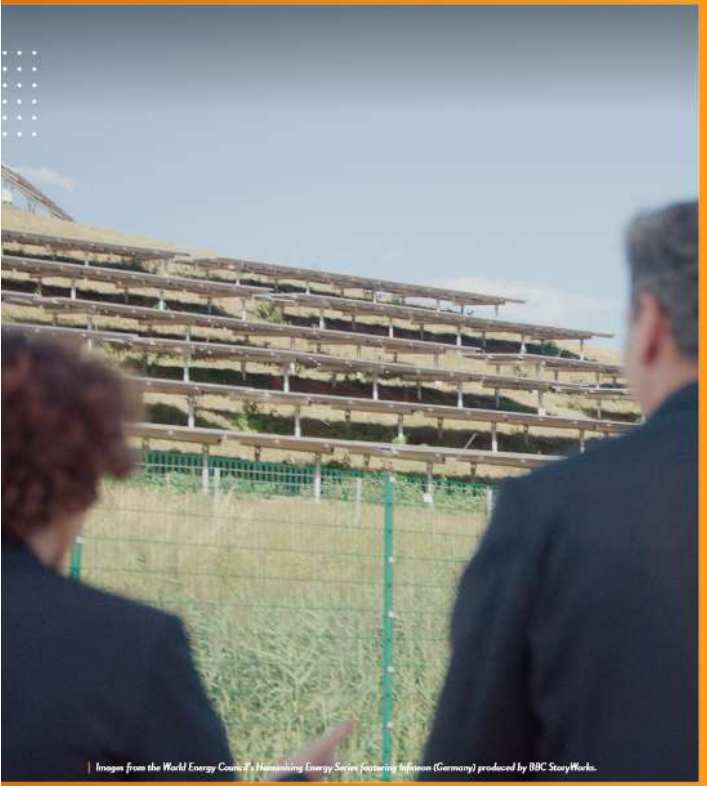
Vanderbilt University

Roegen on waste:

"Robert A Solo [an economist] also asserts that because of growth and technology, the present society could eliminate all pollution … at a bearable cost. It is only because of some perversity of our values that we are not doing it. That we could devote more effort to pollution disposal is beyond doubt. But to believe that with nonperverse values we could defeat the natural laws reflects an indeed perverse view of reality"

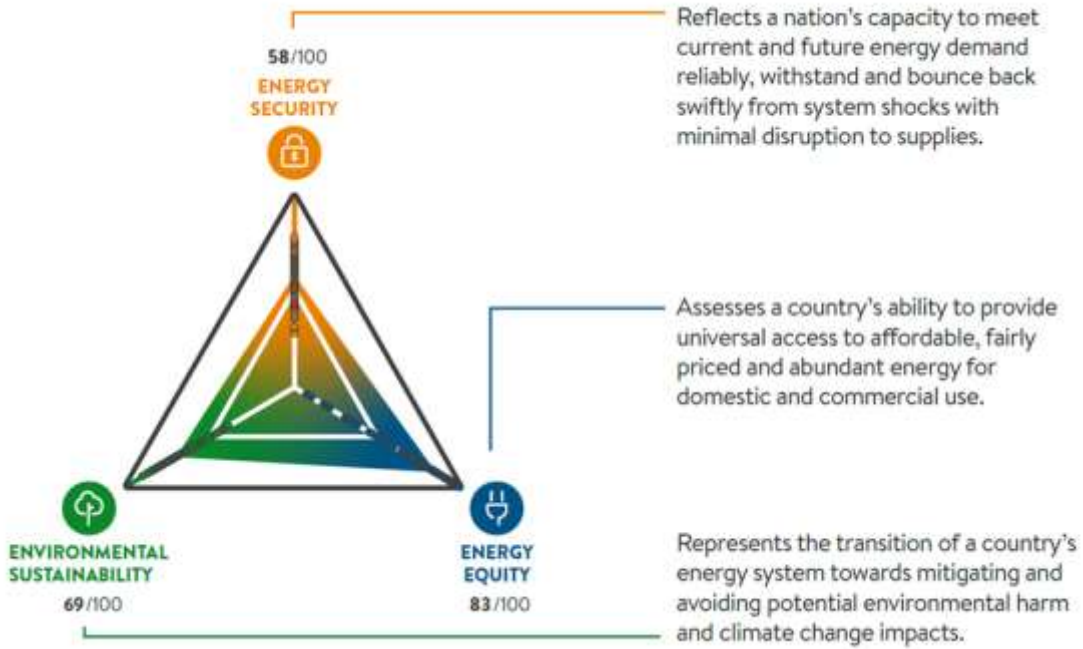
WORLD ENERGY COUNCIL



WORLD ENERGY

TRILEMMA INDEX 2022

In partnership with Oliver Wyman

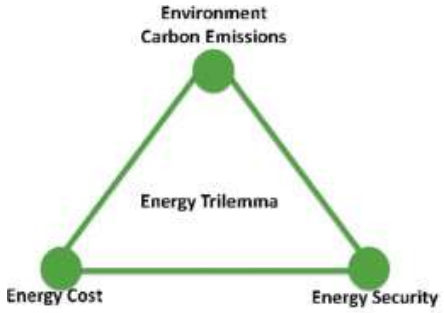


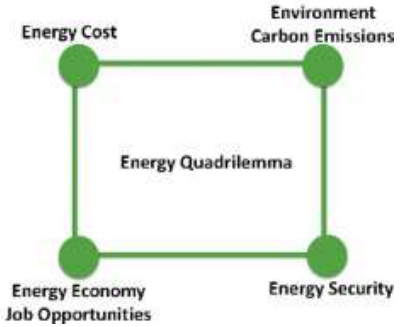
Slide courtesy of Daniela Tafani, University of Pisa

https://www.worldenergy.org/transition-toolkit/world-energy-trilemma-index

The energy quadrilemma: people matter ➔ 'energy justice'

- distributional justice,
- procedural justice, and
- recognition justice





https://icpac.medium.com/energy-and-climate-the-dilemma-trilemma-and-quadrilemma-839a8d657369

https://www.sciencedirect.com/science/article/abs/pii/S0360544216310696


Energy

Volume 108, 1 August 2016, Pages 1-6

Editorial

Energy quadrilemma and the future of renewable energy

A.G. Olabi (Prof)

Courtesy of Daniela Tafani, University of Pisa

LANGDON WINNER

Do Artifacts Have Politics?

The MIT Press

Do Artifacts Have Politics?
Author(s): Langdon Winner
Source: *Daedalus*, Vol. 109, No. 1, Modern Technology: Problem or Opportunity? (Winter, 1980), pp. 121-136
Published by: The MIT Press on behalf of American Academy of Arts & Sciences
Stable URL: http://www.jstor.org/stable/20024652
Accessed: 06/10/2009 20:50

Do Energy Systems Have Politics?

Courtesy of Daniela Tafani, University of Pisa

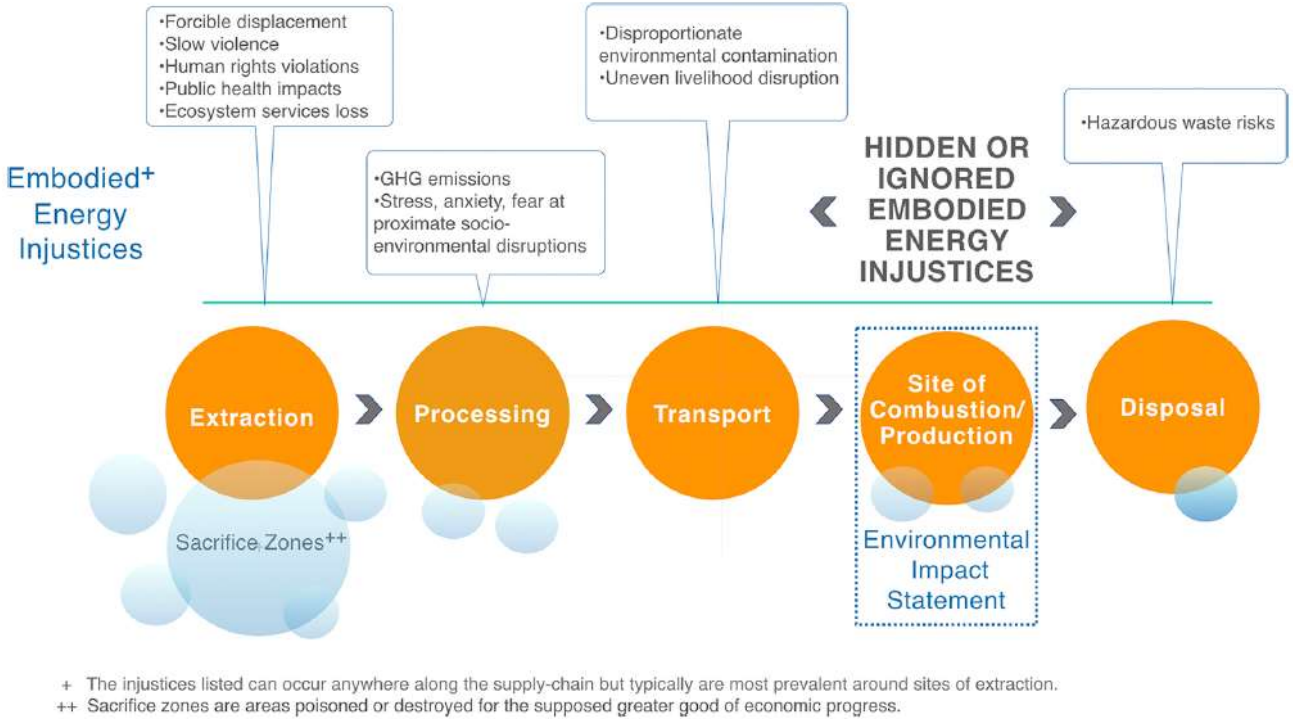
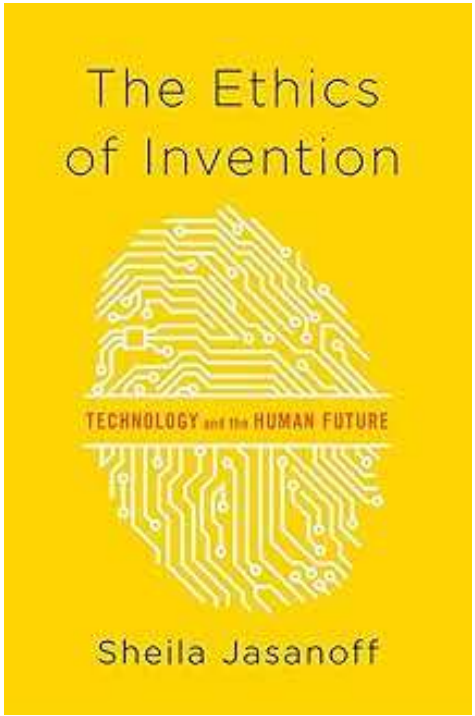


Fig. 1. Embodied energy injustices explicitly consider hidden and distant injustices (upstream or downstream) arising from the extraction, processing, transportation and disposal of energy resources.

Healy, Noel, Jennie C. Stephens, and Stephanie A. Malin. 2019. 'Embodied Energy Injustices: Unveiling and Politicizing the Transboundary Harms of Fossil Fuel Extractivism and Fossil Fuel Supply Chains'. Energy Research & Social Science 48:219–34. doi: 10.1016/j.erss.2018.09.016.

Courtesy of Daniela Tafani, University of Pisa



W. W. Norton & Company (August 30, 2016)

Sheila Jasanoff

- Lock-in effect of energy technologies
- Democratic deficit in energy decision-making
- Unequal risks and energy justice
- Framing energy debates through “Sociotechnical imaginaries".
- Ethics of innovation in renewable energy (look at the entire value chain e.g. rare earth extraction)

Alternative voices; technologies of humility

- Winners and losers, voices to be heard from disciplines and societal actors

Credits: D. Parkins

Sheila Jasanoff

There always was a tension on this subject, as proved by the now famous exchange in the 70's involving Daly (1997a) (1997b), Stiglitz (1997) and Solow (1997) – see a summary of the discussion here

Environmental Science and Policy 142 (2023) 99–111

Contents lists available at ScienceDirect

Environmental Science and Policy

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

Impact assessment culture in the European Union. Time for something new?

Andrea Saltelli [a,b,*], Marta Kuc-Czarnecka [c], Samuele Lo Piano [d], Máté János Lőrincz [d], Magdalena Olczyk [c], Arnald Puy [e], Erik Reinert [f,g], Stefán Thor Smith [d], Jeroen P. van der Sluijs [b,h]

“The debate - started in 1975–1979 by Georgescu-Roegen in opposition to Solow and Stiglitz - was about to what extent one can substitute capital for natural resources in a growth equation, and what role technology could play to make this substitution more effective.

Herman E. Daly… restarted the debate in 1997 in open opposition to neoclassic economists, iterating Georgescu-Roegen’s unanswered critique that one cannot "assume that agents of transformation (funds) can substitute for the resources undergoing transformation (flows)" (Daly, 1997a)”

Herman E. Daly
(1938–2022)

Peter Victor

The Guardian

Obituary

Herman Daly obituary

Pioneering ecological economist who foresaw the catastrophic effects of unlimited economic growth

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ELSEVIER

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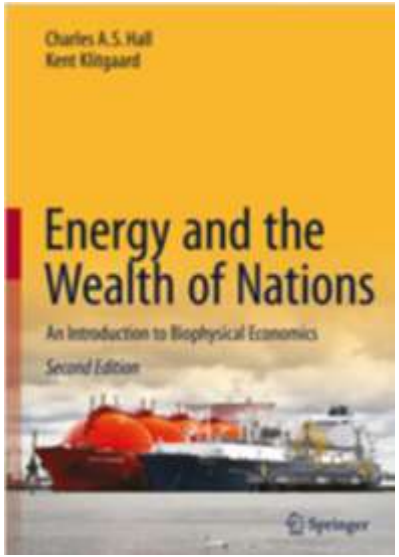
Some slides courtesy of Professor Charles A. S. Hall

chall@esf.edu

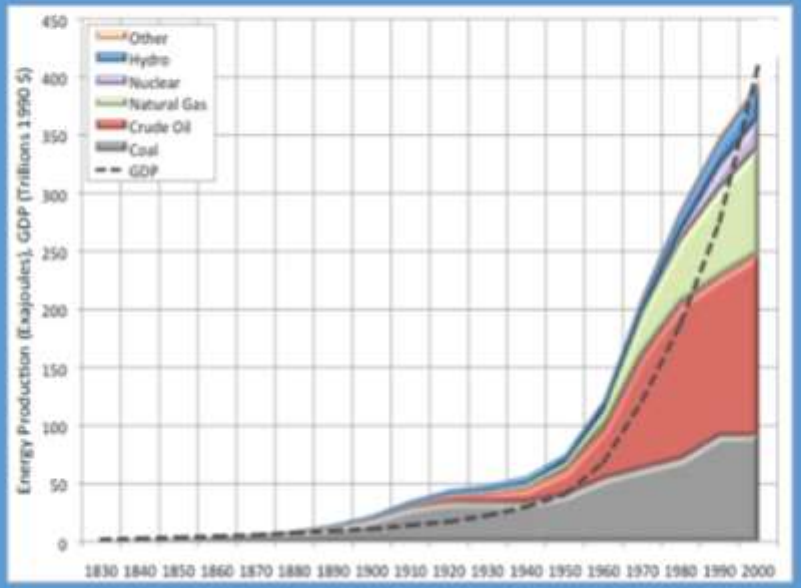


"Tell me the fairy tale about the economy."

Conventional economics is based on "sets of plausible but entirely arbitrary assumptions" leading to "precisely stated but irrelevant theoretical conclusions". (W. Leontief, Nobel Laureate in Economics)

chall@esf.edu

The dirty secret to wealth production: Use more energy



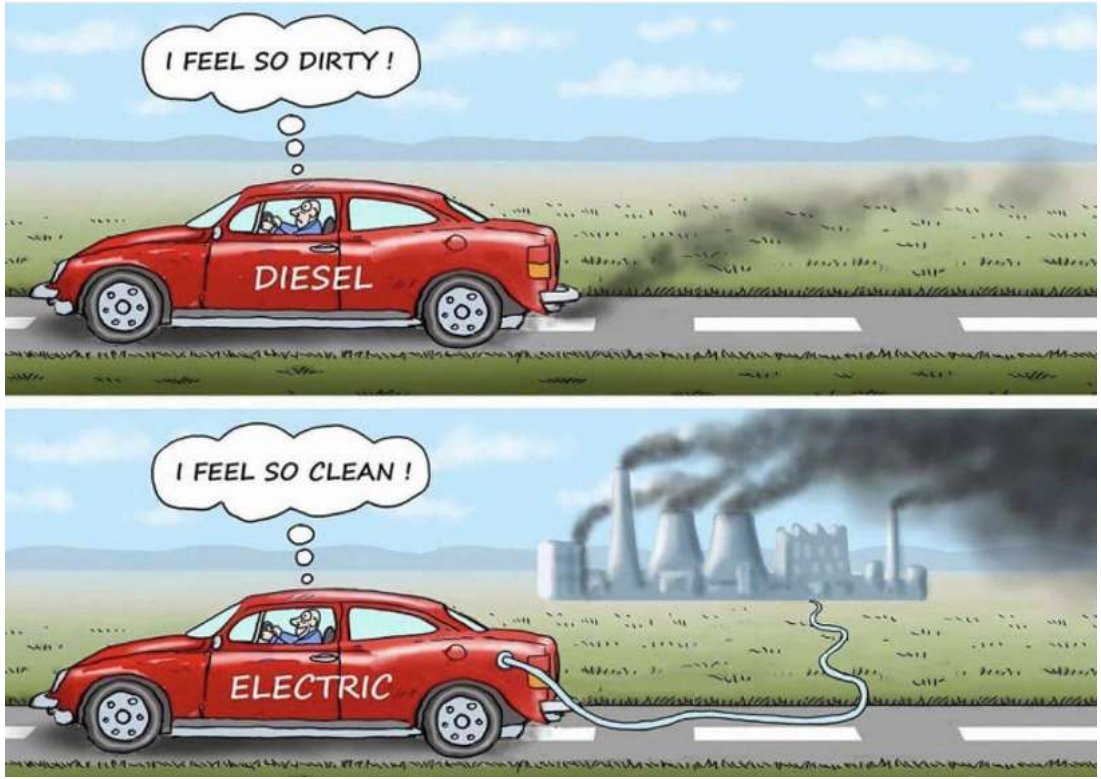
Global GDP and global energy use

chall@esf.edu

Replacing our present reliance on fossil fuels with renewables, if possible, will be extremely fossil fuel intensive

chall@esf.edu

il existe une solution simple et fausse.



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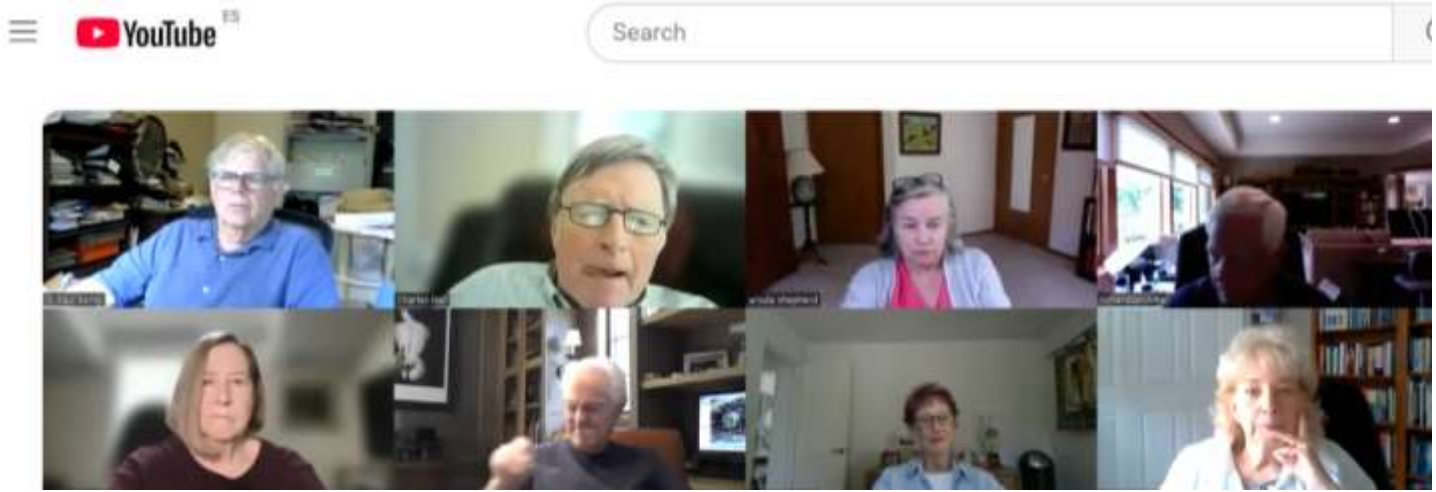
More resources from Charles A. S. Hall



YouTube playlist with all videos: https://www.youtube.com/playlist?list=PLpPcX-rwKS6JucZpentitMCH-2FYvCfgy

Medium versions with transcript: https://medium.com/@alysion42/list/biophysical-economics-df1b957adb88

Together with ecologist Howard T. Odum, Charles A.S. Hall has developed the concept of Energy Return on Investment (EROI)

EROI assesses the efficiency and sustainability of energy sources

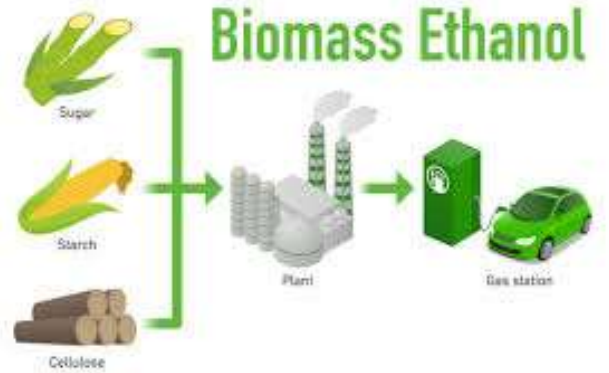
Howard T. Odum
(1924-2002)

$$\text{EROI} = \frac{\text{amount of energy produced (or extracted) by an energy source}}{\text{the energy input required to obtain, process, and distribute that energy}}$$

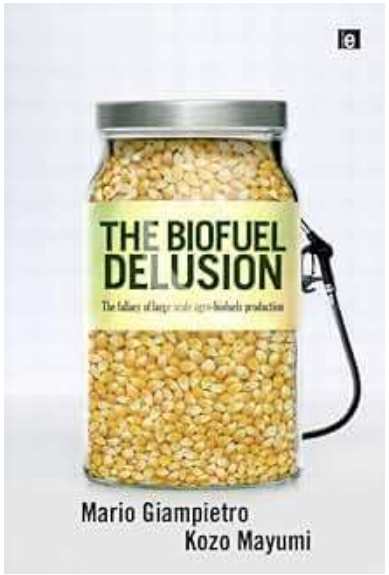
- EROI > 1: An energy source produces more energy than it consumes in its life cycle, making it a net energy gain.

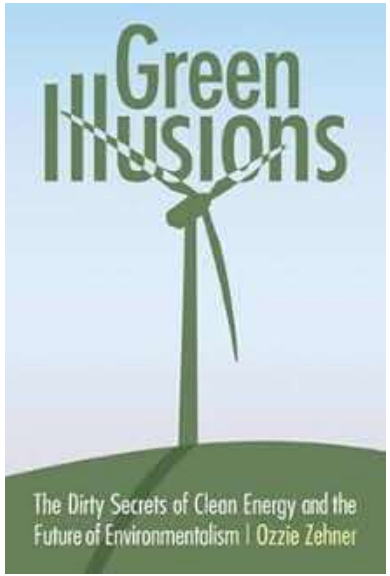
- EROI = 1: Energy input equals energy output

- EROI < 1: An energy consumes more energy than it produces, resulting in a net energy loss.



The case of biofuels





Example: a mean EROI of 20:1 for wind power means that you get ~20 units of electricity in return for every unit of energy invested in manufacturing, installing, maintaining and decommissioning a wind energy system (Hall et al., 2014)

Melgar, Rigo, and Charles Hall. 2023. 'Energy Return on Investment: A Unifying Principle for Socio-Ecological Sustainability'. in *Elgar Encyclopedia of Ecological Economics*. Rochester, NY.

C A Hall , J G Lambert , S B Balogh, EROI of different fuels and the implications for society, Energy policy , volume 64 , p. 141 – 152, 2014.

"… There certainly are oil shales from which we could extract one ton of oil only by using more than one ton of oil"


Southern Economic Journal

January 1975

ENERGY AND ECONOMIC MYTHS*

NICHOLAS GEORGESCU-ROEGEN

Vanderbilt University

ELSEVIER

ECOLOGICAL ECONOMICS

FORUM

Georgescu-Roegen versus Solow/Stiglitz

Herman E. Daly

REPLY

Georgescu-Roegen versus Solow/Stiglitz

Robert M. Solow

REPLY

Georgescu-Roegen versus Solow/Stiglitz

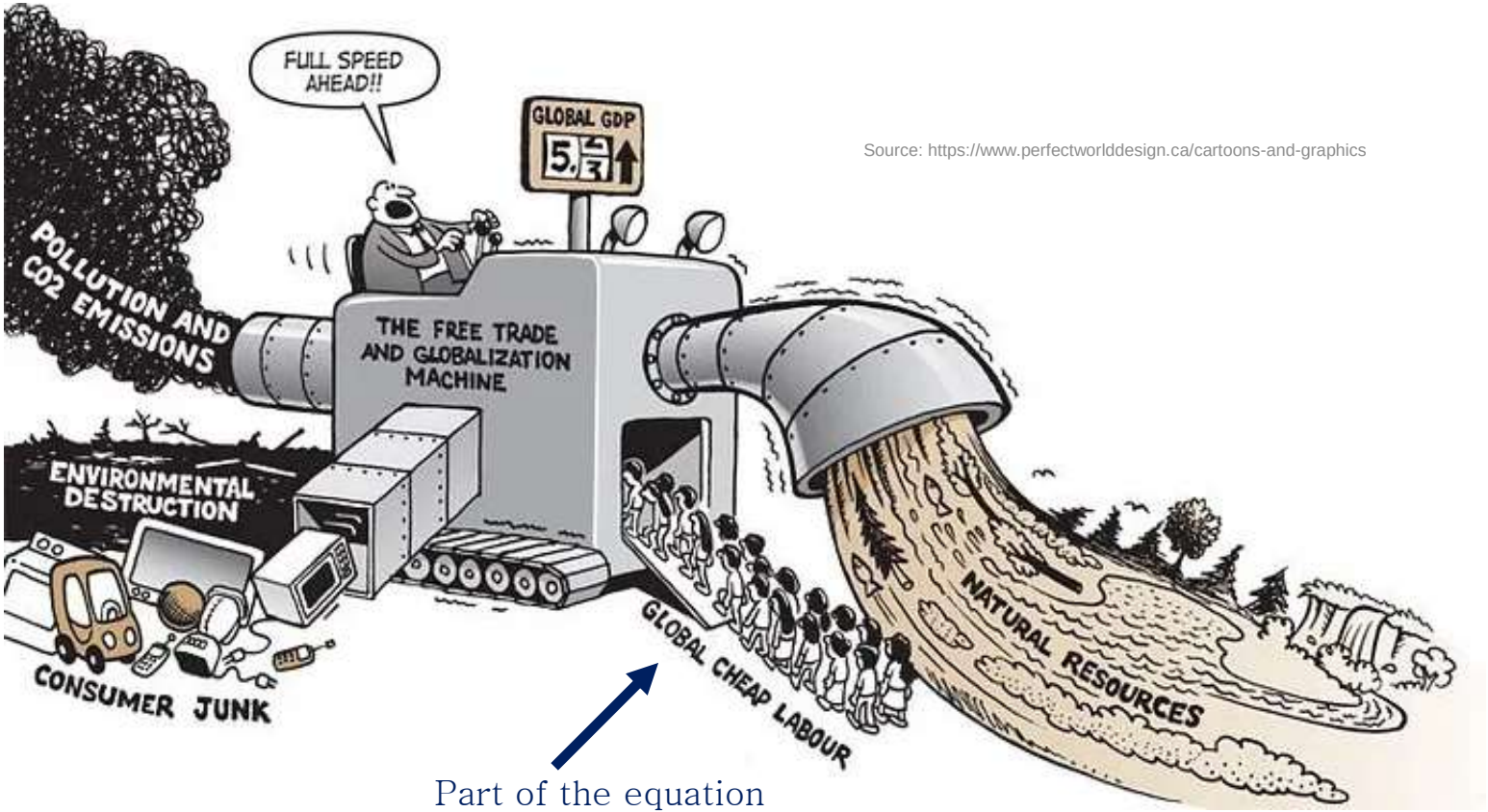
Joseph E. Stiglitz

FORUM

Reply to Solow/Stiglitz

Herman E. Daly

Old (1997) or new debate?



Source: https://www.perfectworlddesign.ca/cartoons-and-graphics

Part of the equation

Gunnar Skirbekk

Epistemic Challenges in a Modern World

From "fake news" and "post truth"
to underlying epistemic challenges
in science-based risk-societies

Das Zentrum für Wissenschaftstheorie an der Universität Bergen
hat einen Druckkostenzuschuss bereitgestellt.

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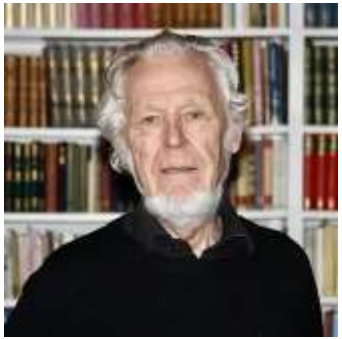


Gunnar Skirbekk

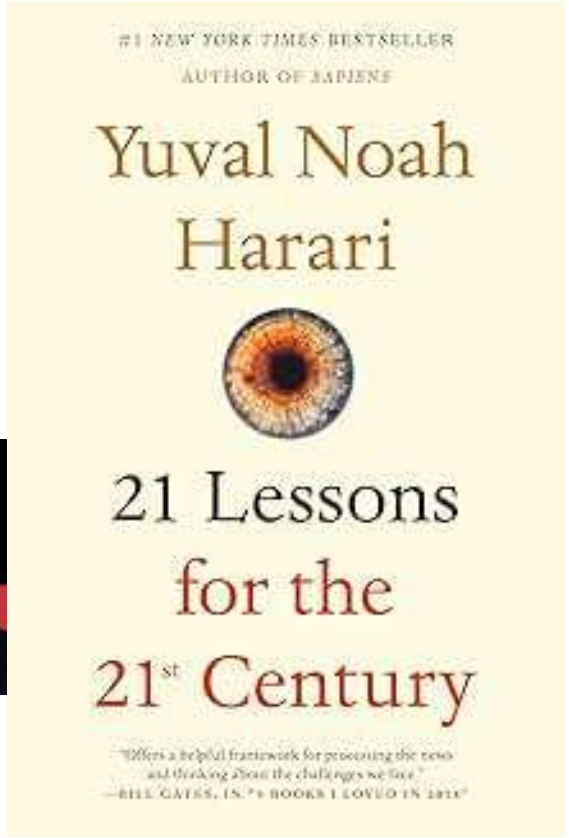
https://gunnarskirbekk.no/b%C3%B8ker/epistemic.pdf

Philosophy – epistemological challenges in SDG's literature

The challenge of challenges

Yuval Harari

The Technological Challenge
The Political Challenge
Despair and Hope
Truth
Resilience



Interlude
George Carlin and the environment (7’39”)

Interlude: George Carlin and the environment –
https://www.youtube.com/watch?v=EjmtSkl53h4

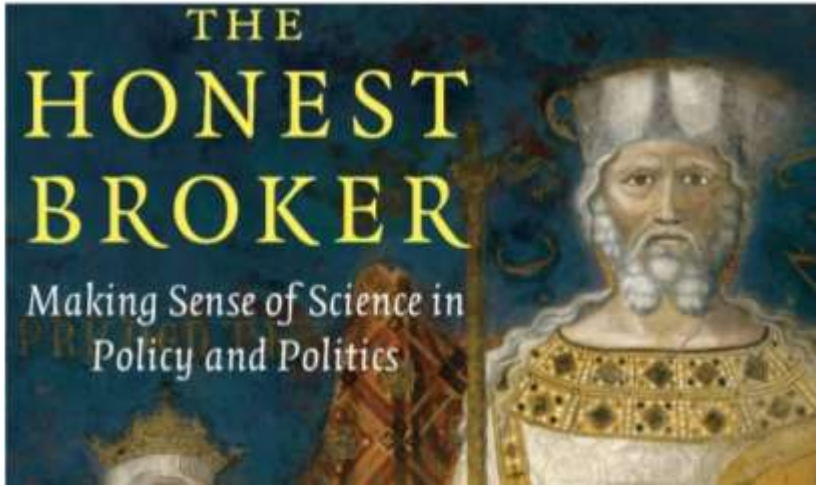
Test in the classroom: engage with Carlin's narrative and develop pros- and counter-narratives (10m+ 10m discussion)

The Ethics of Transitions

Pursuit of truth or pursuit of justice?

Can a scientist be an activist?
Can a scientist not-be an activist?

The case of the transition to a carbon-free future



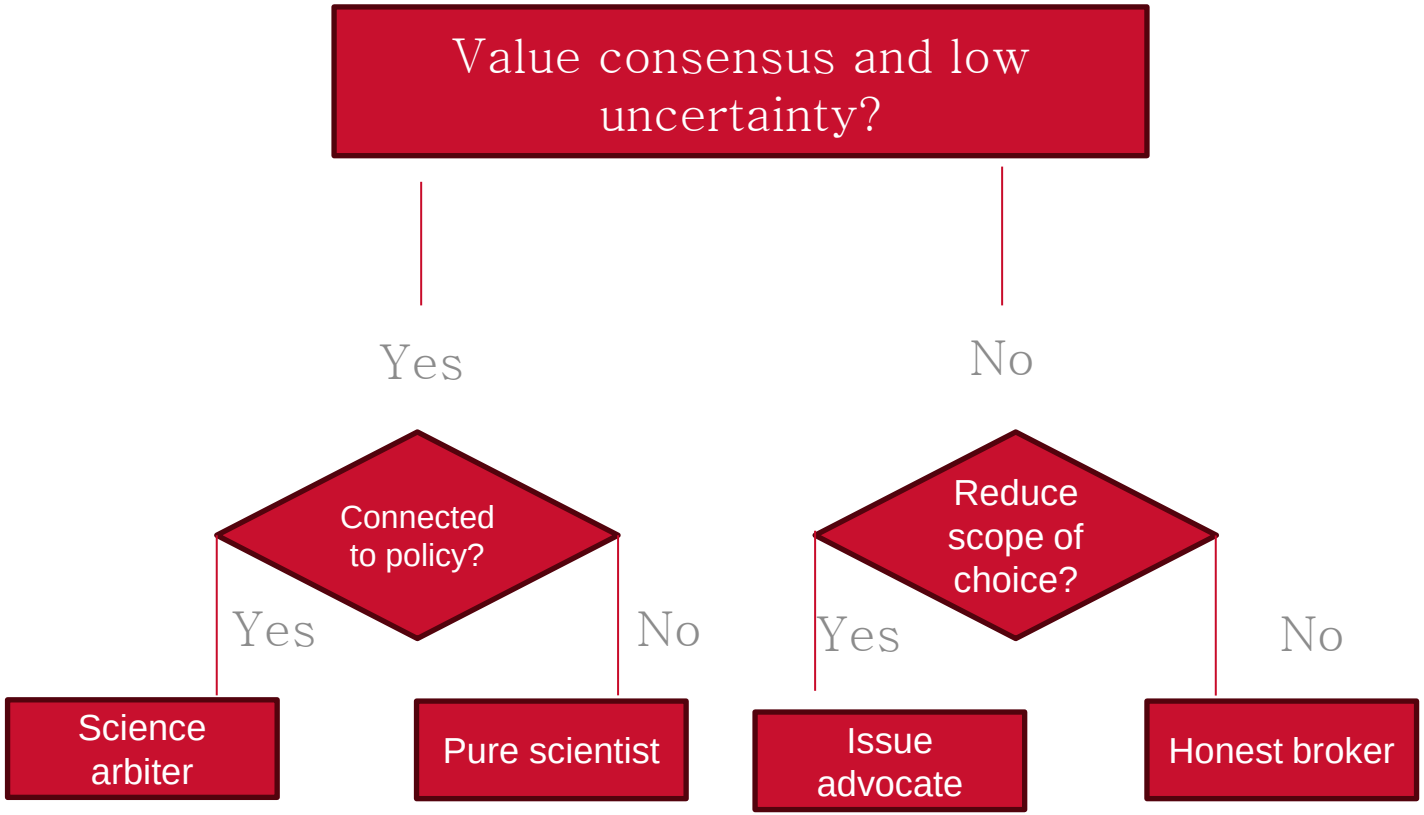
Cambridge University Press, 2007

The Honest Broker

Making sense of science, policy and politics

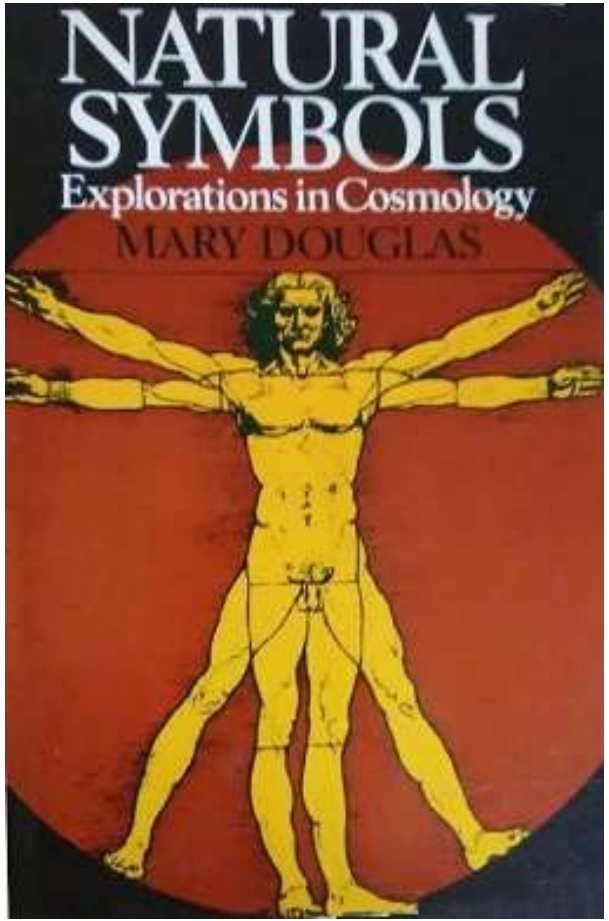
By Roger Pielke Jr. · Over 15,000 subscribers

Roger Pielke
https://rogerpielkejr.com/


Value consensus and low uncertainty?
Yes
No
Connected to policy?
Reduce scope of choice?
Yes
No
Yes
No
Science arbiter
Pure scientist
Issue advocate
Honest broker

Mary Douglas' cultural model of risk

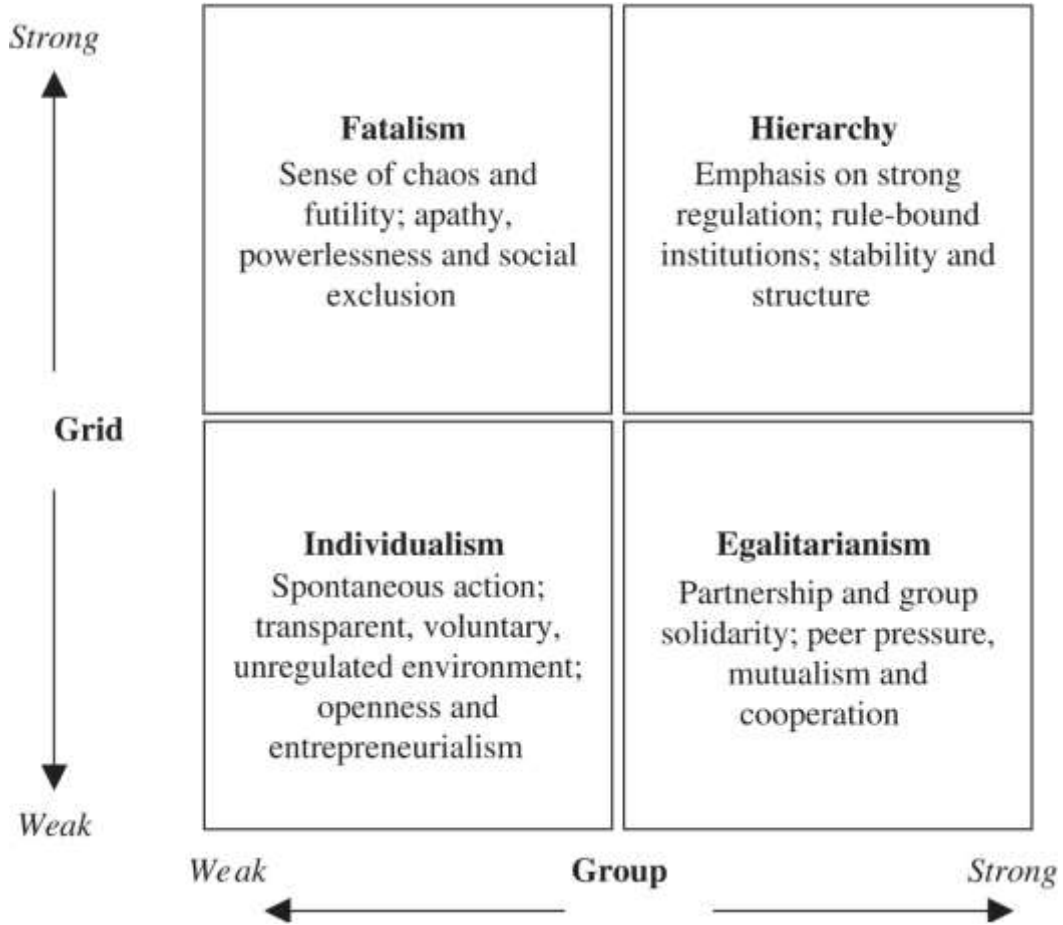
Douglas, M. (1970). *Natural symbols: Explorations in cosmology*, London: Cresset Press.



Mary Douglas (1921-2007)

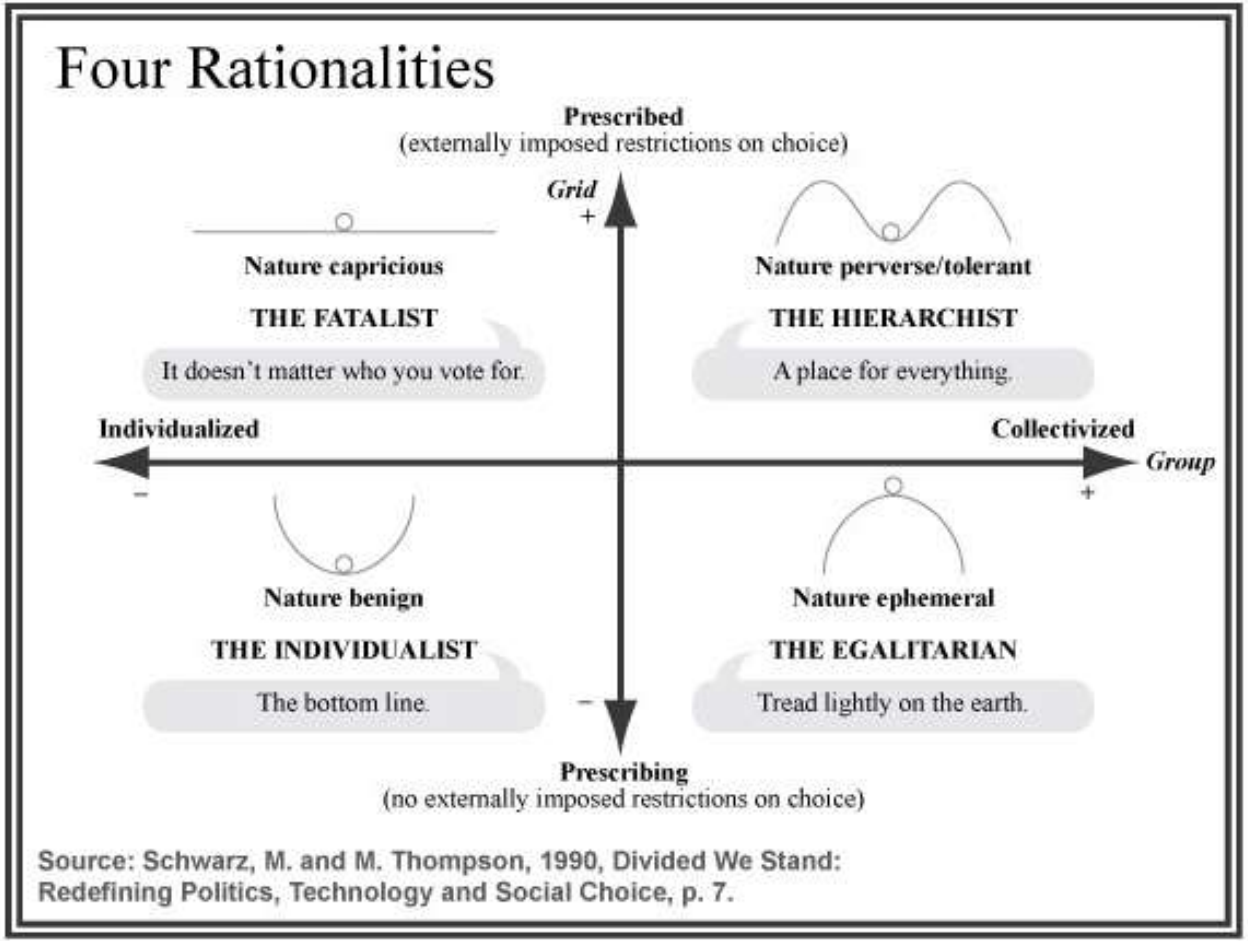
Group
degree of incorporation within a bounded social unit

Grid
degree of social prescriptions and externally imposed rules, with established hierarchies



Source: https://www.dustinstoltz.com/blog/2014/06/04/diagram-of-theory-douglas-and-wildavskys-gridgroup-typology-of-worldviews/

Myths of Nature (Schwarz and Thompson, 1990)



Myths of Nature (Schwarz and Thompson, 1990)

Nature is capricious
Natural systems are unpredictable

Nature is tolerant, but within limits
Natural systems can cope with disturbances, if these stay within certain boundaries

Nature is benign
Natural systems are resilient and able to deal with large disturbances

Nature is ephemeral or fragile
In natural systems, a small disturbance may have enormous impacts

Source: Sander C. S. Clahsen et al., 2018, Why Do Countries Regulate Environmental Health Risks Differently? A Theoretical Perspective, Risk Analysis, DOI: 10.1111/risa.13165

Several approaches to regulating risk reviewed here

Risk Analysis, Vol. 00, No. 0, 2018 DOI: 10.1111/risa.13165

Why Do Countries Regulate Environmental Health Risks Differently? A Theoretical Perspective

Sander C. S. Clahsen,[1,2,*] Irene van Kamp,[1] Betty C. Hakkert,[3] Theo G. Vermeire,[3] Aldert H. Piersma,[2,4] and Erik Lebret[2,5]

… and yet this work (not necessarily the approaches it reviews) is paradigmatic of a vision of policy (or human affairs) where ‘risk’ is the substance of the matter

Risk Analysis, Vol. 00, No. 0, 2018 DOI: 10.1111/risa.13165

Why Do Countries Regulate Environmental Health Risks Differently? A Theoretical Perspective

Sander C. S. Clahsen,[1,2,*] Irene van Kamp,[1] Betty C. Hakkert,[3] Theo G. Vermeire,[3] Aldert H. Piersma,[2,4] and Erik Lebret[2,5]

Risk is mostly perceived in relation to health, and is hence quantified by science. Additionally, risk is also the result of a perception, and can thus be investigated, again by science

Risk Analysis, Vol. 00, No. 0, 2018 DOI: 10.1111/risa.13165

Why Do Countries Regulate Environmental Health Risks Differently? A Theoretical Perspective

Sander C. S. Clahsen,[1,2,*] Irene van Kamp,[1] Betty C. Hakkert,[3] Theo G. Vermeire,[3] Aldert H. Piersma,[2,4] and Erik Lebret[2,5]

As a result, technology resistance is interpreted as misplaced or erroneous risk perception, which in turn can be attributed to incomplete or deficient scientific understanding of the lay-person

Risk Analysis, Vol. 00, No. 0, 2018 DOI: 10.1111/risa.13165

Why Do Countries Regulate Environmental Health Risks Differently? A Theoretical Perspective

Sander C. S. Clahsen,[1,2,*] Irene van Kamp,[1] Betty C. Hakkert,[3] Theo G. Vermeire,[3] Aldert H. Piersma,[2,4] and Erik Lebret[2,5]

This is the so-called ‘deficit model’ – a sort of hydra
(because if you cut one head another one sprouts up)

Source: https://www.dndbeyond.com/monsters/16929-hydra

=a deficit of scientific knowledge among nonscientific publics leads to worse decisions and a hostile attitude to science

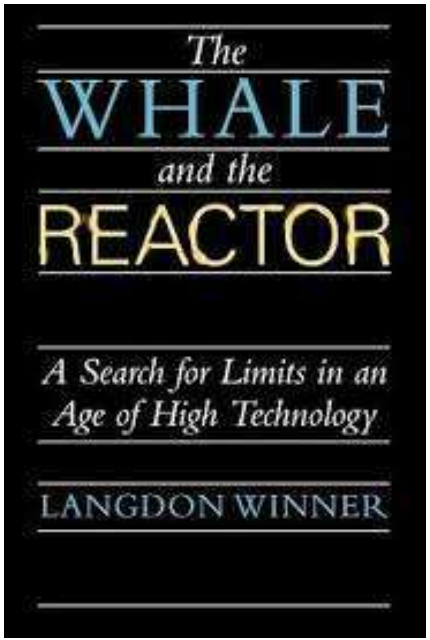
https://oxfordre.com/communication/display/10.1093/acrefore/9780190228613.001.0001/acrefore-9780190228613-e-1396?

Different things can be at risk beside health, e.g. democracy, agency, justice, fairness, fundamental beliefs …

Why should (health) risk dominate regulatory and policy narratives?

Winner (1986): ecologists should not fall into the trap of cost benefit analysis and risk analyses

Langdon Winner



(Chapter ON NOT HITTING THE TAR-BABY)

Winner, L., 1986. The Whale and the Reactor: a Search for Limits in an Age of High Technology. The University of Chicago Press, 1989 edition.

The deficit model

Who defines public meanings?

Science's hermeneutic imperialism

Special Issue: Public Engagement in Science

P U S

Public Understanding of Science
2014, Vol. 23(1) 60–70

DOI: 10.1177/0963662513505397
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SAGE

Further disorientation in the hall of mirrors

Brian Wynne
Lancaster University, UK; University of Oslo, Norway

"After seamlessly extending from informing policy, to justifying resultant political commitments, science now plays a further role … as de facto author of public meanings, thus also of proper public concerns"

This results in a confusion of the role of science

Special Issue: Public Engagement in Science

P | U | S

Public Understanding of Science
2014, Vol. 23(1) 60–70

DOI: 10.1177/0963662513505397
pus.sagepub.com
SAGE

Further disorientation in the hall of mirrors

Brian Wynne
Lancaster University, UK; University of Oslo, Norway

"‥ a problematic presumption··· that scientific meanings themselves, as given to public objects like 'risk', are also just facts, which therefore have natural proper authority over those of non-experts"

Special Issue: Public Engagement in Science

PUS

Public Understanding of Science
2014, Vol. 23(1) 60–70

DOI: 10.1177/0963662513505397
pus.sagepub.com
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Further disorientation in the hall of mirrors

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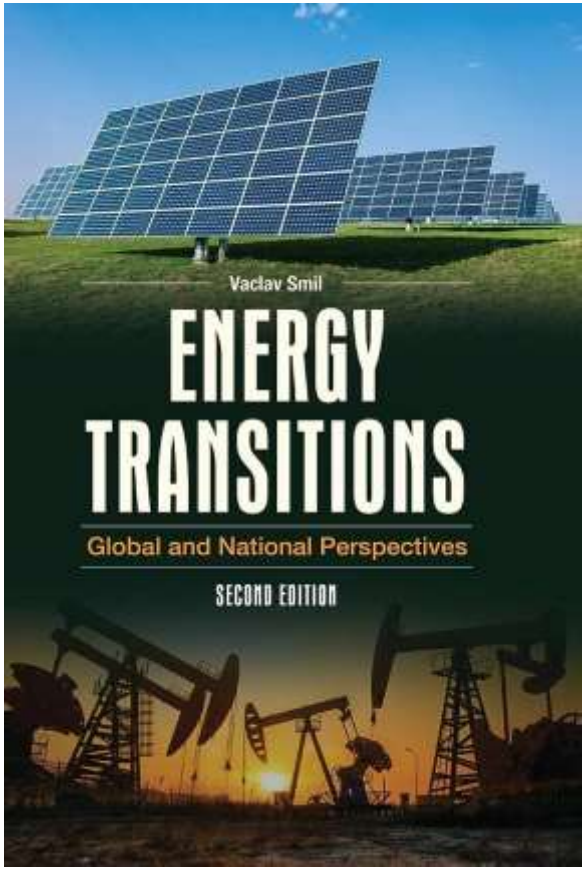
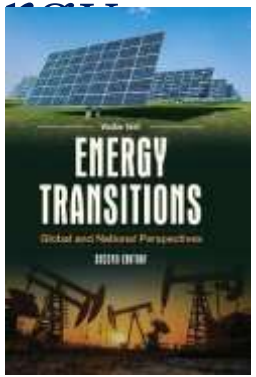

Vaclav Smil
ENERGY TRANSITIONS
Global and National Perspectives
SECOND EDITION

Vaclav Smil

Promise of rapid transformation away from fossil fuels are often based on misconceptions

- Confusing installed capacity of renewables with actual energy output

- Confusing contribution to electricity generation from renewables with fraction of total ene
utilization



Energy transitions are more than a change in the fuel base (wood, charcoal, carbon, oil, renewables…) but involve primary energy movers

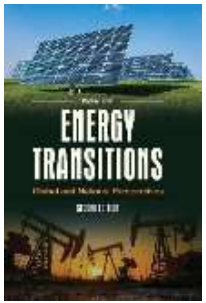
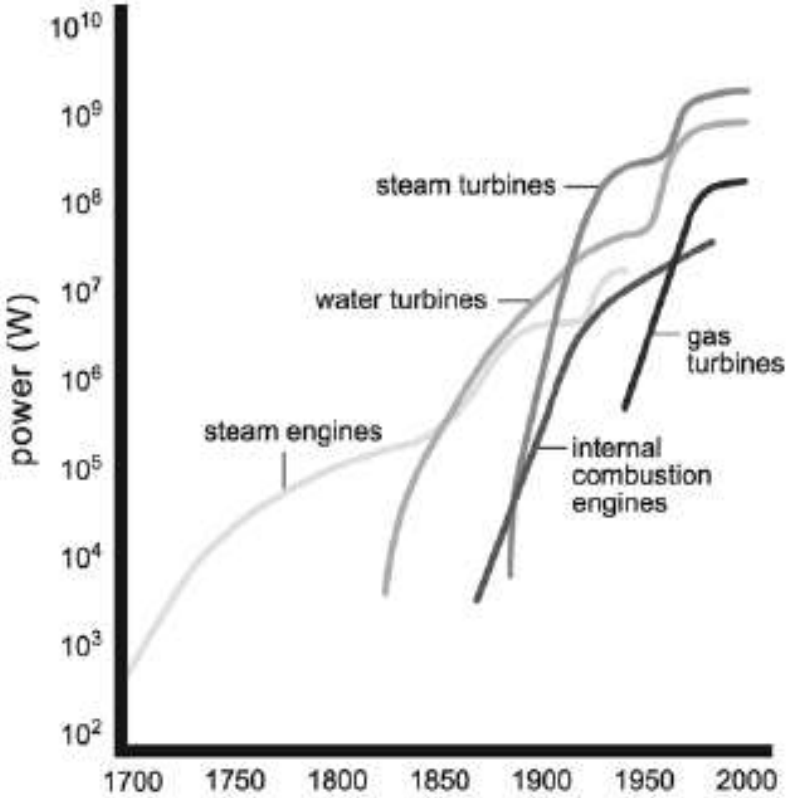
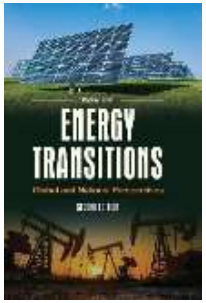


Figure 2.11 Maximum capacities of inanimate prime movers, 1700–2000. Based on Smil (1994).





History of past transition shows "gradual, prolonged affairs with new sources taking decades to become significant contributors"

Figure 2.12 Fisher-Pry plot of the global primary energy transition from biomass fuels to coals, hydrocarbons, and primary electricity, 1800–2010. Data points calculated from statistics in UNO (1956 and 1976) and BP (2009). The most remarkable phenomenon is the post-1970 stasis of all fossil fuel shares.

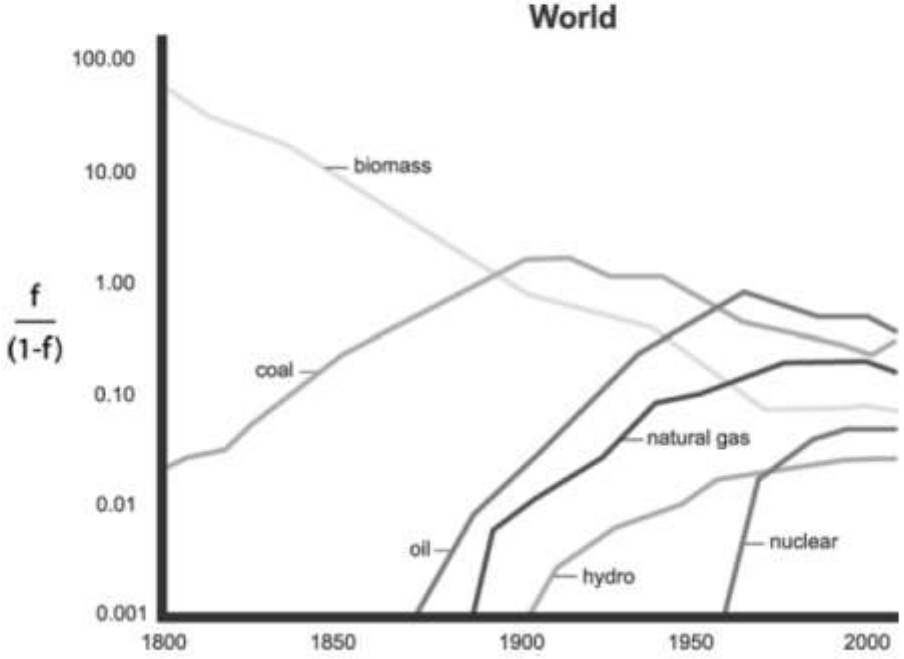
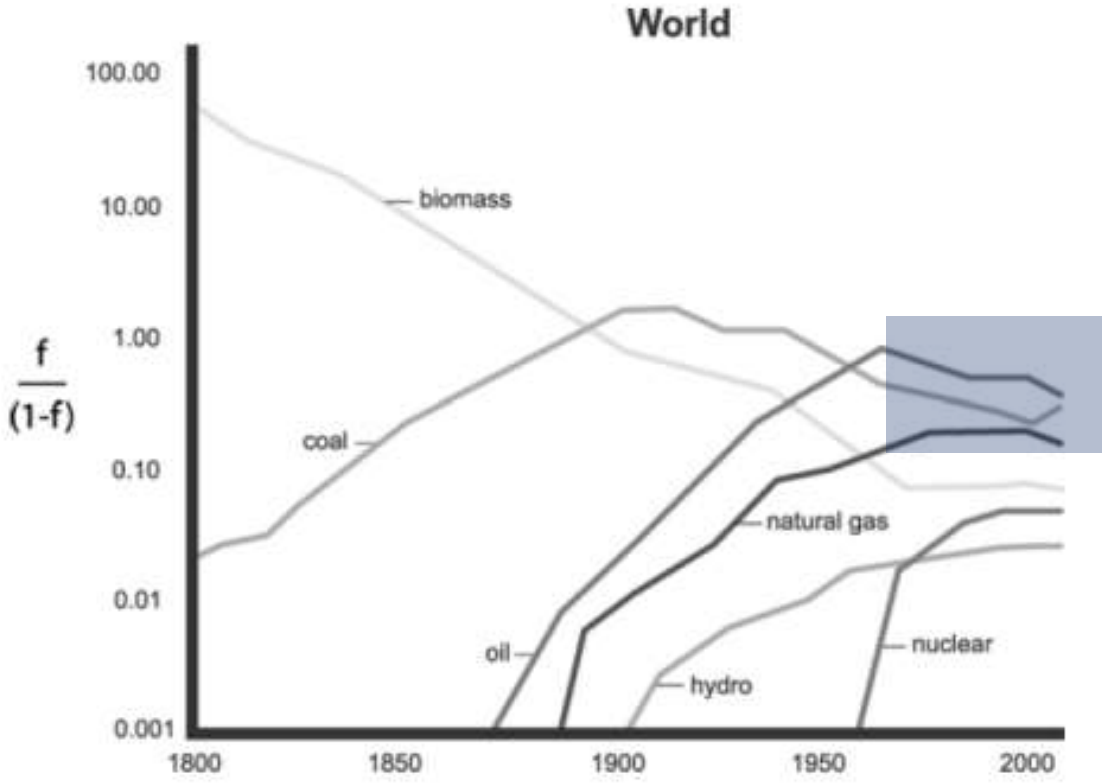
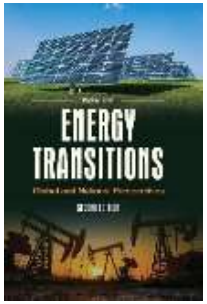


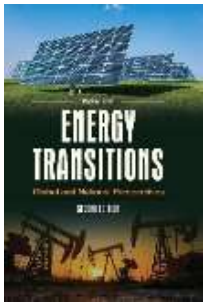
Figure 2.12 Fisher-Pry plot of the global primary energy transition from biomass fuels to coals, hydrocarbons, and primary electricity, 1800–2010. Data points calculated from statistics in UNO (1956 and 1976) and BP (2009). The most remarkable phenomenon is the post-1970 stasis of all fossil fuel shares.





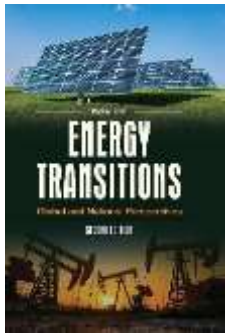
Five factors of the challenge

- Overall scale of the shift
- Magnitude and distribution of renewable
- Lower energy density of biofuels replacing liquid and solid fossil
- Intermittency of renewables
- Lower power densities of renewables



Unavoidable surprises

- Who would have predicted in the 70's (all dams are good) the present hesitancy (not even the World Bank now thinks the same)
- Who would have predicted in 1965 when nuclear were set to boom that nuclear would become a contested option in just two decades



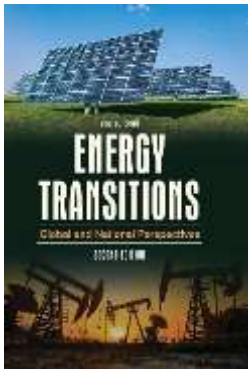
Source: Wikipedia Common

Lewis Strauss's 1945 prophesy of nuclear power 'too cheap to meter'

Trivia: L. Strauss is the 'villain' in the Oppenheimer movie

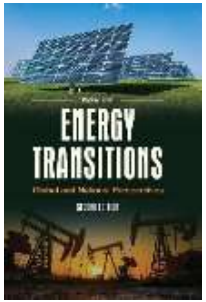
Bold predictions

“The uselessness of the 2100 scenario, equivalent to envisaging the energy realities of 2015 from the perspectives of 1930 is all too obvious…”



“Robust optimism or naïve expectations”, p. 164

Al Gore in 2008: 100% electricity by renewable in ten years (Smil is skeptical…)

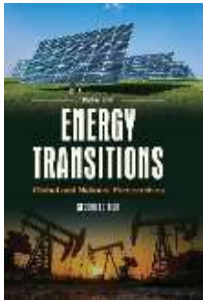


In fact, it did not happen

“Robust optimism or naïve expectations”, p. 164

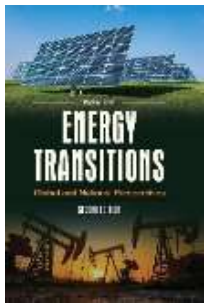
CEC (now EC) in 2008: energy consumption from renewable in 2020 will reach 20% (which Smil does not believe…) **but:**

This target was achieved!
Smil (writing in 2017) was too pessimist



The mixed record of Energiewende (p. 169-173)

2014: wind and solar contribute 22% to all primary energy derived from renewables while biomasses are at 60%; “in order to met its post 2020 targets Germany will have to import biomass, outsourcing impacts to the US South”



OPINION ENERGY

Germany's Energiewende, 20 Years Later ›

Germany's far-reaching program to reduce the share of fossil fuels in energy has achieved almost exactly what the United States achieved, but at greater expense

BY VACLAV SMIL | 26 NOV 2020 | 3 MIN READ |

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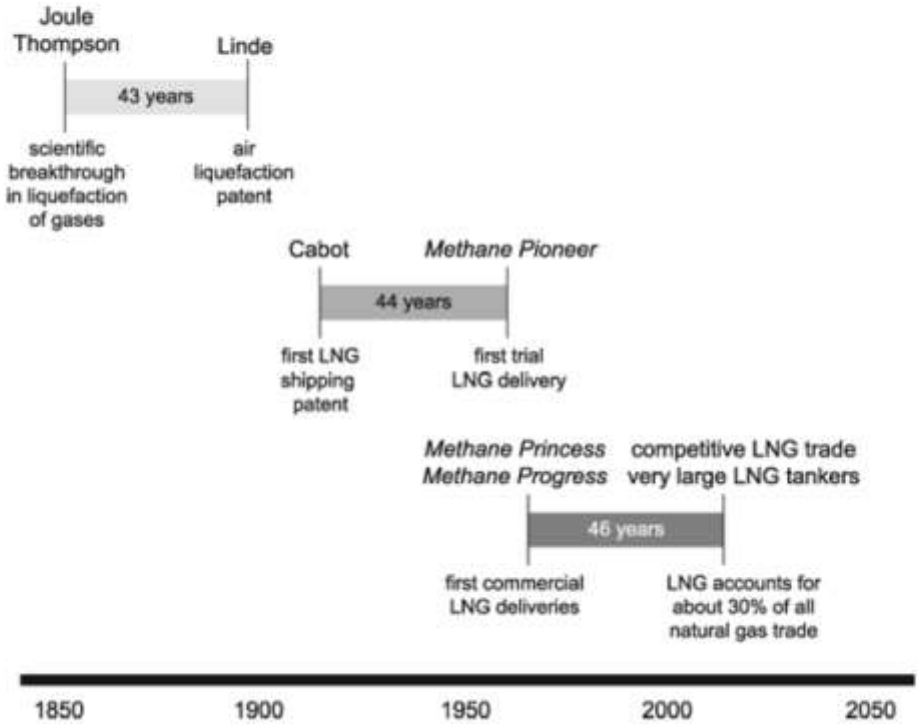
OPINION TRANSPORTATION

The Staggering Scale of the EV Transition

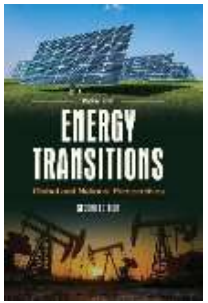
FEATURE ENERGY

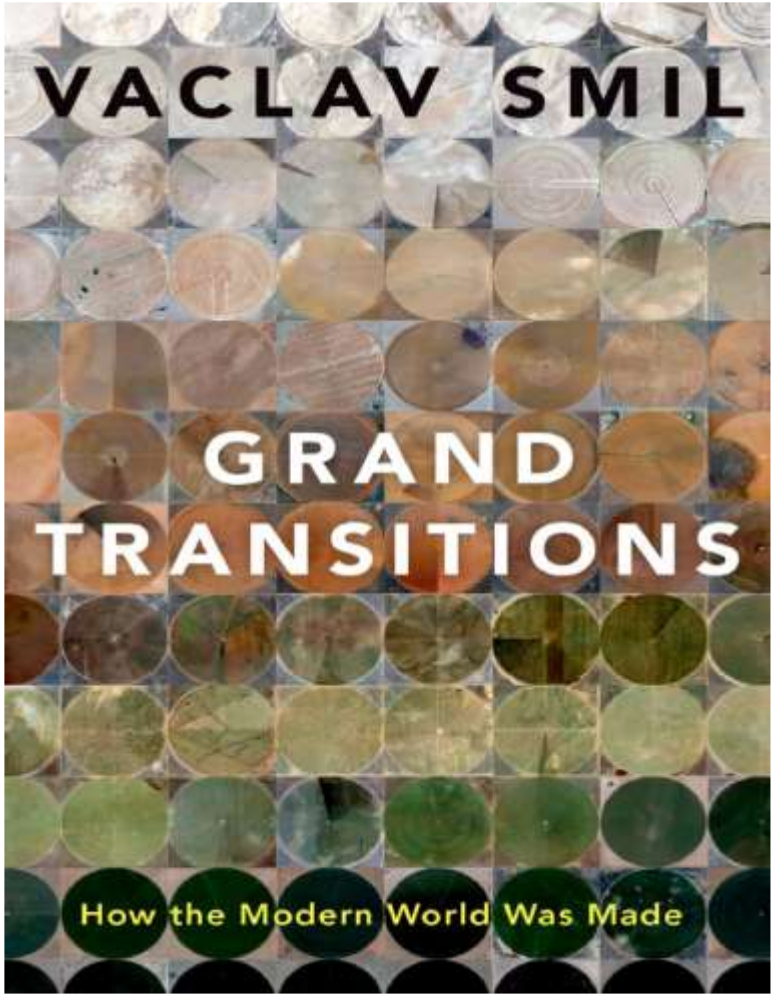
This New Breed of Generator Can Run on Almost Any Fuel

Figure 1.4 History of LNG shipments illustrates often very long time spans required for the maturation and diffusion of innovations in energy extraction, transport, and conversion.



Even a transition apparently uneventful as LNG has had its stop and go … and the 2022-2023 war has put the issue back on the agenda



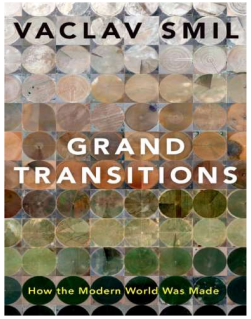


More recent work

(2021)

More recent work

(2021)



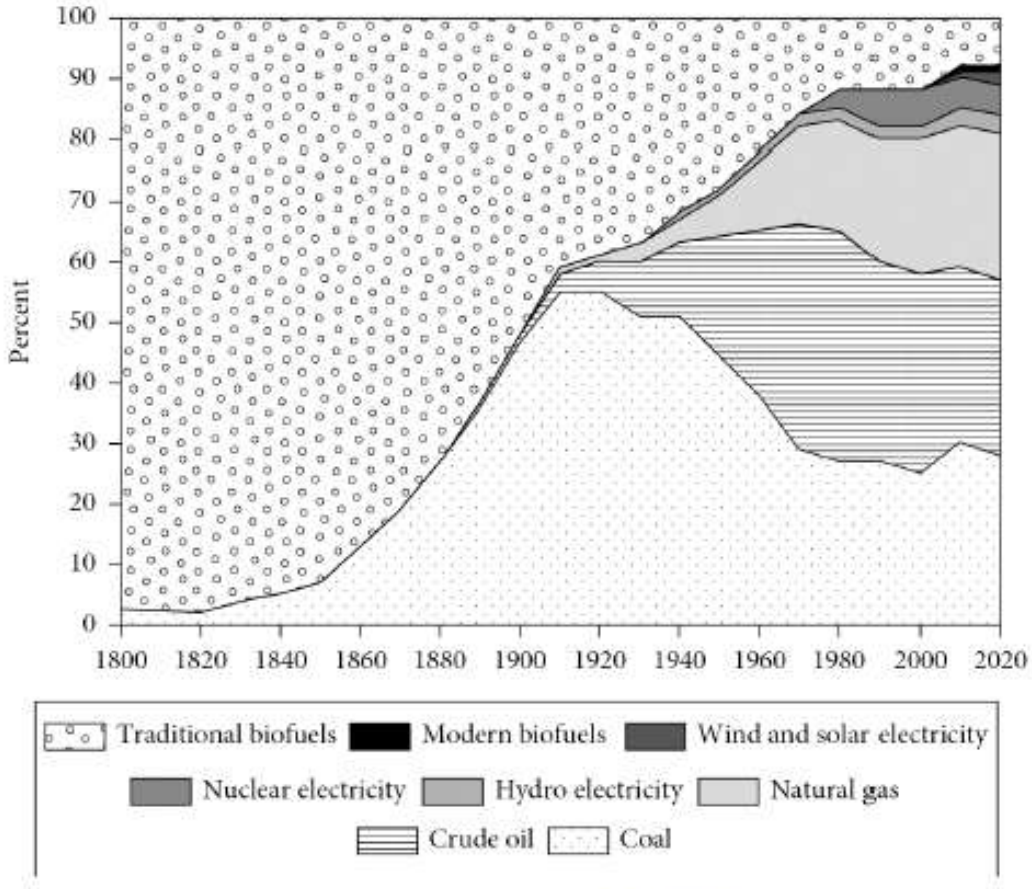


Figure 4.3 Global energy transitions, 1800–2015. Based on Smil (2017b).

Evaluating the Potential for Green Growth in a context of Technology Optimism and Technology Pessimism

A different way to look at transitions; adopting renewables and cleantech, not just for emission reduction, but because these embody technological change, manufacturing, learning curve effects, and are thus capable of capturing increasing returns. In contrast, fossil fuels are a typical diminishing returns activity.

Erik S. Reinert
(image Wikipedia Commons)

Based on: Andrea Saltelli, Lorenzo Benini, Silvio Funtowicz, Mario Giampietro, Matthias Kaiser, Erik Reinert, Jeroen P. van der Sluijs, 2020, The technique is never neutral. How methodological choices condition the generation of narratives for sustainability, Environmental Science and Policy, Volume 106, Pages 87-98, https://www.sciencedirect.com/science/article/pii/S1462901119304721. OPEN ACCESS

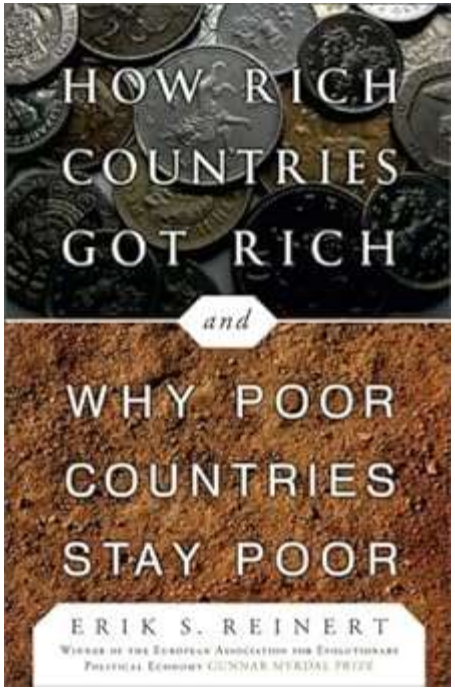
upf. BARCELONA SCHOOL OF MANAGEMENT

Evaluating the Potential for Green Growth in a context of Technology Optimism and Technology Pessimism

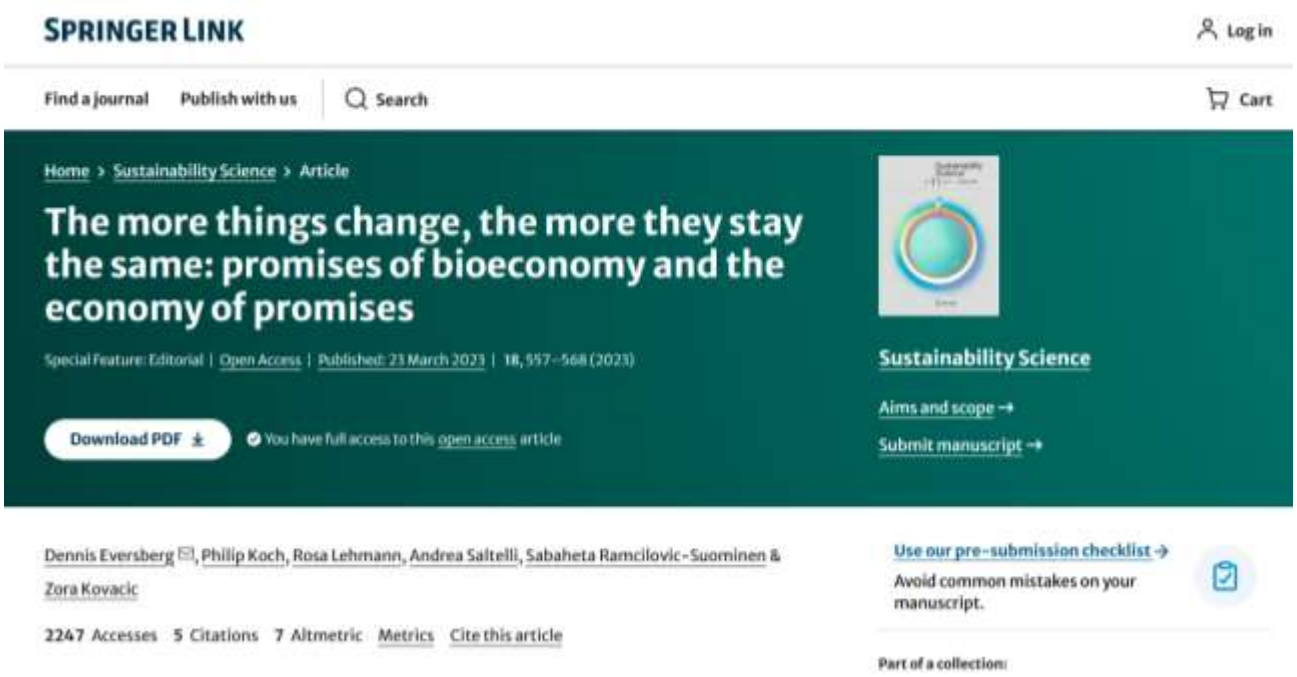
Putting renewable energies at the core of a country's industrial policy will drive down costs as the country moves along the learning curve…

With renewable power energy can be harvested, which at present is only practiced in hydropower, while with fossil fuels it needs to be extracted under diminishing returns…

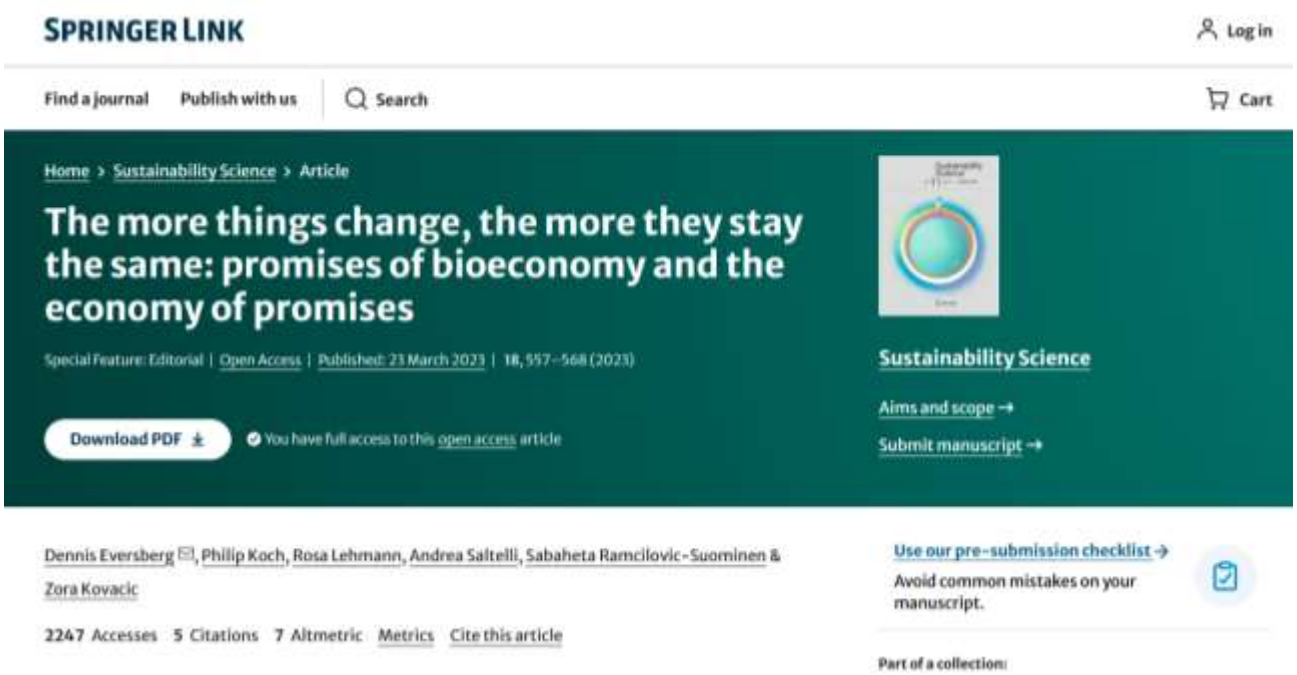
As for the past, a period of protection will be needed to let these "infant industries" gain speed. At present, the case for renewables is opposed by vested interest of the fossil fuel sector as well as by the so called "neutral" economists who insist that markets should be allowed to function "free of interference".



upf. BARCELONA SCHOOL OF MANAGEMENT



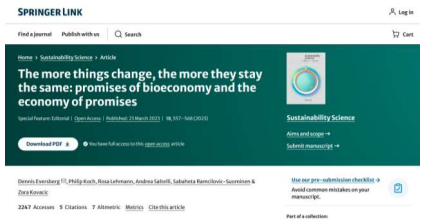
Optimistic promises can be looked at from a different angle



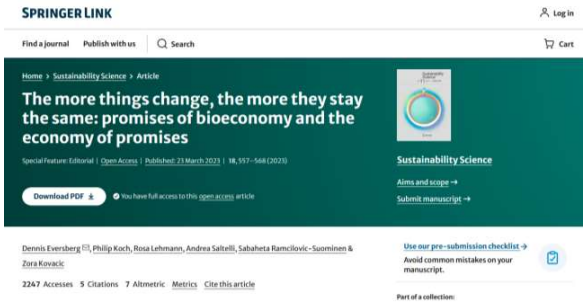
"… promises of far-reaching change made by recent bioeconomy policies are in fact strategically directed at avoiding transformative change to existing societal arrangements"

"We live in a world of limited resources. Global challenges like climate change, land and ecosystem degradation, coupled with a growing population force us to seek new ways of producing and consuming that respect the ecological boundaries of our planet" (European Commission 2018, p. 4)

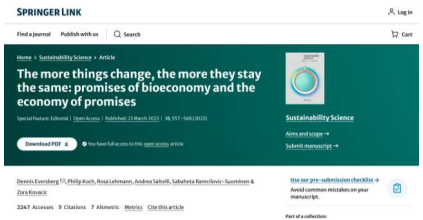
"… rapid, concerted and sustained changes in lifestyle and resource use that cut across all levels of society and the economy" (European Commission 2012, p. 3)



“[In the present narrative,] benefits such as combating climate change, helping restore ecosystems, halting land degradation and reducing food waste while delivering new jobs in a sustainable ‘circular economy’ (**European Commission** 2018, pp. 5–7) are not to result from changes in lifestyles”

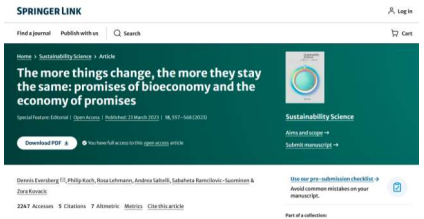


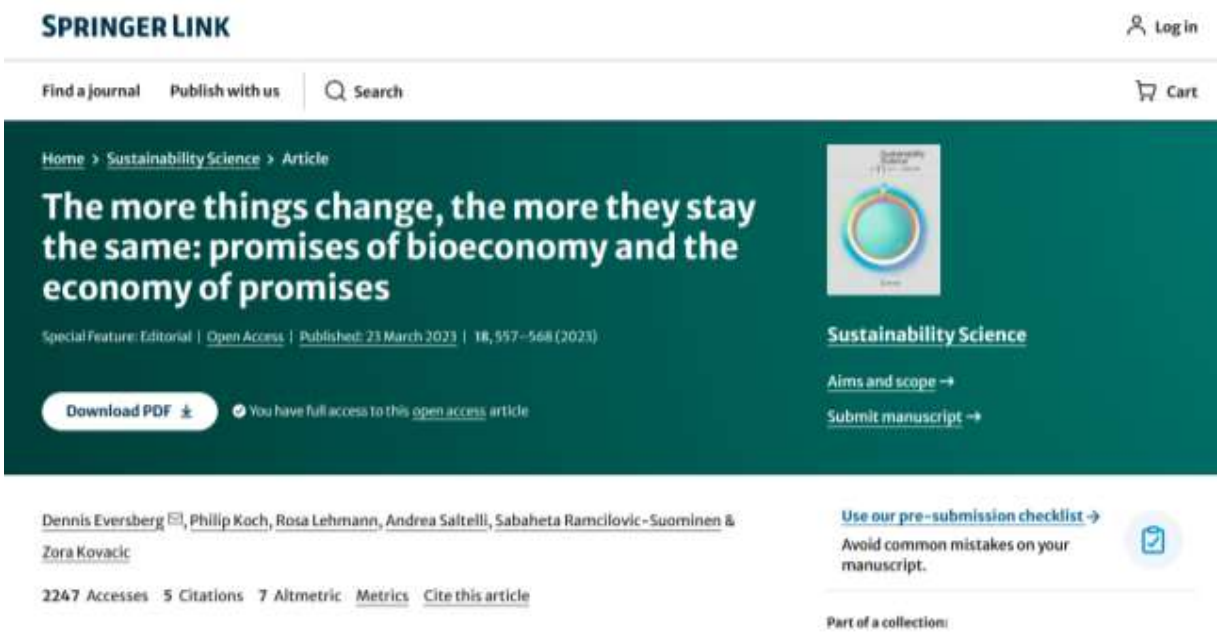
“Rather, [these achievements] are presented as resulting from ‘unprecedented advances in life sciences and biotechnologies, as well as innovations merging the physical, digital and biological worlds’ (European Commission 2018 p. 6)”



A model where “more of the same in technological advance and economic expansion will transform societies toward sustainability without actually transforming anything substantial about them”

Innovation here becomes a magic wand that help defuse the political nature of the problem, and to reframe it as a technical one





We talk of “economics of techno-scientific promises’ (ETP)” … The promise of ‘transformation without transformation’

ETP mobilizes the authority of science and its supposed impending breakthroughs as the mode of achieving change

This amounts to a ‘production of irreversibility’ and ‘lock-ins’ that renders society dependent and can progressively lock out any other solutions (P.-B. Joly)

DÉBORDEMENTS | Madeleine Akrich, Yannick Barthe, Fabian Muniesa, et al.

On the economics of techno-scientific promises

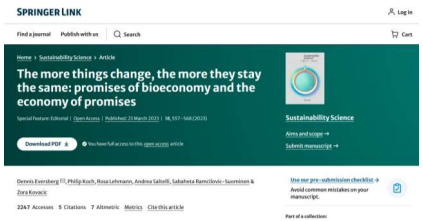
Pierre-Benoît Joly

p. 203-221

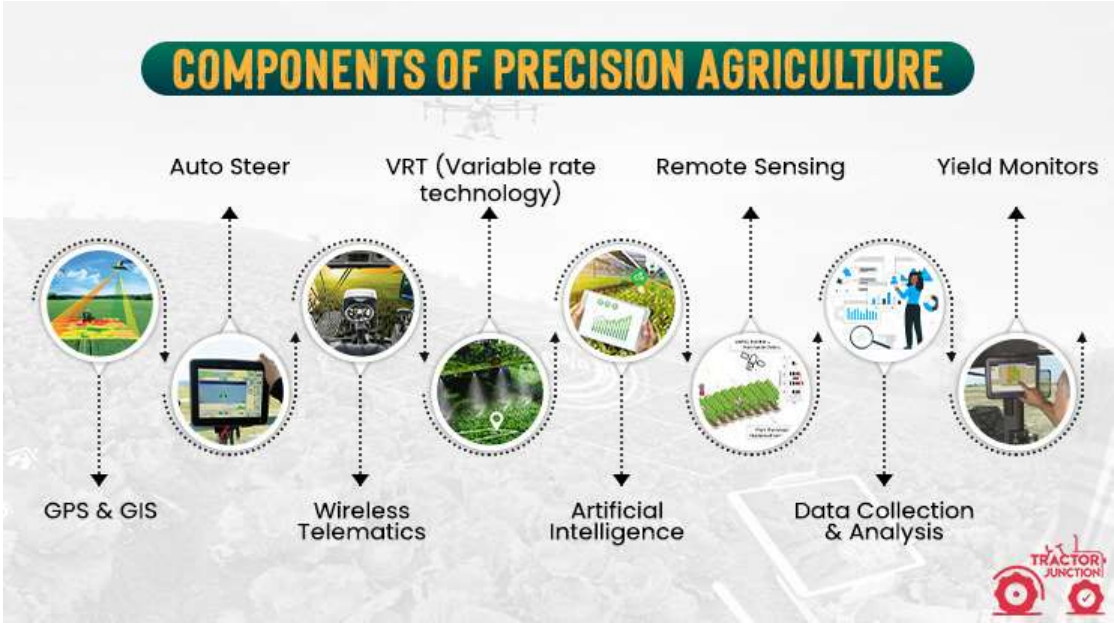
TEXT BIBLIOGRAPHY NOTES AUTHOR ILLUSTRATIONS

FULL TEXT

Governments supply imagery such as that of the “bioeconomy airport” … plant-based unbreakable window panes and moss walls to filter out air pollution ➔ ‘change’ in the lobby while wide-body planes burning hundreds of tons of fossil kerosene keep taking off from the runway … hypocrisy that rich societies can avoid changes to modes of living based on unprecedented levels of resource and energy use …

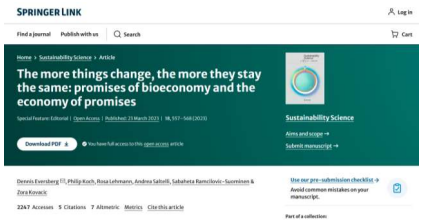


… technologies promising to boost biomass production by improved control over genetic and environmental factors (GMOs, precision agriculture), …

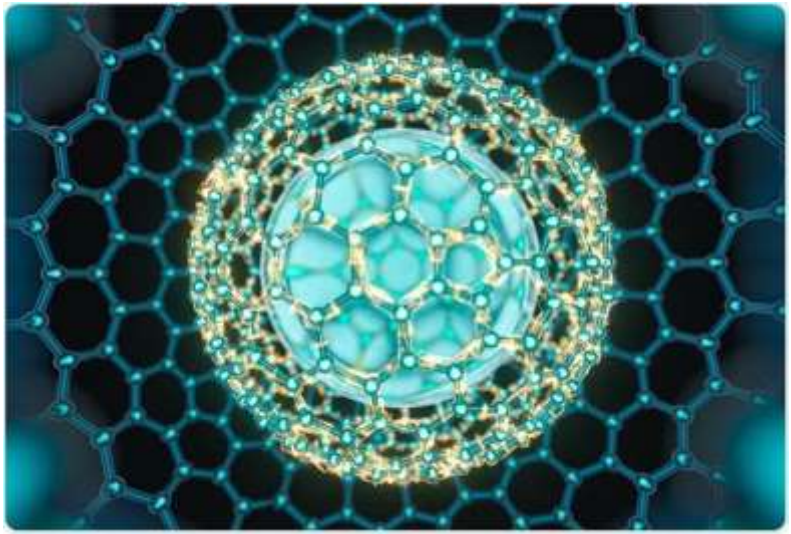


Source: https://www.tractorjunction.com/blog/what-is-precision-farming/

Source: https://www.dnv.com/to2030/technology/precision-agriculture.html

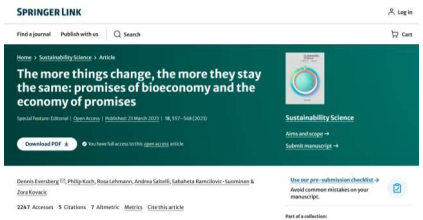


… and/or substitute fossil-based materials and processes as bio-based drop-in replacements, such as tires made from dandelion or biopolymers produced by genetically modified bacteria

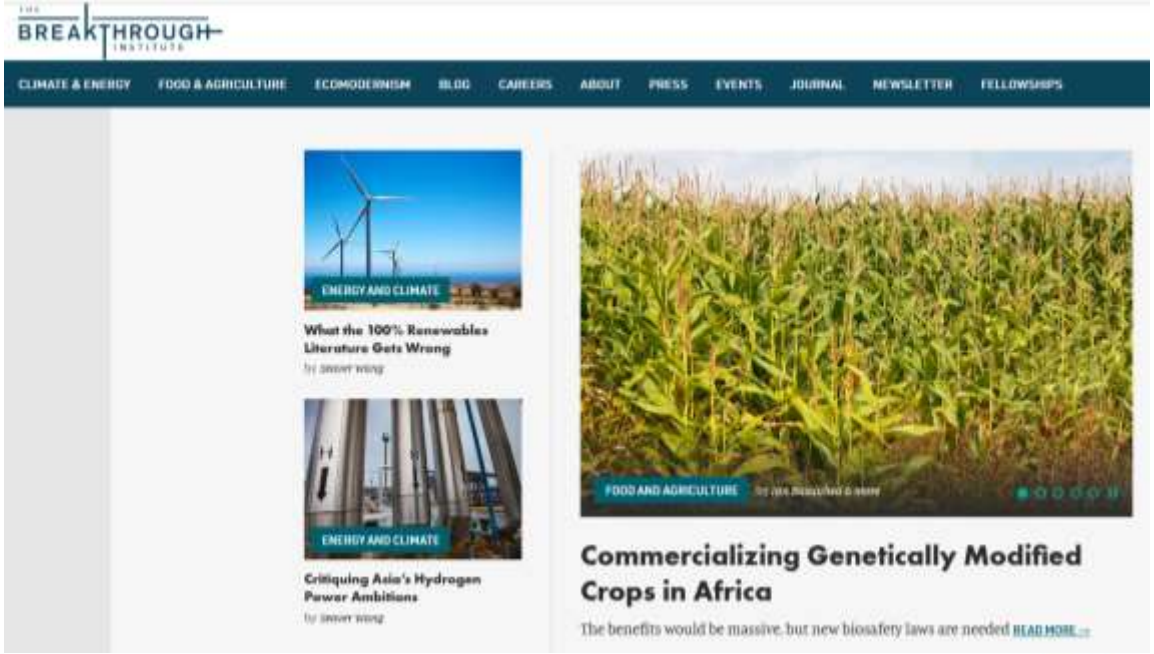


Source: https://www.news-medical.net/life-sciences/Production-of-Biopolymers-by-Microorganisms.aspx

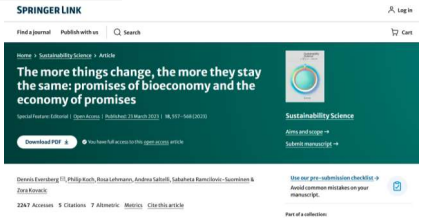
Source: https://weibold.com/continental-receives-award-for-tires-made-from-dandelion-rubber



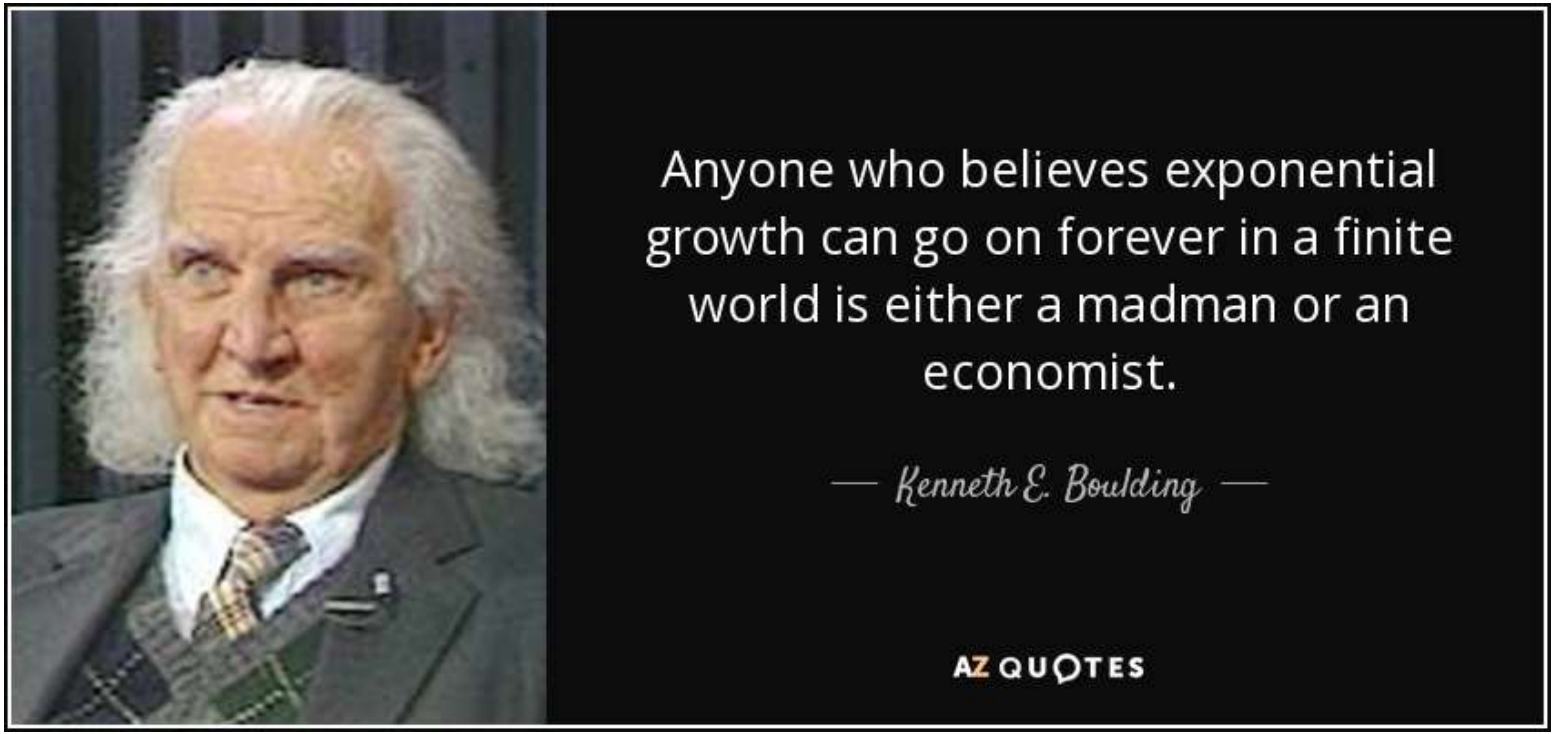
Ecomodernism

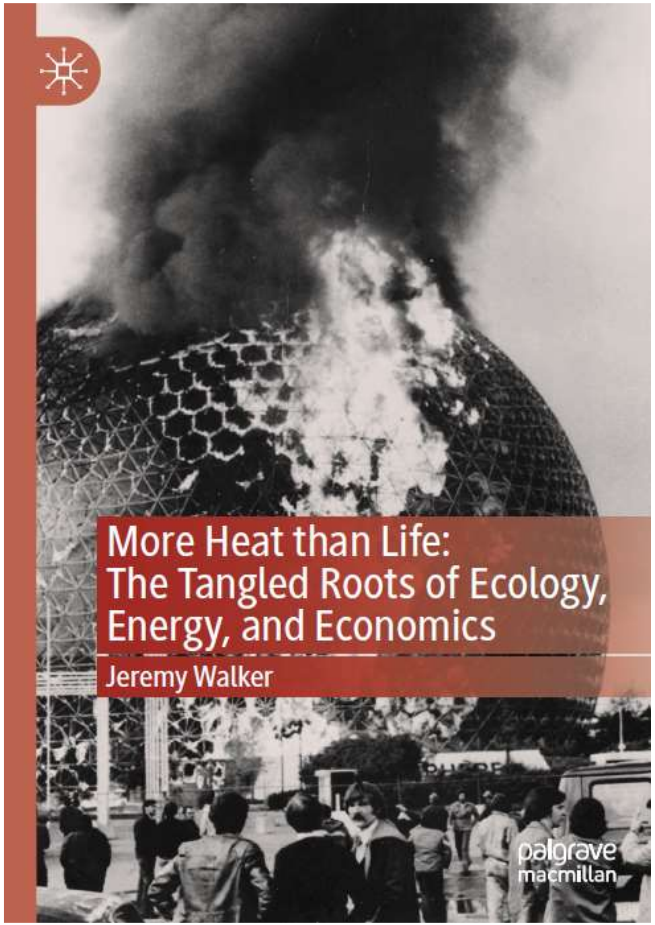


Substantial embraced by both the EU's Green deal and Biden's 'Inflation Reduction Act'



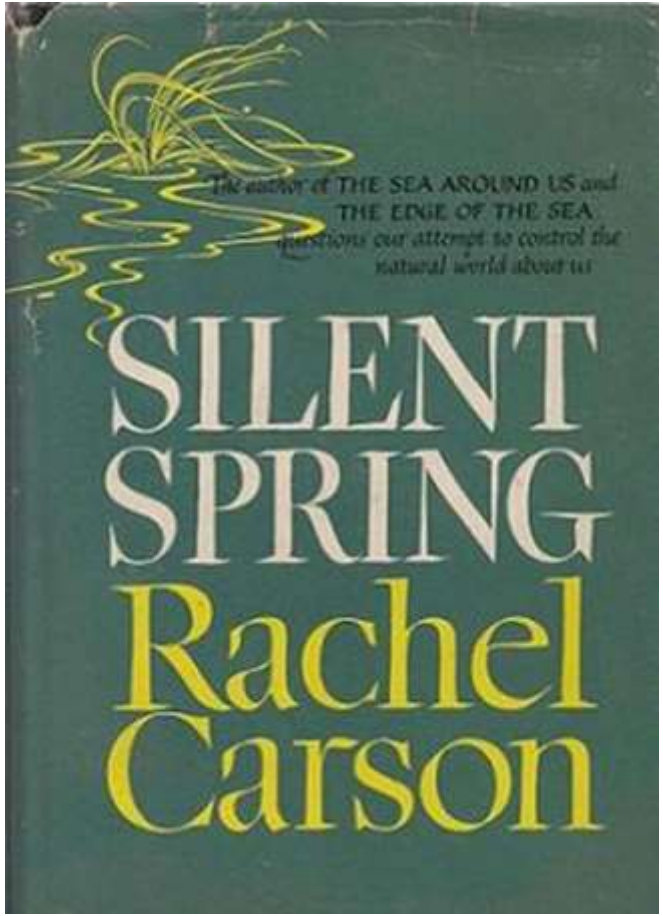
Bioeconomy policies: contradictory efforts to deal with the destructive effects of economic expansion while at the same time attempting to keep it going at all costs





Ecological world-view gone from a position of critical collision with economists to neoliberal solutions, such as financial markets for carbon and 'ecosystem services'

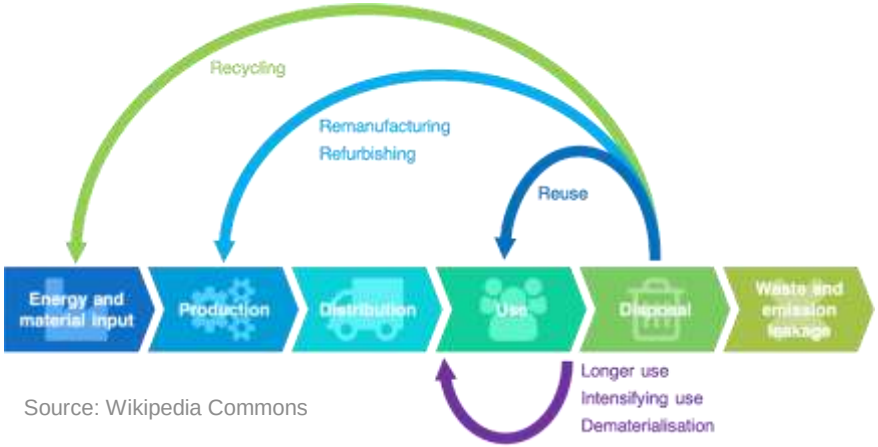
Against techno-utopian geoengineering projects to offset planetary heating



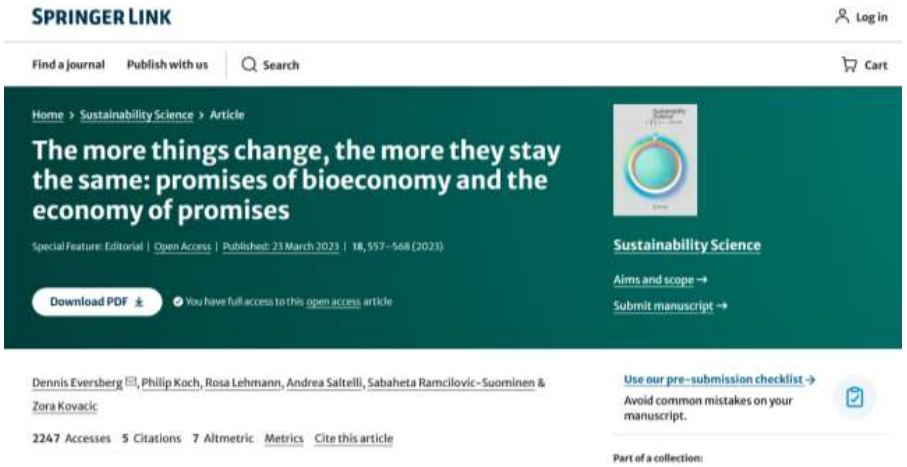
From science sounding an alarm (Rachel Carson 1962) …

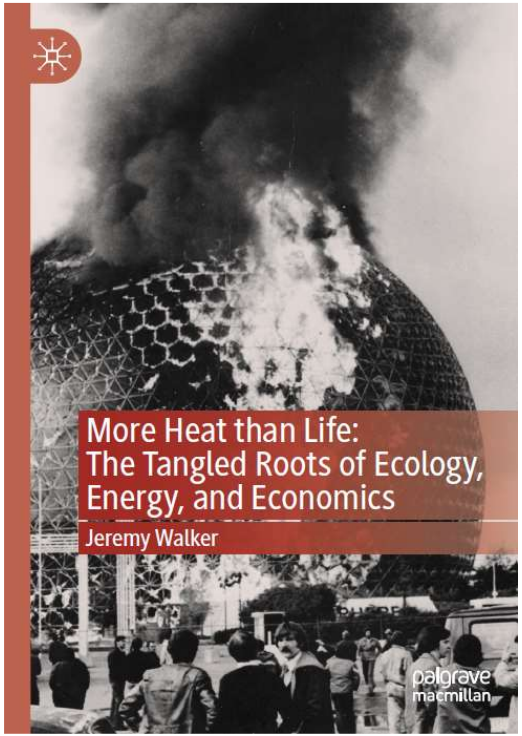
"The 'control of nature' is a phrase conceived in arrogance, born of the Neanderthal age of biology and philosophy, when it was supposed that nature exists for the convenience of man"

… to science enrolled in alimenting the economy of promises



Source: Wikipedia Commons



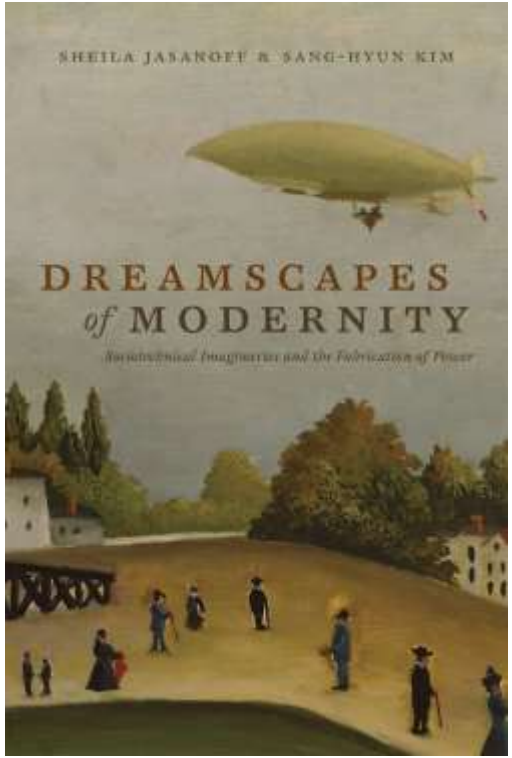


Critique of commitment to infinite economic growth

+ Roegen-like: “The 2nd law of thermodynamics, despite being the most directly relevant principle of physics to our economic existence on Earth, has never been integrated into the canon of economic theory”

Sociotechnical imaginaries: how visions of scientific and technological progress carry implicit ideas about public purposes, collective futures, and the common good

Sheila Jasanoff



ROGER PIELKE JR.

MAR 26, 2025

Global Energy Demand Set to Accelerate

Five takeaways from IEA's Global Energy Review 2025

ROGER PIELKE JR.
MAR 26, 2025

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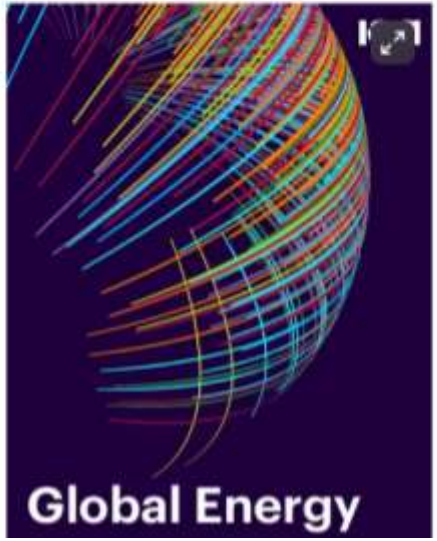
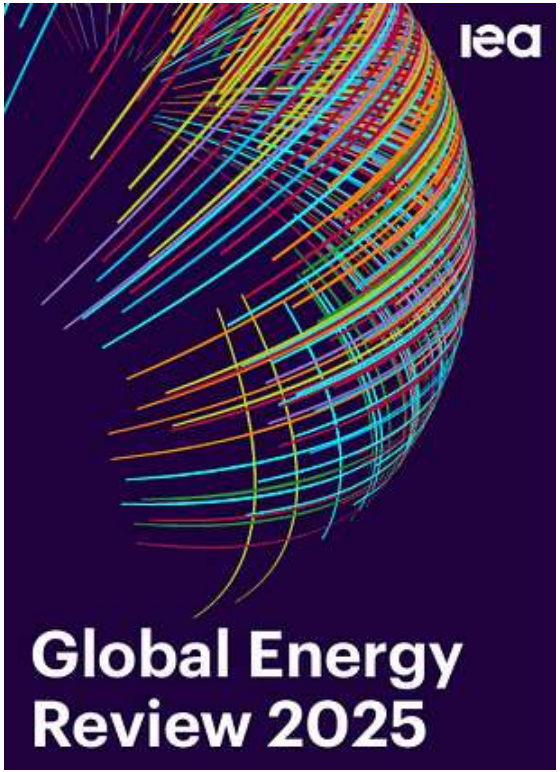
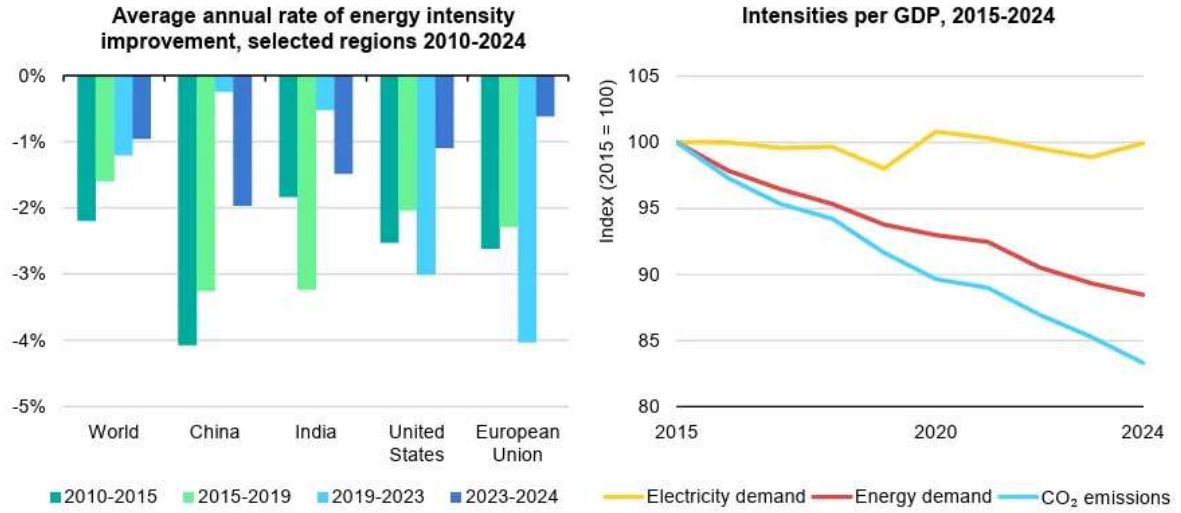




Rates of improvement in energy intensity

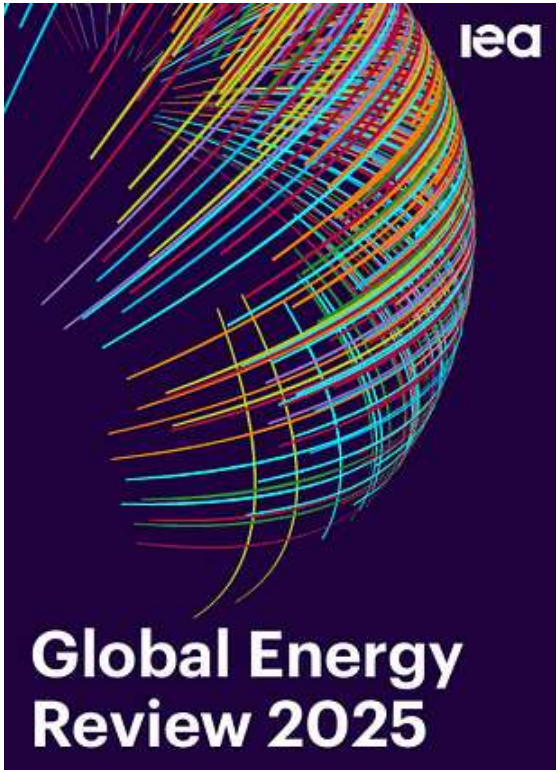


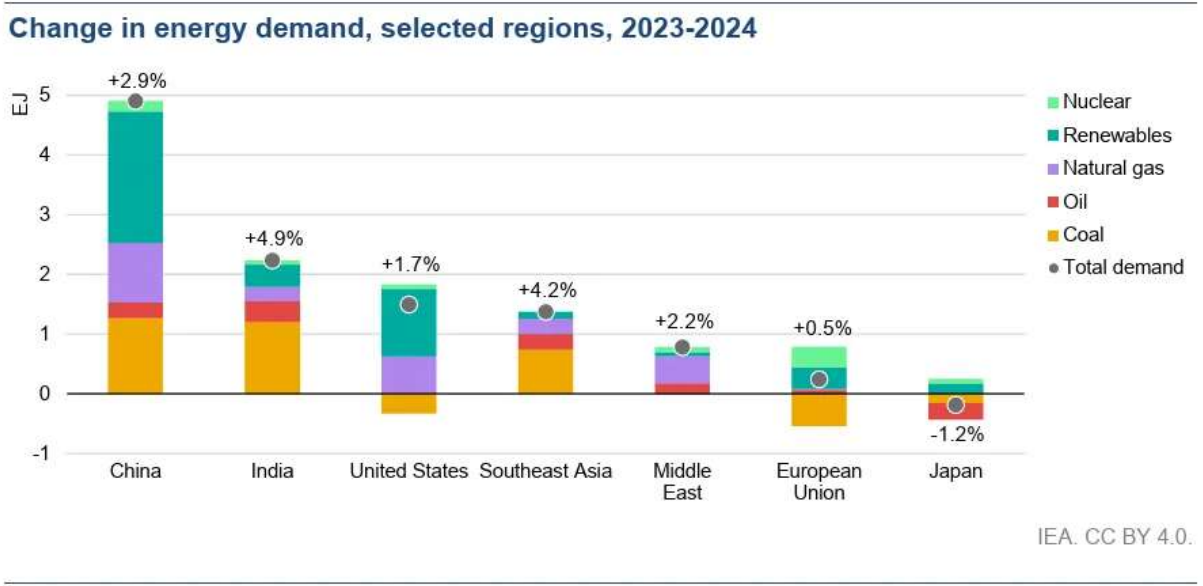
IEA. CC BY 4.0.

Carbon intensity goes down at a rate of ~1.9% per year in 2015 to 2024… Good!

But to reduce CO2 emissions by 80% by 2050 would take a rate of 8.1%

(see https://rogerpielkejr.substack.com/p/up-up-and-away?)

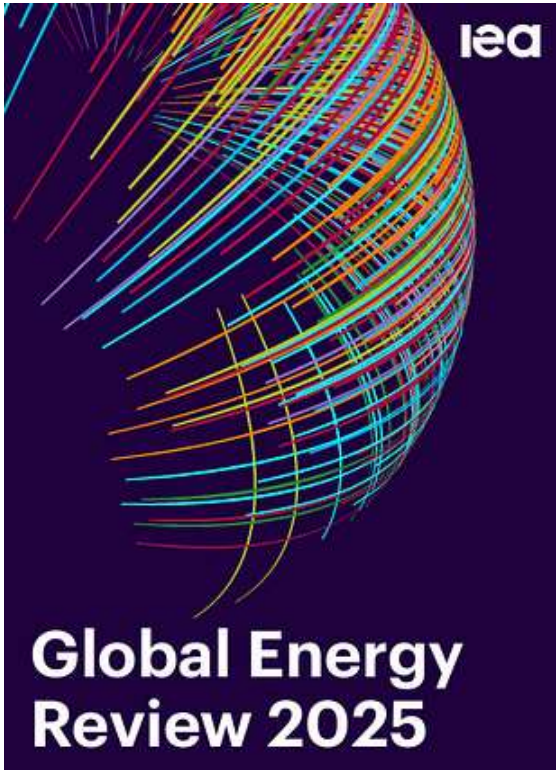


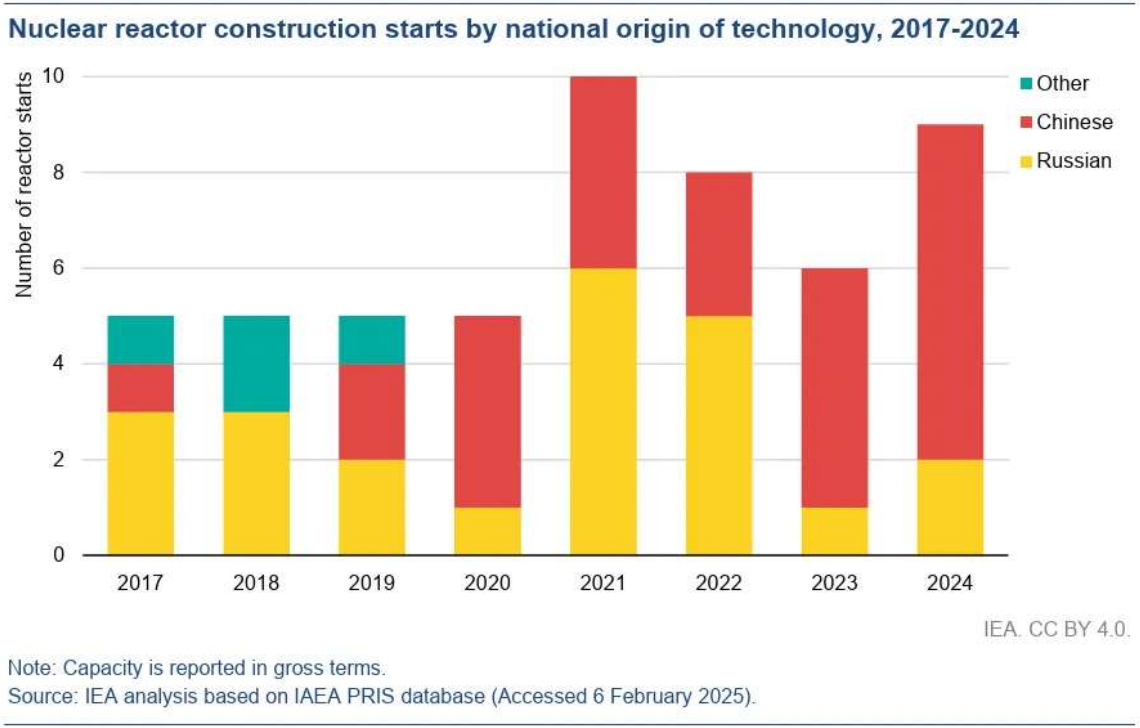


Energy demand increases everywhere (but Japan)

Coal down (US, EU) but up in Asia

(see https://rogerpielkejr.substack.com/p/up-up-and-away?)

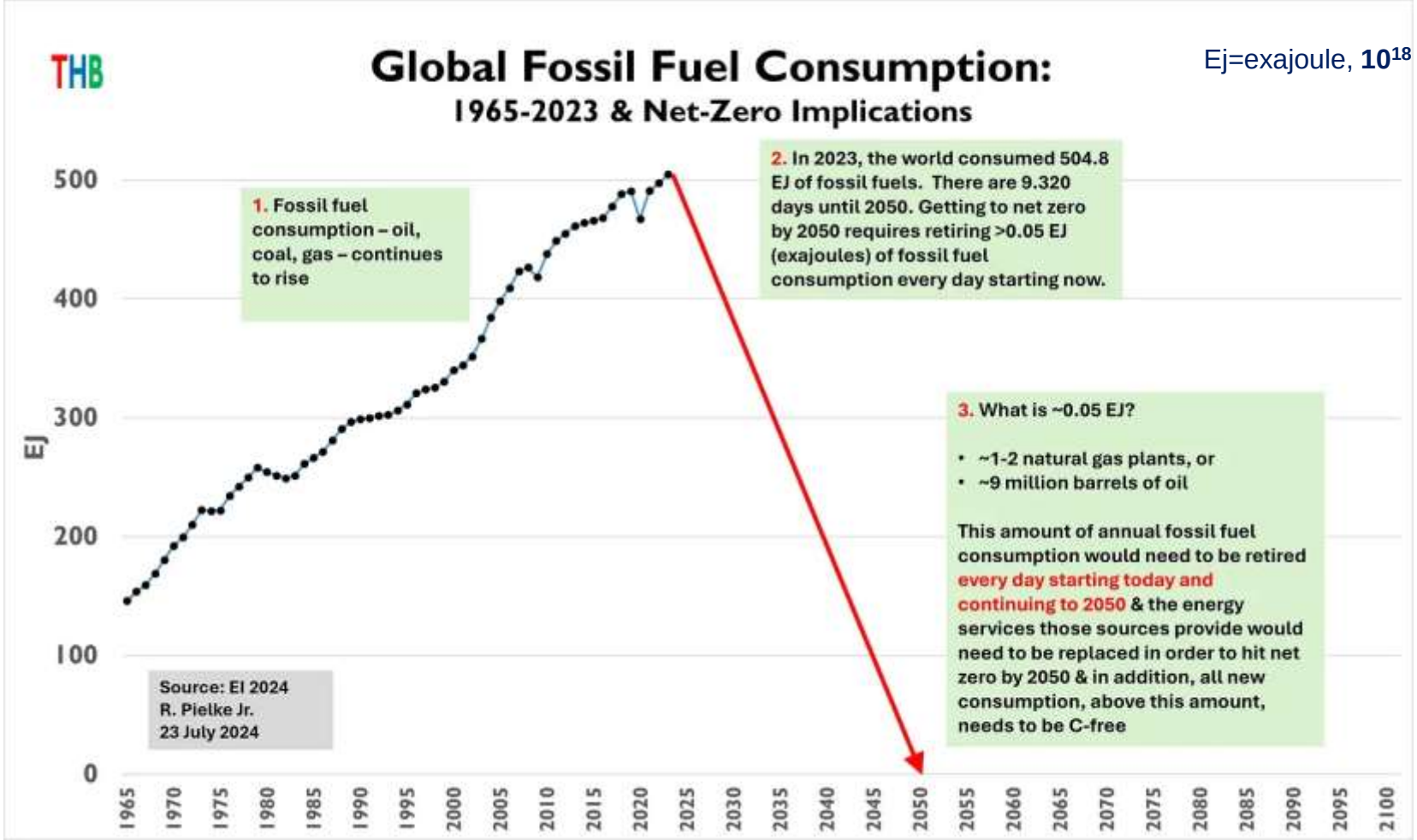




Nuclear is up (but only in China and Russia)

(see https://rogerpielkejr.substack.com/p/up-up-and-away?)

Ej=exajoule, **10^{18} joules**.



see https://rogerpielkejr.substack.com/p/up-up-and-away?

The ethos of science

Robert K. Merton, sociologist of science, considered the father of Science and Technology Studies, 1910-2003

CUDOS

Communalism – the common ownership of scientific discoveries, according to which scientists give up intellectual property rights in exchange for recognition and esteem …

Universalism – according to which claims to truth are evaluated in terms of universal or impersonal criteria, and not on the basis of race, class, gender, religion, or nationality;

CUDOS

Disinterestedness – according to which scientists are rewarded for acting in ways that outwardly appear to be selfless;

Organized Scepticism – all ideas must be tested and are subject to rigorous, structured community scrutiny

CUDOS

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Organized **S**cepticism – all ideas must be tested and are subject to rigorous, structured community scrutiny

Practicum here

- Split in groups
- Debate among yourselves the pros and cons of **one** norm & elect **two** advocated, one pro the norm and the other against (15m)
- The two advocates for each group report in class

The same R.K. Merton realized later in life that norms have corresponding counter norms

Mitroff, I. I. 1974, Norms and Counter-Norms in a Select Group of the Apollo Moon Scientists: A Case Study of the Ambivalence of Scientists, American Sociological Review, 39, 579-595.

NORMS AND COUNTER-NORMS IN A SELECT GROUP OF THE APOLLO MOON SCIENTISTS: A CASE STUDY OF THE AMBIVALENCE OF SCIENTISTS*

IAN I. MITROFF

American Sociological Review 1974, Vol. 39 (August): 579-595

This paper describes a three and a half year study conducted over the course of the Apollo lunar missions with forty-two of the most prestigious scientists who studied the lunar rocks. The paper supports the Merton-E. Barber concept of sociological ambivalence, that social institutions reflect potentially conflicting sets of norms. The paper offers a set of counter-norms for science, arguing that if the norm of universalism is rooted in the impersonal character of science, an opposing counter-norm is rooted in the personal character of science. The paper also argues that not only is sociological ambivalence a characteristic of science, but it seems necessary for the existence and ultimate rationality of science.

Three-and-a-half-year study conducted over the course of the Apollo lunar missions with forty-two of the most prestigious scientists who studied the lunar rocks

The paper supports the Merton-E. Barber concept of **sociological ambivalence, that social institutions reflect potentially conflicting sets of norms**

[We must] consider, first, how potentially contradictory norms develop in every social institution; next, how in the institution of science conflicting norms generate marked ambivalence in the lives of scientists; and finally, how this ambivalence affects the actual, as distinct from the supposed, relations between men of science (Merton, 1963a:80).

- Solitariness (secrecy, miserism) is often used to keep findings secret in order to be able to claim patent rights…

Instead of Communalism

- Particularism […] a real issue, particularly when you consider the ratio of researchers in rich countries compared with those in poor countries

Instead of Universalism

- Interestedness arises because scientists have genuine interests at stake in the reception of their research…

Instead of Disinterestedness

- Dogmatism because careers are built upon a particular premise (theory) being true…

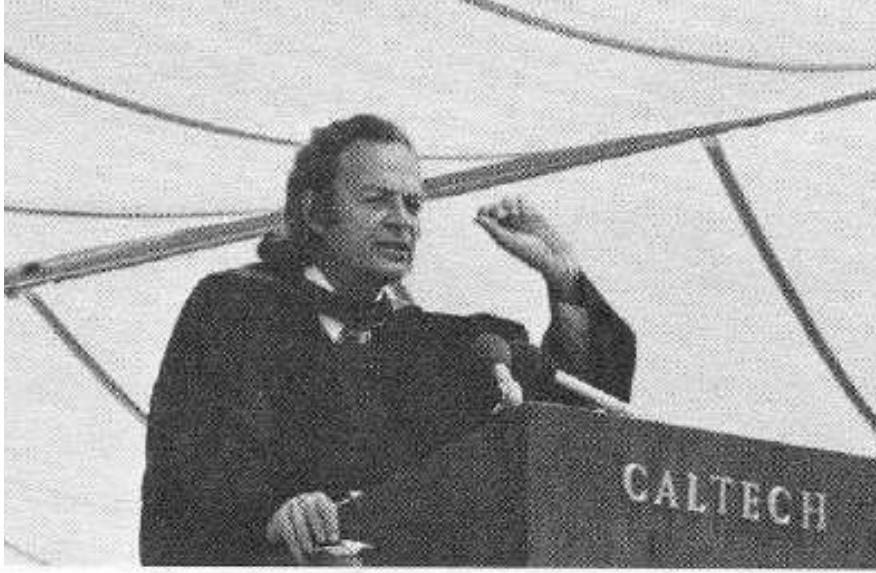
Instead of Organized Skepticism

A lesson from a recent past

Cargo Cult Science

by RICHARD P. FEYNMAN

Some remarks on science, pseudoscience, and learning how to not fool yourself. Caltech's 1974 commencement address.



http://calteches.library.caltech.edu/3043/1/CargoCult.pdf

“In the South Seas there is a cargo cult of people. During the war they saw airplanes land with lots of good materials, and they want the same thing to happen now.

So they've arranged to imitate things like runways, to put fires along the sides of the runways, to make a wooden hut for a man to sit in, with two wooden pieces on his head like headphones and bars of bamboo sticking out like antennas—he's the controller—and they wait for the airplanes to land”

“They're doing everything right. The form is perfect. It looks exactly the way it looked before. But it doesn't work. No airplanes land. So I call these things cargo cult science, because they follow all the apparent precepts and forms of scientific investigation, but they're missing something essential, because the planes don't land”

“[…] there is one feature I notice that is generally missing in cargo cult science. That is the idea that we all hope you have learned in studying science in school […] .

It's a kind of scientific integrity, a principle of scientific thought that corresponds to a kind of utter honesty--a kind of leaning over backwards.

“Details that could throw doubt on your interpretation must be given, if you know them. […] give all of the information to help others to judge the value of your contribution.”

Thanks

www.andreasaltelli.eu
https://orcid.org/0000-0003-4222-6975
@AndreaSaltelli@mstdn.social
https://www.youtube.com/channel/UCz26ZK04xchekUy4GevA3DA

upf. BARCELONA SCHOOL OF MANAGEMENT