How will ending poverty impact climate change? A wellbeing-centered approach to energy transitions

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Oxford Energy Seminar, May 16, 2022

International Institute for Applied Systems Analysis
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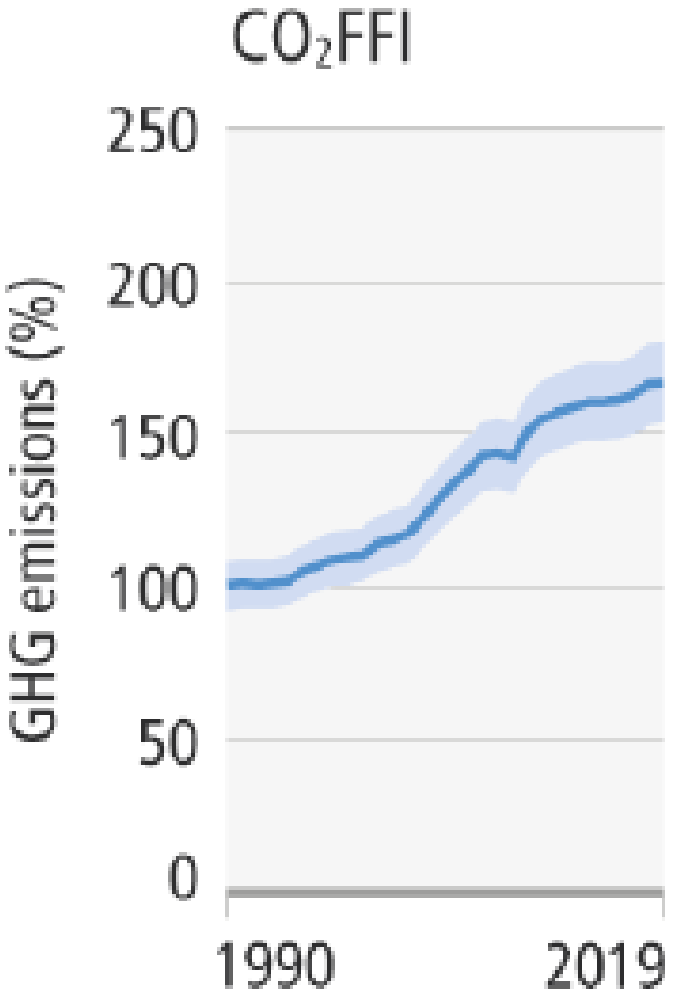
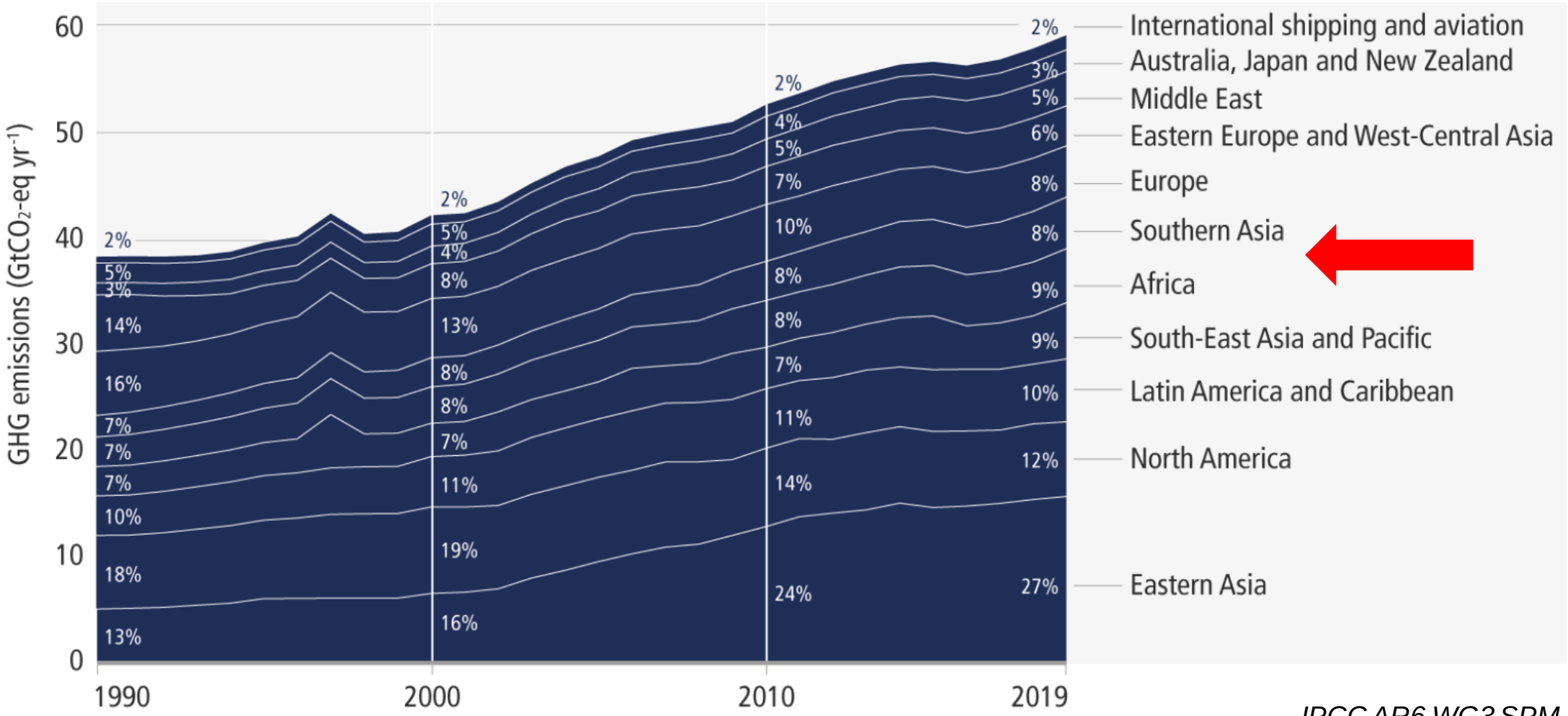


IPCC AR6 WG3 SPM

"Rapid" economic growth drives GHG mostly in China…

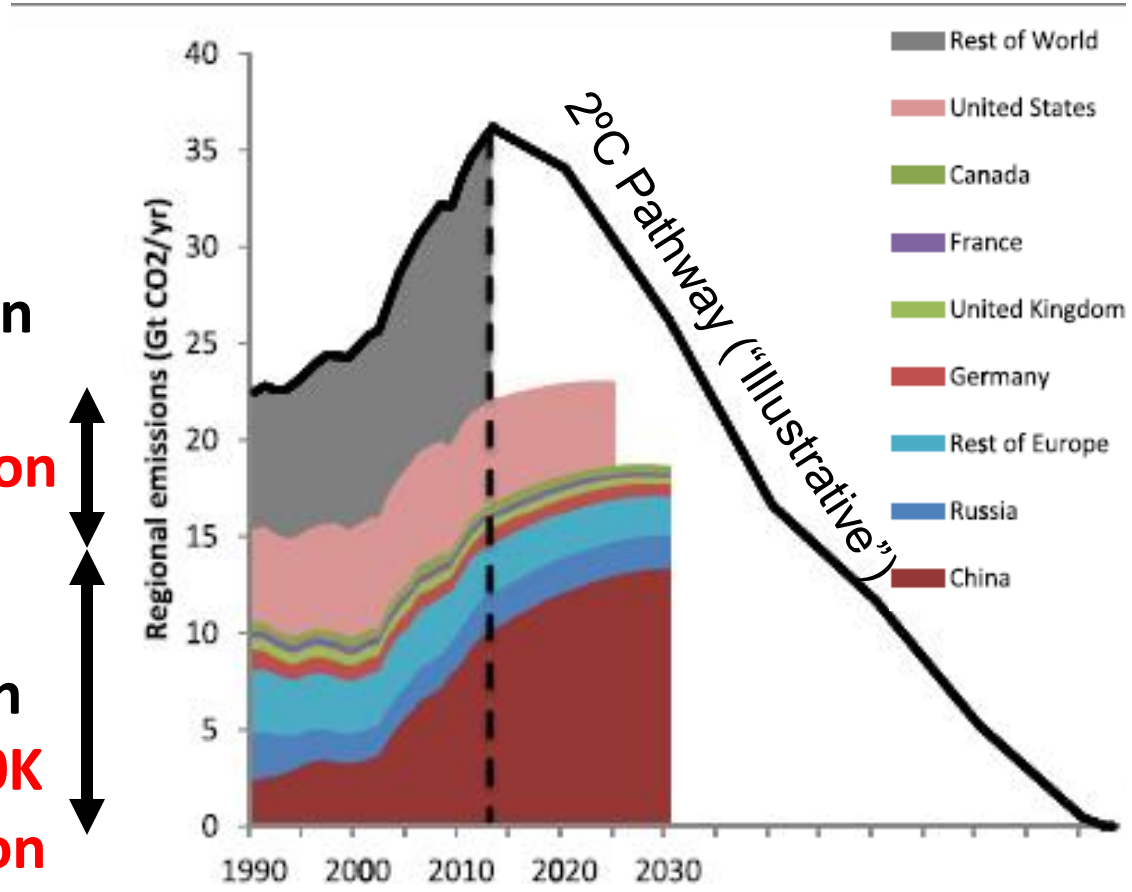


IPCC AR6 WG3 SPM

How much of the remaining carbon budget does poverty eradication require?

3.5 billion
$1K-10K
per person

3.5 billion
$10K-100K
per person



Adapted from Gignac & Matthews, *Env. Res. Ltrs*, 2015

Slums **~1 bil**

Biomass stoves **~2.6 bil**

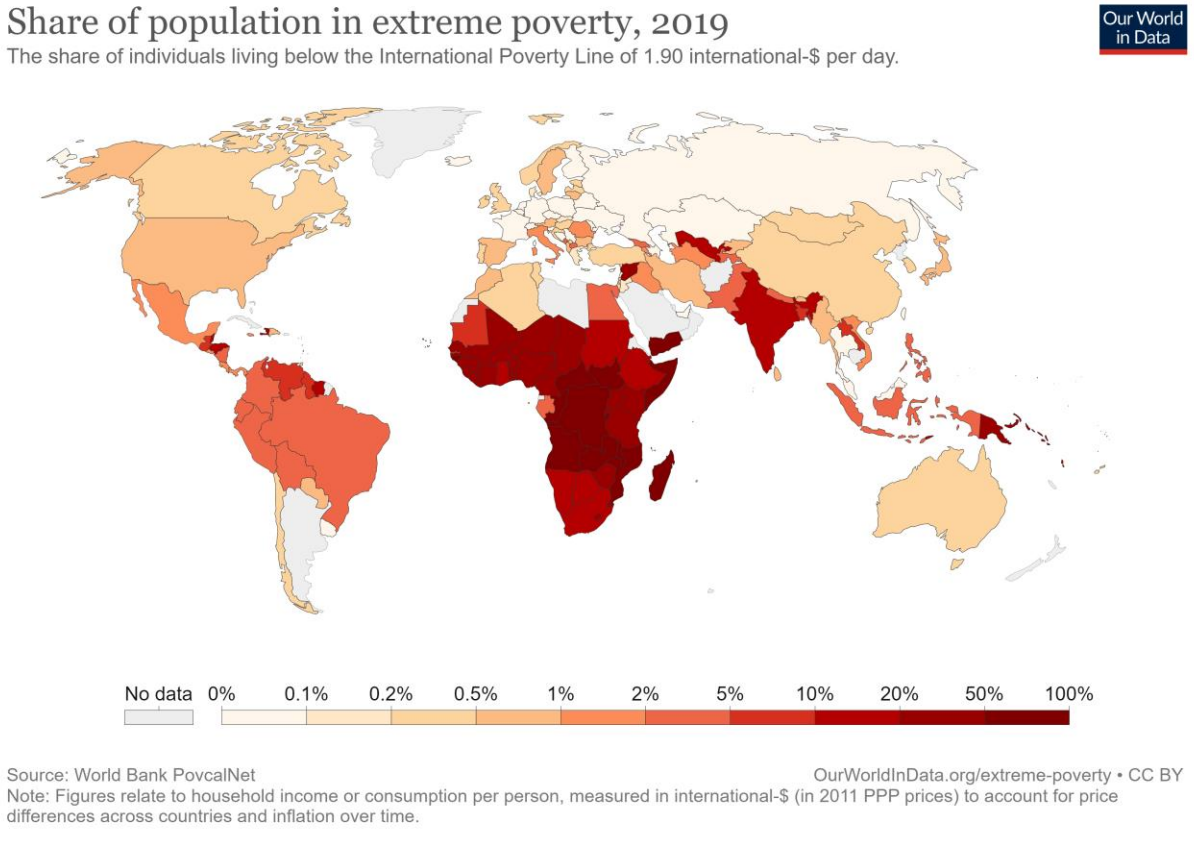
Hidden Hunger 2 **bil**

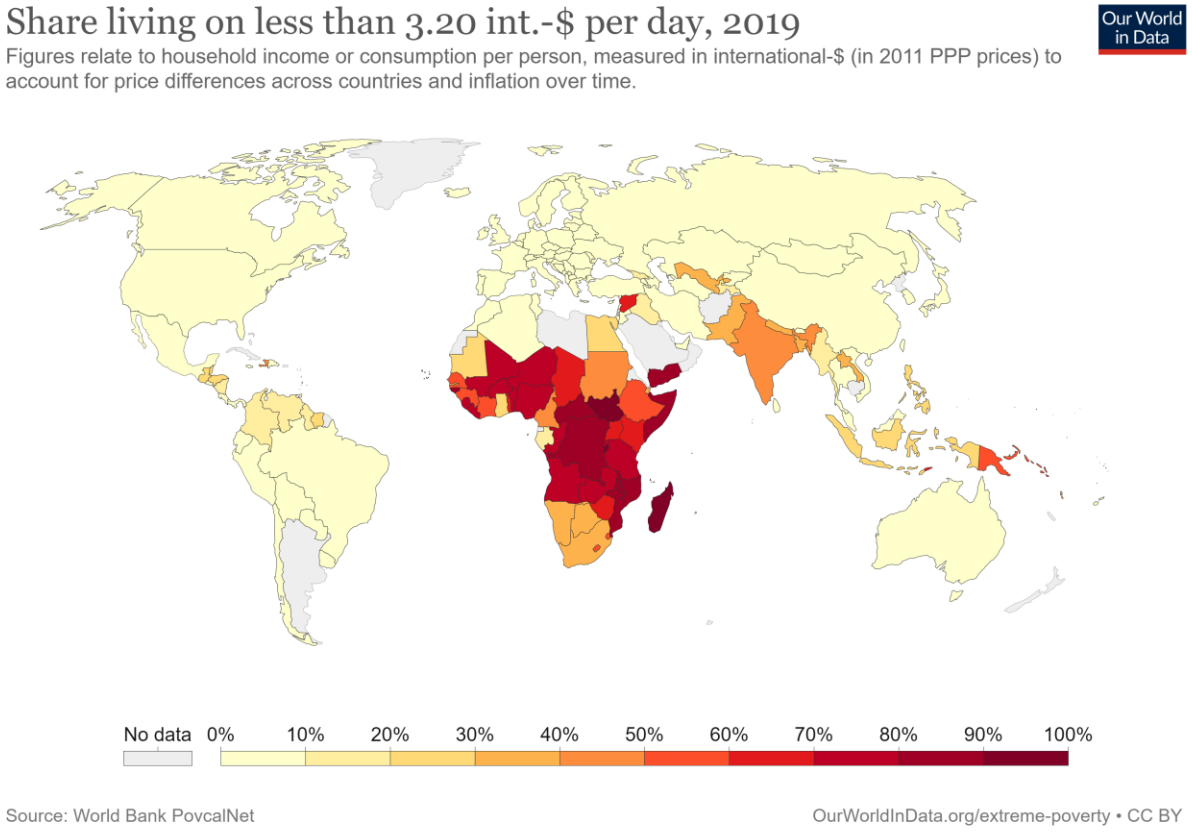
Unsafe sanitation **~2 bil**

How much energy growth does poverty eradication require?

Umm.. what's poverty ?

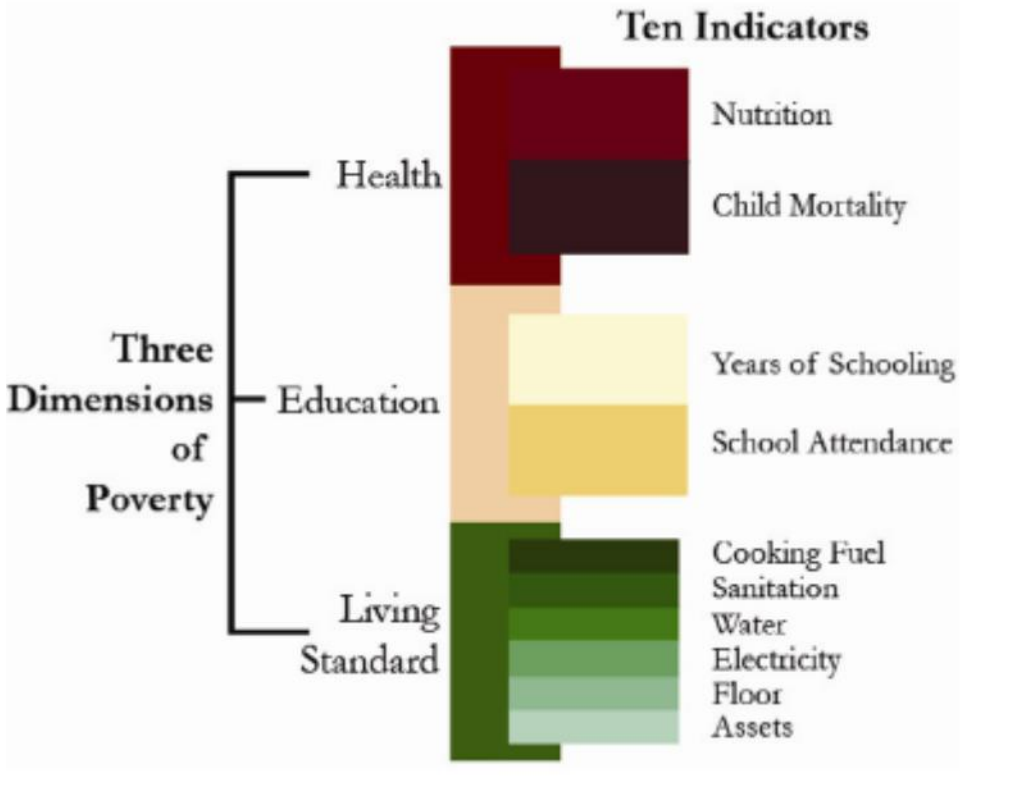
Income poverty doesn't tell a consistent story about deprivations.






No Sanitation
No piped water
No waste disposal
Narasimha D. Rao

Multidimensional Poverty Index (MPI)



Alkire & Santos, World Dev, 2014

What's needed

Means vs Ends

Comprehensive

Access vs. Services

Decent living standards – one link between energy and wellbeing

Theory
Capabilities, Basic needs

Expert elicitation

Other Wellbeing Indicators

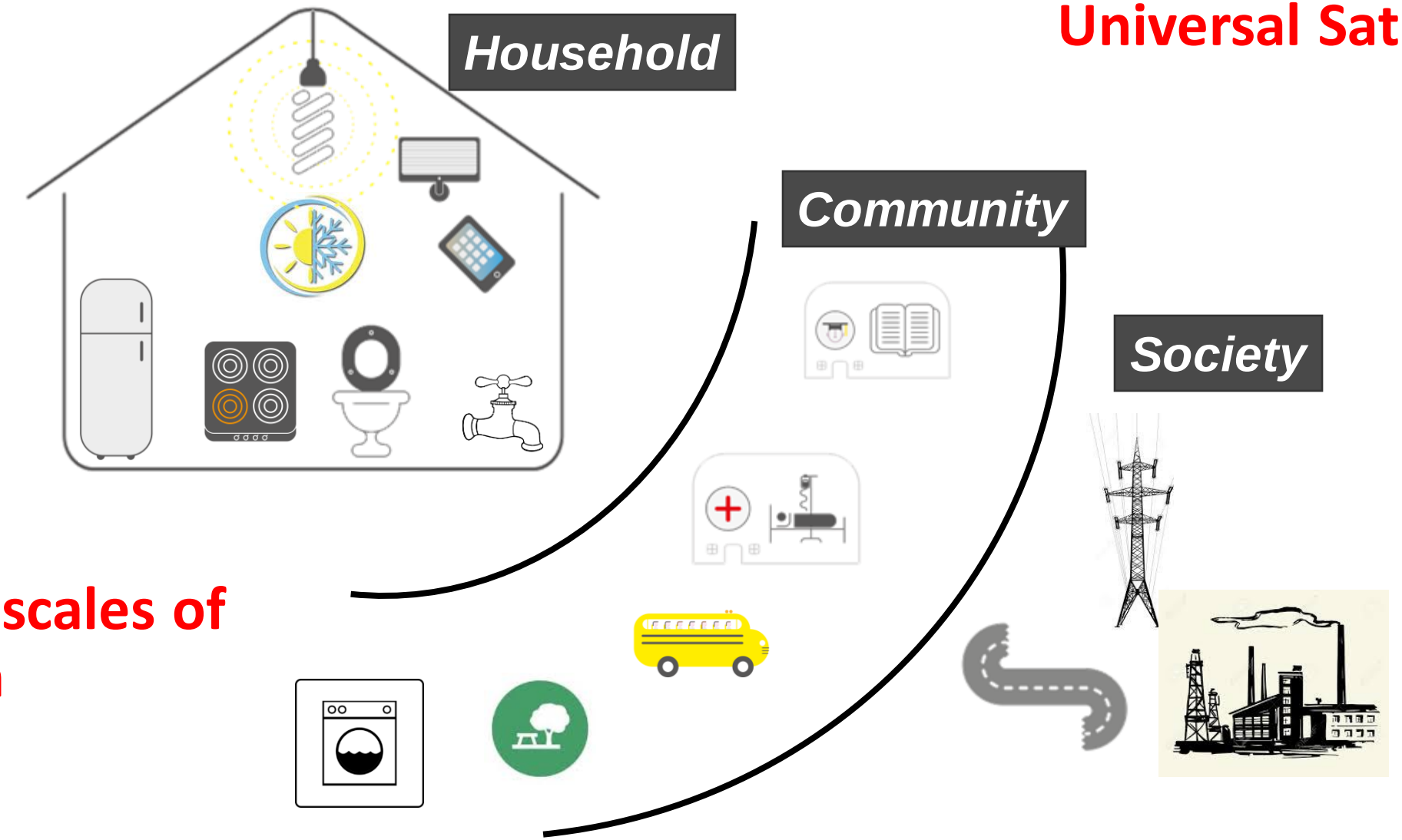
Empirical data
Household surveys worldwide

Decent Living Standards

A comprehensive, theory-based measure of the **material** pre-requisites for wellbeing

Rao, ND & J. Min, *Social Indicators Research, 2018*

Decent Living Standards



Universal Satisfiers

Multiple scales of provision

Rao, ND & J. Min, *Social Indicators Research, 2018*

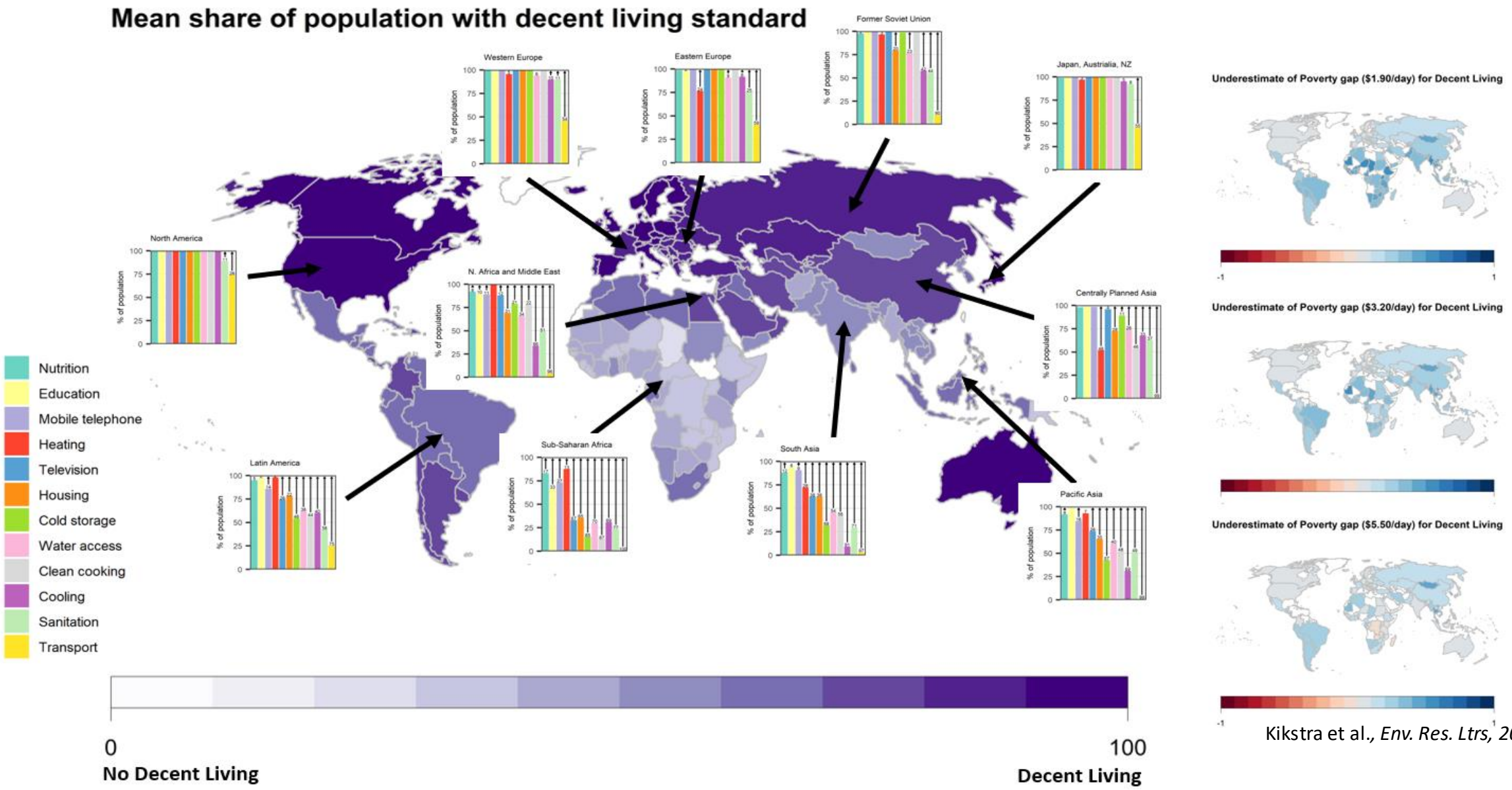
Decent Living Standards

Physical Wellbeing

Dimension	Description/ Threshold
Housing	Safe, durable (permanent), min space (10 m^2/cap)
Thermal comfort	AC Use (26°C, 60% Humidity), 1 bedroom, nights only. Heating to 18°C
Nutrition	Macro- and micronutrients (protein, zinc, iron, calories)
Clean ckg	LPG or electricity cook stoves
Water	65 l/cap/day, indoor access
Sanitation	Sewage distribution (urban only)
Appliances	Fridge: <200 l; TV; cell phone per adult
Health care	$665 per capita (national)
Education	$1000 -$1500 per student (national)
Mobility Infrastructure	10K p-km motorized; paved roads; public transit

Social Wellbeing

Rao, ND & J. Min, *Social Indicators Research., 2018*



Kikstra et al., *Env. Res. Ltrs, 2021*

Energy Calculation Methods:

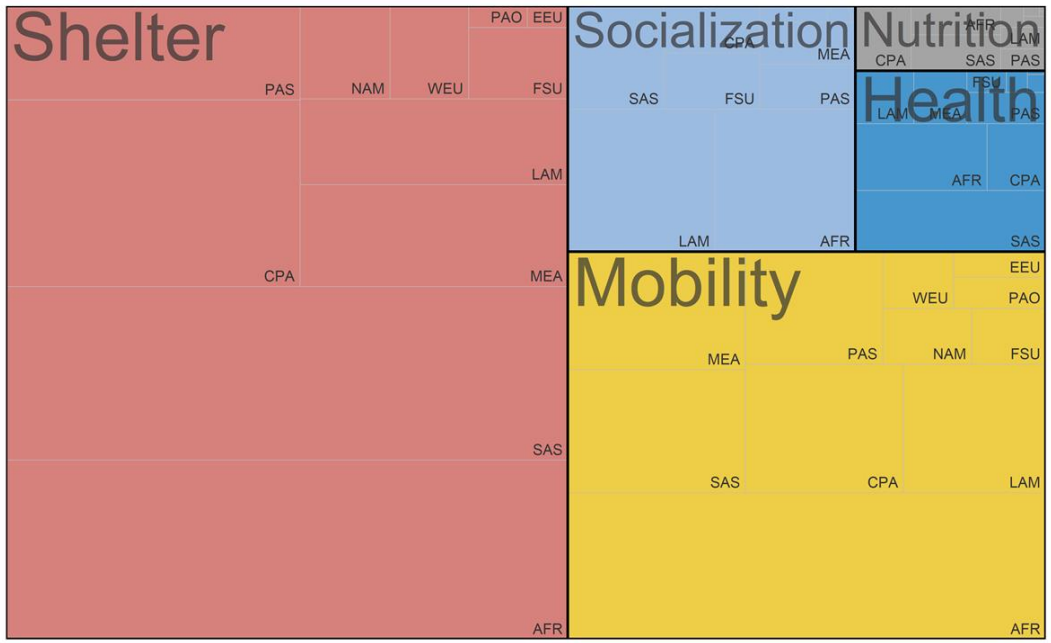
Direct household

Indirect Embodied (industrial ecology)

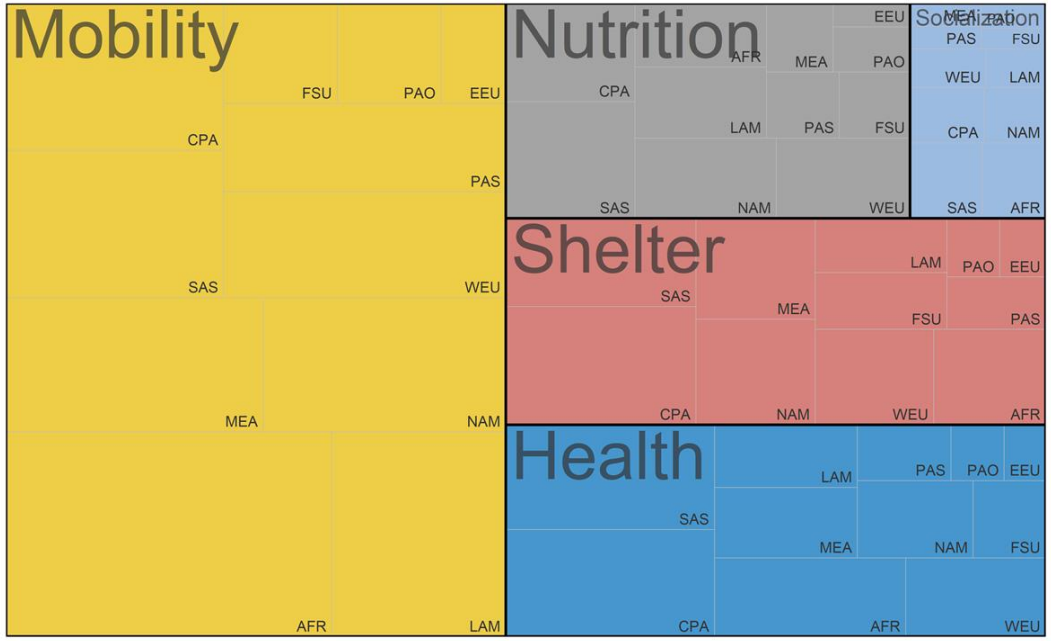
Wellbeing Satisfiers	Methods Used
Physical Wellbeing	
Nutrition	Input-Output, Optimization (healthy diets)
Household Appliances	LCA (literature)
Shelter + space conditioning	Building simulation + LCA
Health care	Input-Output
Utilities (water, sanitation)	LCA (literature)
Clothing/footwear	Input-Output
Social Wellbeing	
Education	Input-Output
Motorized transport	LCA (literature)

Transport and buildings dominate basic energy requirements

Cumulative Buildout Energy (2020-2040)



Annual Maintenance Energy



Kikstra et al., *Env. Res. Ltrs, 2021*

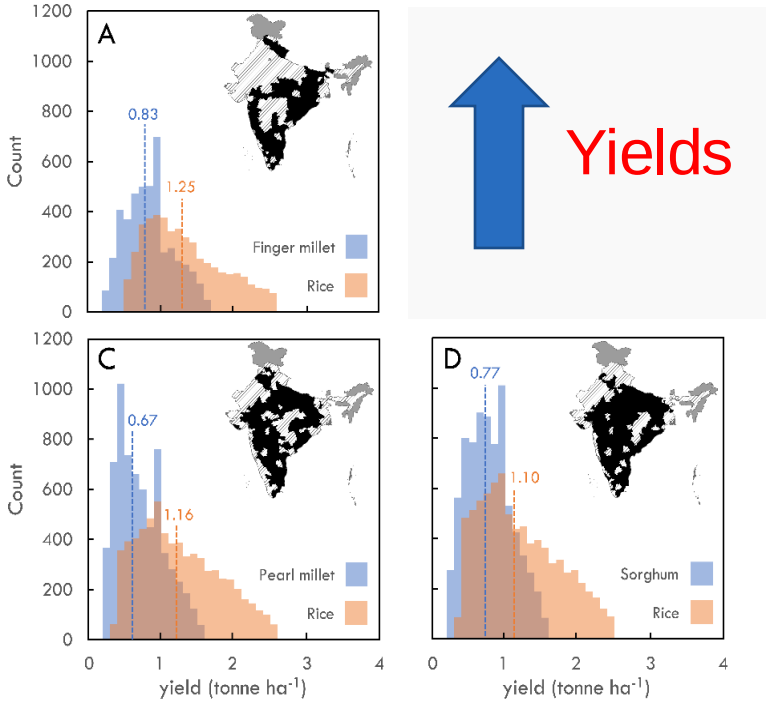
To maximize climate/development synergies

Public transport, Efficient public housing, Diversified Diets

Deep Dives – Sustainable Grains (India)

C3 CEREALS

White rice



Yields

C4 CEREALS

Pearl millet

Finger millet

Sorghum

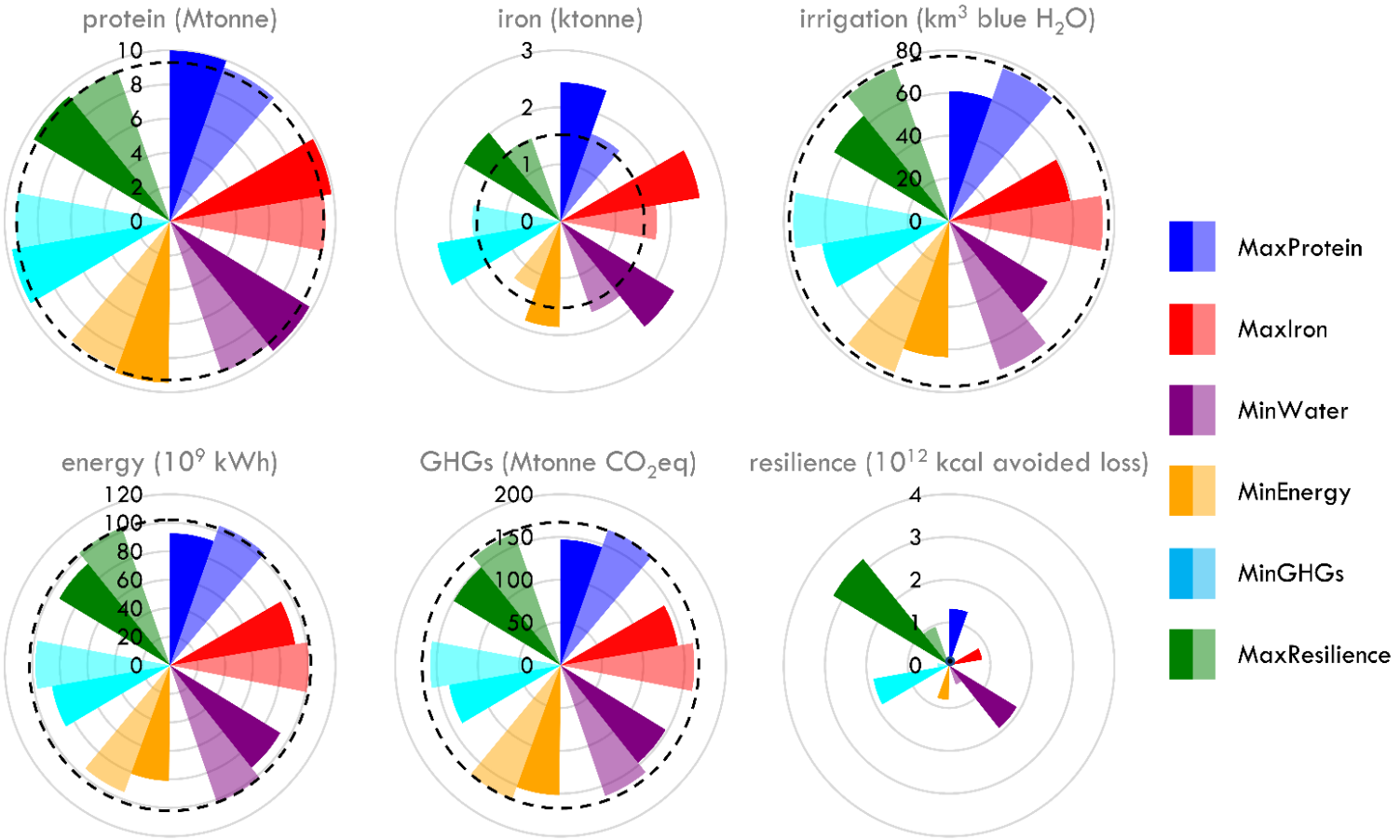
Iron, zinc

Water, irrigation

Energy, GHG

Drought resistance

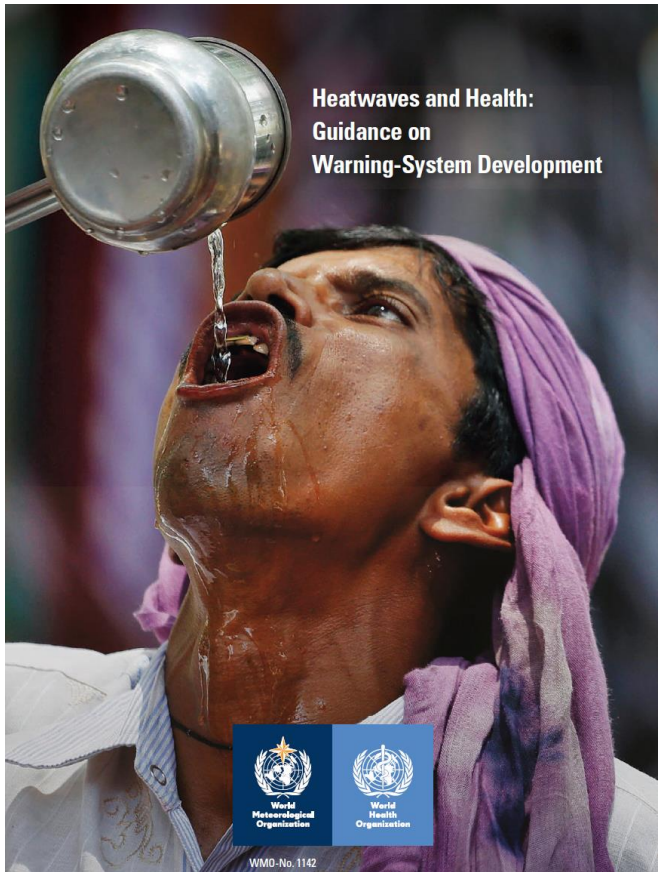
Shifting from rice to coarse grains by ~20% furthers all objectives



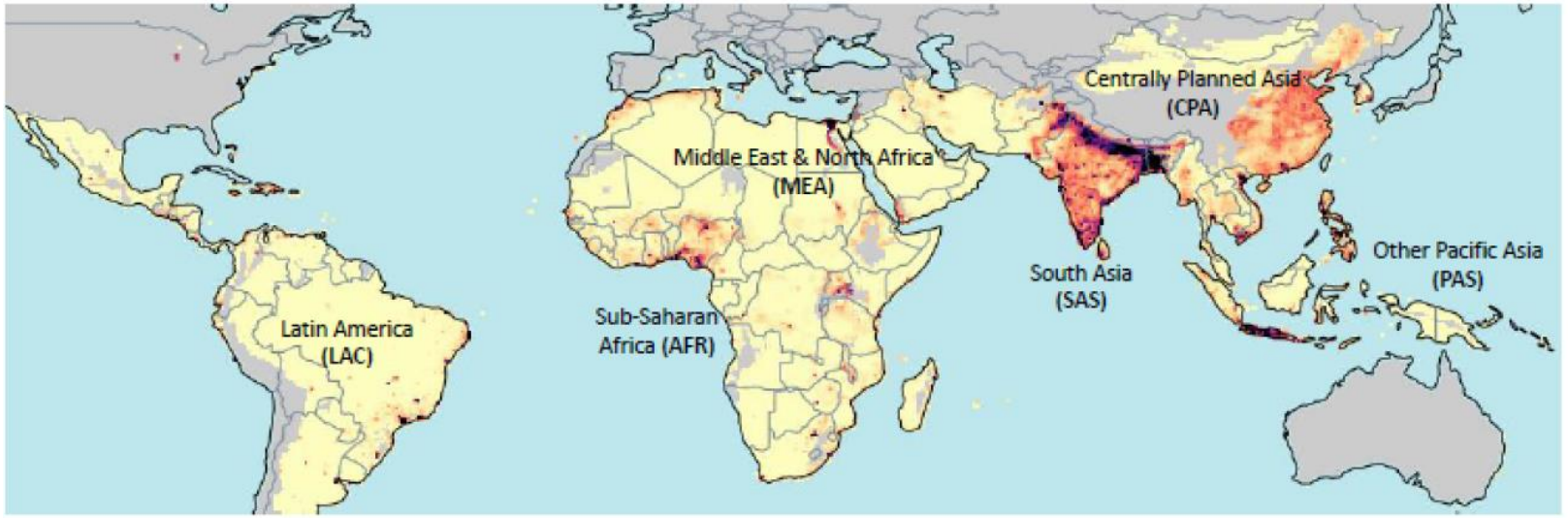
Lightly shaded wedges: Historically constrained land use shifts

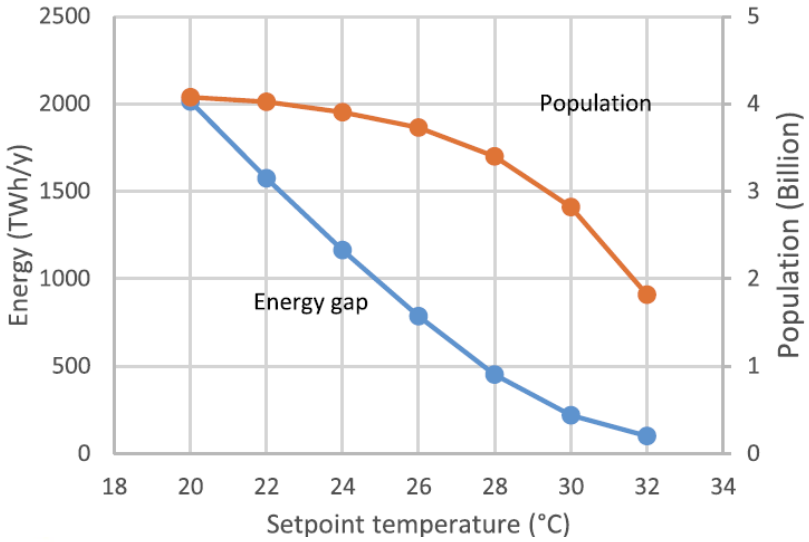
Davis, K., et al., *Proc. Nat. Acad. Sci.*, 2019

Deep Dives – Air Conditioning (AC) and Heat Stress



Roughly 3 billion exposed to heat stress (today)

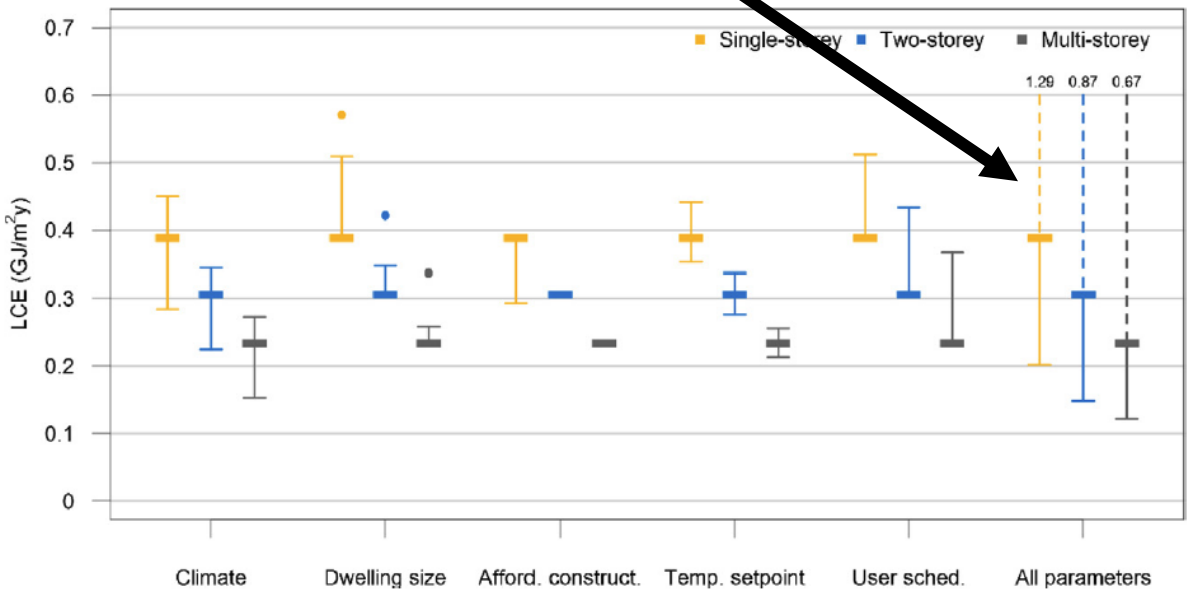




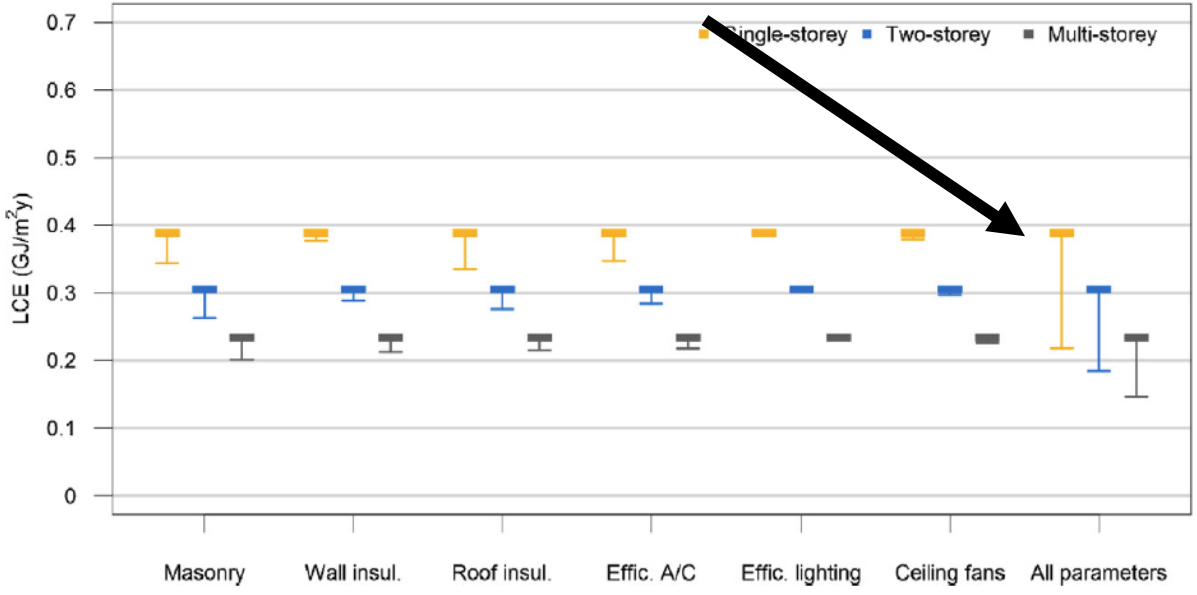
Population without access to AC where needed. Indoor set point temp. 26°C. Adapted from Mastrucci et al, 2019

Air conditioning: Behavior and Context more influential than technology

Behavior/context

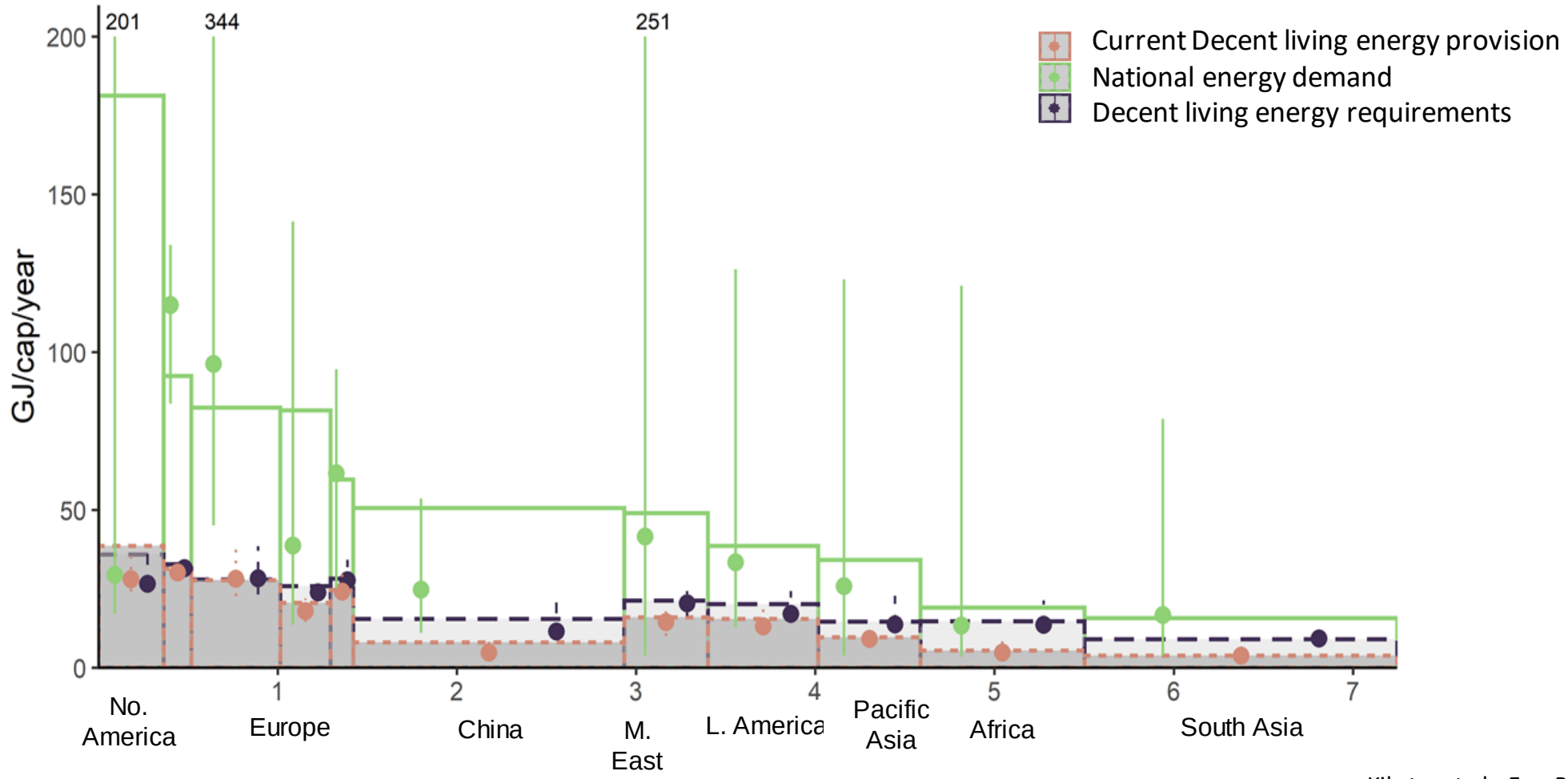


AC efficiency/Bldg Insulation



Mastrucci & Rao, Energy. & Bldgs, 2017

Affluence dominates energy growth.

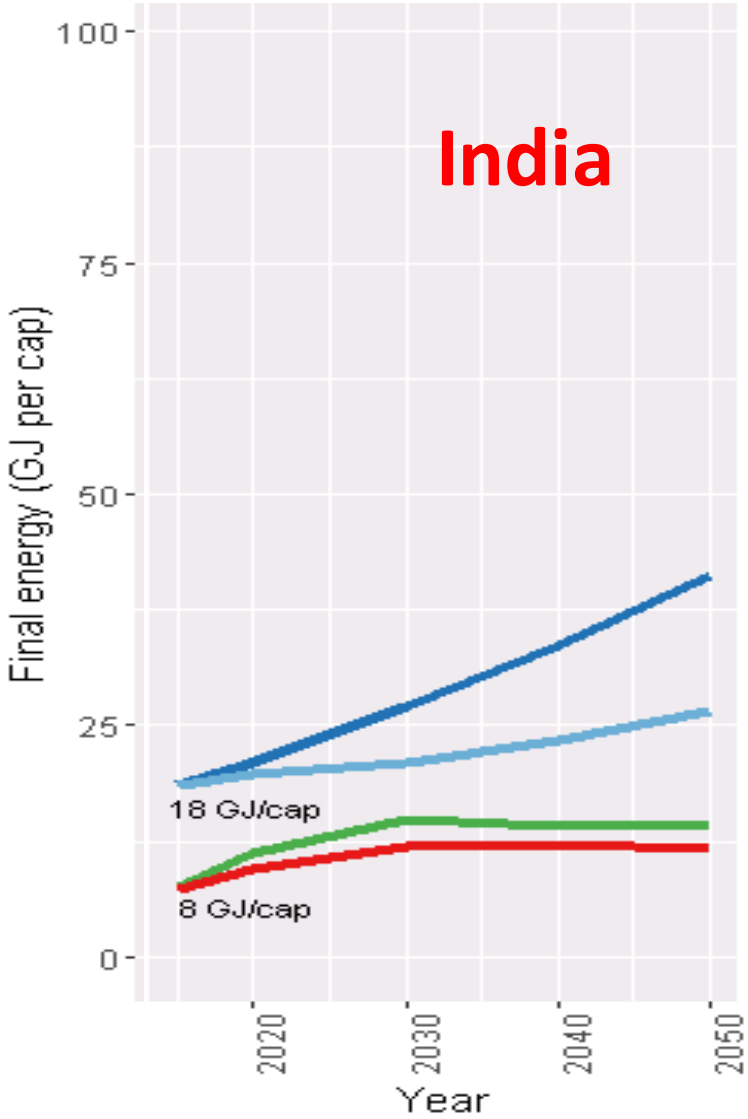


Kikstra et al., *Env. Res. Ltrs, 2021*

Eradicating extreme poverty, energy poverty, and providing decent living standards (FOOTNOTE 21) to all in these regions in the context of achieving sustainable development objectives, in the near-term, can be achieved without significant global emissions growth. (*high confidence*) (Figure SPM.2) {Figure

IPCC AR6 WG3 SPM

How much inequality reduction in future energy growth is feasible?



National energy demand

In a 2°C world

Decent Living Requirement

Maximize co-benefits

Rao, et al., *Nat. Energy,* 2019

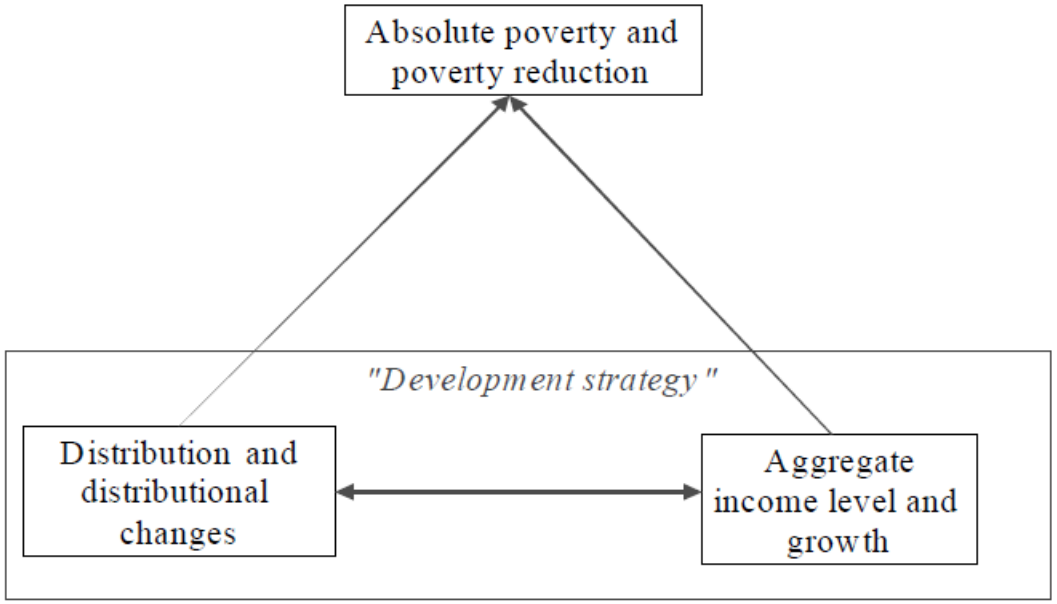
Structural inequality change is SLOW

Gini Index of income: 10-point drop/decade is the most observed in recent history.

Country	Gini@year0	Period	Avg ΔGini/decade (p.p)	# of obs
Serbia	39.3	2004-2013	-12.4	5
Venezuela	50.0	2002-2011	-11.6	10
Niger	44.4	2005-2014	-11.5	4
Bolivia	61.9	2000-2009	-11.5	8
Zambia	51.2	1993-2002	-9.8	4
Ghana	36.0	1988-1997	-9.7	6
El Salvador	51.8	1999-2008	-9.0	9
Slovakia	26.7	2002-2011	-8.8	7
Kyrgyzstan	48.9	1996-2005	-8.2	10
Cote d'Ivoire	45.2	1985-1994	-8.2	5
Kazakhstan	35.4	2001-2010	-7.6	10
Ukraine	35.2	1996-2005	-7.5	5
Iceland	28.6	2006-2015	-7.2	9
Chile	57.3	1999-2008	-7.1	4
Ecuador	55.9	2000-2009	-6.9	8

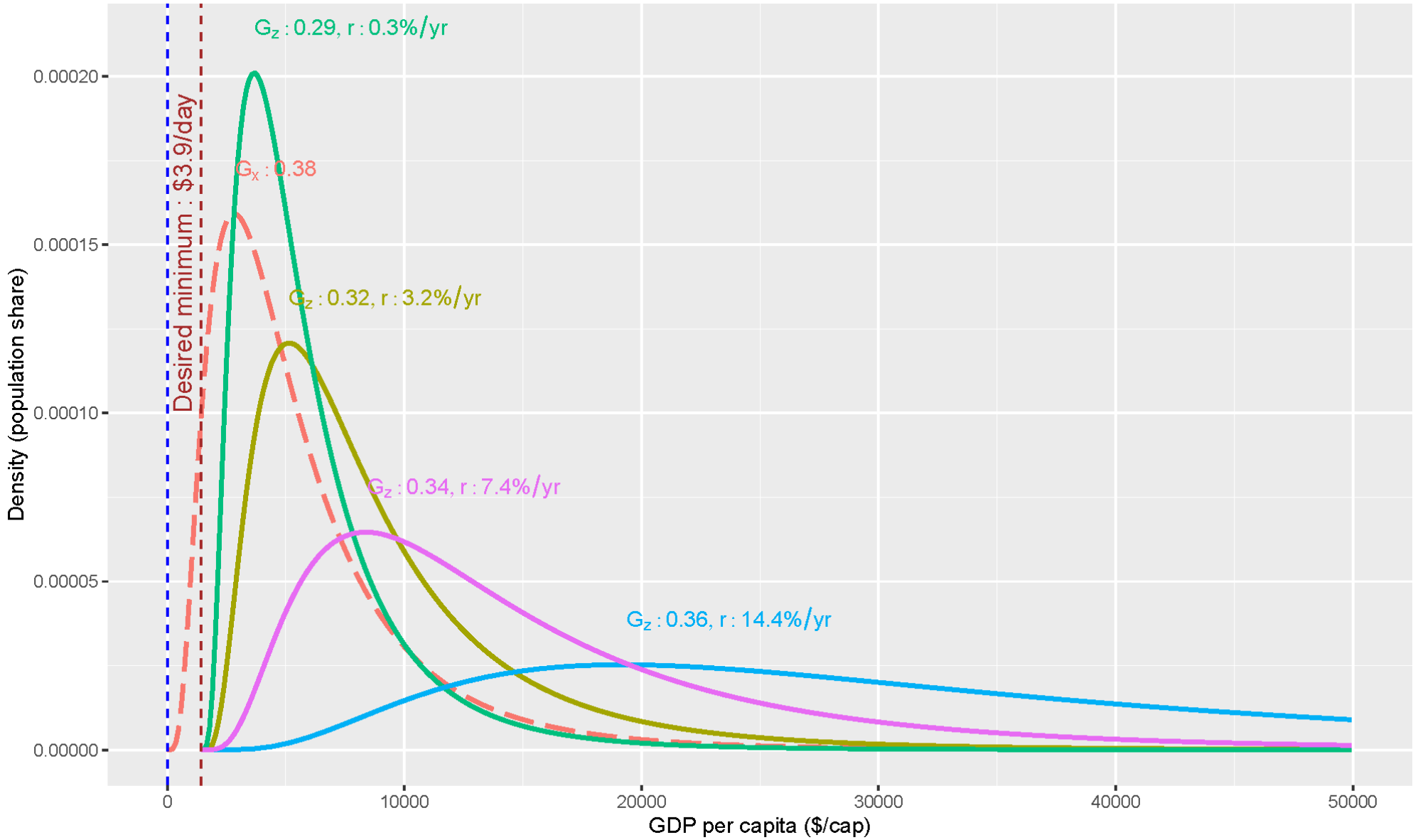
Data : PovcalNet, World Income Inequality Database

Poverty-Growth-Inequality Triangle

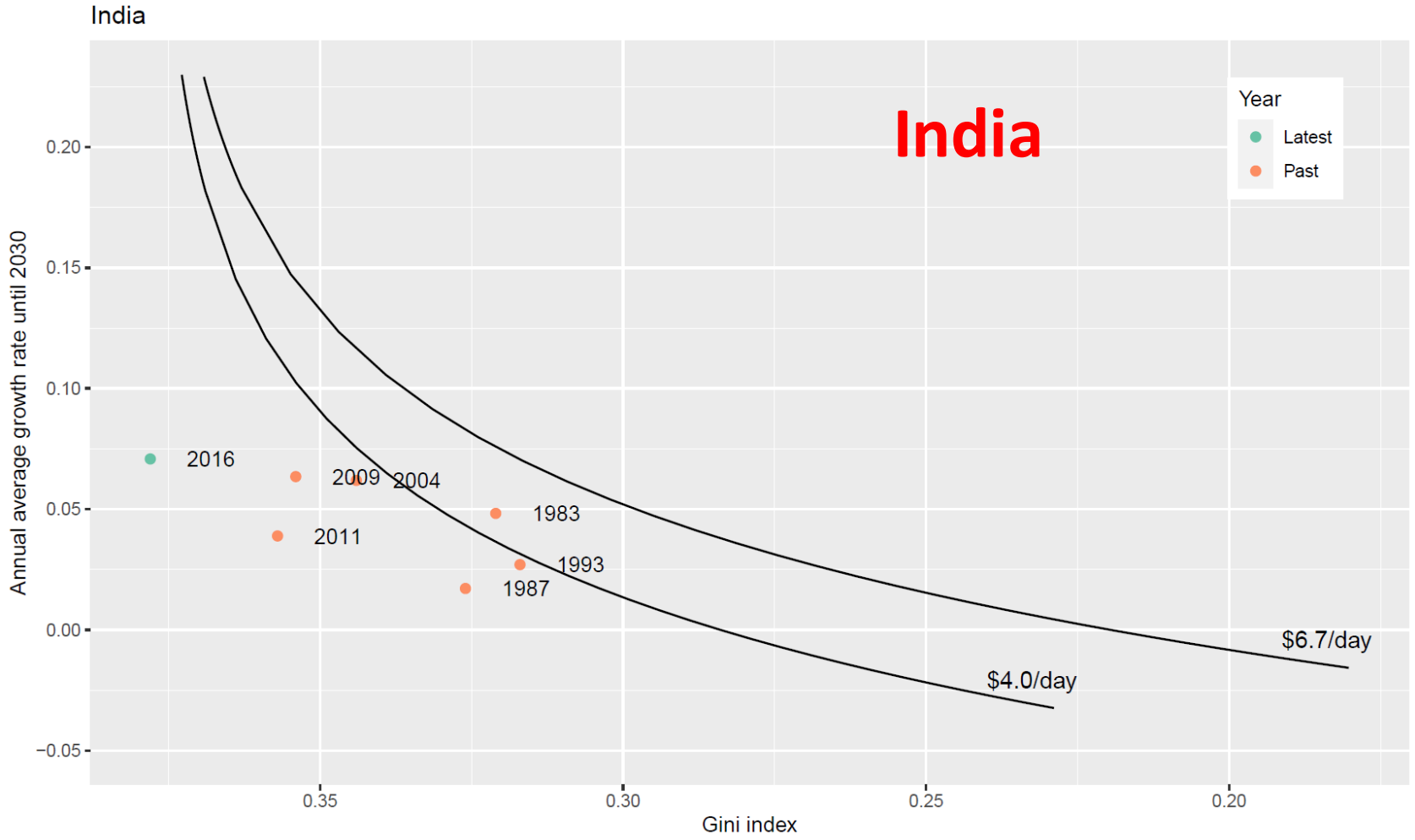


Source: Bourguinon (2004)

- Intellectual exercise
- 'Closed form' solution
- Shift and scale income distribution

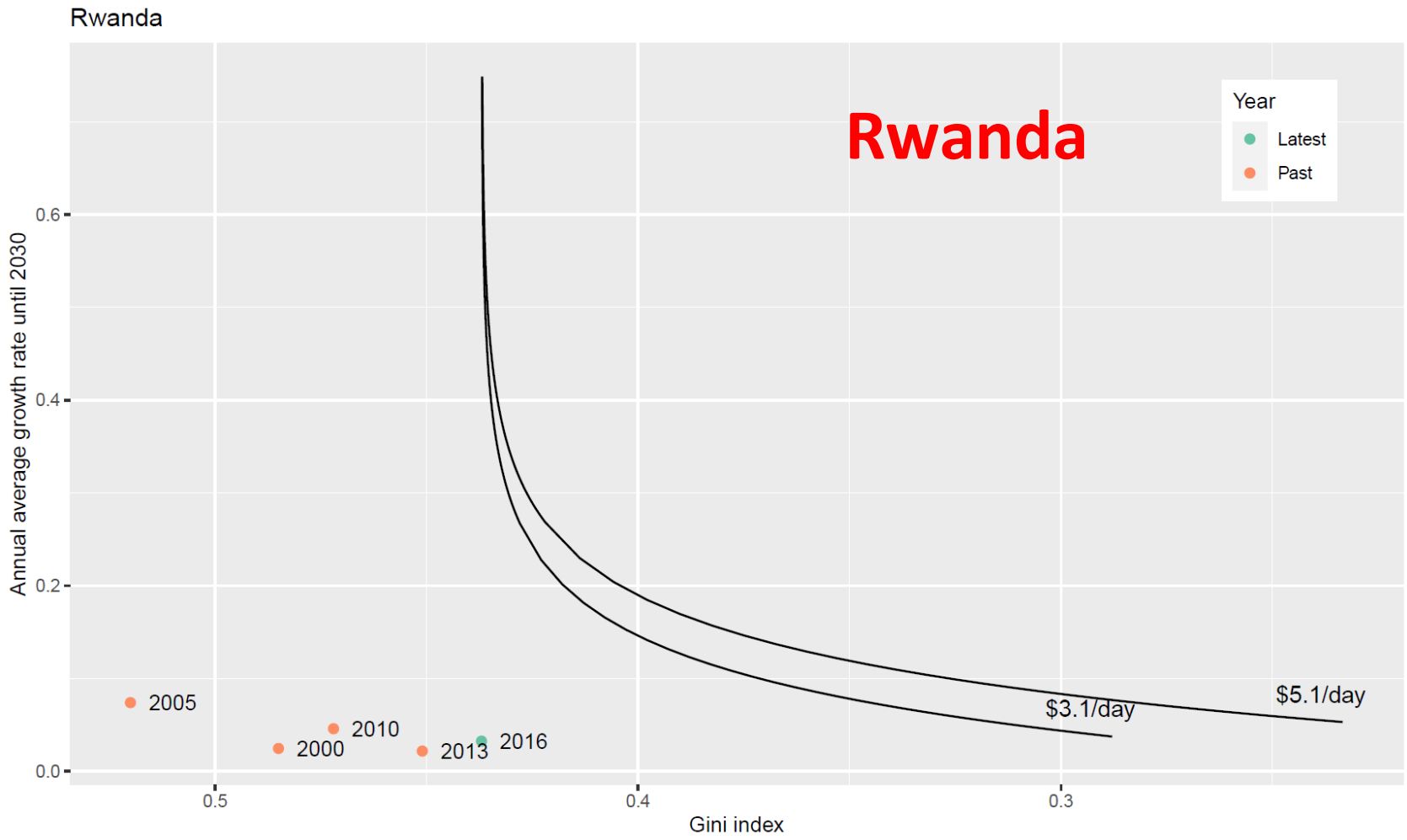

G_z : 0.29, r : 0.3%/yr
G_x : 0.38
G_z : 0.32, r : 3.2%/yr
G_z : 0.34, r : 7.4%/yr
G_z : 0.36, r : 14.4%/yr
Desired minimum : $3.9/day
Density (population share)
0.00020
0.00015
0.00010
0.00005
0.00000
0
10000
20000
30000
40000
50000
GDP per capita ($/cap)

Growth-Inequality Frontier (No poverty by 2030)



Interpretation: India needs to keep current (2016) 7%/year GDP growth for the next 10 years while reducing Gini from 38% to 34% during the same period to completely eradicate poverty at $1.9.0/day level. At 2019 level of growth (4.2%), It needs to get to 32% Gini.

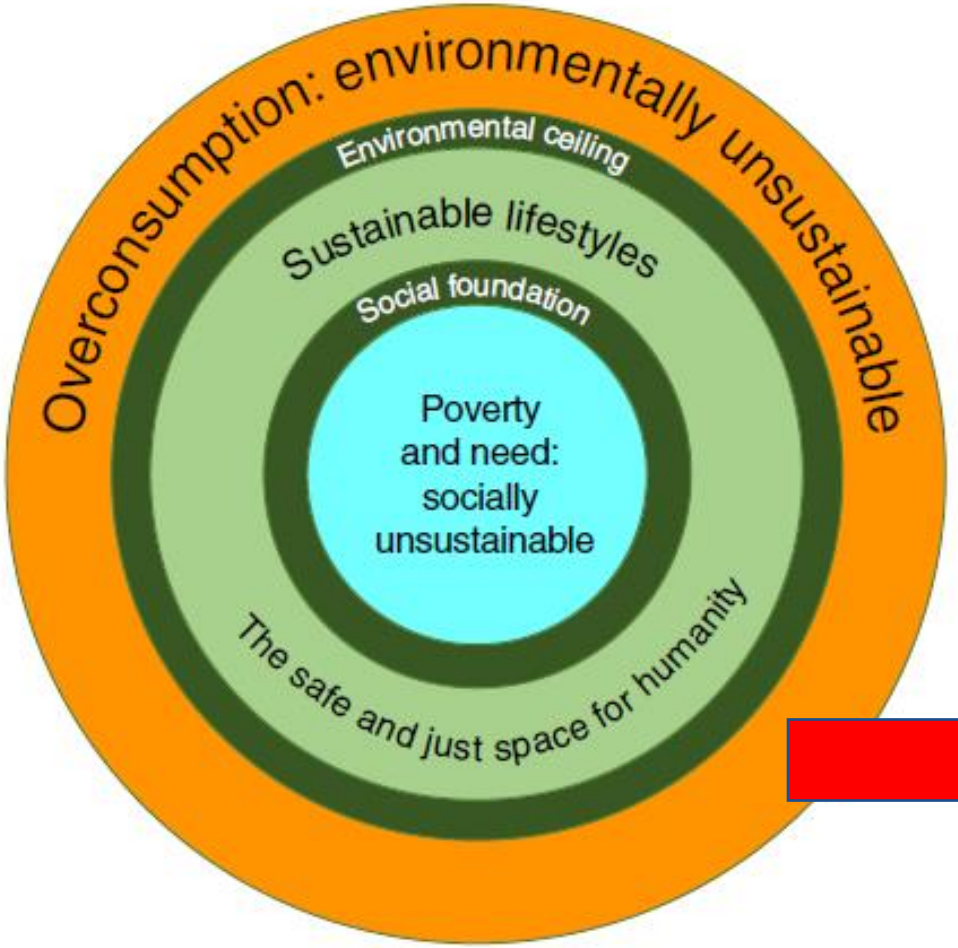
Growth-Inequality Frontier (No poverty by 2030)



Application to ‘Decent living energy’

- More expansive than the $1.90/day threshold
- Requires projection of technology-driven ‘decoupling’
- Energy ‘redistribution’ entails targeted social policies

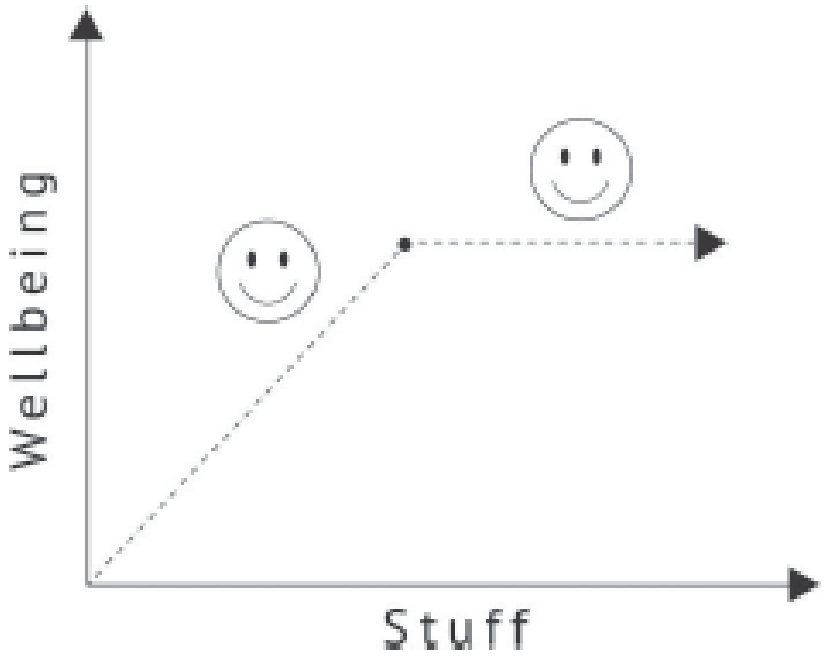
Addressing 'sufficiency' through the lens of wellbeing



Consumption → Wellbeing?

Wiedman et al., *Nat. Comm.*, 2020

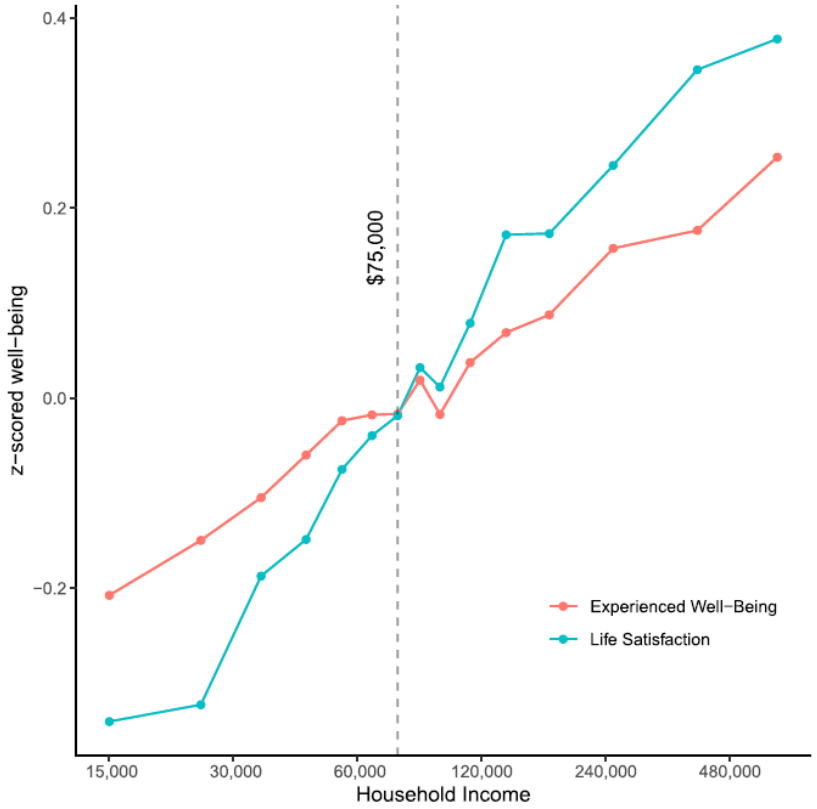
Saturation of wellbeing?



Credit: Fuchs et al., *Consumption Corridors*, 2021

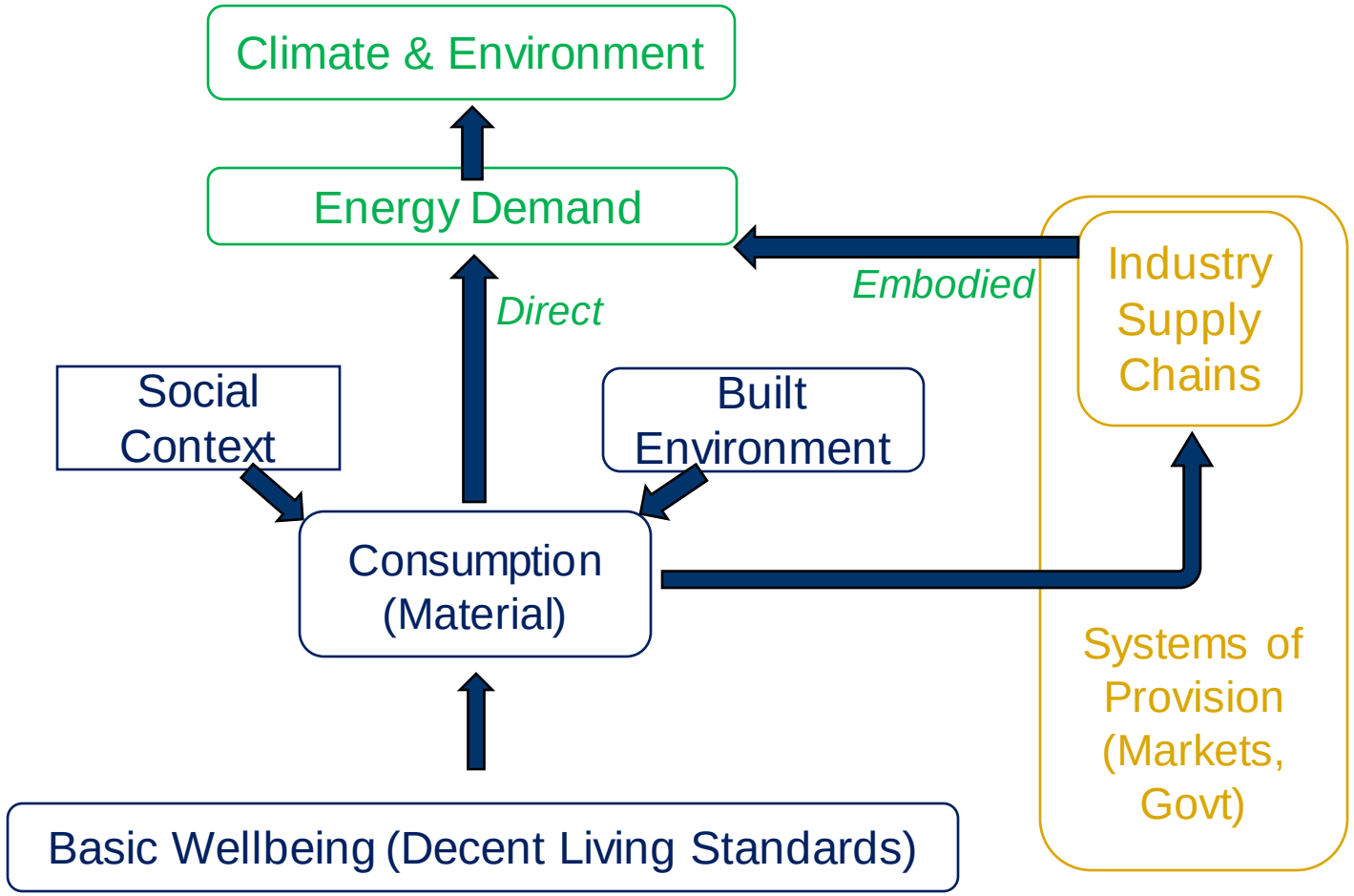
OR

More is (always) better?



Killingsworth, *Proc. Nat. Acad Sci*, 2021

Extending the Energy-Wellbeing linkage beyond poverty



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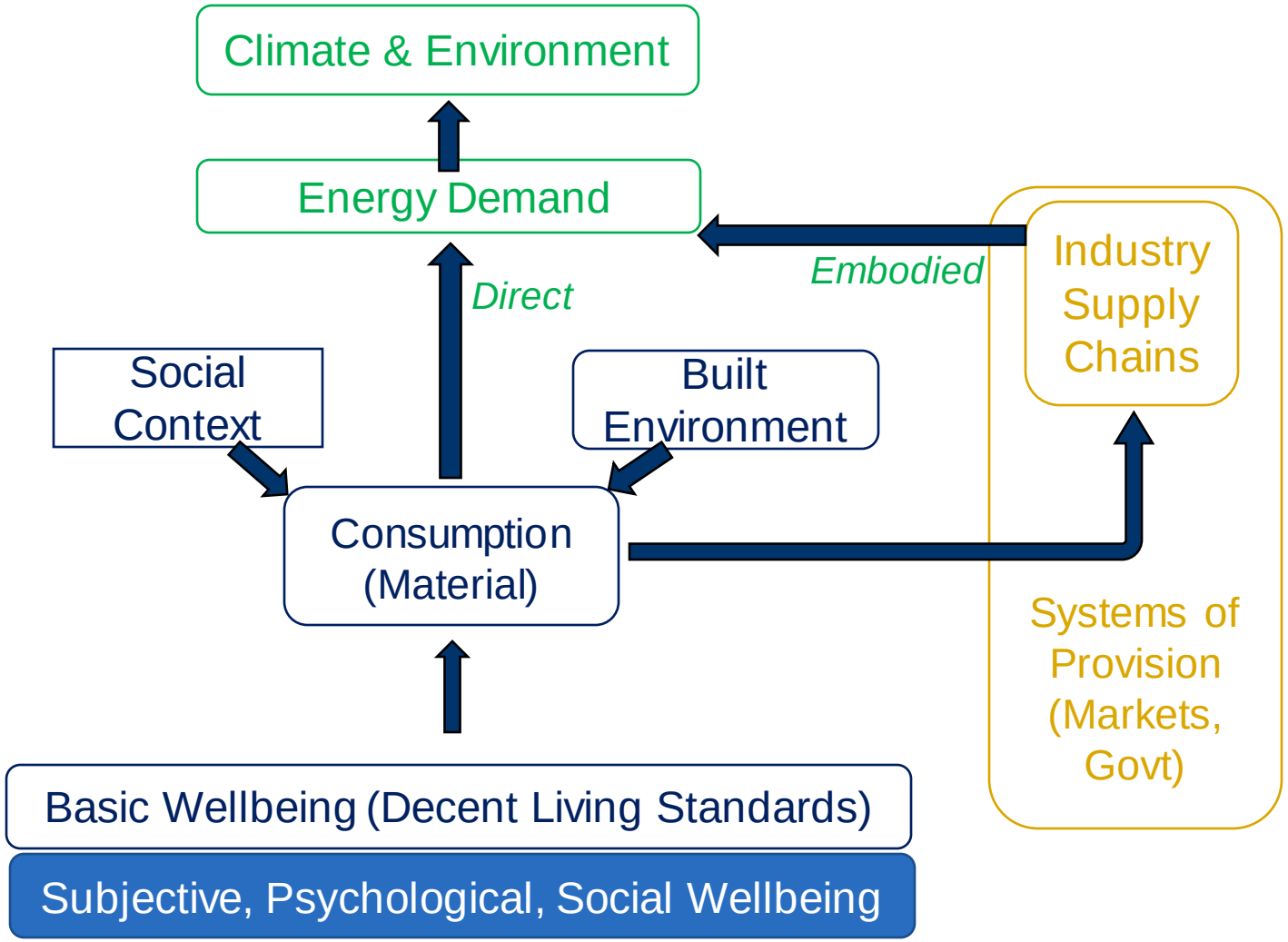
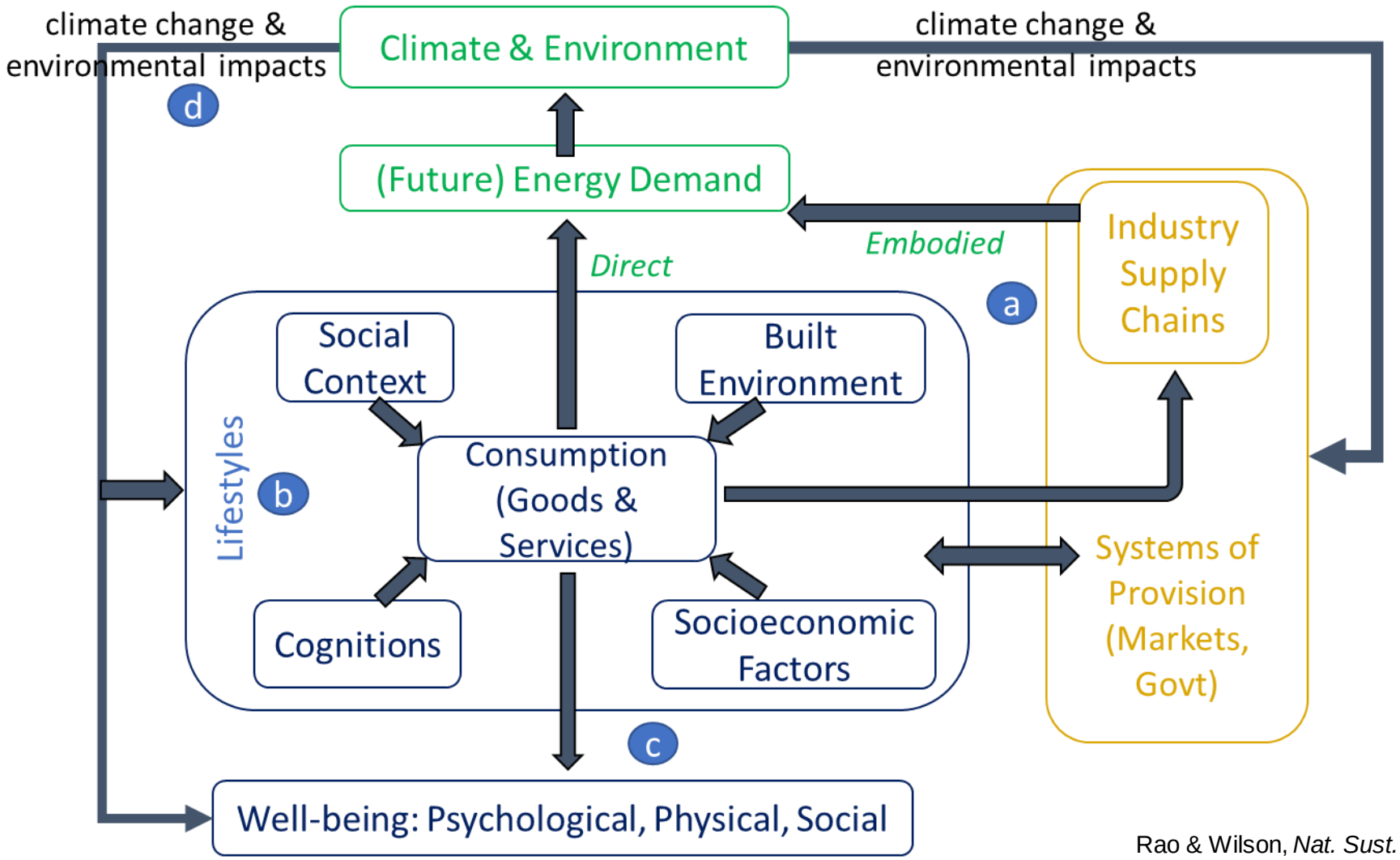


An integrative research agenda



Rao & Wilson, *Nat. Sust.*, 2021

Building bridges across research communities

Social sciences

Global Scenarios and models

Normative analysis

Wellbeing studies

Takeaways

- Poverty eradication, in its most expansive form, is not driving climate change — affluence is.

- Yet, there is scope for more climate-friendly development choices, such as public transport, sustainable housing, diversified diets

- An integrative research framework linking energy use to wellbeing through consumption can deepen our understanding of ‘overconsumption’