

Living Well Within Planetary Limits: Is it possible? And what will it take?



Seminar 13/07/2023

LEVERHULME
TRUST _____

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Unil
UNIL | Université de Lausanne

Outline

1. Climate context
2. Energy & well-being
3. The “Living Well Within Limits” project
 1. Motivation & basic idea(s)
 2. Some results
4. Directions for research
5. Directions for action



Geneva, Climate Strike, October 2021, photo from Olivier de Marcellus

An aerial photograph of a city, showing streets, buildings, and green spaces, is the background. A large blue semi-circle is on the left side, and a green circle is in the center. The text "CLIMATE CRISIS CONTEXT" is written in white, bold, uppercase letters inside the green circle.

CLIMATE CRISIS CONTEXT



Yantze, China, August 2022



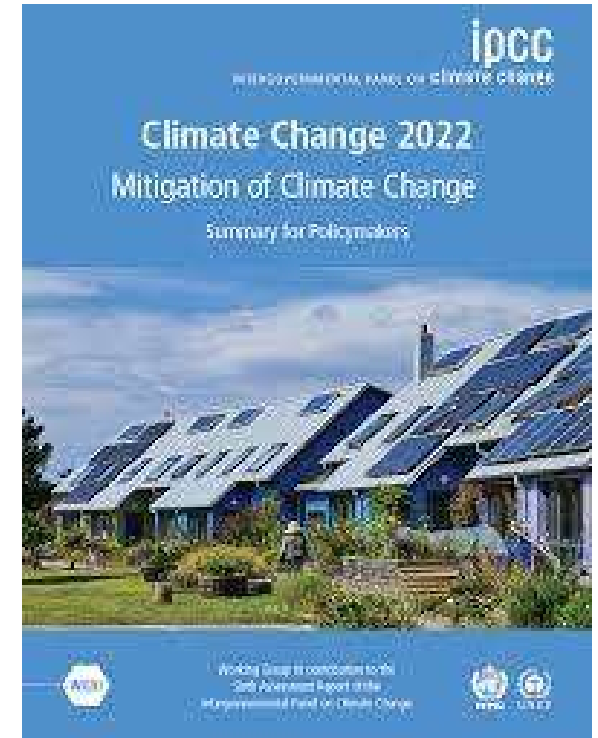
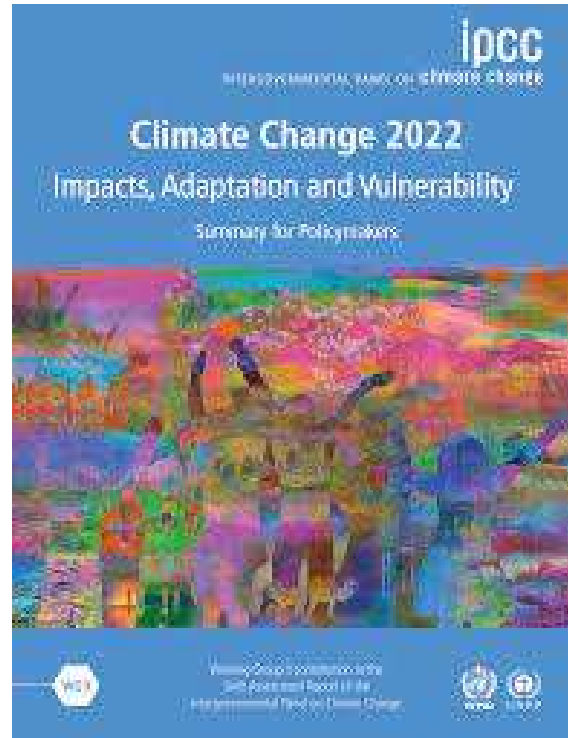
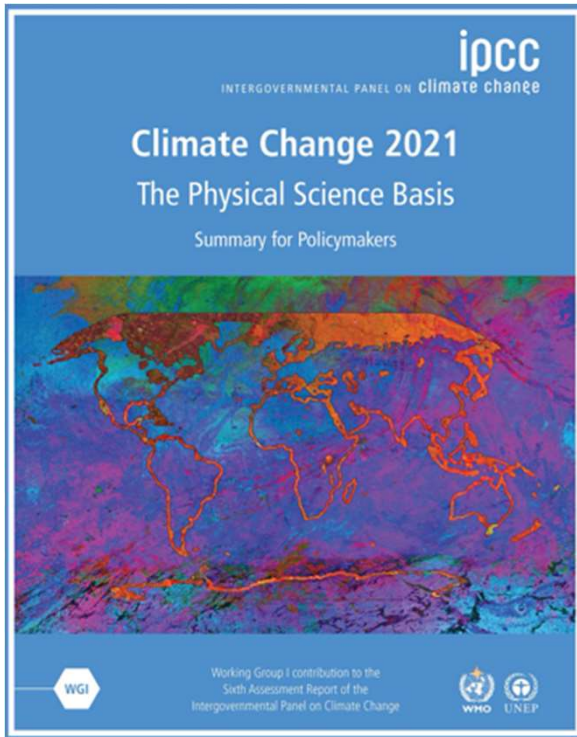
Po, Italy, August 2022



Rhine, August 2022



Danube, August 2022



Scientific motivation for the climate crisis

Reports from the Intergovernmental Panel on Climate Change (IPCC)

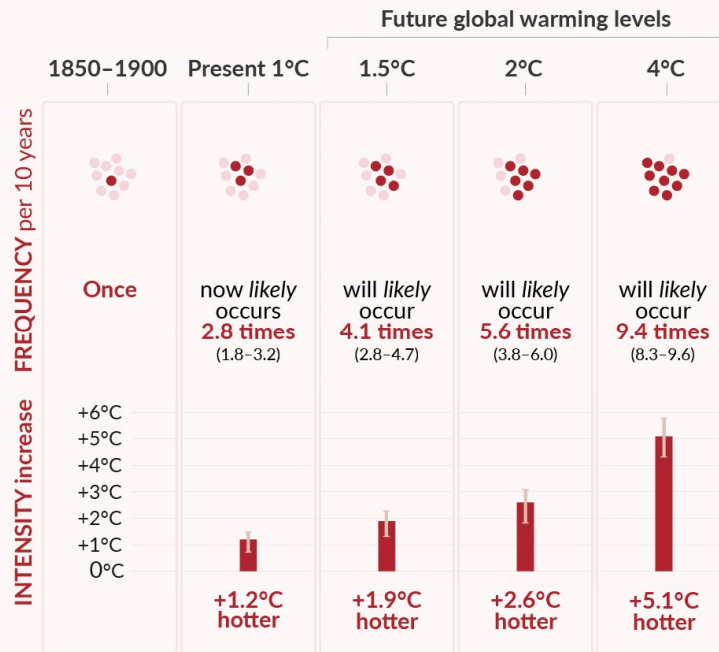


Projected changes in extremes are larger in frequency and intensity with every additional increment of global warming

Hot temperature extremes over land

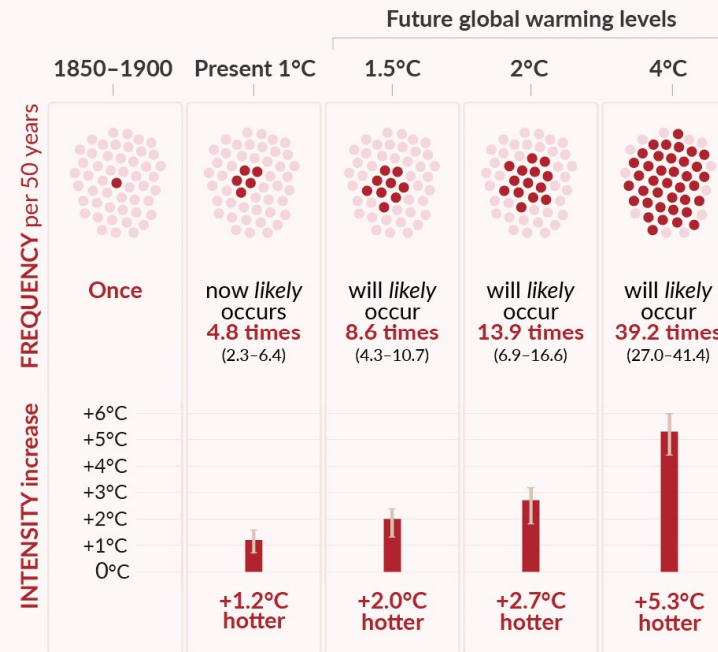
10-year event

Frequency and increase in intensity of extreme temperature event that occurred **once in 10 years** on average in a climate without human influence



50-year event







Frequency and increase in intensity of extreme temperature event that occurred **once in 50 years** on average in a climate without human influence



WG1, Figure SPM6

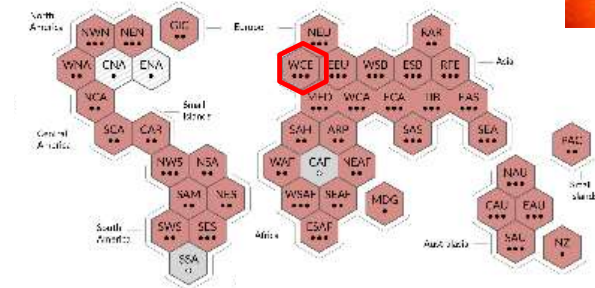
Global warming increases extreme weather in all global regions.

(IPCC AR6 WG1, Fig. SPM.3)

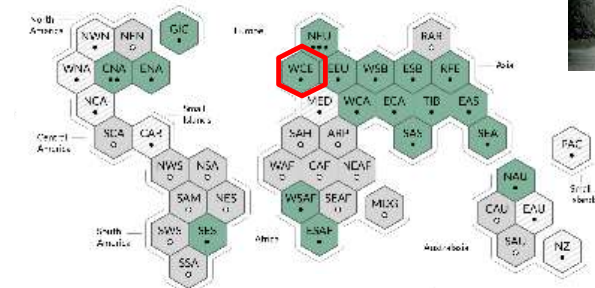
 Low agreement in the type of change
 Limited data and/or literature
Confidence in human contribution to the observed change
 High
 Medium
 Low due to limited agreement
 Low due to limited evidence

 Increase (T) (T) (T)
 Decrease (T) (T) (T)

Heatwaves

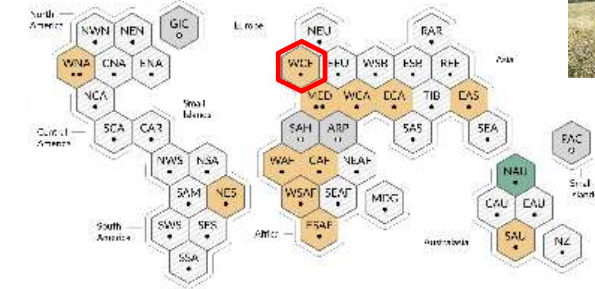


Extreme rainfall

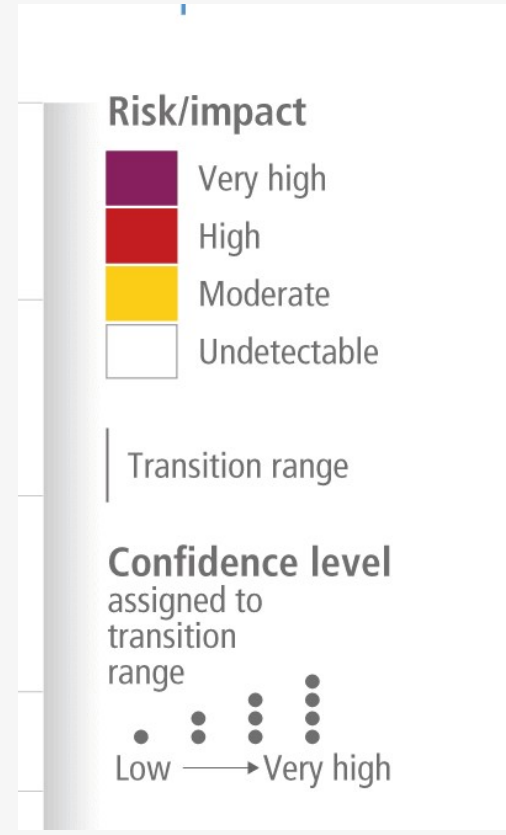
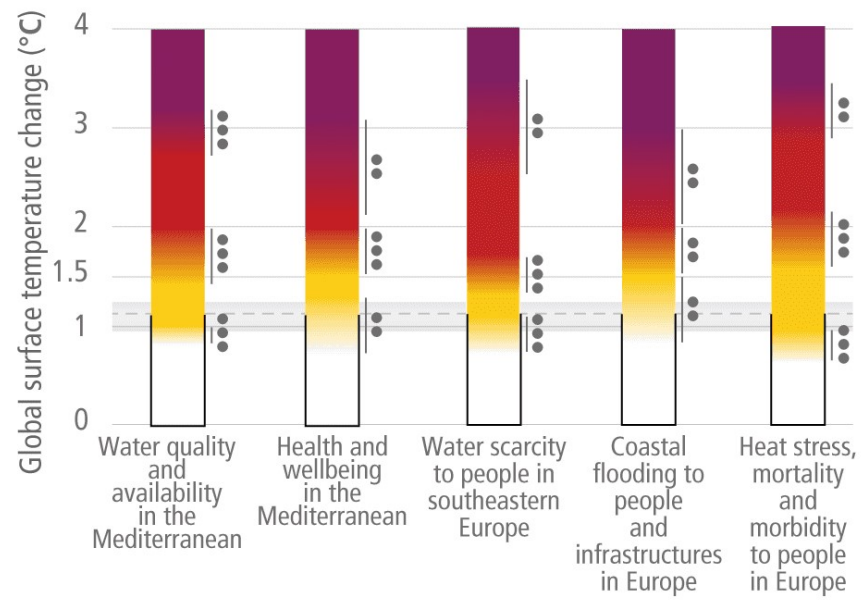
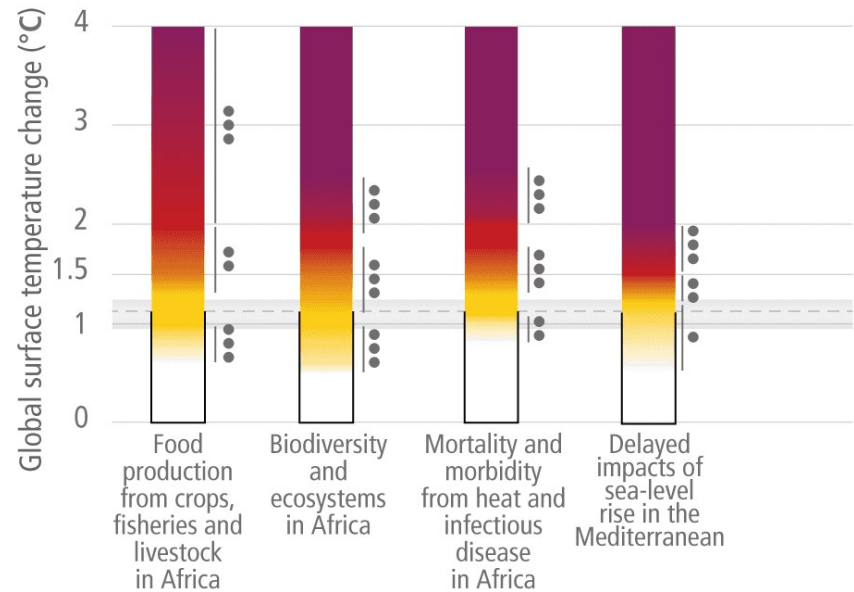


 Increase (T) (T) (T)
 Decrease (T) (T) (T)


Droughts



 Increase (T) (T) (T)
 Decrease (T) (T) (T)

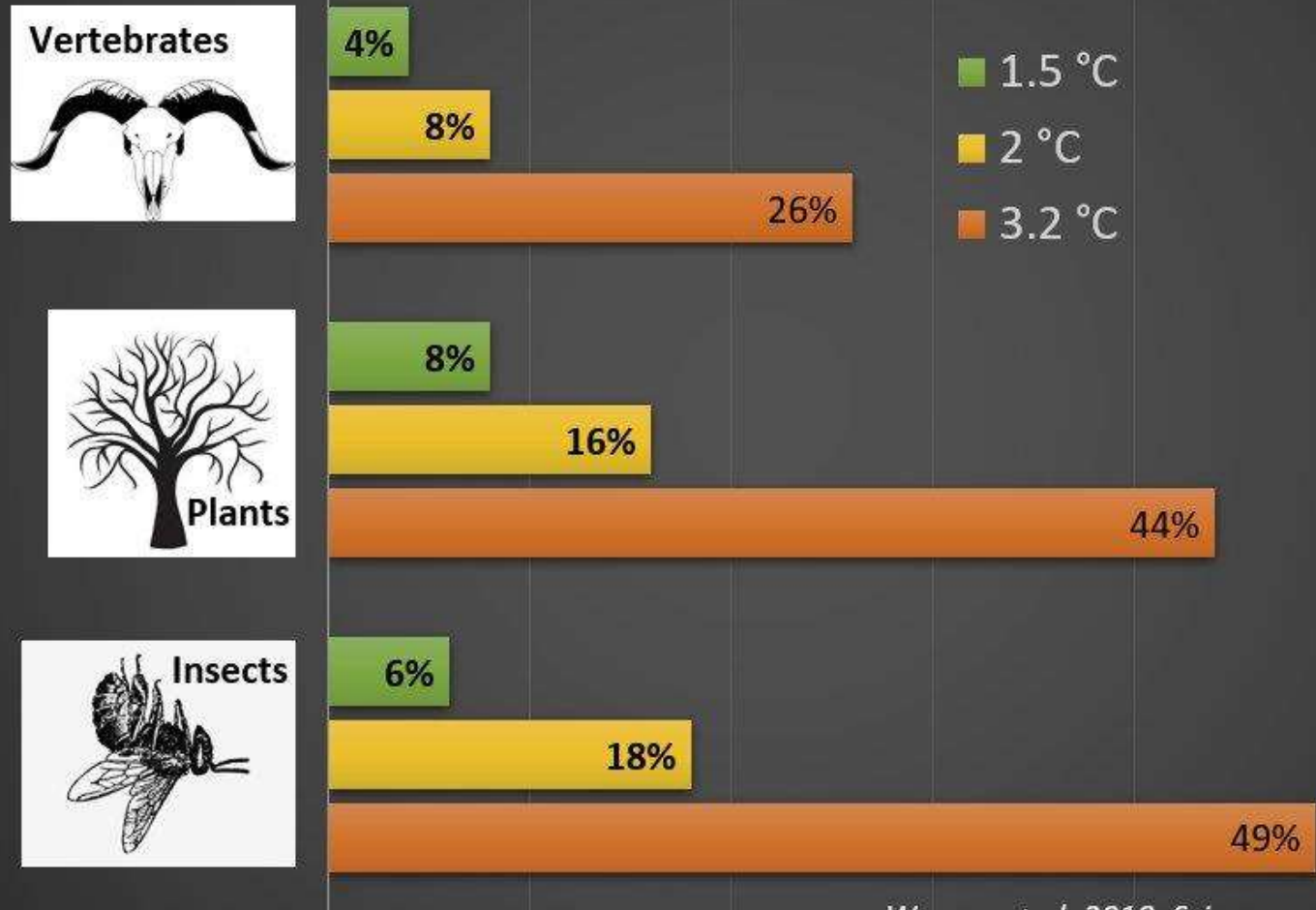


WG2, Figure SPM.3

A hand is shown from the bottom, holding a blue, semi-transparent globe of the Earth. The globe is the central focus, with white text overlaid on it. The background is a blurred landscape of a body of water, possibly a lake or river, with a forested shoreline and a cloudy sky. The lighting suggests a sunset or sunrise, with soft light reflecting on the water's surface.

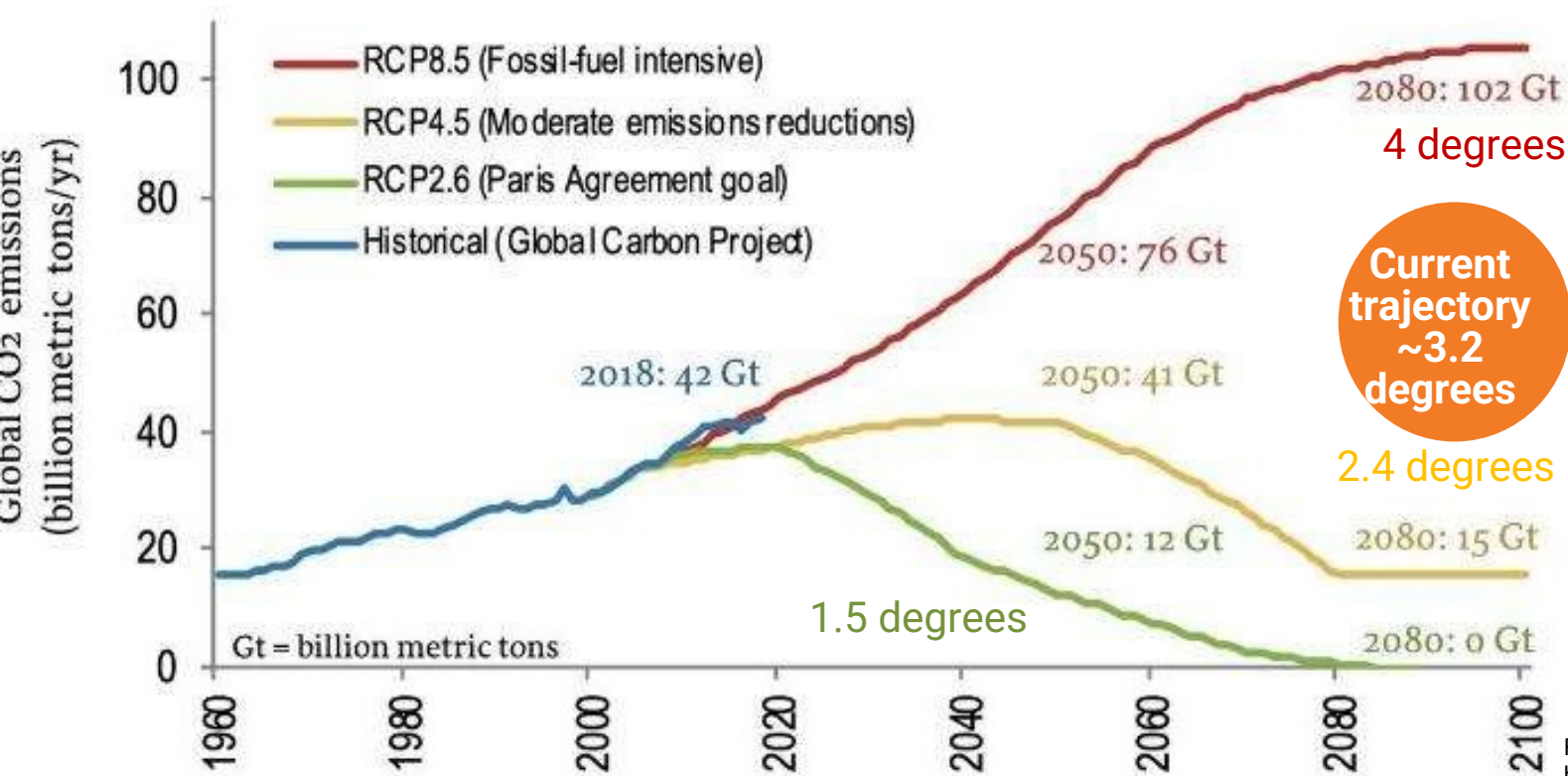
The impact on
biodiversity
will be
devastating.

PERCENTAGE OF SPECIES AT RISK OF EXTINCTION BY 2100



Warren et al, 2018, Science

WHAT TEMPERATURE ARE WE CURRENTLY HEADED FOR?



Paris Agreement:
Keep warming to
1.5 C if possible,
definitely «well
below» 2 C

Figure de Bob Kopp
basées sur des données du
data Global Carbon Budget

WE HAVE LEFT THE HOLOCENE: AN UNCERTAIN AND DANGEROUS FUTURE

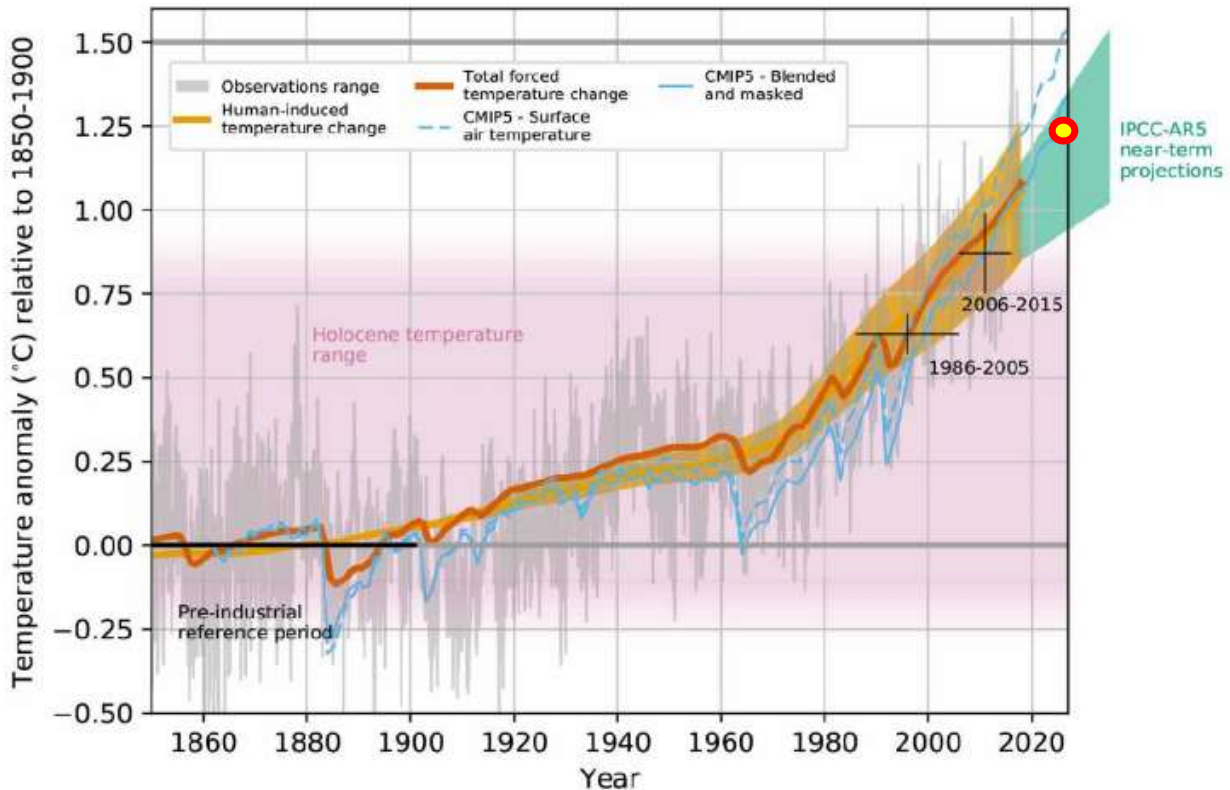


Figure 1.2 : Evolution of global mean surface temperature (GMST) over the period of instrumental observations. Grey line shows monthly mean GMST in the HadCRUT4, NOAA, GISTEMP and



IPCC SR1.5

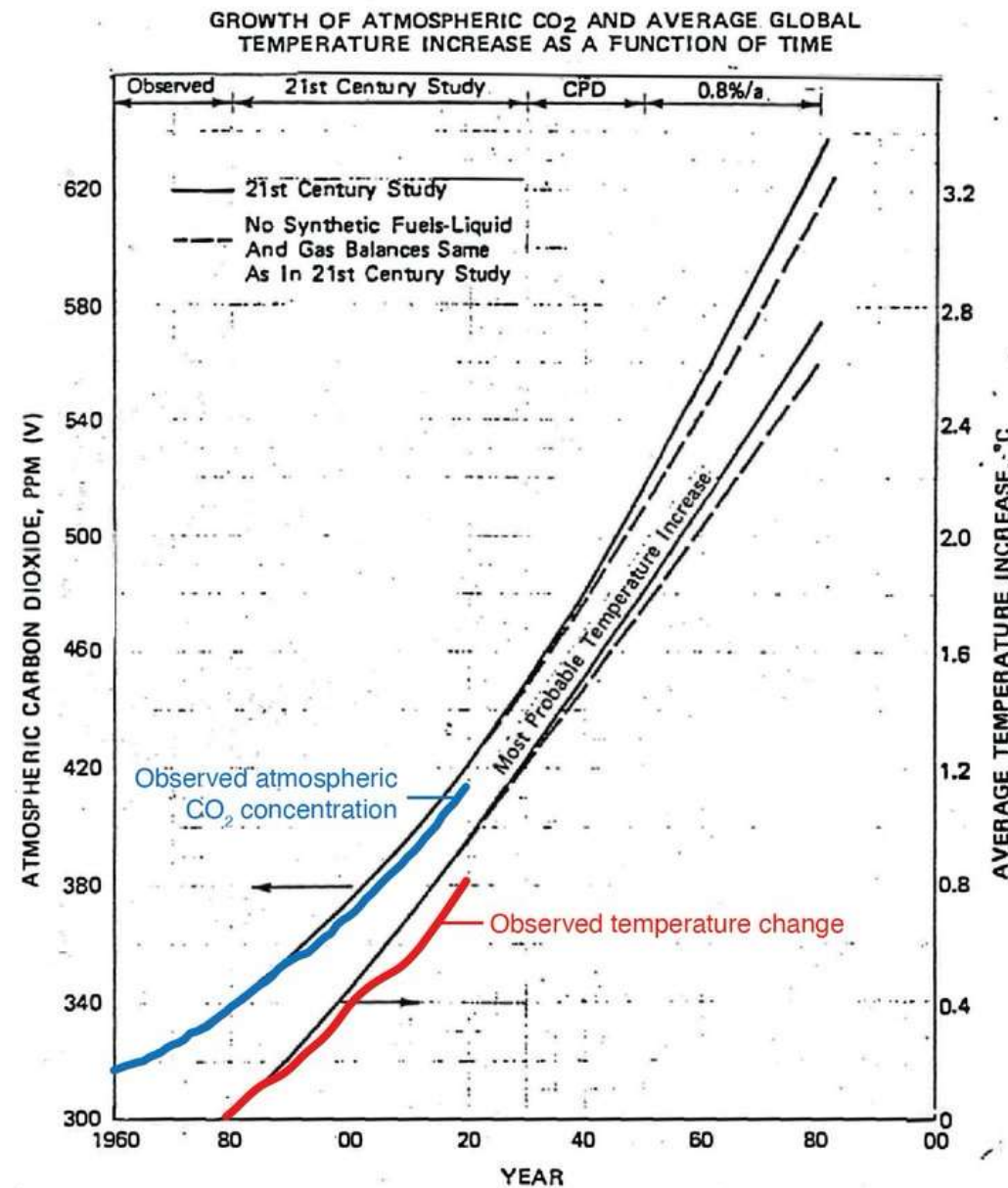
**But who could have possibly
known?
The fossil fuel industry,
since decades.**



PRÉDICTIONS JUSTES = DESINFORMATION INDUSTRIELLE.

Rapport interne Exxon, 1982

EXCELLENT new paper by Supran, Rahmstorf & Oreskes in Science on Exxon's highly accurate climate predictions.



Supran et al 2023

Implications for research & action?

1. Urgent & large scale action is required (“Radical emission reductions”)
 - Getting to zero or close WITHIN next twenty years.
2. Fastest & surest way to do that is reduce consumption
 - Reducing consumption doesn’t require [as much] new technology or infrastructure.
3. But until recently very little research into **how consumption could be reduced while preserving/enhancing well-being.**



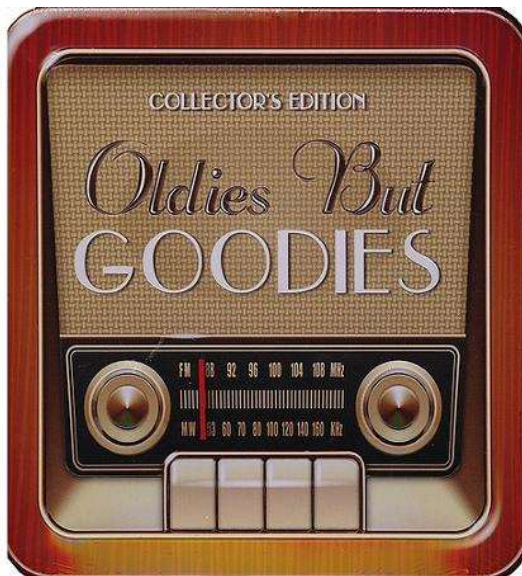
A hand is shown holding a blue globe of the Earth. The globe is semi-transparent, revealing the continents and oceans. The text is centered on the globe. The background is a blurred landscape with water and a cloudy sky.

Stylised facts
on
**Energy &
Well-being**

Energy & well-being: stylised fact #1

“The high plateau”

Beyond a certain level, energy increases do not result in measurably higher well-being.



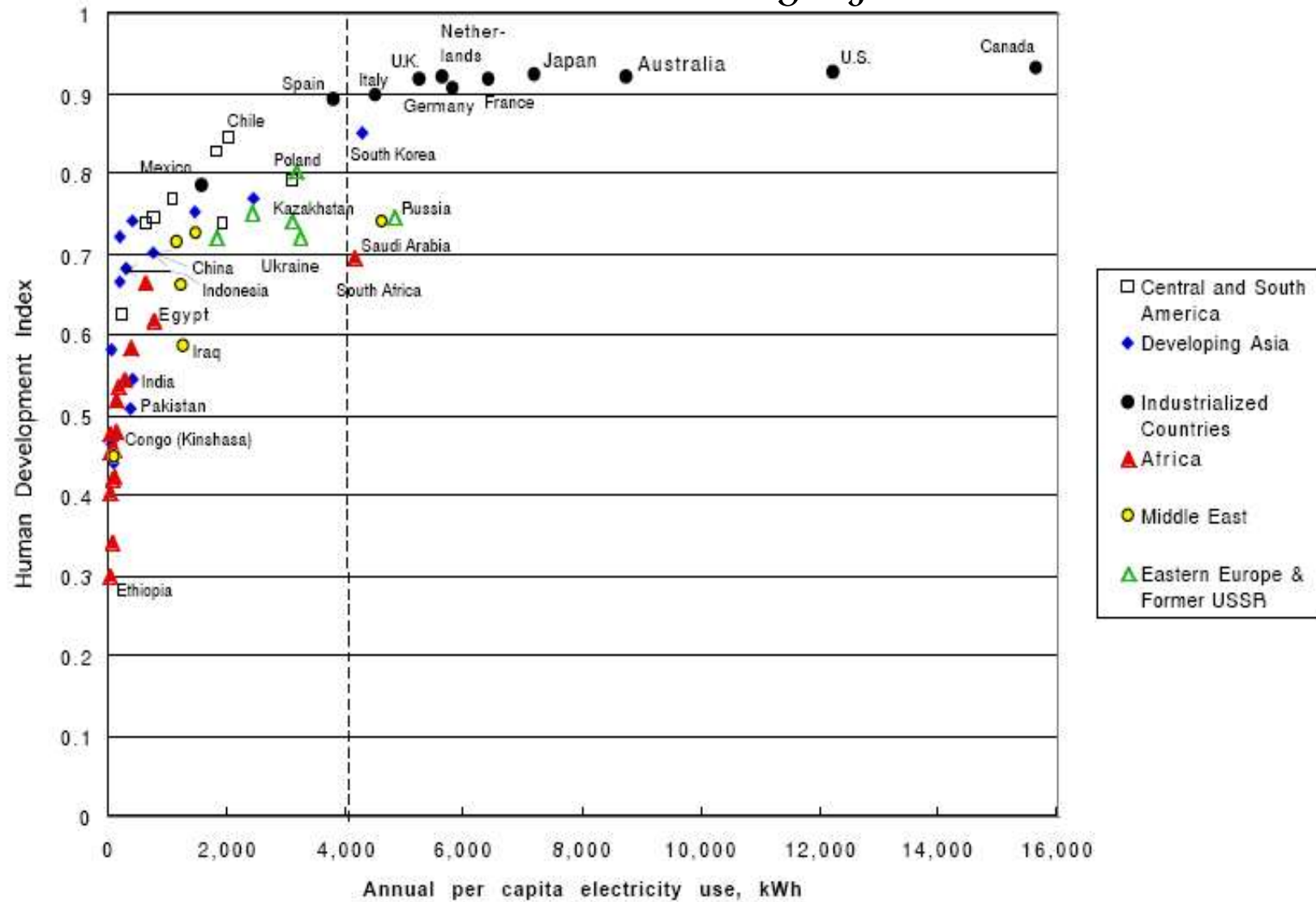
Science, New Series, Vol. 186, No. 4164. (Nov. 15, 1974), pp. 607-610.

Energy and Life-Style

Massive energy consumption may not be necessary to maintain current living standards in America.

Allan Mazur and Eugene Rosa

“The high plateau”

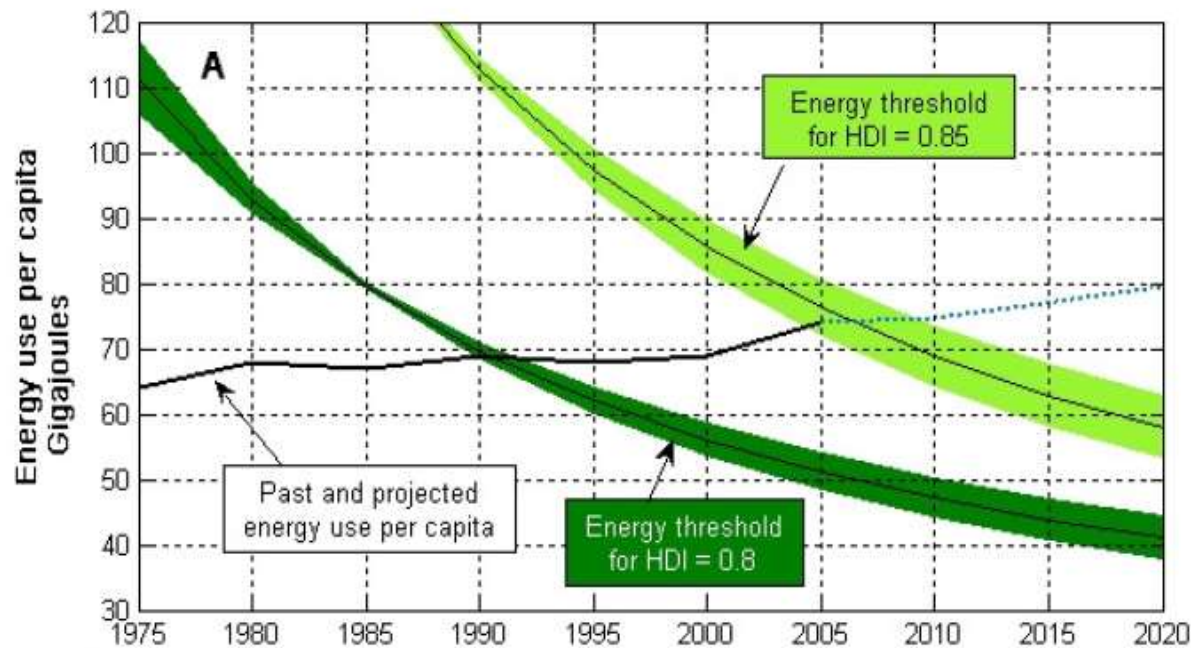


Source: A. Pasternak, United States Department of Energy, 2000

Energy & well-being: stylised fact #2

“Dynamic decline”

The energy threshold associated with any given level of well-being decreases dramatically over time.



Steinberger, J. K. and J. T. Roberts (2010). "From constraint to sufficiency: the decoupling of energy and carbon from human needs, 1975-2005." *Ecological Economics* 70(2): 425-433.

“Dynamic decline”

used as a basis for emission reduction scenarios

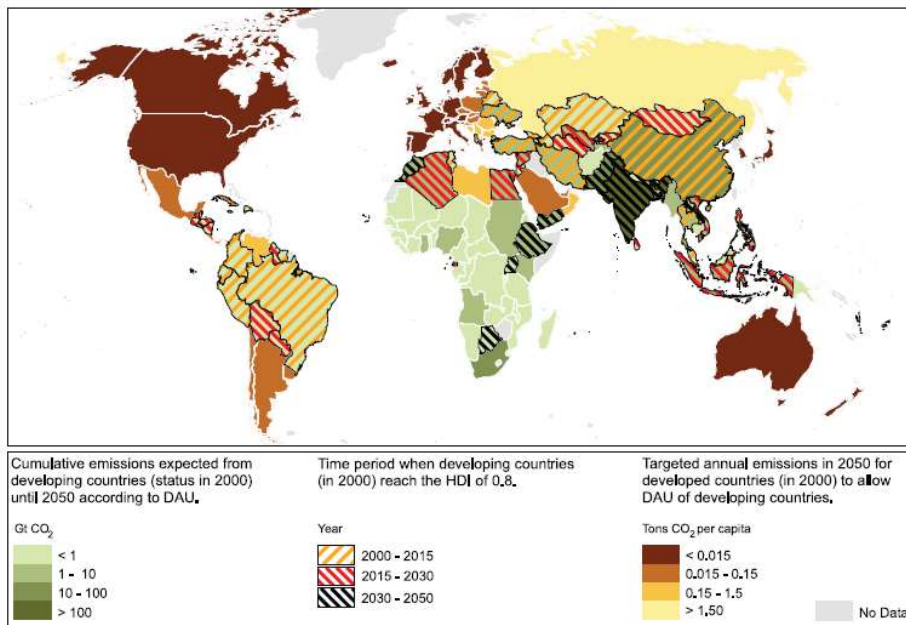
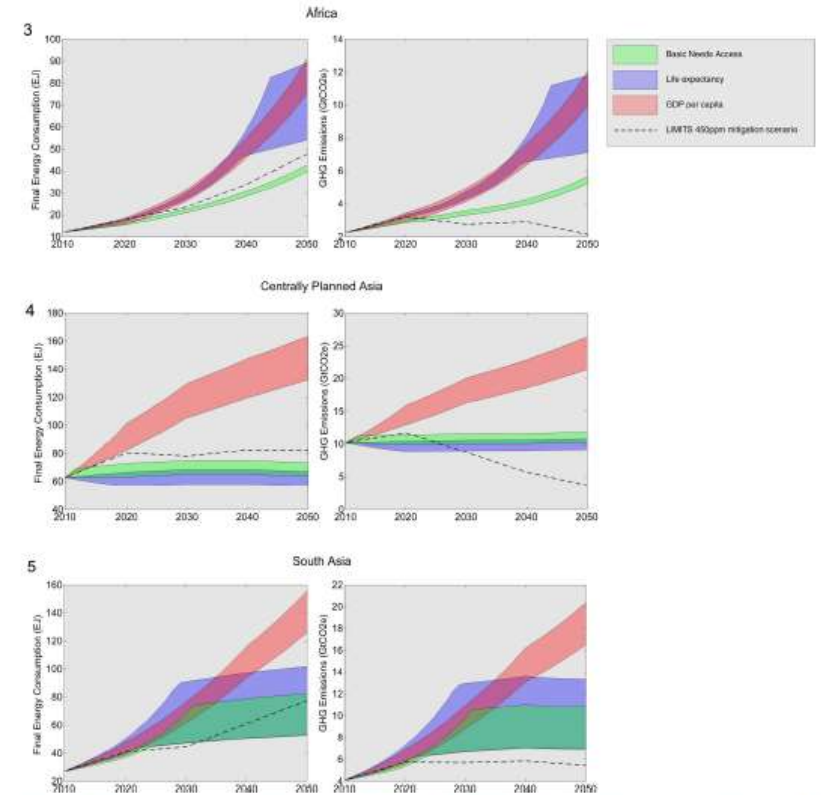


Figure 7. Global distribution of allowed emissions for DAU from developing countries (green shading) and per capita CO₂ targets in 2050 for developed countries (brown shading) under the proposed framework to keep temperatures below 2°C target – as implied by the M75 CO₂ budget. The period in time when developing countries are expected to reach an HDI of 0.8 is represented by the colored hatches.
doi:10.1371/journal.pone.0029262.g007

Costa, L., D. Rybski and J. P. Kropp (2011). "A Human Development Framework for CO₂ Reductions." *PLoS ONE* 6(12): e29262.



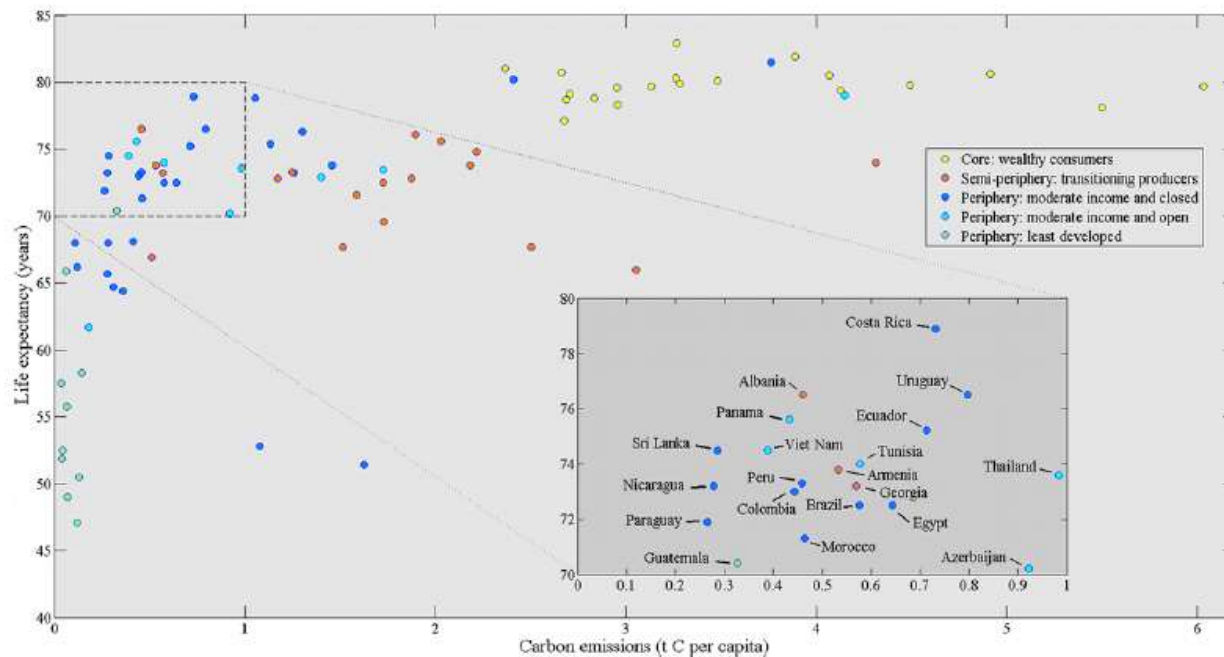
Figs. 3–5. Projections of energy and GHG emissions for human development. Final energy consumption and greenhouse gas emissions required to meet three dimensions of development from 2010 to 2050, constrained with the LMWTR 450ppm mitigation scenario. Each coloured area represents a sensitivity range: the upper bound consisting of a higher human development threshold (72.8 years, 89.9% access) and a low decoupling rate (a constant level from 2010); the lower bound consisting of low human development thresholds (70.4 years, 83.5% access) and a higher decoupling rate projected to 2020 and constant thereafter. (For interpretation of the references to color in figure legend, the reader is referred to the web version of the article.)

Lamb, W. F. and N. D. Rao (2015). "Human development in a climate-constrained world: What the past says about the future." *Global Environmental Change* 33(0): 14-22.

Energy & well-being: stylised fact #3

“Multi-dimensional diversity”

Many types of countries (climate, geography, history) achieve relatively high well-being at relatively low energy use.

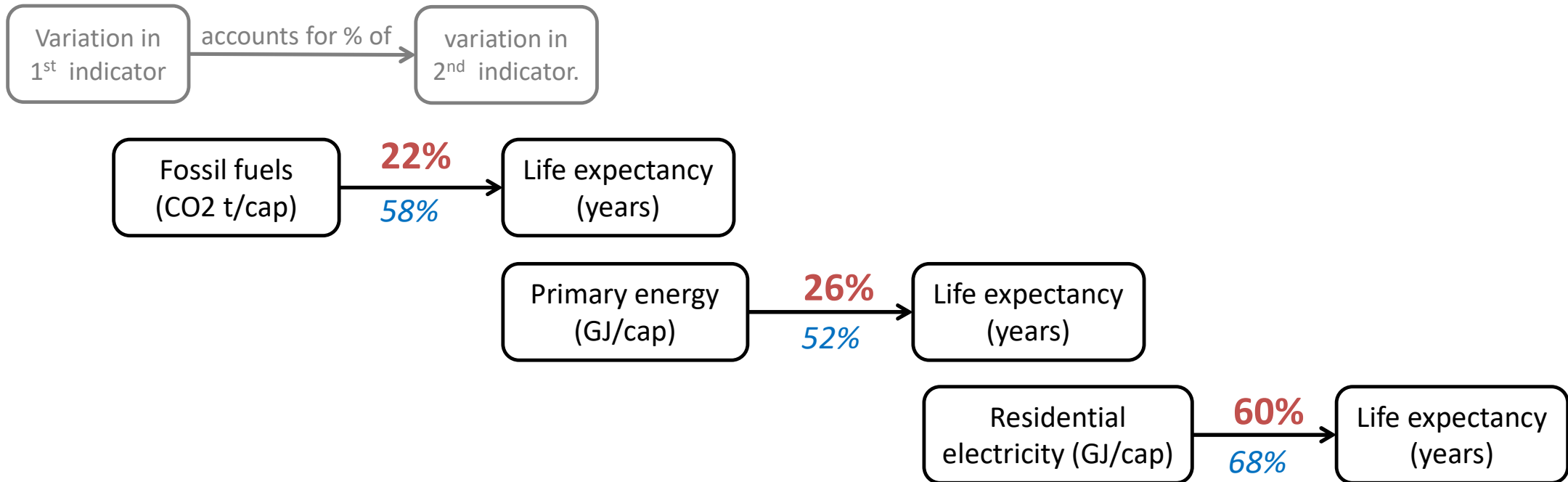


Lamb, W. F., J. K. Steinberger, A. Bows-Larkin, G. P. Peters, J. T. Roberts and F. R. Wood (2014). "Transitions in pathways of human development and carbon emissions." *Environmental Research Letters* 9(1): 014011.

Energy & well-being: stylised fact #4

“The Fossil fuels – Well-being Paradox”

Correlation at 1 point in time does not mean **explanatory power over time**.



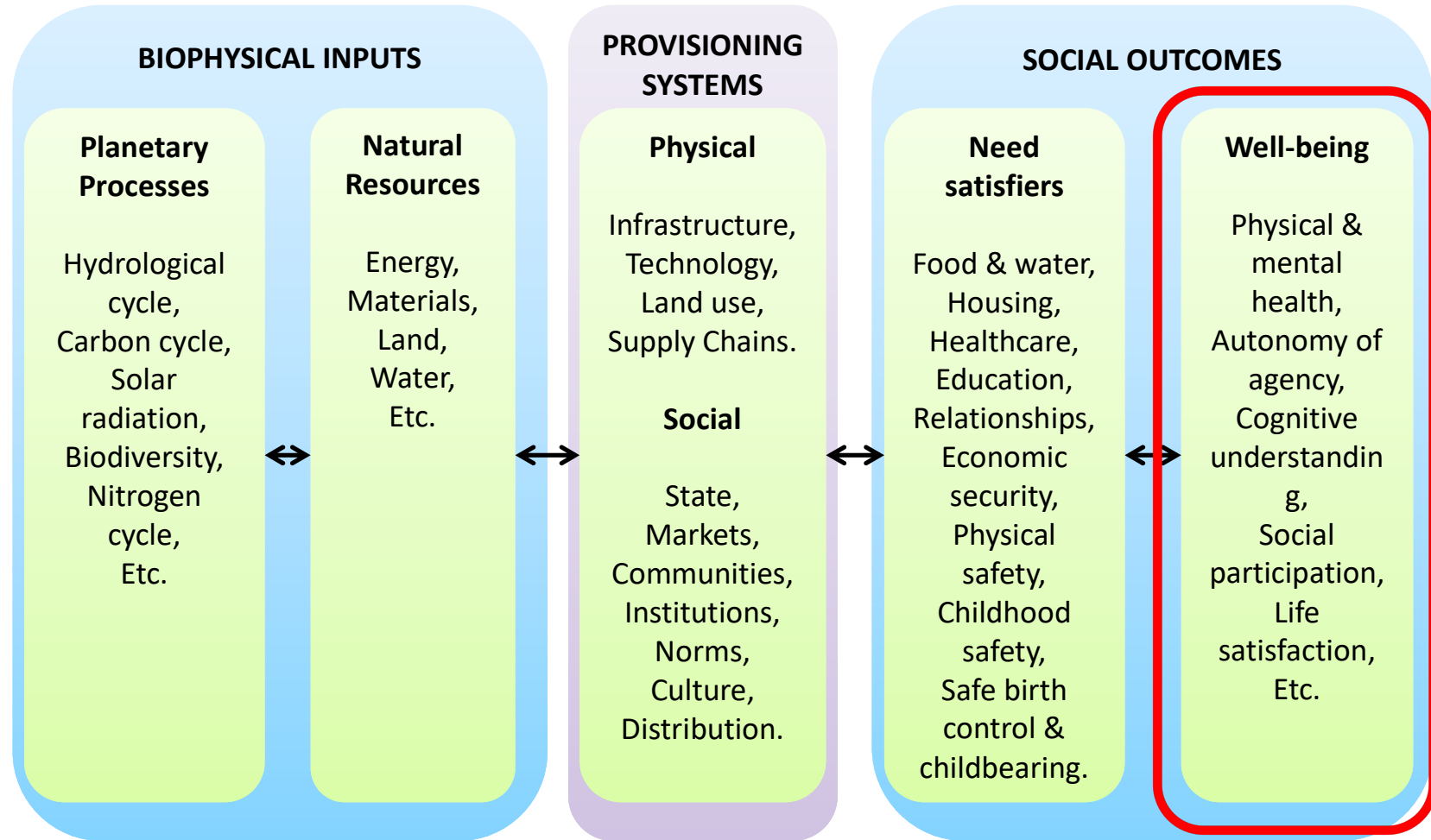
Timespan 1971-2014

**BEYOND STYLISED FACTS?
NEED FOR A NEW
FRAMEWORK: THE LIVING
WELL WITHIN LIMITS
(LILI) PROJECT**



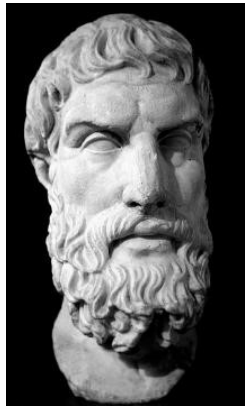
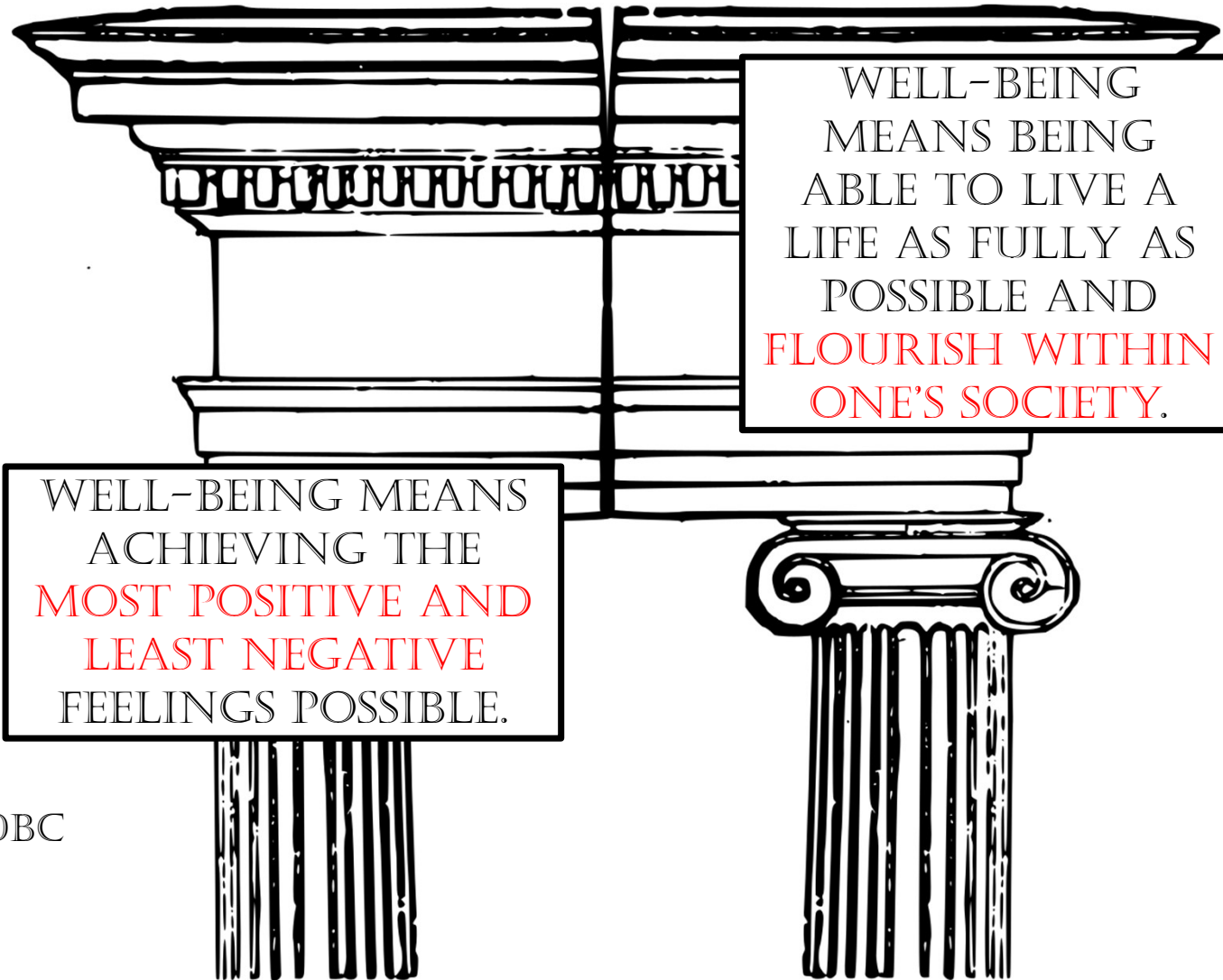
The LiLi analytic framework

Living Well
Within
Limits [LiLi]

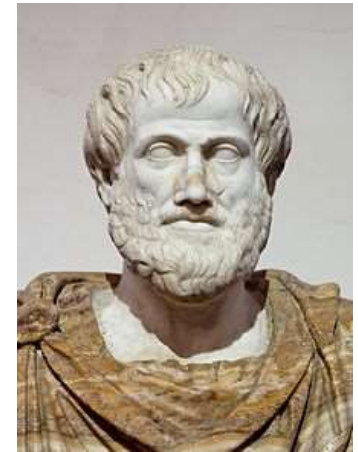


O'Neill, Fanning, Lamb & Steinberger 2018, Nature Sustainability

WELCOME TO ANCIENT GREECE ...



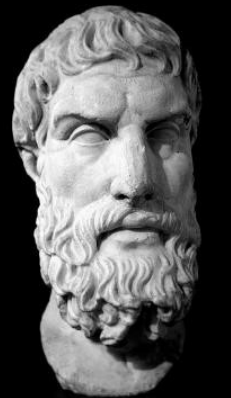
EPICURUS, 300BC



ARISTOTLE, 350BC

THE TWO CAMPS
PERSIST TO THIS DAY!

TEAM
EPICURUS



HAPPINESS

INDIVIDUAL

HAPPINESS INDICATOR
UTILITY

ECONOMIC GROWTH:
MORE INCOME =>
MORE CONSUMPTION =>
MORE POSITIVE FEELINGS

TEAM
ARISTOTLE



FLOURISHING

SOCIAL

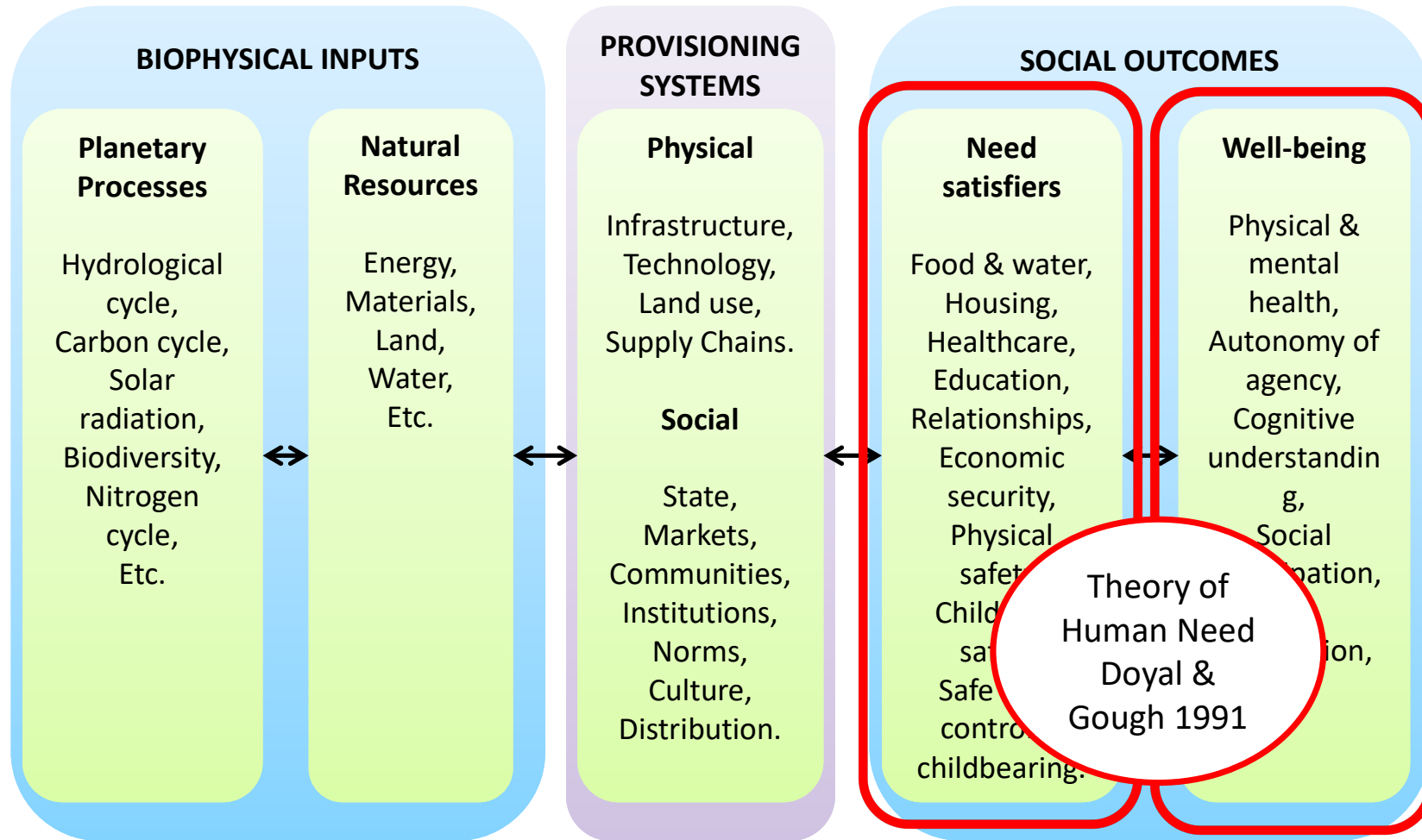
HUMAN DEVELOPMENT
INDEX, SUSTAINABLE
DEVELOPMENT GOALS

DEVELOPMENT: SUPPORT
HUMAN POTENTIAL

LILI ARE NEW RECRUITS OF TEAM ARISTOTLE:
BRAND CORREA & STEINBERGER 2017
LAMB & STEINBERGER 2017

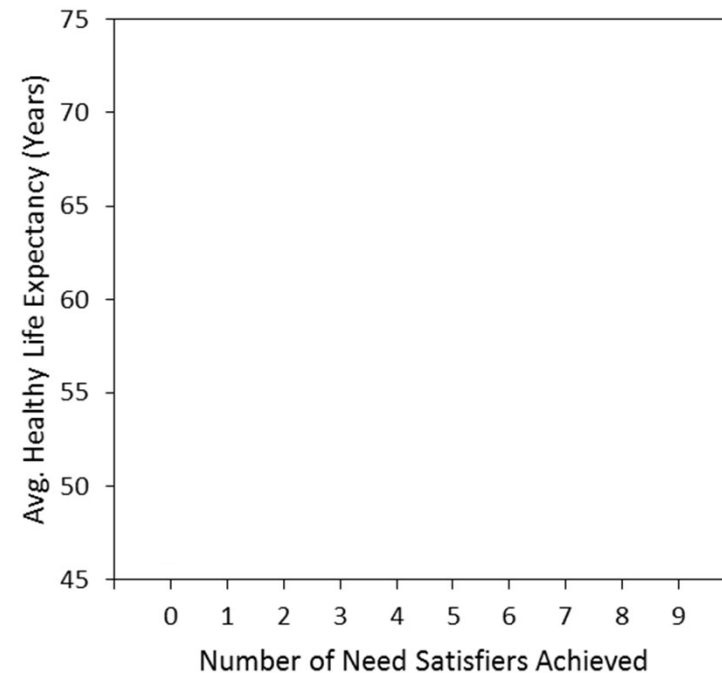
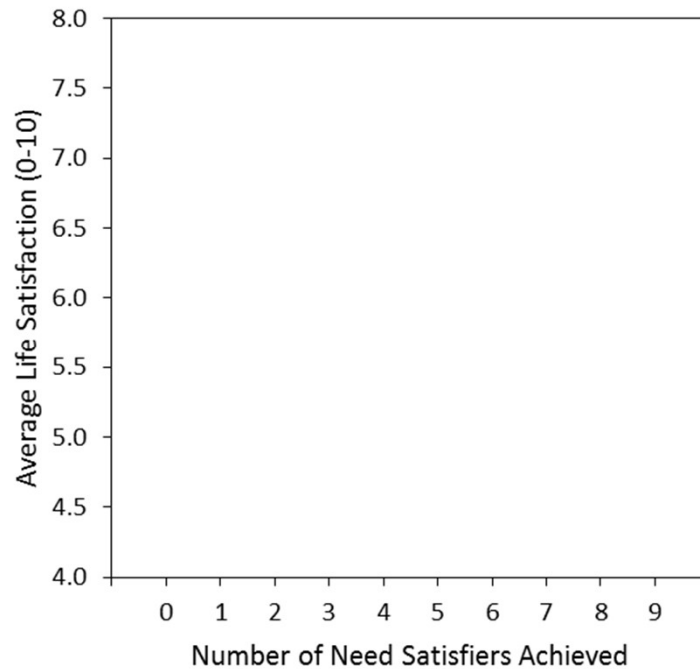
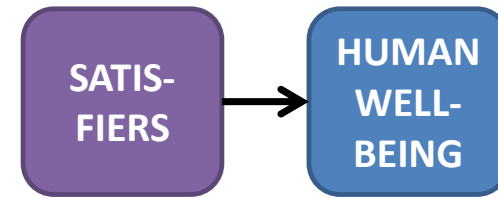
Can we test Aristotle's theory?

Living Well
Within
Limits [LiLi]



O'Neill, Fanning, Lamb & Steinberger 2018, Nature Sustainability

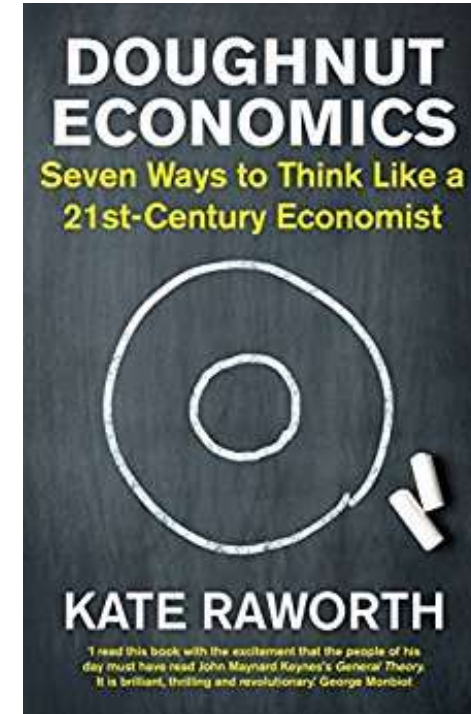
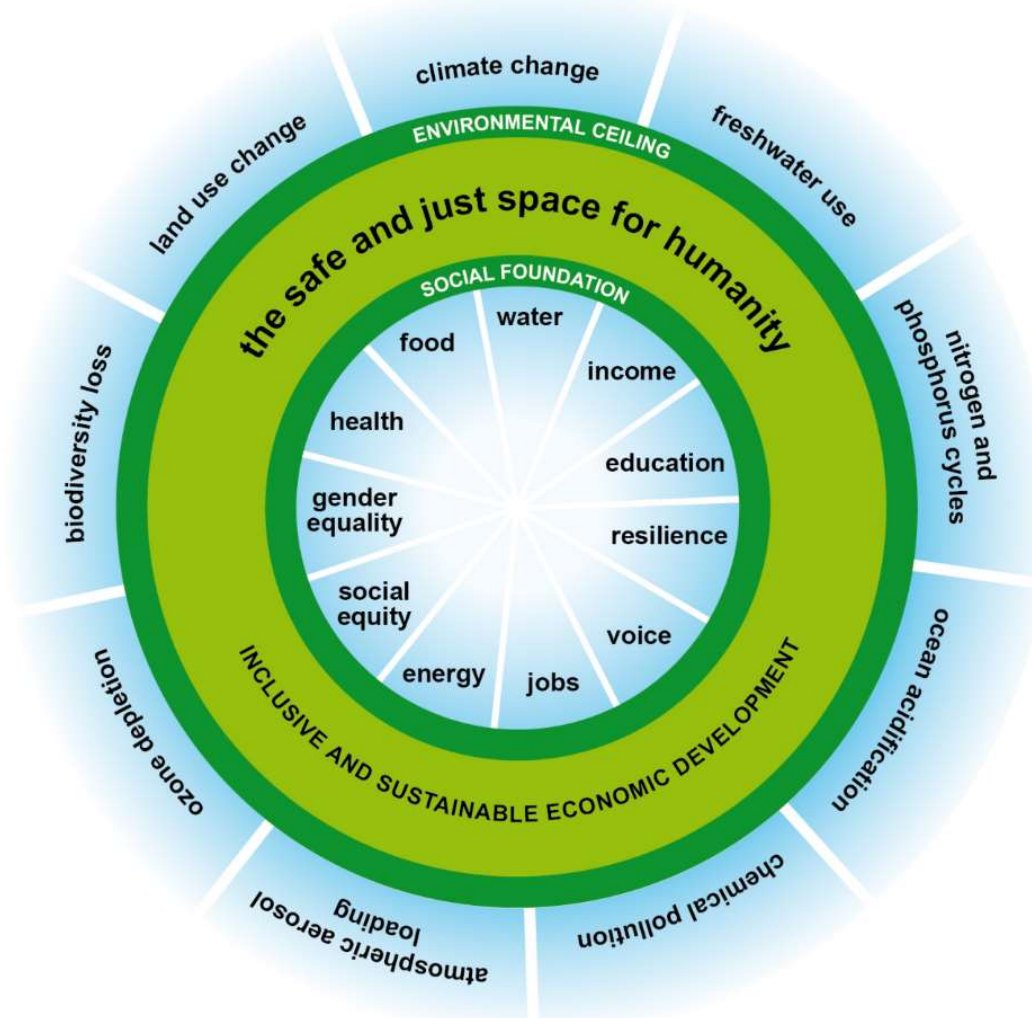
Empirical evidence that multidimensional need satisfaction is a pre-condition for well-being



O'Neill, Fanning, Lamb & Steinberger 2018, Nature Sustainability

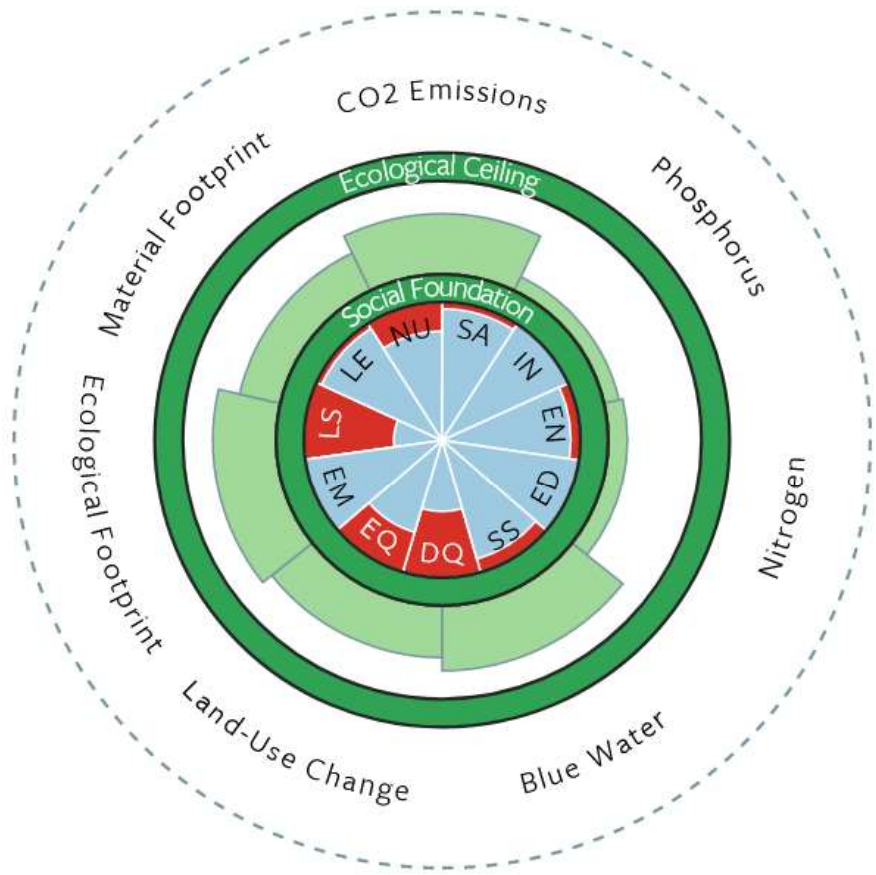
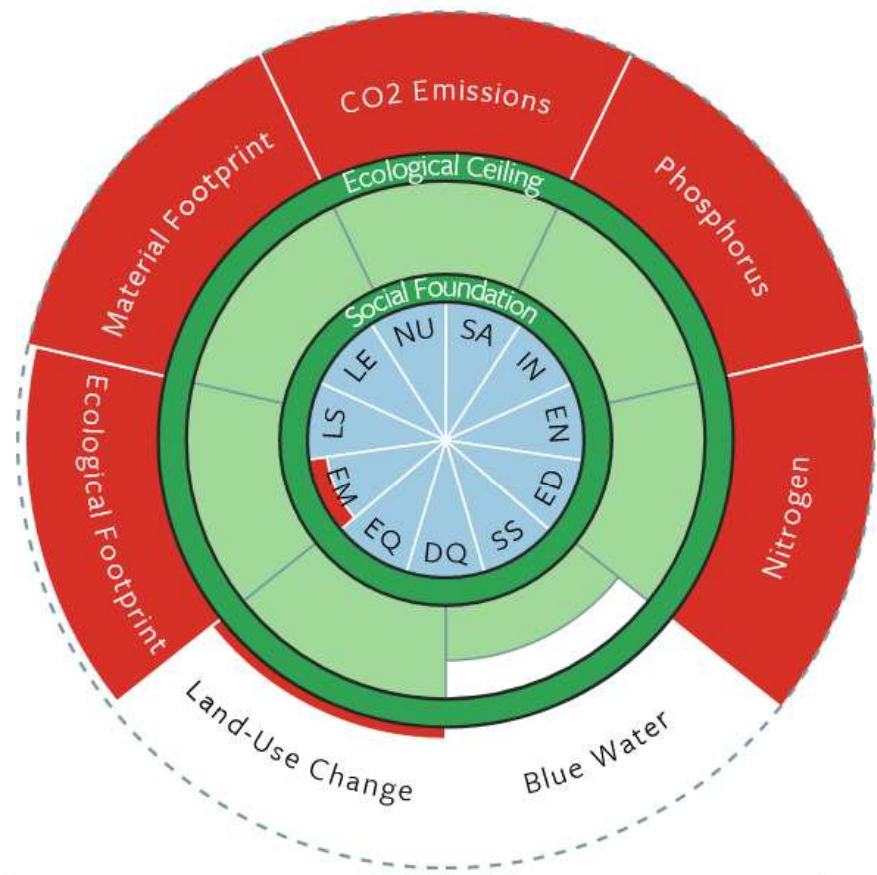
Does well-being within limits exist internationally?

Testing Kate Raworth's Doughnut.



France ▼

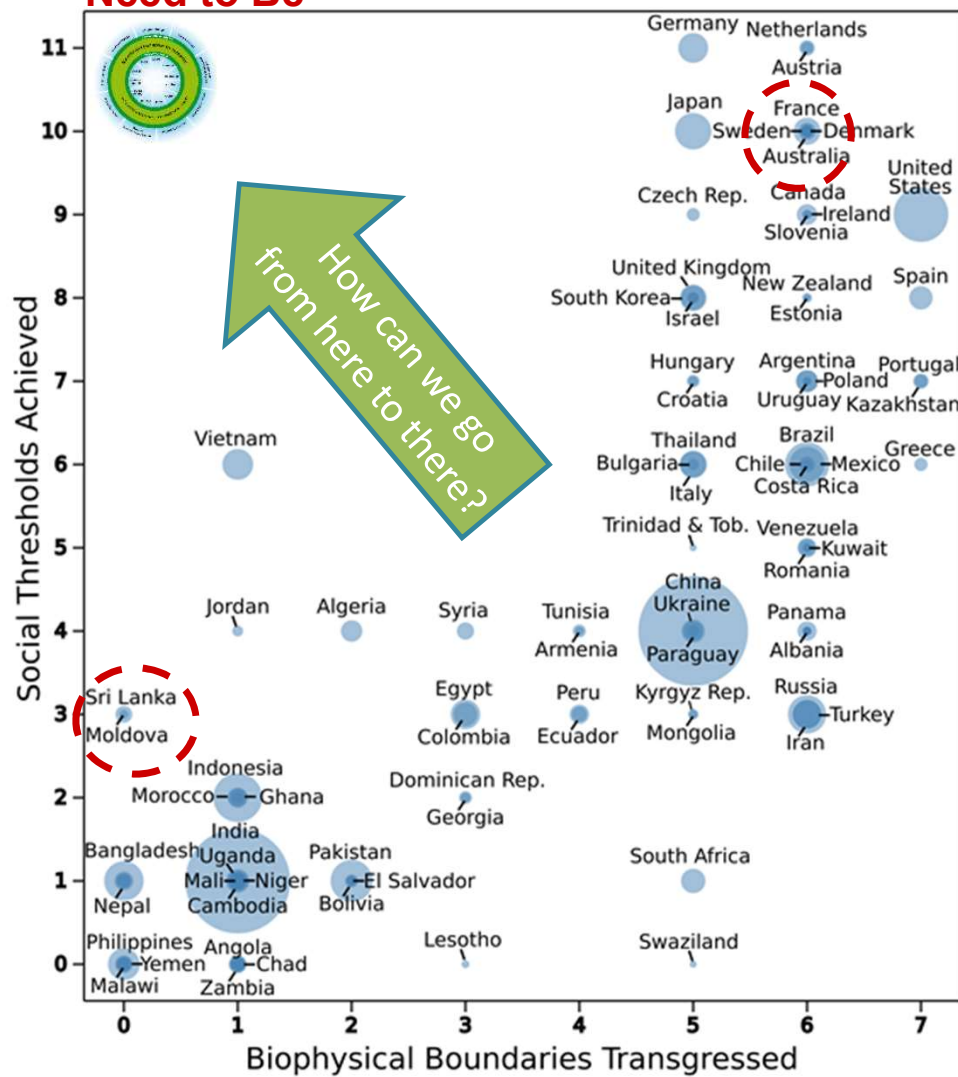
Sri Lanka ▼



LS - Life Satisfaction	ED - Education
LE - Healthy Life Expect.	SS - Social Support
NU - Nutrition	DQ - Democratic Quality
SA - Sanitation	EQ - Equality
IN - Income	EM - Employment
EN - Access to Energy	

<https://goodlife.leeds.ac.uk>

**Where We
Need to Be**



<https://goodlife.leeds.ac.uk>

O'Neill, Fanning, Lamb & Steinberger 2018, Nature Sustainability



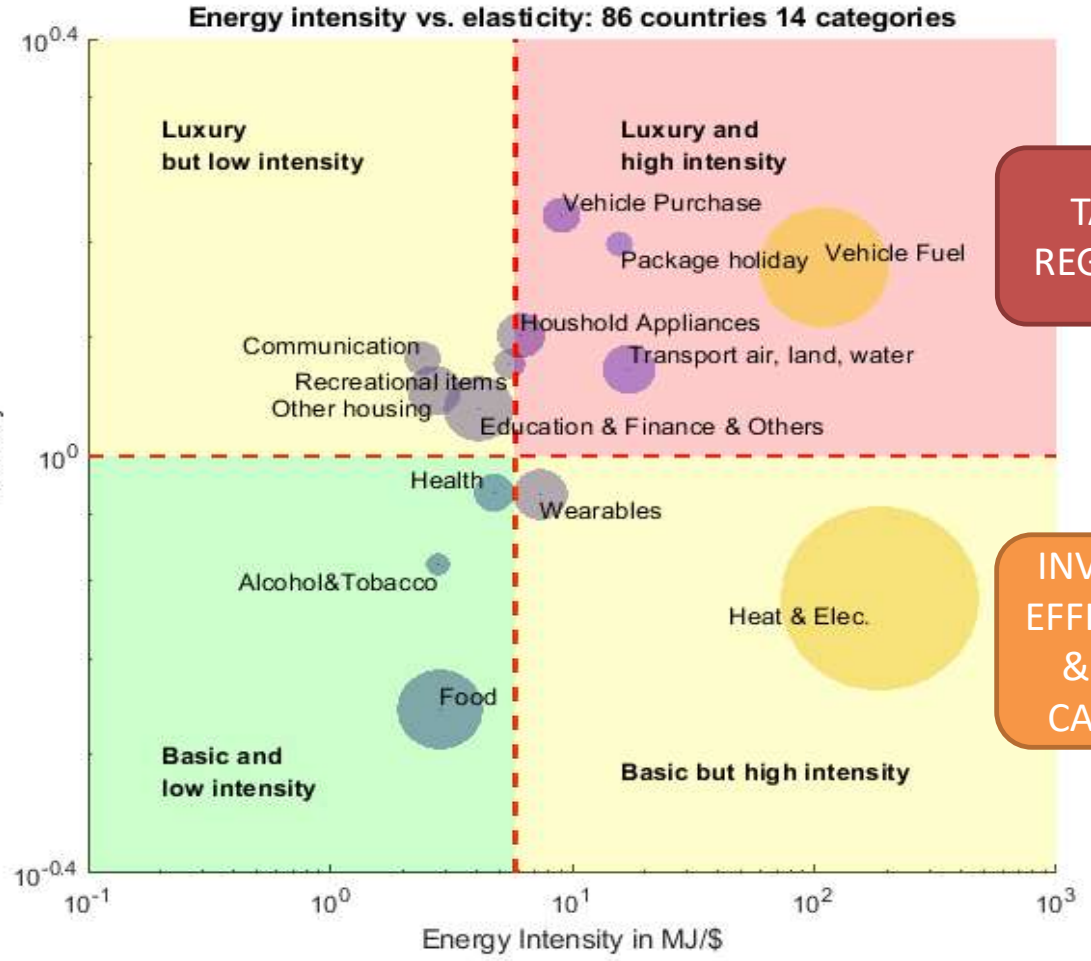
What role does
inequality play?

Large inequality in international and intranational energy footprints between income groups and across consumption categories

Yannick Oswald, Anne Owen and Julia K. Steinberger

Mapping product categories

Consumed more by rich people
 ↑
 ↓
 Consumed more by poor people

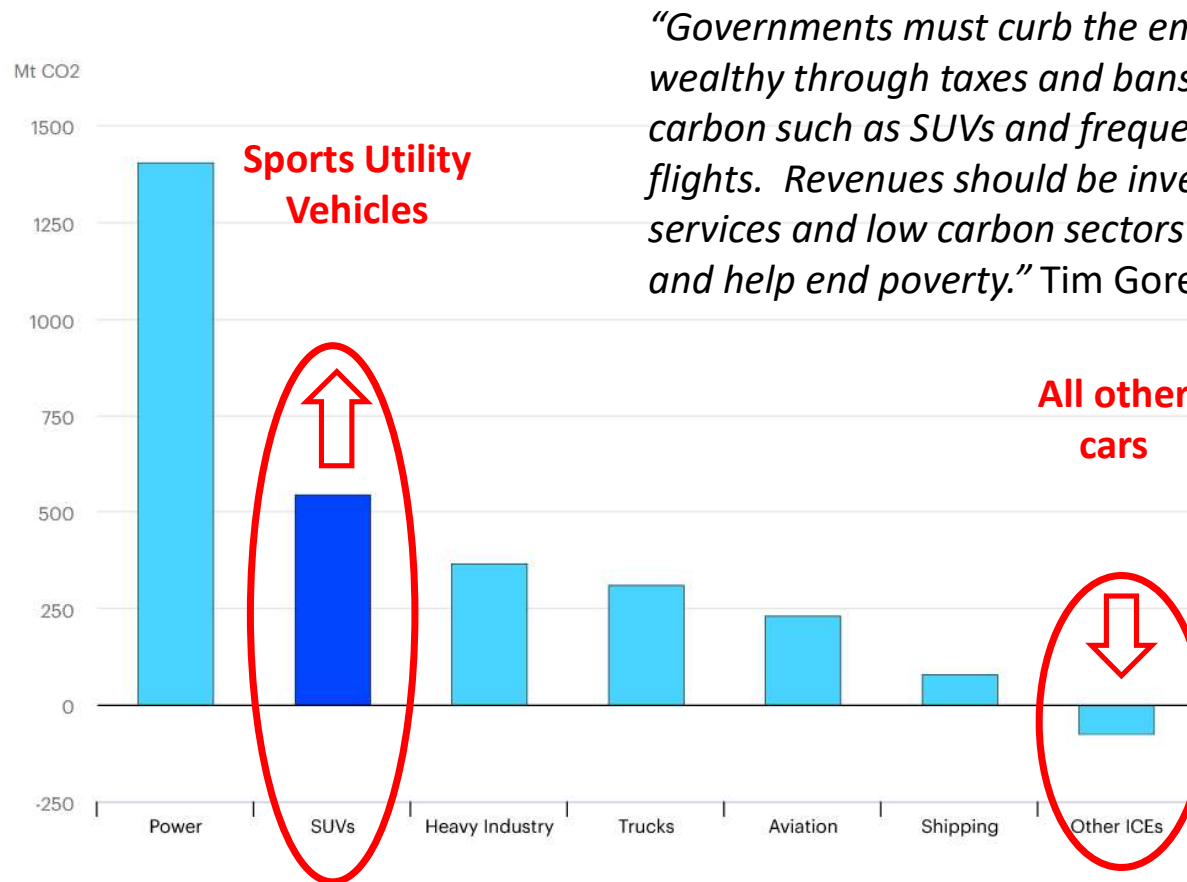


Less energy per \$ spent ← → More energy per \$ spent

Oswald, Owen & Steinberger, 2020, Nature Energy

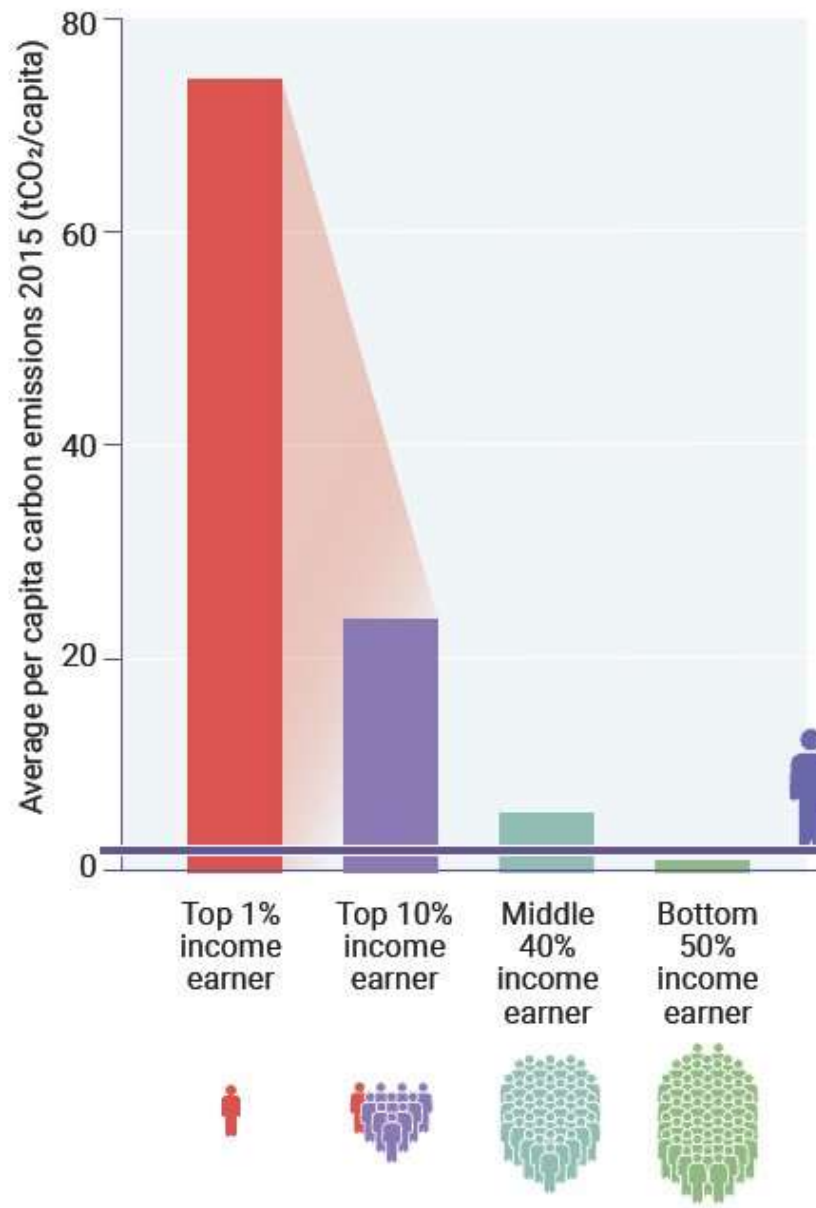
Car transport increasingly drives climate breakdown

Change in global CO2 emissions by energy sector, 2010-2018

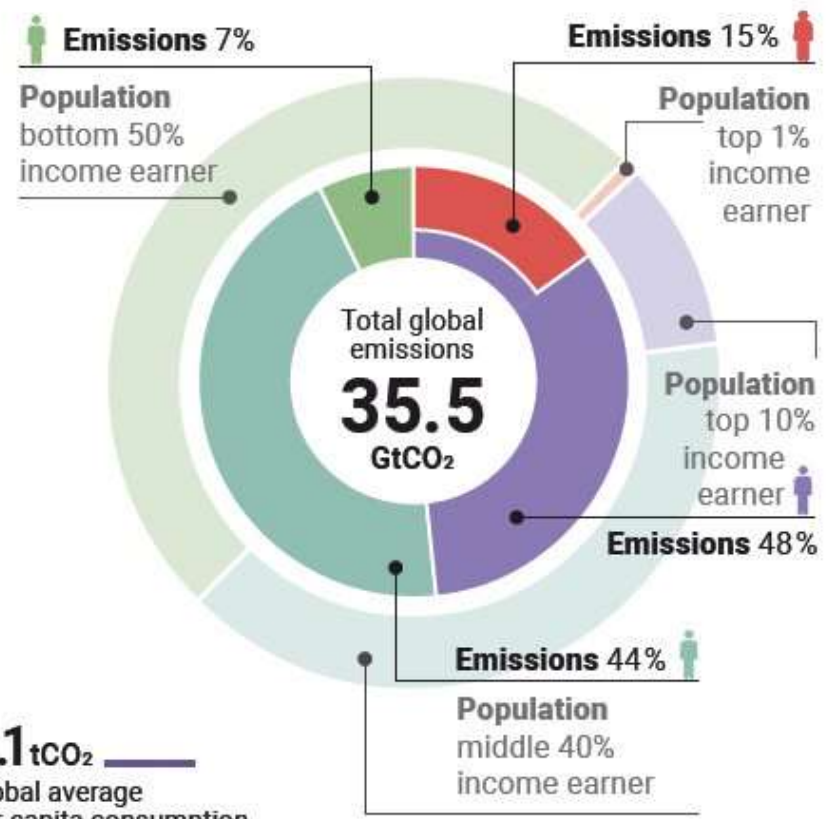


“Governments must curb the emissions of the wealthy through taxes and bans on luxury carbon such as SUVs and frequent flights. Revenues should be invested in public services and low carbon sectors to create jobs, and help end poverty.” Tim Gore, Oxfam

Cozzi & Petropoulos, IEA, 2019

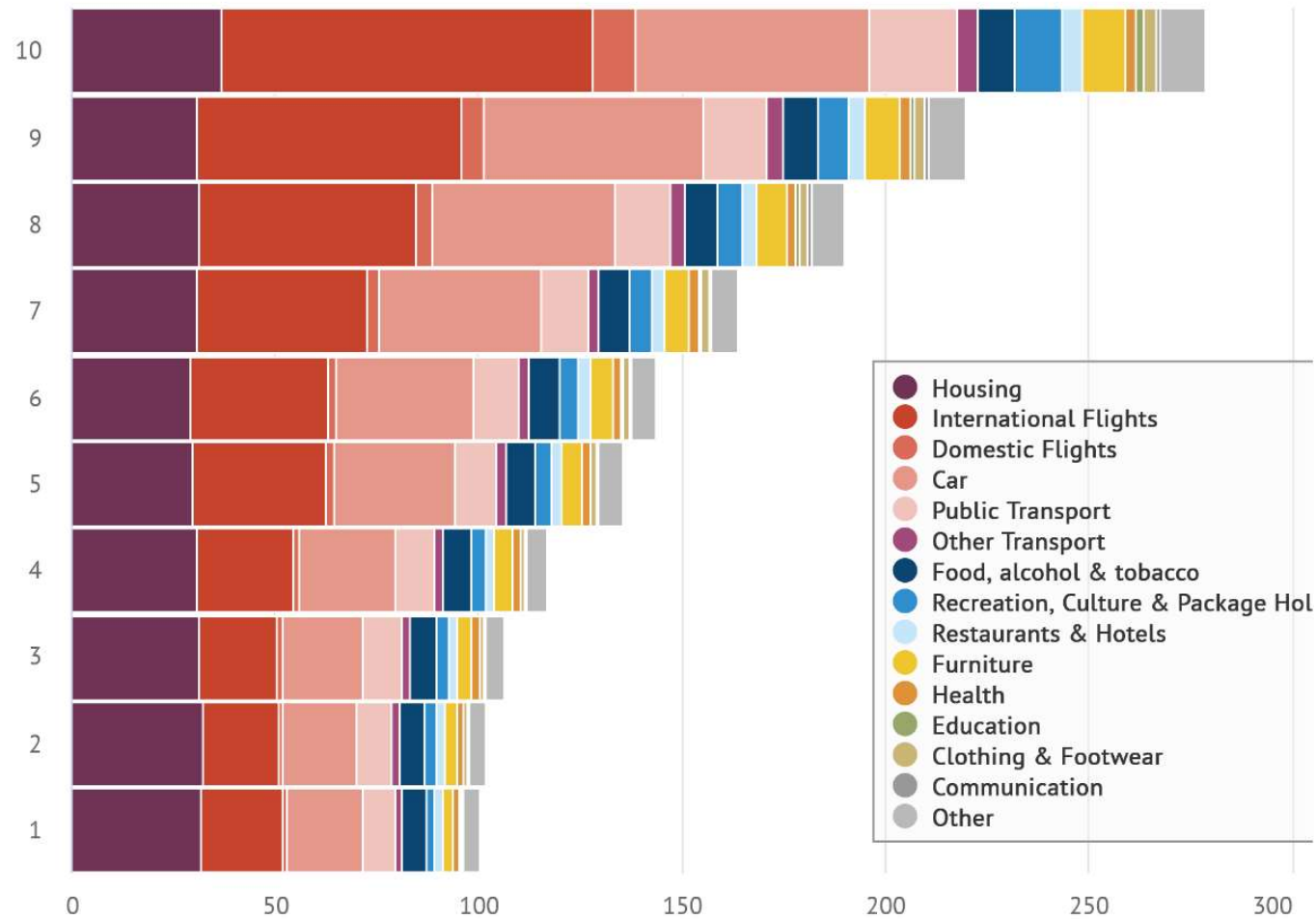


Total carbon emissions per group 2015 (GtCO₂)



Wealthy British people use far more **energy for transport**, but housing energy use remains similar across income brackets

Annual energy use per adult equivalent, GJ



Baltruszewicz et al 2023

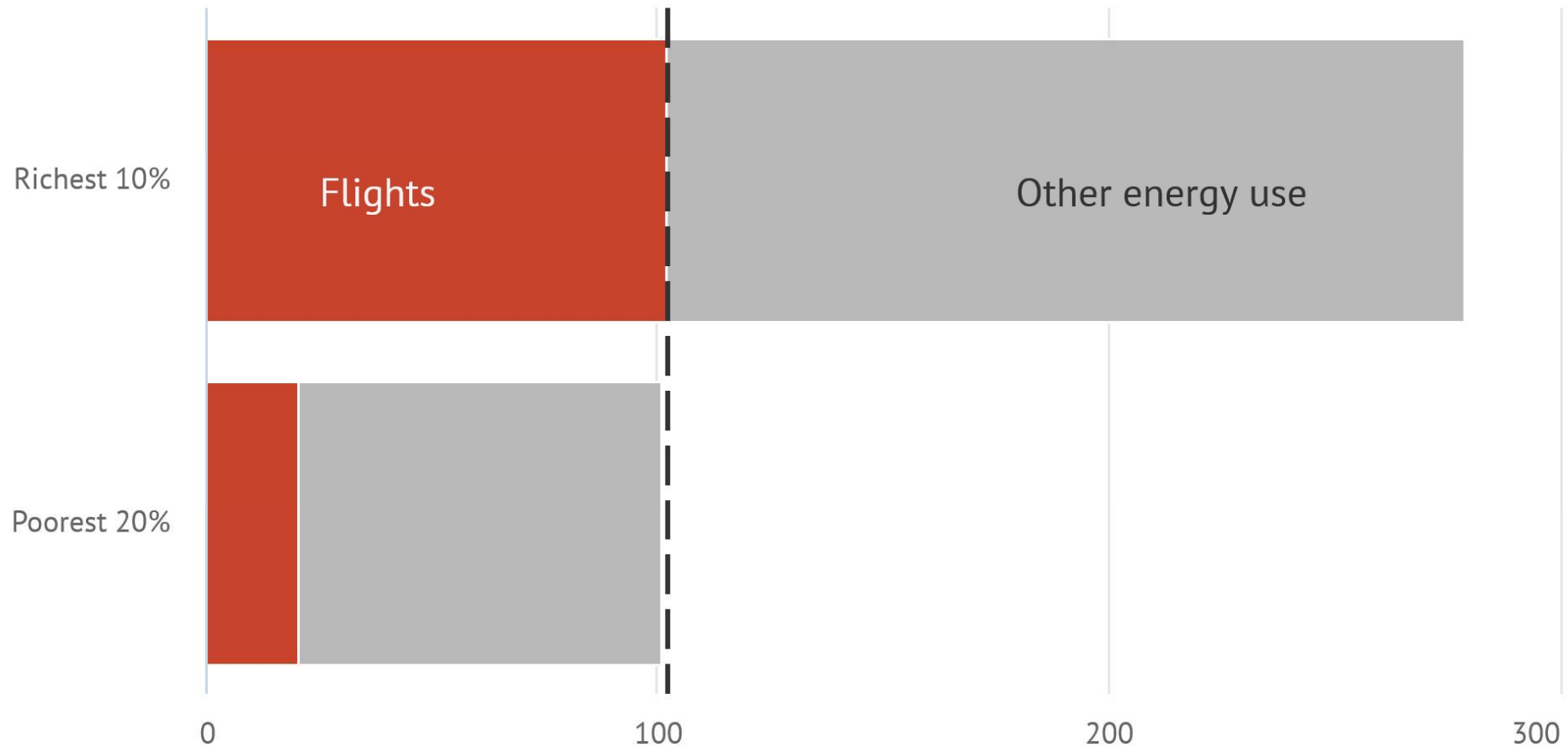
Carbon Brief <https://www.carbonbrief.org/richest-people-in-uk-use-more-energy-flying-than-poorest-do-overall/>

13.07.2023




The richest British people use **more energy flying** than the poorest use overall

Annual energy use per adult equivalent, GJ



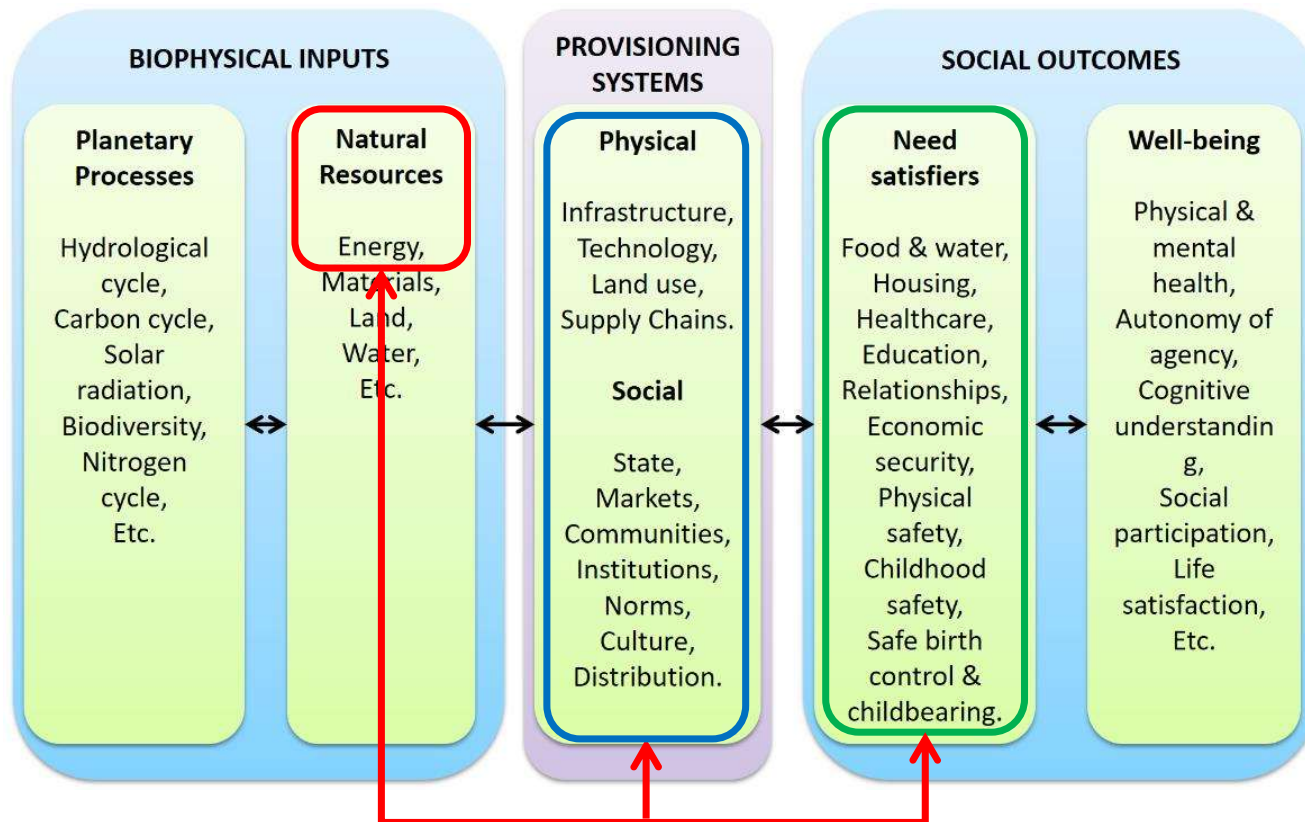
Baltruszewicz et al 2023

Carbon Brief <https://www.carbonbrief.org/richest-people-in-uk-use-more-energy-flying-than-poorest-do-overall/>



**What factors
enable (or disable)
societies from
achieving well-being at
low energy use?**

International energy demand vs well-being: what are mediating factors?



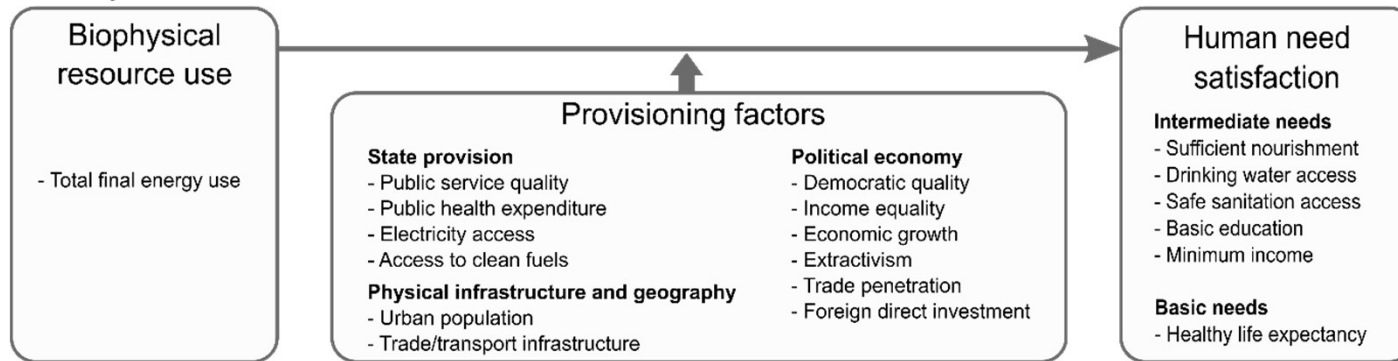
$$NS_{i,c} = a + b_1 ENU_{j,c}$$

Need
satisfaction

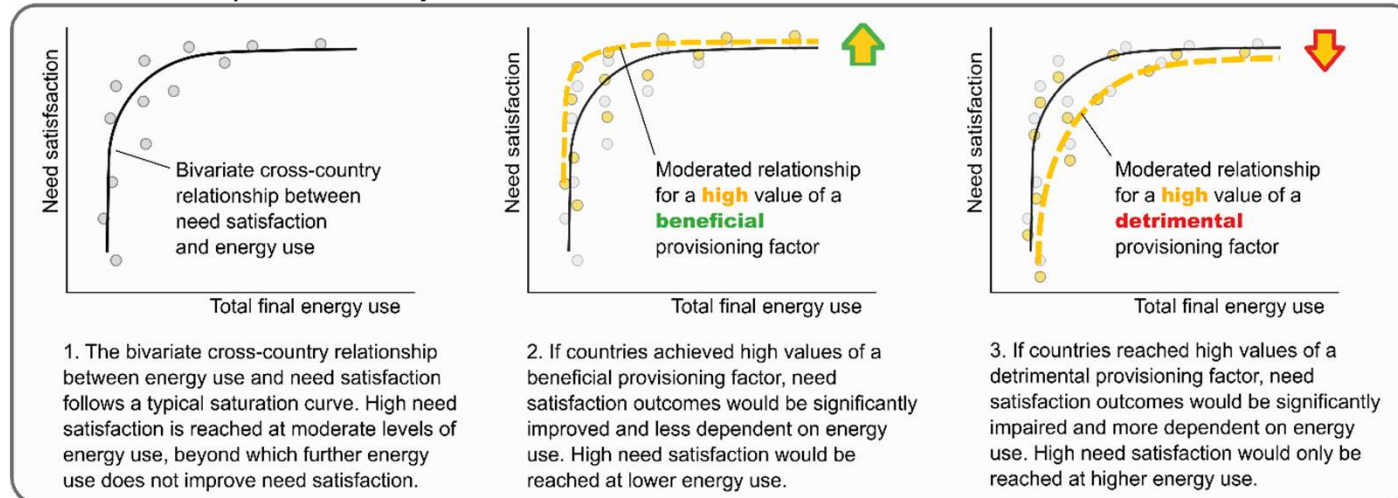
Energy
use

International energy demand vs well-being: what are mediating factors?

A. Analytical framework



B. Qualitative depiction of analysis



Socio-economic factors enabling well-being at lower energy use

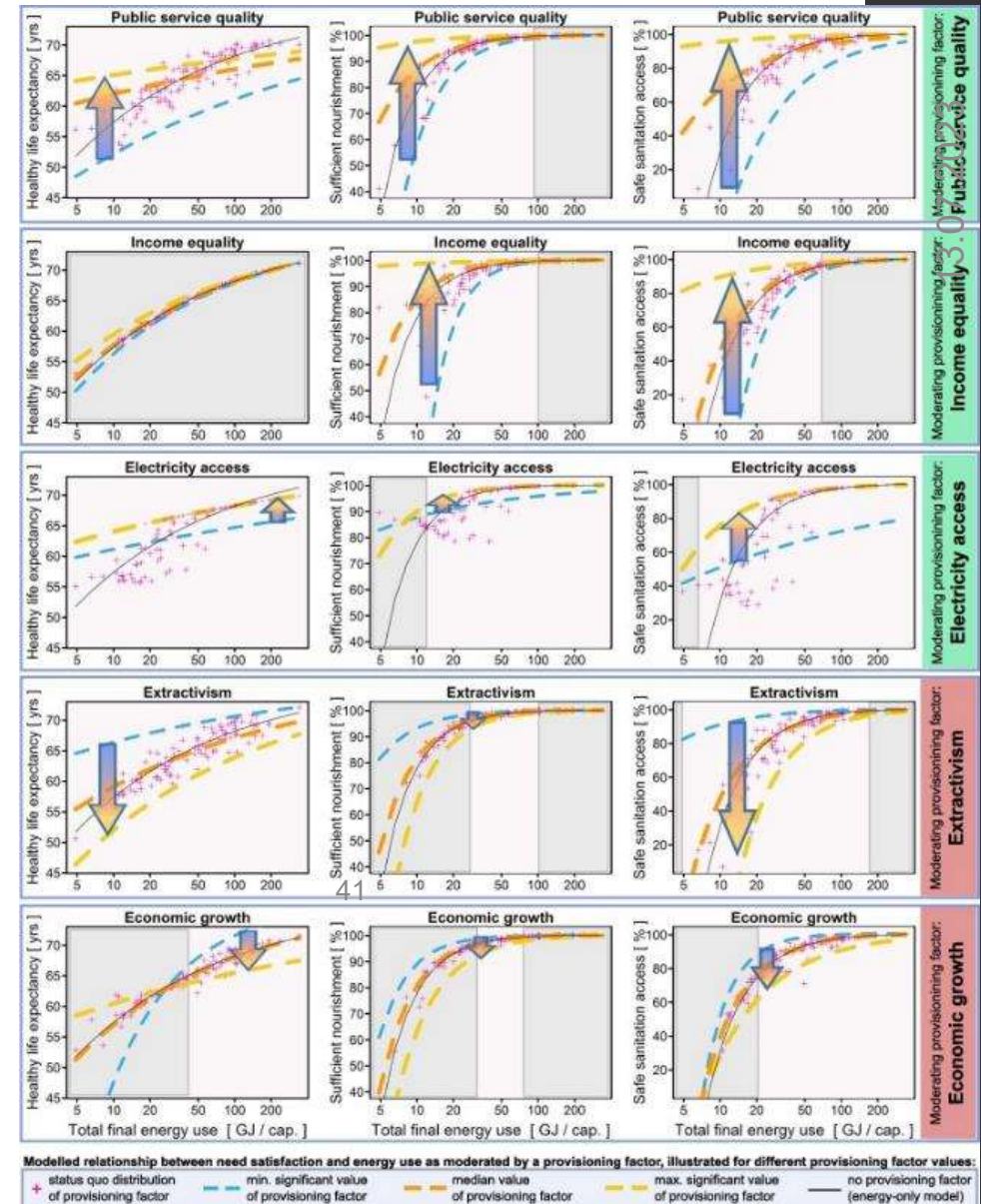
Positive factors

- Public services
- Income equality
- Democracy
- Electricity & sanitation access.

Negative factors:

- Extractivism
- Economic growth above a moderate income.

Vogel et al 2021



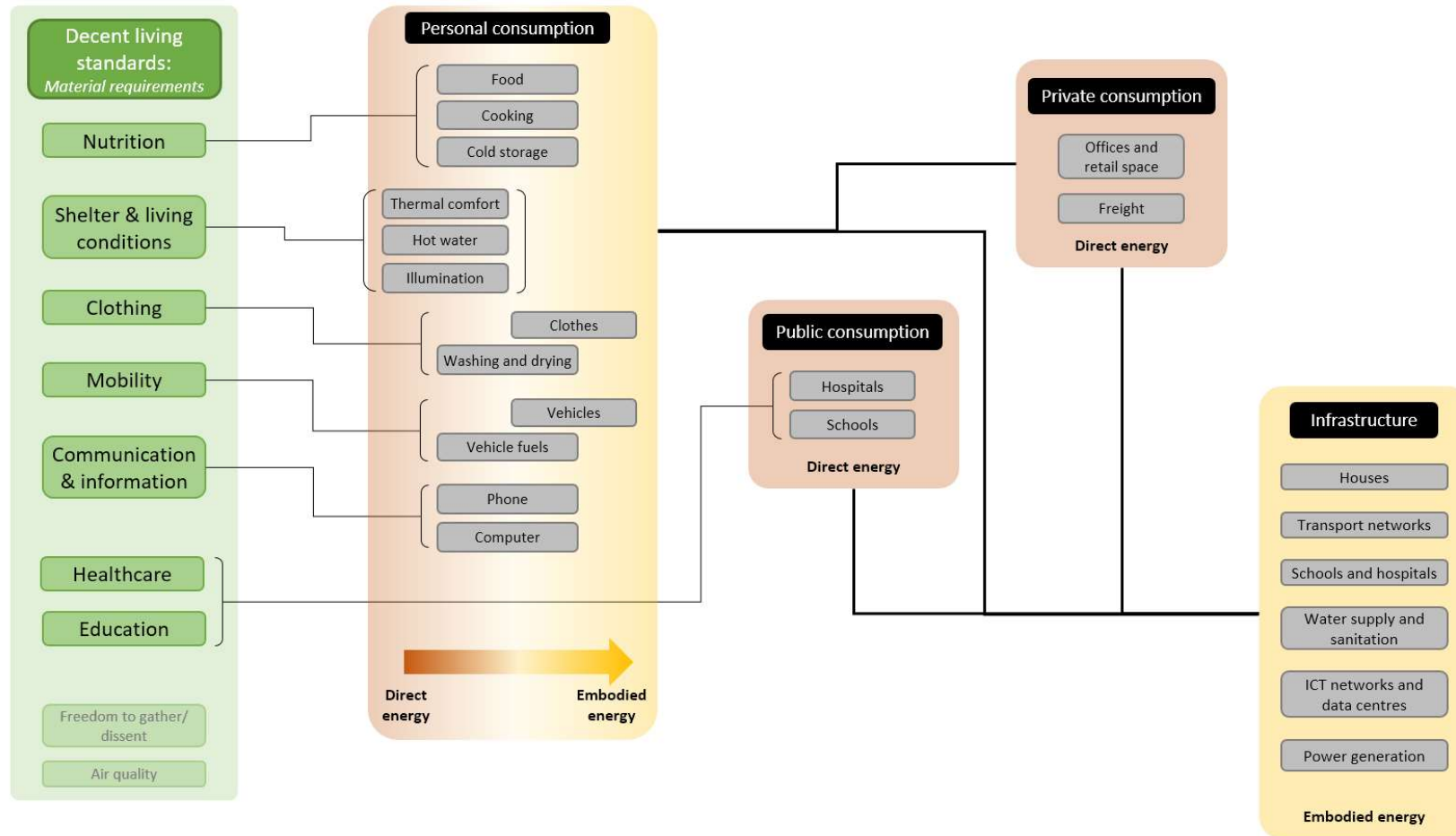


Modelling a low
energy & high
well-being
future

Can we model a different future?

- Based on the “Decent Living Energy” framework of Professor Narasimha Rao, Yale.
- Connects needs to sufficient levels of energy services.
- Global model takes into account technology improvements, equal distribution, lower demand levels.

What the model looks like, and takes into account



Millward-Hopkins, Steinberger, Rao & Oswald, 2020, *Global Environmental Change*

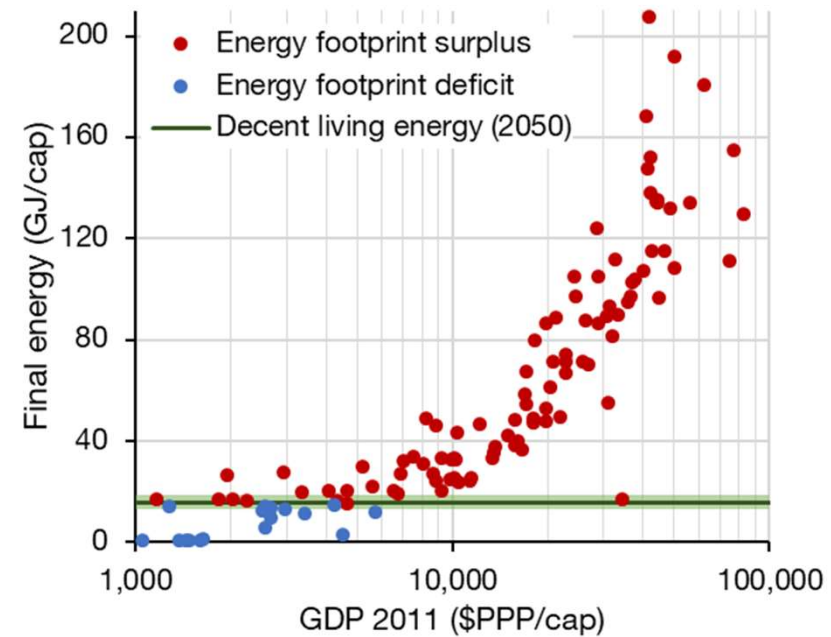
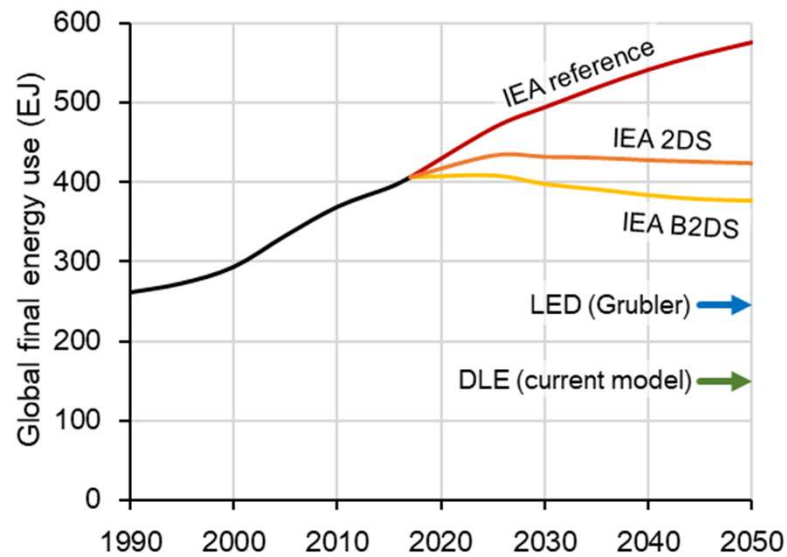
Decent Living Energy Services

Energy service	Level per person	Depends upon
Nutrition	2000–2150 kcal/day	Demography
Living space heated or cooled to 20 degrees year round	15 m ² per person	Rural-urban Climate
Clean water	50 liters, of which 20 heated	
Communication	1 mobile phone per person 1 laptop per household	
Mobility	5'000 - 15'000 km/year	Rural-urban
Health	8 hospital beds per 1000 persons	
Education	5-19 year-olds in school	Demography

And the energy embodied in appliances, infrastructure, etc.

Millward-Hopkins, Steinberger, Rao & Oswald, 2020, Global Environmental Change

Global decent living energy results



Decent Living Energy for all achievable at 40% of current energy use, despite population growth until 2050.

A good life for all within planetary limits may be technically possible.

What is standing in our way?

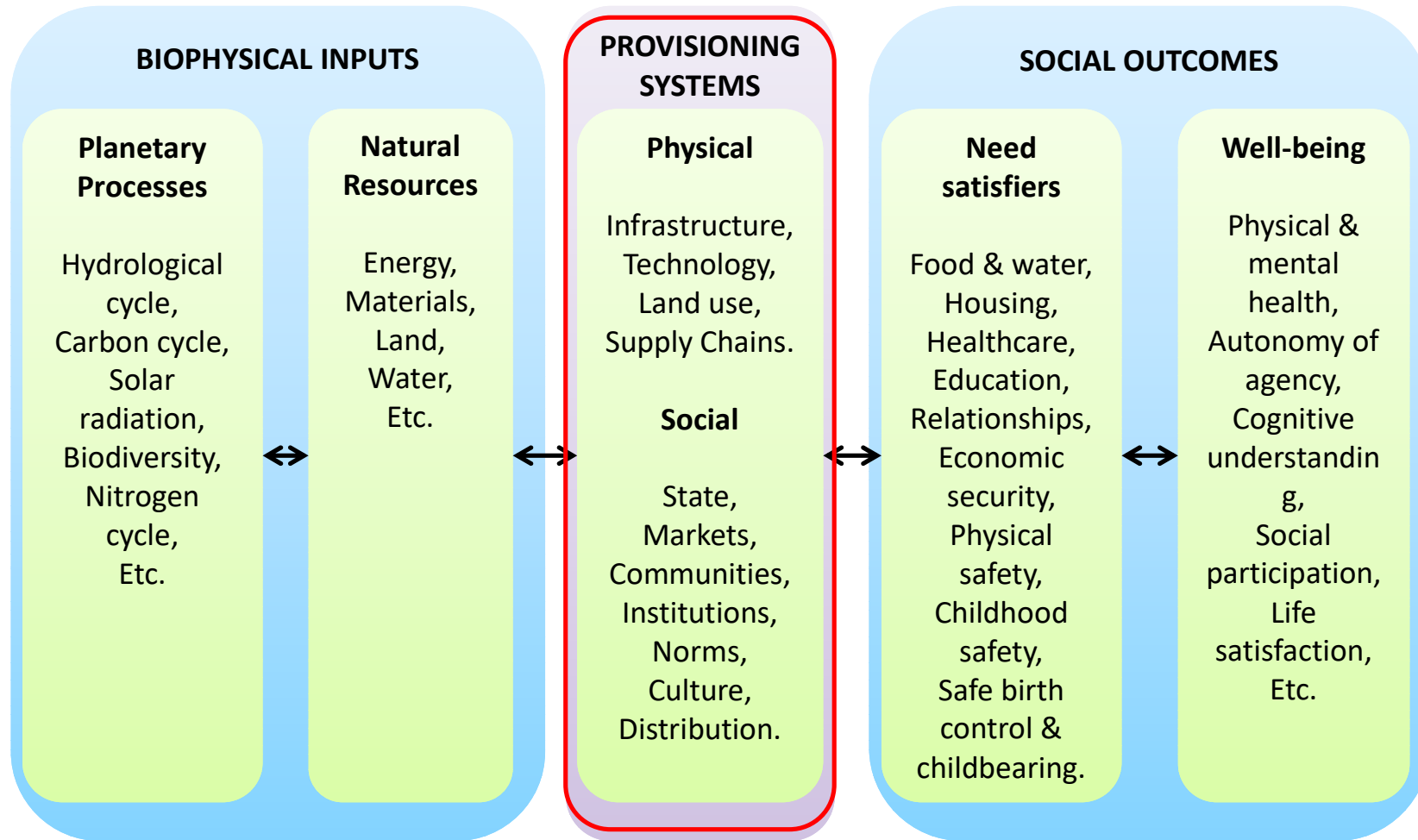
Recent results regarding the political economy of car dependency ...

A political economy of car dependence



Wikimedia, creative commons

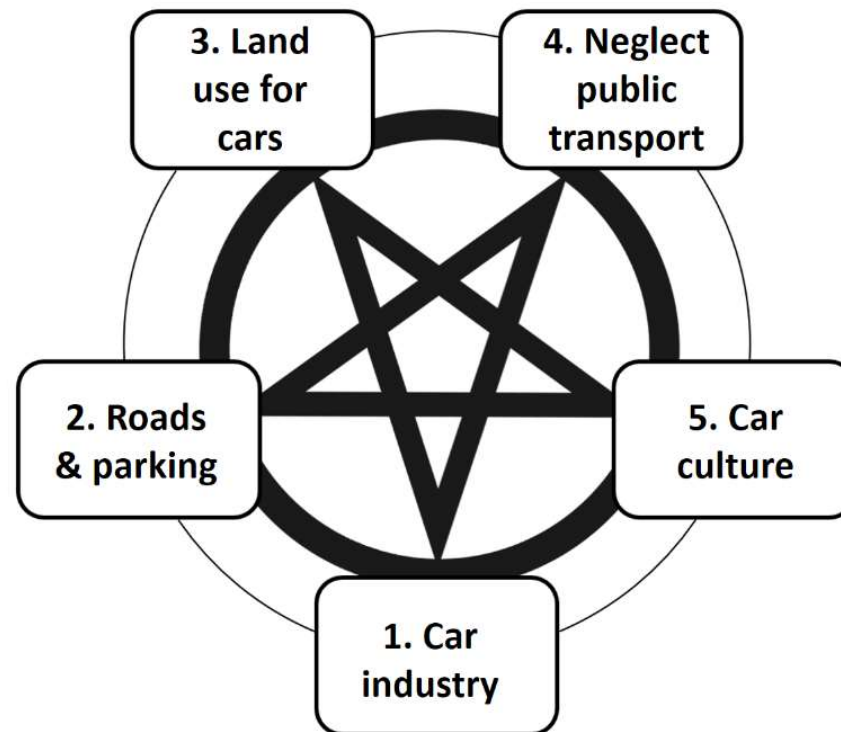
Systems of provision of car dependence



J. Steinberger, D. O'Neill & W. Lamb

A political economy of car dependency

Systems of provision
approach to studying the
creation & evolution of
car dependency.



Mattioli, Roberts, Steinberger & Brown, 2020, Energy Research and Social Science

real

A POST GROWTH DEAL



Prof. Giorgos Kallis
Autonomous University of
Barcelona, Spain



Prof. Julia Steinberger
University of Lausanne,
Switzerland



Prof. Jason Hickel
LSE and Autonomous University
of Barcelona, Spain

WP1

Planetary Possibilities

- North-South convergence scenarios of resource use.
- Material prerequisites for decent living.
- Postgrowth IAM scenarios.

WP2

Postgrowth Policies

- Mapping unequal exchange.
- Post-Growth Deals for EU and Global South.
- Modelling and feedback on policies.

WP3

Postgrowth Provisioning

- Determinants of social progress.
- Democratic provision alternatives.
- Modelling transformed provision.

WP4

Postgrowth Politics

- Learning from labour, peasant and municipal movements.
- Role of protest and conflict.
- Models of postgrowth political organizing.

WP4

Postgrowth in Practice

- Planning processes for postgrowth in practice.
- Execution and public consultation for Post-Growth.
- Prototyping Post-Growth Deals.



European Research Council
Established by the European Commission

<i>Cause:</i> <i>Effect:</i>	1 Automotive Industry	2 Car Infrastructure	3 Land Use Patterns	4 (Undermining of) Public Transport	5 Car Culture
1 Automotive industry		Car infrastructure enables the sale of more cars, by providing space to accommodate them. The status of roads goes from shared public spaces to motorised flow spaces, literally driving other modes out, and enhancing the value of car ownership.	The need for cars to navigate urban sprawl creates an incentive for consumers to purchase more of them, thereby stabilising demand for automobiles. Suburban, car-dependent constituencies further strengthen the car industry's lobbying efforts.	Historically, the legacy of monopolistic public transport companies has strengthened the political hand of the car industry. Currently, deteriorating public transport forces more people to buy cars.	Car culture produces a continuous demand for vehicles that upholds the car industry. It also influences the cultural dynamics of the industry itself, locking in certain approaches and business models.
2 Car Infrastructure	The automotive industry plays a key role in lobbying coalitions which pressure government to invest public resources, and co-opt public space, to make room for cars.		The expansion of the suburbs demands high-capacity roads and highways to serve them, while also making it more challenging to travel by foot, bike, or public transport.	Public transport becomes dependent on car-dependent road infrastructure, bolstering car industry's lobbying efforts.	Car infrastructure has durable cultural associations with progress, modernity, ruralism, and competent governance, which improve its political viability.
3 Land Use Patterns	The car industry, working with other aligned industries, such as suburban real-estate developers, actively promotes urban sprawl. Historically, car companies promoted visions of an efficient, modern cityscapes and suburban areas.	The expansion of car infrastructure encourages suburban and single-purpose development, which become more viable and more desirable due to mass automobility.		Lack of public transport options leads to locational indifference of sprawl, with no reason to prioritize land use around public transport axes.	Suburban land use has a potent set of cultural imaginaries (for example, white picket fences in the USA), which encourage more people to move to the suburbs and own cars.
4 (Undermining of) Public Transport	The car industry deliberately attempts to undermine public transport, and is strengthened in its attempts to do so by the fact that the public costs it imposes are more hidden than those of public transport. During economic crises, public transport gets cut while the car industry gets bailed out. Meanwhile, the surplus capacity that the car industry builds into cars gives it a critical advantage over public transport in terms of range, marginal cost, and cargo capacity.	Infrastructure designed primarily for cars crowds out public transport road-based options such as buses, and pulls financial resources away from other alternatives, such as railways or tramways.	Lower population densities make it more challenging to effectively organise public transport networks, leading to more car dependence and settlements outside public transport networks, in a vicious cycle.		Public transport is portrayed as unattractive, burdensome, and for the poor, young, or infirm.
5 Car Culture	The car industry actively supports the development of car culture, both deliberately, through advertising and marketing, and tacitly, through the built-in redundancy in the vehicles they sell, and the effects this has on people's daily practices.	Car infrastructure creates practices, habits and cultural trends (e.g. it is normalised as a symbol in children's toys).	Land use patterns, both for residential and work developments, normalise car transport, ensuring that alternatives are portrayed as marginal.	Poor public transport networks encourage more people to adopt car-centric lifestyles.	



Next research steps: ERC Synergy Grant
REAL “A Post-Growth Deal”
2023-2029

Prof Giorgos **Kallis**, UAB, Barcelona, Spain

Prof Jason **Hickel**, UAB, Barcelona, Spain

Prof Julia **Steinberger**, University of Lausanne, Switzerland

Major Contributions

01.

Ground-breaking models charting diverse aspects of post-growth pathways.

02.

Post-Growth Deals, for Europe and Global South, based on systemic analysis and evidence.

03.

Bridging the gap between Post-Growth theory and implementation, engaging with social movements and decision-makers.



From analysis to rebellion

nature
ecology & evolution



Credit: Louise Gardner



Credit: Alfredo Romero-Muñoz

Scientists must act on our own warnings to humanity

We face interconnected planetary emergencies threatening our climate and ecosystems. Charlie J. Gardner and Claire F. R. Wordley argue that scientists should join civil disobedience movements to fight these unprecedented crises.

“The scientists who alerted the world to the climate and ecological crises have a moral duty to join the popular movements demanding political action.”

ENVIRONMENT OCTOBER 13, 2019 / 3:09 AM / 3 DAYS AGO

Scientists endorse mass civil disobedience to force climate action

Matthew Green

5 MIN READ



LONDON (Reuters) - Almost 400 scientists have endorsed a civil disobedience campaign aimed at forcing governments to take rapid action to tackle climate change, warning that failure could inflict “incalculable human suffering.”

From Publications to Public Actions: The Role of Universities in Facilitating Academic Advocacy and Activism in the Climate and Ecological Emergency

Charlie J. Gardner¹, Aaron Thierry², William Rowlandson³ and Julia K. Steinberger⁴

Environment protest being criminalised around world, say experts

More than 400 climate scientists sign letter that says activists are being targeted at pivotal time in fight against global heating

“It has become abundantly clear that governments don’t act on climate without pressure from civil society: threatening and silencing activists thus seems to be a new form of anti-democratic refusal to act on climate.”

Civil disobedience by scientists helps press for urgent climate action

Time is short to secure a liveable and sustainable future; yet, inaction from governments, industry and civil society is setting the course for 3.2 °C of warming, with all the cascading and catastrophic consequences that this implies. In this context, when does civil disobedience by scientists become justified?

Stuart Capstick, Aaron Thierry, Emily Cox, Oscar Berglund, Steve Westlake and Julia K. Steinberger

The scientific community is well aware of the grim trajectory on which the Earth is headed^{1,2}; many of those working on climate change experience anxiety, grief or other types of distress as a result³. Increasingly stark warnings and the gathering pace of climate impacts stand in contrast to the persistent growth in global emissions^{4,5}. Some scientists conclude that the discordance between the evidence and lack of response constitutes a broken contract between science and society⁶. Others point to powerful vested interests and systemic inertia obstructing significant emissions reduction^{7,8}.

Although scientists are not to blame for the lack of an adequate societal response, it is reasonable to ask what more can be done to accelerate desperately needed change, beyond the further accumulation and communication of evidence.

Many already accept a role for scientists in advocacy^{9,10}; around two-fifths of IPCC authors have signed petitions or letters calling for action, and a quarter report having taken part in protests¹¹. To press for more meaningful efforts, and to push back against the negligence and bad faith tactics that frustrate this^{12,13}, a legitimate next step for scientists is to participate in peaceful civil disobedience.

We argue that this is justified on the basis that it is effective as a strategy for change, it strongly communicates the urgency of the climate crisis, is a reasonable and ethical activity for scientists to undertake, and is revealing of the barriers to climate action.

Civil disobedience works

Civil disobedience involves public acts of conscience that seek to disrupt and resist business as usual and/or to effect changes in laws and practices; examples in relation to climate action include the bodily obstruction of investment banks enabling new fossil fuel exploration and the pasting without permission of scientific papers to government buildings. In concert with

international movements such as youth strikes, a growing number of scientists are becoming involved with this type of protest¹⁴ (Fig. 1).

Practitioners of civil disobedience often refer to important historical precedents such as the suffragettes or the civil rights movement; its use within contemporary climate activism is based on the linked claim that it is more effective than conventional protest. In some cases, civil disobedience has prompted a direct response from decision-makers; for example, following the 2019 Extinction Rebellion protests in London, the UK parliament supported a motion to declare a climate emergency that called on the government to increase its ambition¹⁵. More often, disruptive protests are part of broader politics, such as campaigns against coal extraction in South Africa and by indigenous-led coalitions resisting new fossil fuel infrastructure in the United States¹⁶.

The IPCC concludes with 'high confidence' that collective action connected to social movements has played a substantial role in pressuring governments to create new laws and policy, noting that the more confrontational tactics of civil disobedience and direct action have become increasingly common in recent years¹⁷. Meta-analysis of social movements worldwide contesting fossil fuel projects finds that civil disobedience makes a demonstrable difference to their chances of success, over and above the use of other tactics¹⁸.

Civil disobedience needs scientists

The trusted position of scientists in society affords a respected standpoint from which to demand change; for this reason alone, their participation is valuable as part of social movements. At the same time, the credibility of scientists is influenced by whether they are seen to be acting in line with shared values and promoting the well-being of others¹⁹ and, in the context of climate change, according to whether



Fig. 1 | Scientists in lab coats join a climate protest. Credit: Crispin Hughes.

their actions clearly align with their message²⁰. More generally, studies on social influence and leadership show that particular meaning and purpose tends to be ascribed to conduct that incurs personal costs (for example, risk or discomfort) when carried out with the intention of advancing collective goals²¹.

Civil disobedience by scientists has the potential to cut through the myriad complexities and confusion surrounding the climate crisis in a way that less visible and dispassionate evidence provision does not, sending a clear signal that scientists believe strongly in the evidence and its implications. When those with expertise and knowledge are willing to convey their concerns in a more uncompromising manner than through papers and presentations, this affords them particular effectiveness as a communicative act²². This is the insight of Greta Thunberg when she calls on us to 'act as you would in a crisis'.

comment

Civil disobedience is justifiable

As an 'ethical crisis'²³, the climate emergency warrants civil disobedience under certain specific conditions. These include that fundamental rights to life and well-being are being undermined in an unjust manner, that the action has the potential to be effective and avoids harm; and that such action is undertaken as a last resort, other avenues having been pursued²⁴. More long-standing scholarship has argued that civil disobedience is justified in the context of a broader 'fidelity to law' that contests specific policies or practices but not the legitimacy of the state in general terms; central to this is the separation of the legal from the legitimate, siding where necessary with the latter²⁵.

We argue that the circumstances of the climate crisis more than fulfil the 'last resort' criterion; for decades, scientists have tried to sound the alarm through other means, but years of delay and obfuscation by decision-makers mean that severe consequences are already unfolding around the world, with little time remaining to avoid even more far-reaching and long-lasting harm. The climate crisis is epitomized by destructive impacts on large numbers of people; it is pervaded by injustice, and exacerbated through obstruction by powerful institutions, including the conditions set by legislators. Carefully targeted and peaceful civil disobedience is able to align with overall fidelity to law, where scientists accept the risk of arrest for conscientious but potentially unlawful acts.

The trouble with scientific neutrality

A familiar counter argument to scientist involvement in civil disobedience is that this risks undermining the integrity of science. The legitimacy of scientists is said to rest on their status as impartial, objective or 'neutral' observers, and the idea that science and politics should remain separate. However, these ways of linking science and society are not founded on absolute principles; rather, they exist as partially applied assumptions based on historical precedent²⁶. We need to ask how well these inherited norms are serving us in a time of existential environmental crisis.

Moreover, no dialogue between science and society can ever be value neutral, and it should not aim to be²⁷. The widespread notion that sober presentation of evidence

by an 'honest broker' to those with power will accomplish the best interests of populations is itself not a neutral perspective on the world; it is instead conveniently unthreatening to the status quo and often rather naive^{28,29}.

Misgivings about how civil disobedience by scientists may be perceived by the wider public may also be misplaced. In general terms, studies have found the credibility of scientists is not undermined by advocacy^{30,31}; on the contrary, many members of the public expect scientists to use their knowledge to advocate for the public good³².

Think then act

While historical evidence can offer pointers, there is no one-size-fits-all approach to civil disobedience. With respect to climate action, it entails an ongoing experiment; scientists might best consider themselves participatory action researchers, fully cognisant and transparent about the value-based concerns that enable their involvement^{33,34,35}. At the same time, participation can lead to deeper understanding of the social and political structures that surround the climate crisis and the processes by which change can occur³⁶.

It is important to be clear that the personal risks associated with civil disobedience vary dramatically with people's circumstances. We recognize that there are many frontline activists who have lost their lives protesting and resisting in defence of people and planet. To be able to engage in disruptive protest in relative safety is a privilege held by citizens living in comparatively liberal societies. For those in such a fortunate position, the opportunity exists to press for action, while helping to shape the nature of protest activity and reducing the barriers to participation by others³⁷.

By engaging with the subject matter of this article, the authors — and, we hope, our readers — are pushed into difficult territory concerning a fundamental question: are our traditional modes of research and communication failing in the face of the climate crisis and, if so, what can we do about it? An unflinching engagement with this question requires us to move beyond our comfort zone, in ways which might challenge but also energize the position of scientists in society.

In addition to documenting the climate crisis in ever greater detail, we are obliged

to consider how we might act in new ways to help bring about a necessary and urgent transformation.

In the meantime, we have long since arrived at the point at which civil disobedience by scientists has become justified.

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Competing interests

All authors have participated in, and offered support to, groups carrying out civil disobedience to press for climate action.

Thanks! Any questions?

