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science for global insight

Strategies for achieving carbon neutrality by mid-century and their multiple co-benefits

SDGs:
Prosperity
Social Inclusion
Sustainability

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TWI2050
The World in 2050
www.twi2050.org

ALPS International Symposium: Long-term climate strategy toward carbon neutrality, Tokyo, Japan – 13 February 2020

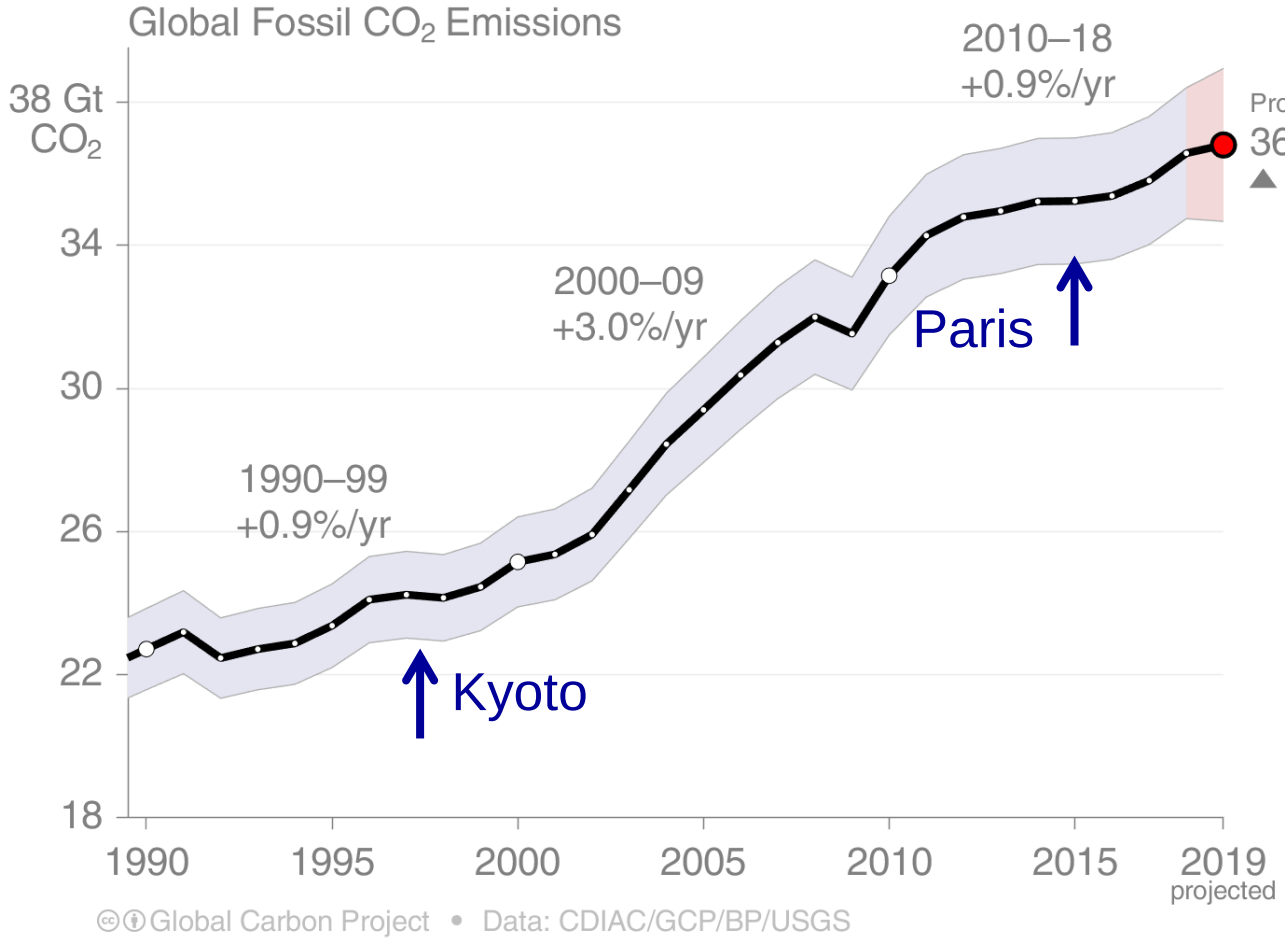
The World is at "Crossroads"

Explosive development transgressing planetary boundaries but many left behind

- Global economy increased 100 fold, energy 50 times and CO_2 30 times
- Temperature increase over 1^{o}C, about 8 million die due to indoor and regional air pollution
- Achievement of Paris Agreement would bring multiple co-benefits for people and the planet

Global Fossil CO_2 Emissions

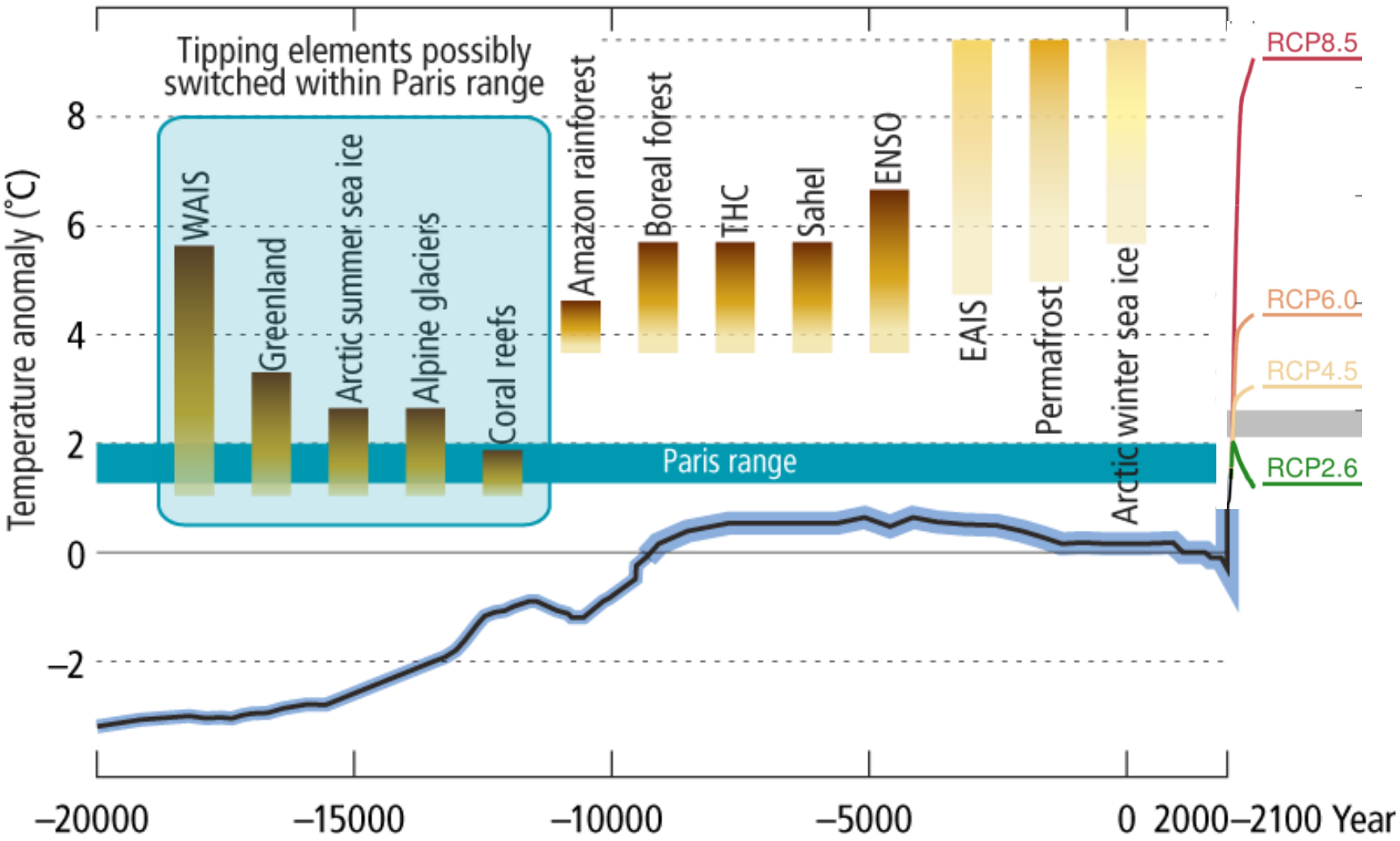
Global fossil CO_2 emissions: 36.6 ± 2 $GtCO_2$ in 2018, 61% over 1990
Projection for 2019: 36.8 ± 2 $GtCO_2$, 0.6% higher than 2018 (range -0.2% to 1.5%)
Fossil CO_2 emissions will likely be more than 4% higher in 2019 than the year of the Paris Agreement in 2015



Uncertainty is ±5% for one standard deviation (IPCC "likely" range)

The 2019 projection is based on preliminary data and modelling.
Source: CDIAC; Friedlingstein et al 2019; Global Carbon Budget 2019

Holocene, Paris &Tipping Elements



Greenhouse gas emissions pathways

SDGs:
Prosperity
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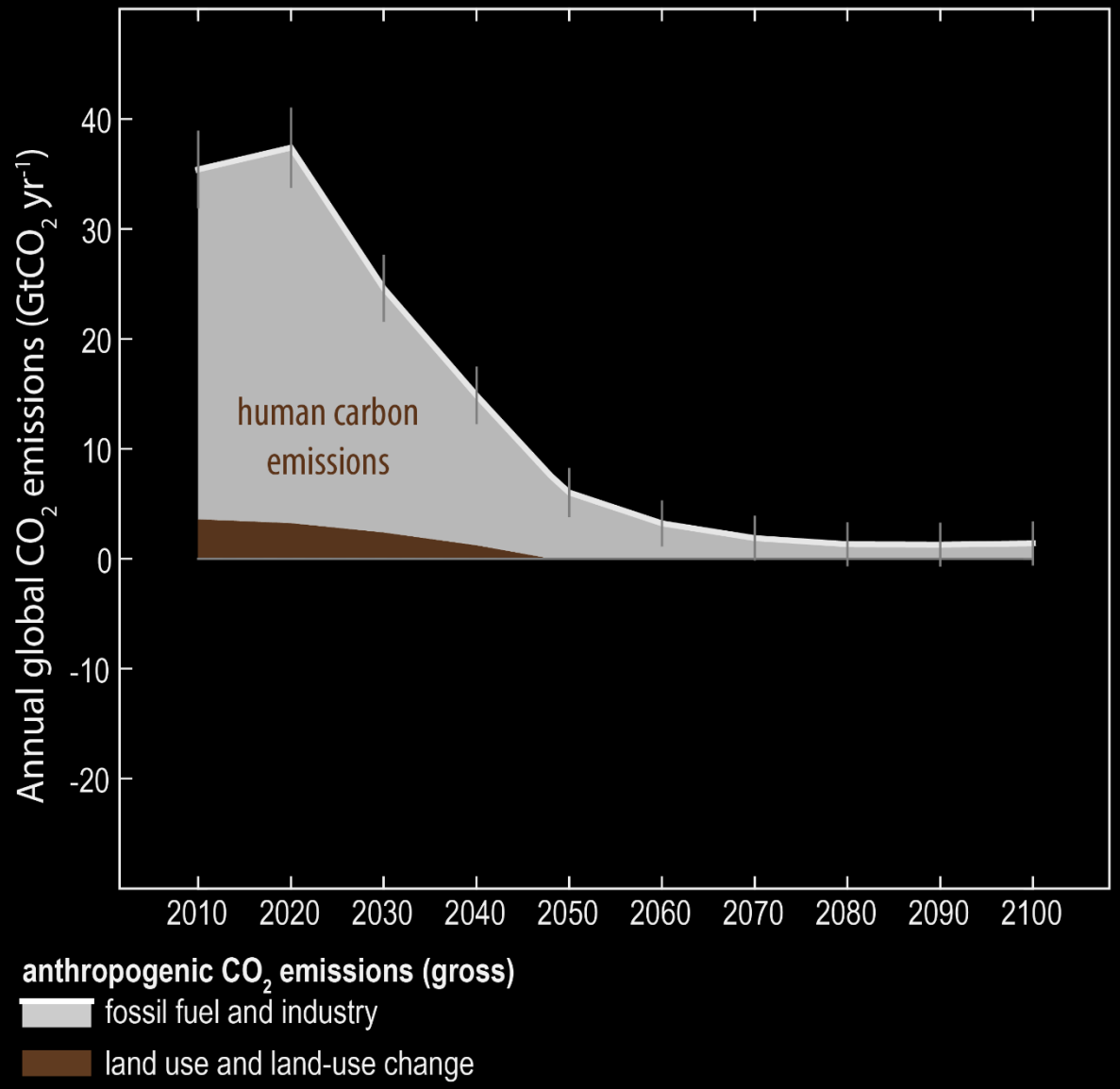
- To limit warming to 1.5°C, CO_2 emissions fall by about 45% by 2030 (from 2010 levels)
- To limit warming to 1.5°C, CO2 emissions would need to reach 'net zero' around 2050
- Reducing non-CO2 emissions would have direct and immediate health benefits

“Carbon Law”



Rockström, Gaffney, Rogelj, Meinshausen, Nakicenovic, Schellnhuber. *Science* 24 March 2017

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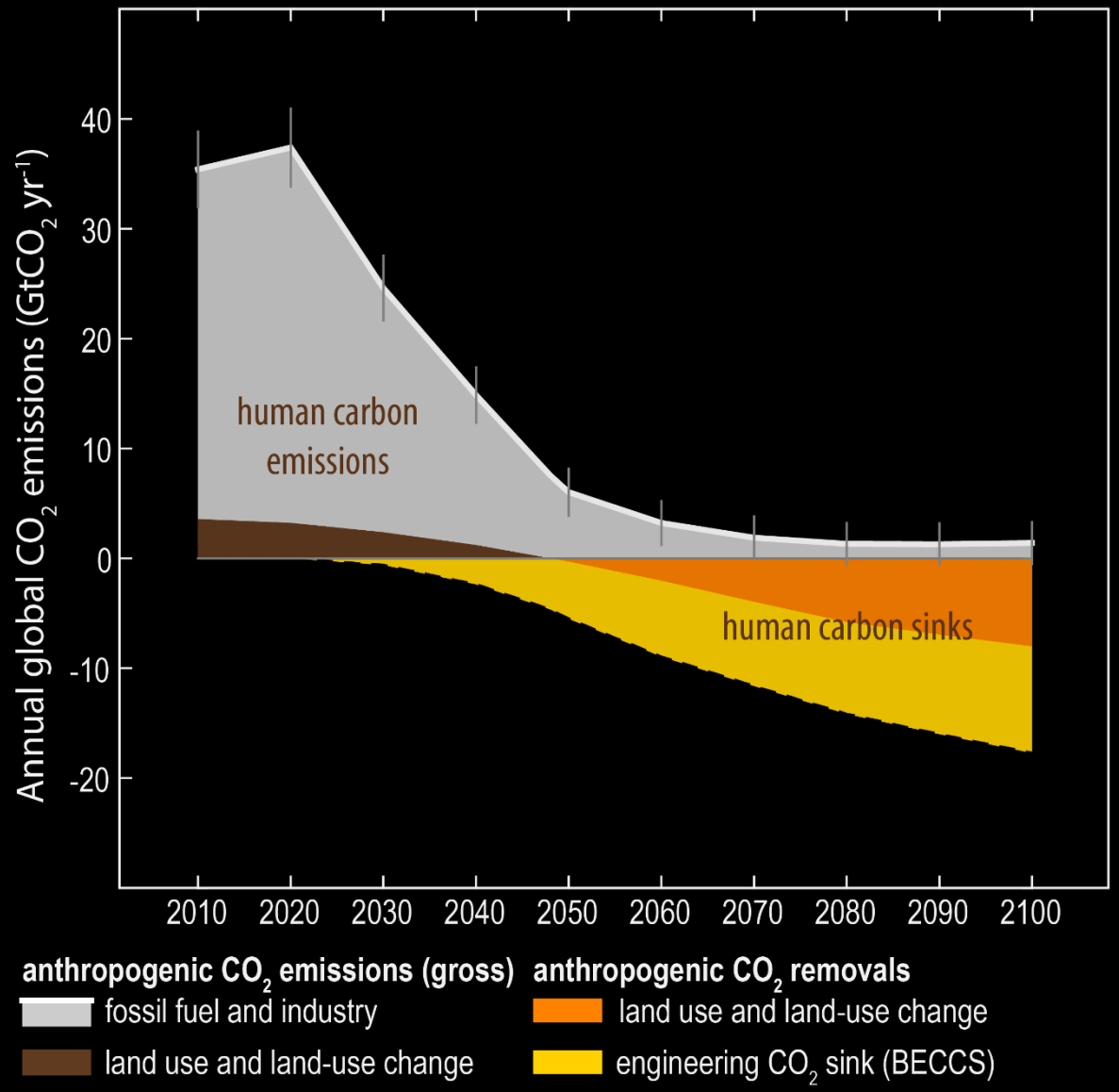

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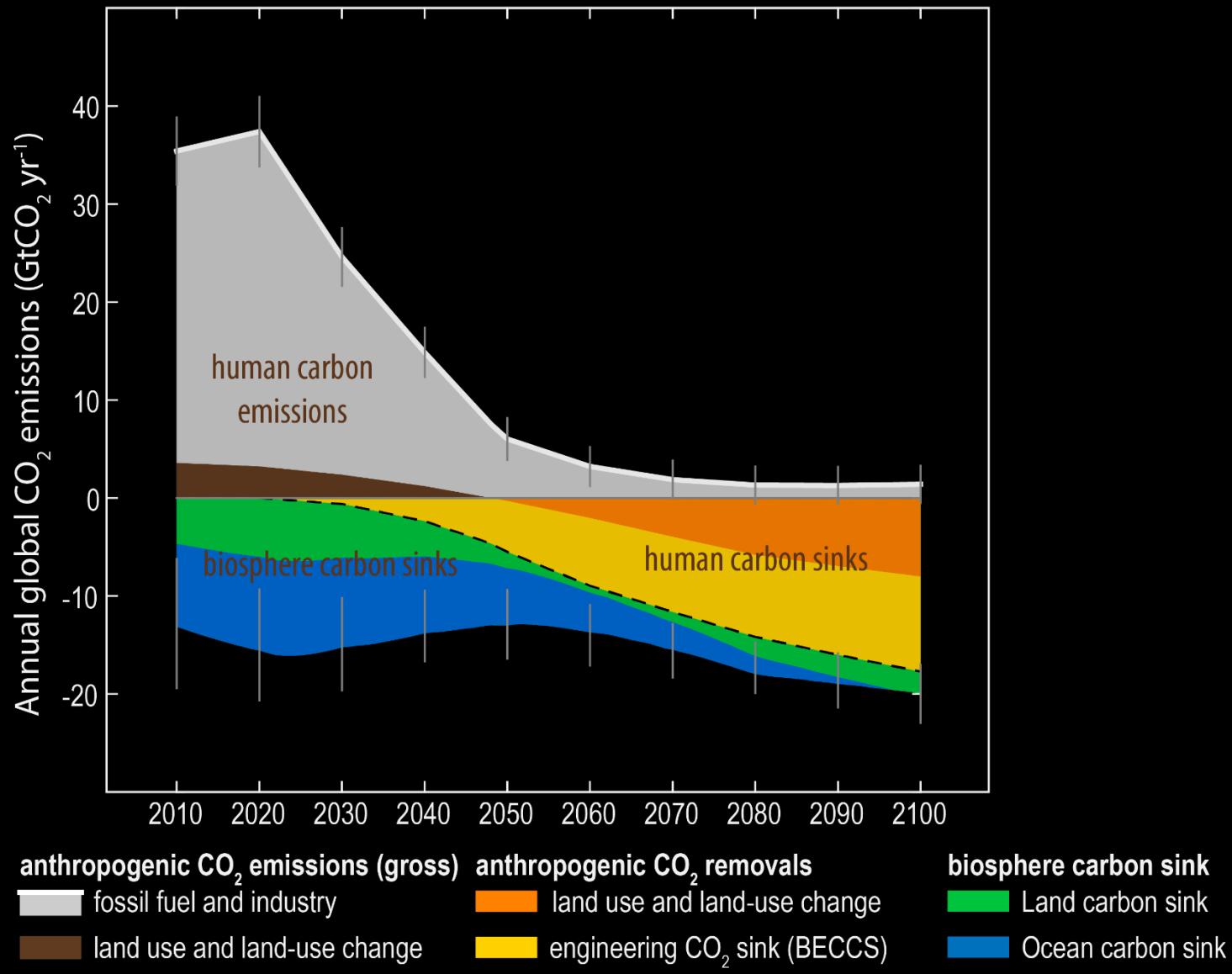

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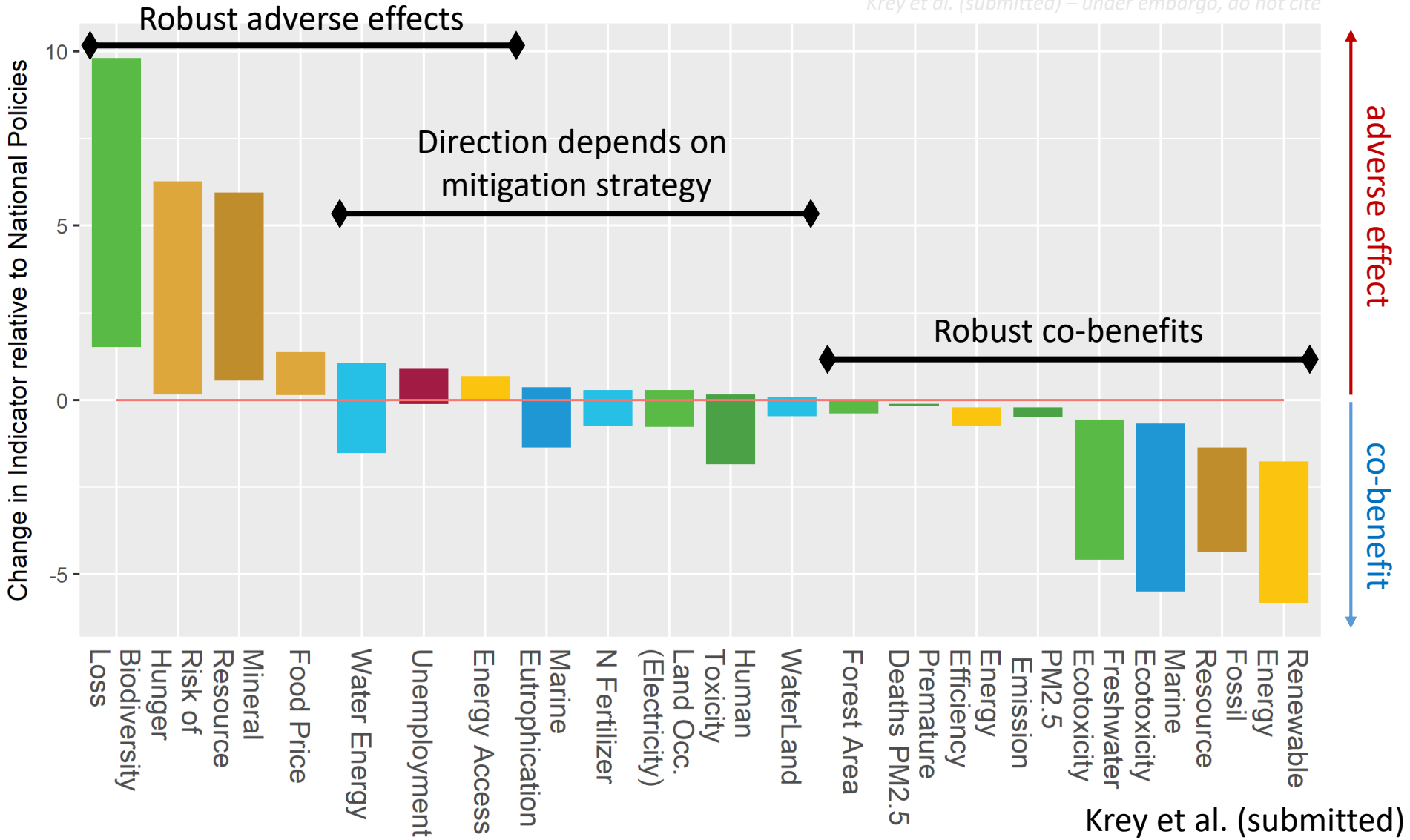
Climate Policy Impact on SDG
of stabilization at 1.5°C by 2050



Krey et al. (submitted)

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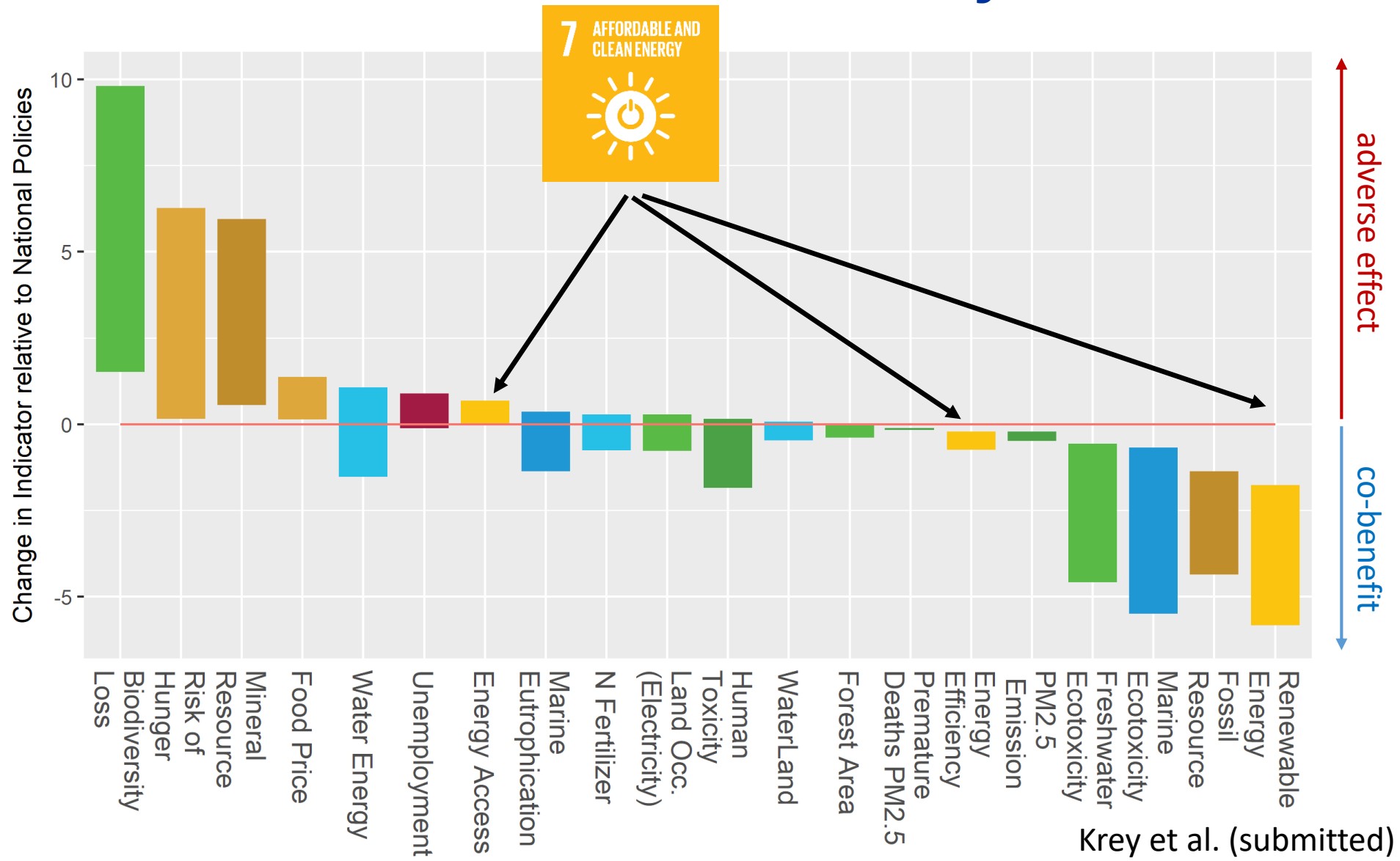

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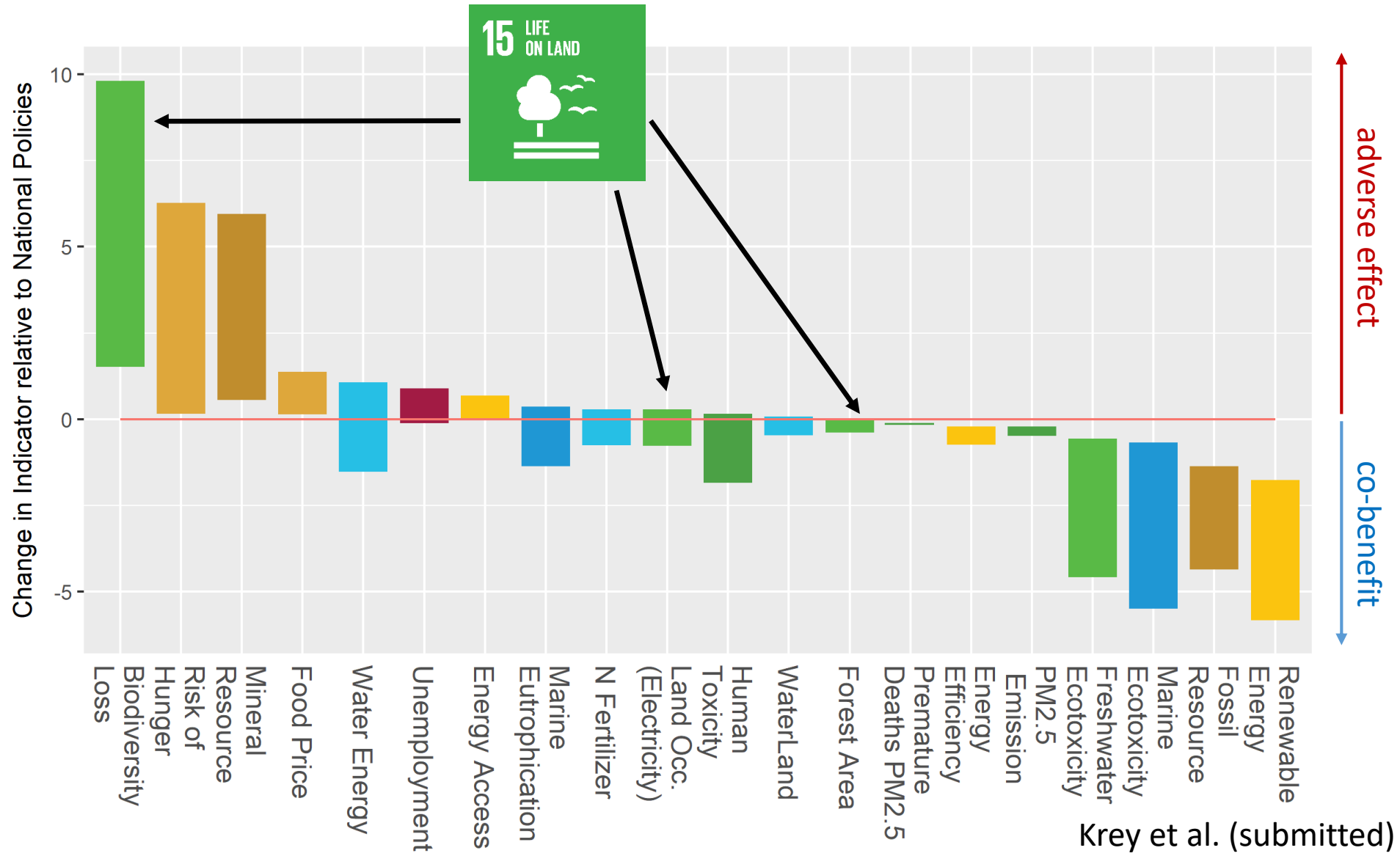

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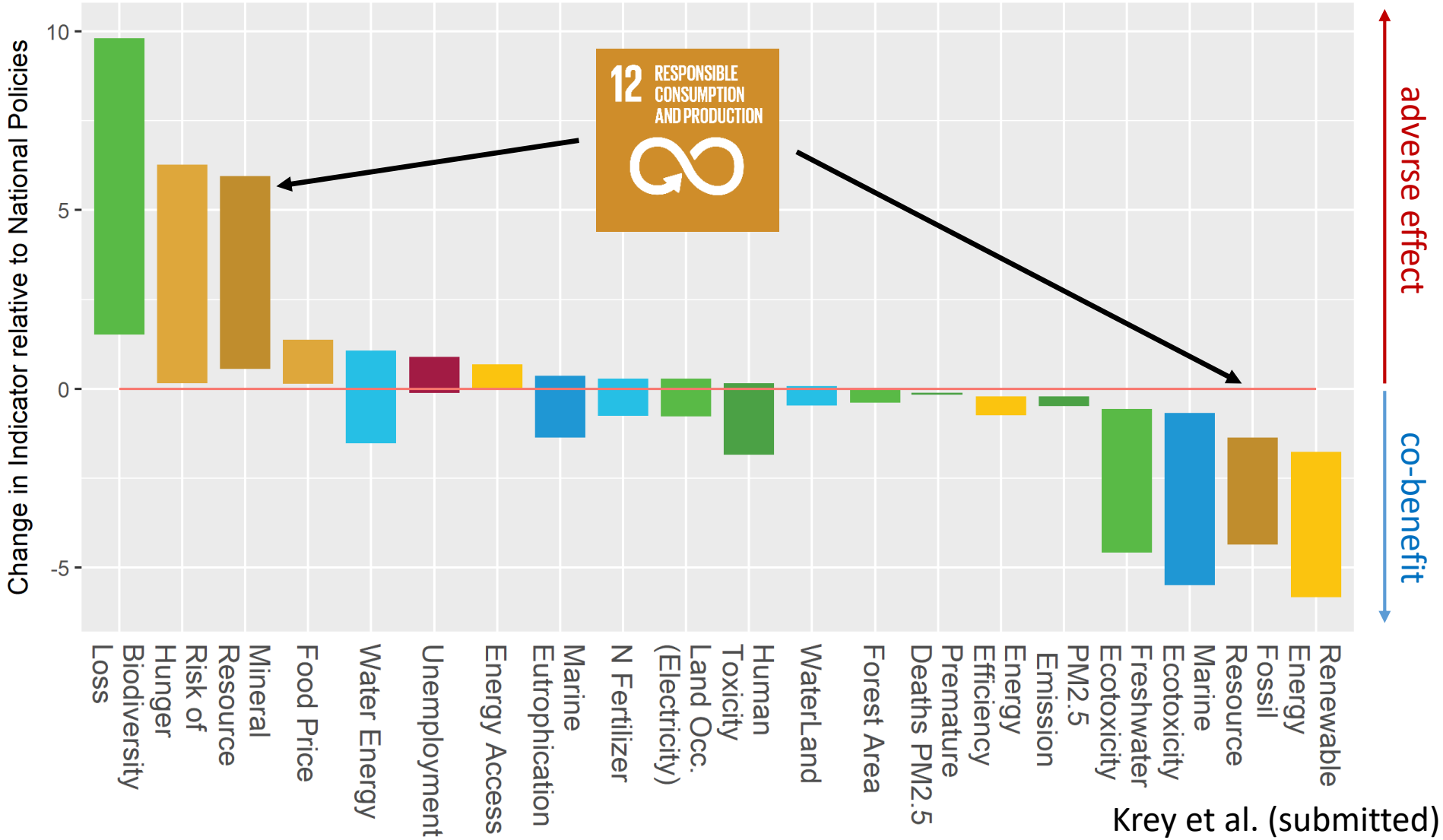


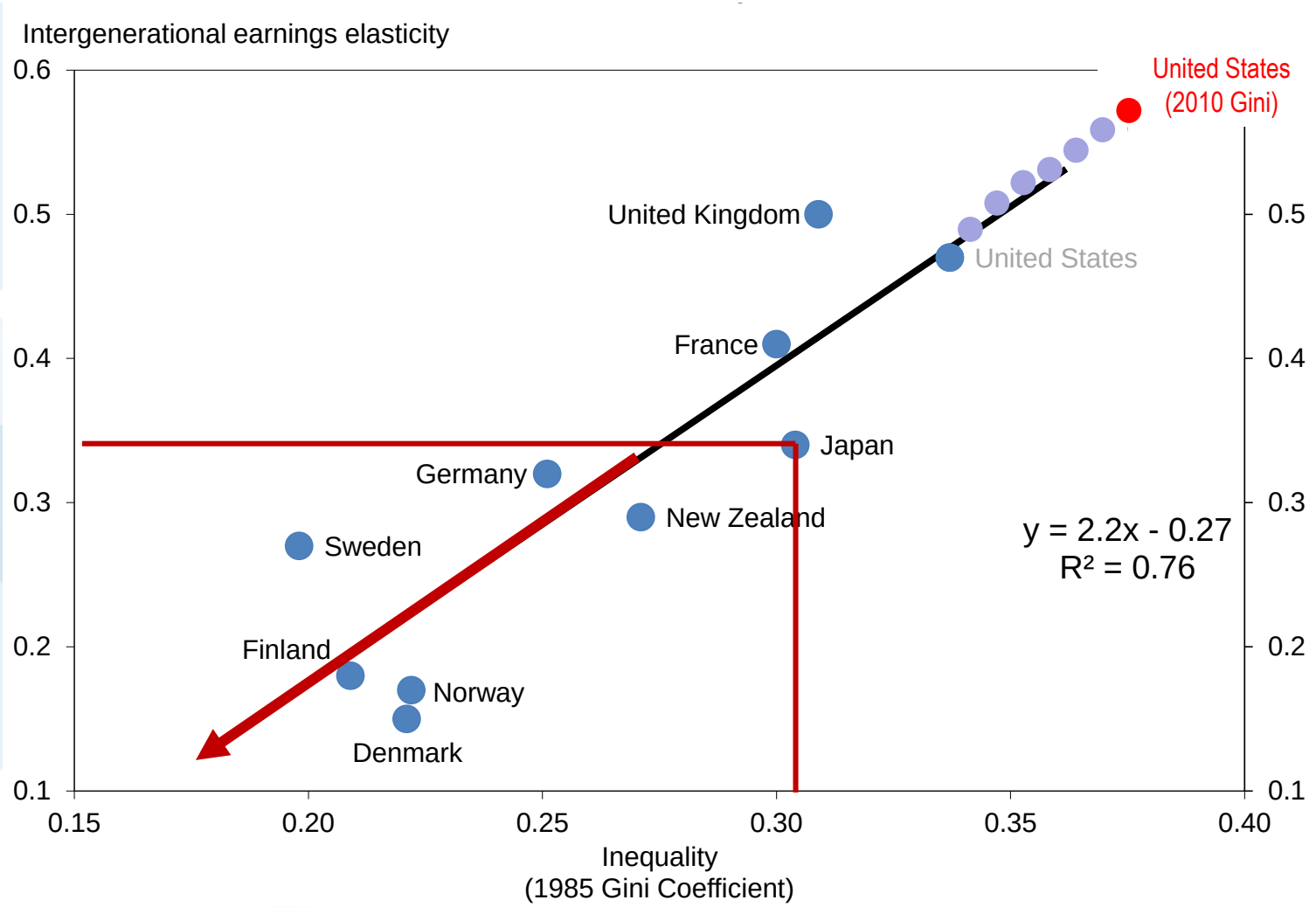
Krey et al. (submitted)

Students studying under street lights

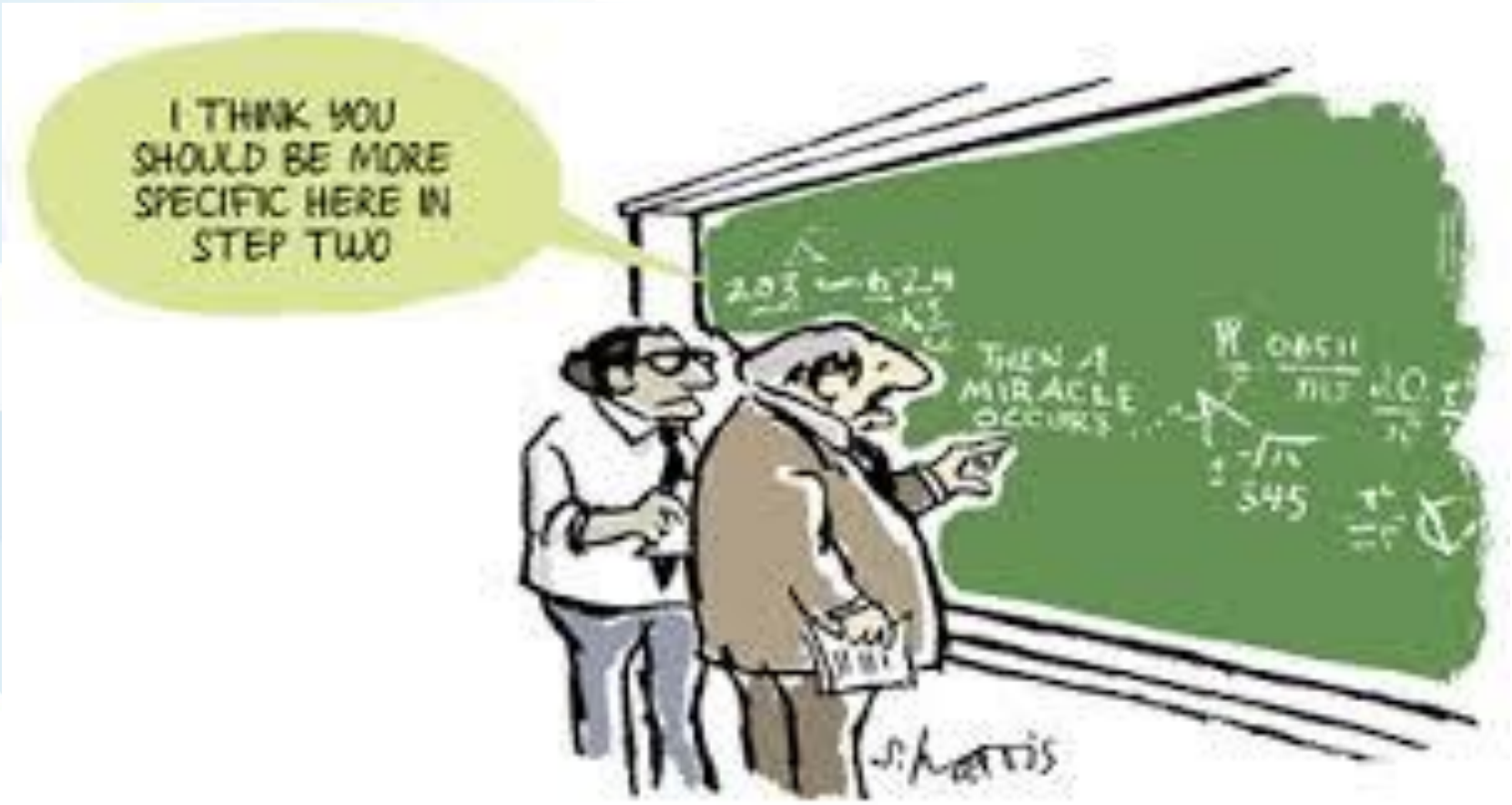
The Great Gatsby Curve

Higher income inequality associated with lower intergenerational mobility

Veća prihodna nejednakost povezana s nižom međugeneracijskom mobilnošću



Than a Miracle Occurs



Grand Transformation

Interplay and the SDGs

- **Fundamentally, there are two agendas embedded in the SDGs**
  - We can call them (i) the human security agenda and (ii) the planetary boundaries agenda
- **The challenge is to make these agendas synergistic rather than competitive**
  - Consider the case of Africa and the issues of demographic trends and food security under the impacts of climate change

GSD

Oran Young, Program on Governance for Sustainable Development
Bren School, UCSB http://www.gsdprogram.org

UN DESA and UNFCCC conference on synergies between the SDGs and the Paris Agreement – 1-3 April 2019 Copenhagen.

Six Major Transformations (TWI2050.org)

Digital Revolution

Human capacity Demography & Health

Smart Cities & Mobility

SDGs:
Prosperity
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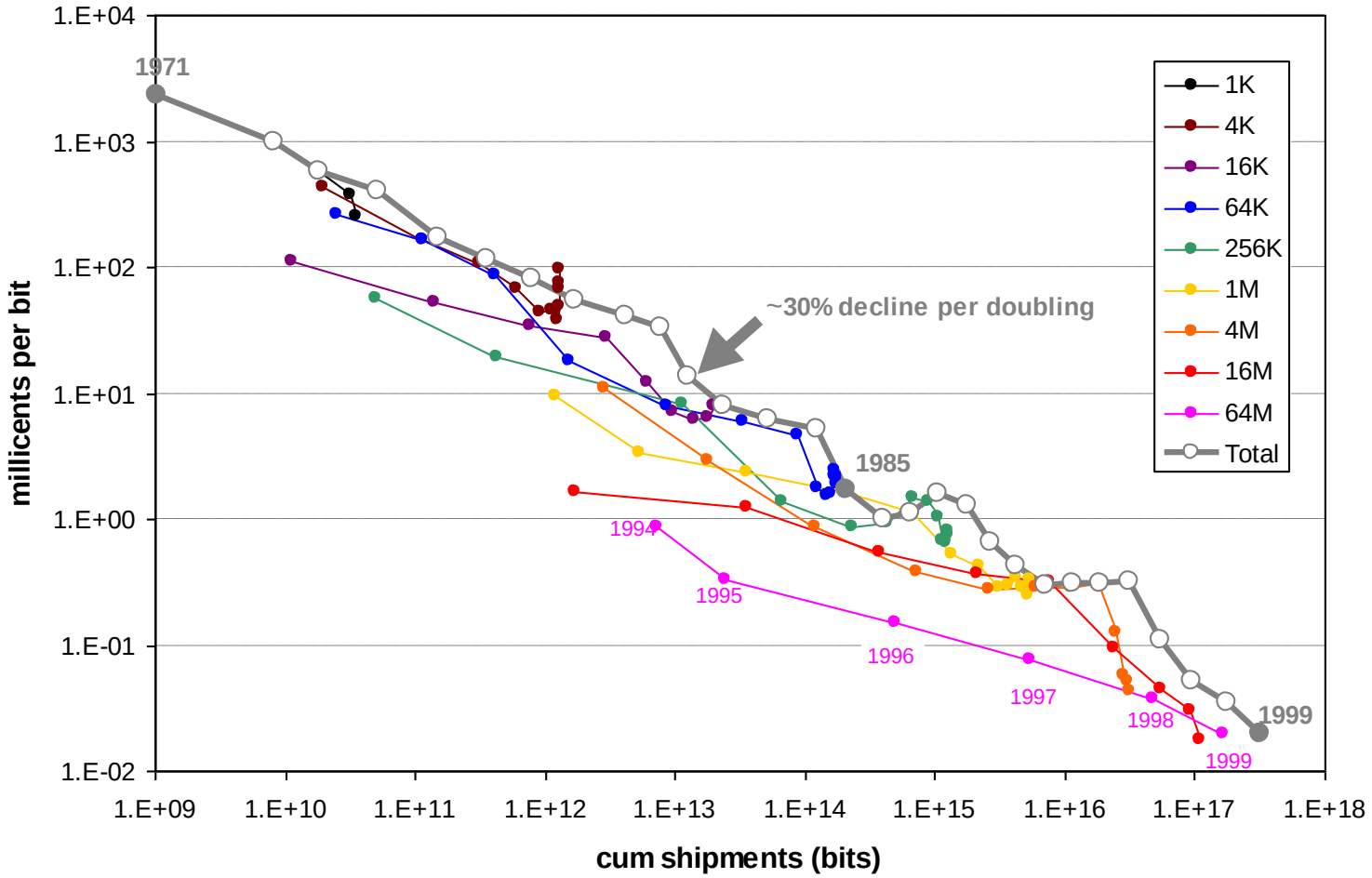
Consumption & Production

Food, Biosphere & Water

Decarbonization & Energy

Moore's Law – DRAMS Prices per Bit



lumpy
large unit size
high unit cost
indivisible

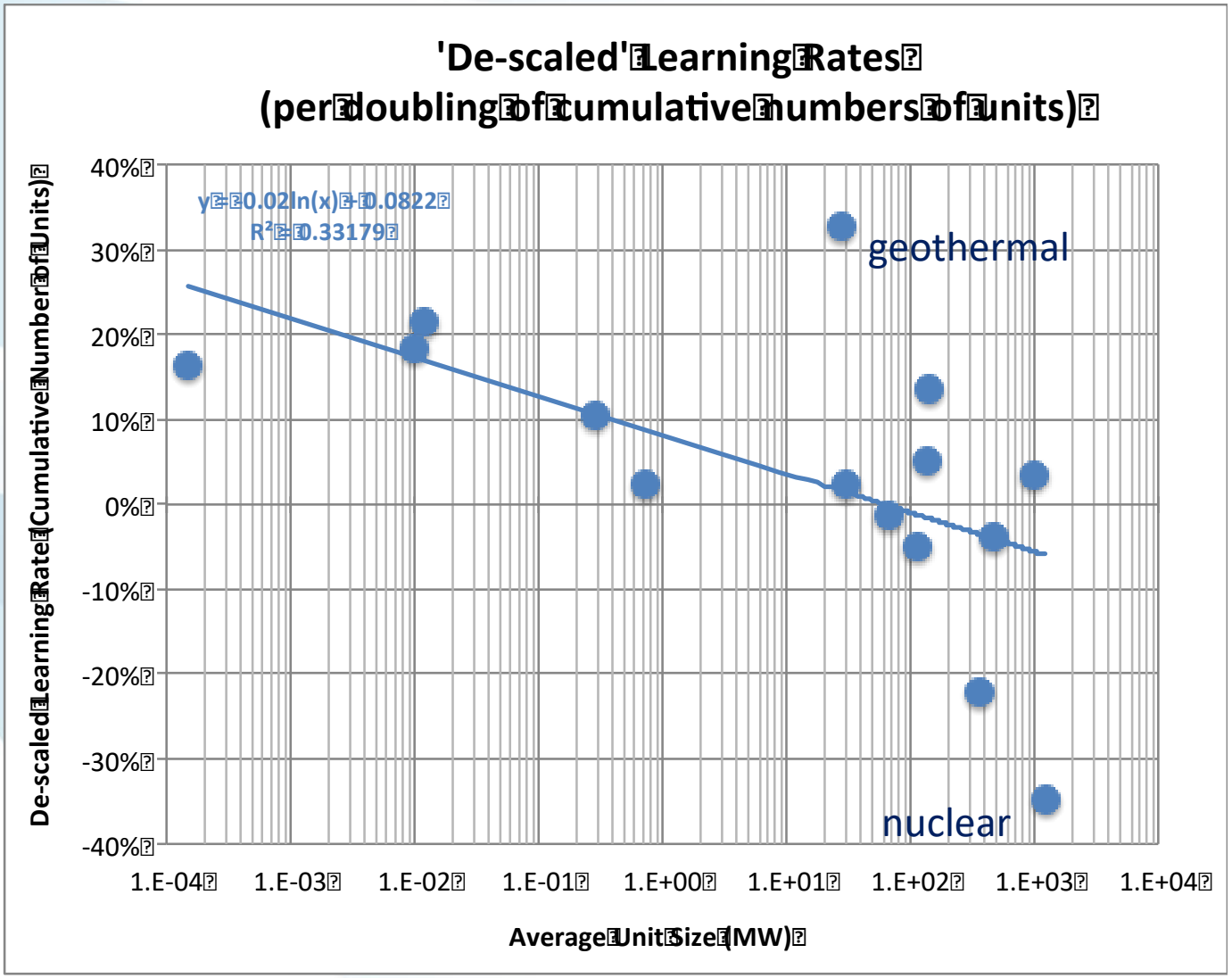
Granularity:
Technology
Unit
Scales

granular
small unit size
low unit cost
modular

Pictures: Courtesy of Charlie Wilson

Granularity Benefits

Higher Learning with Smaller Unit Scale After Accounting for Economies of Scale



smaller units

-> more units

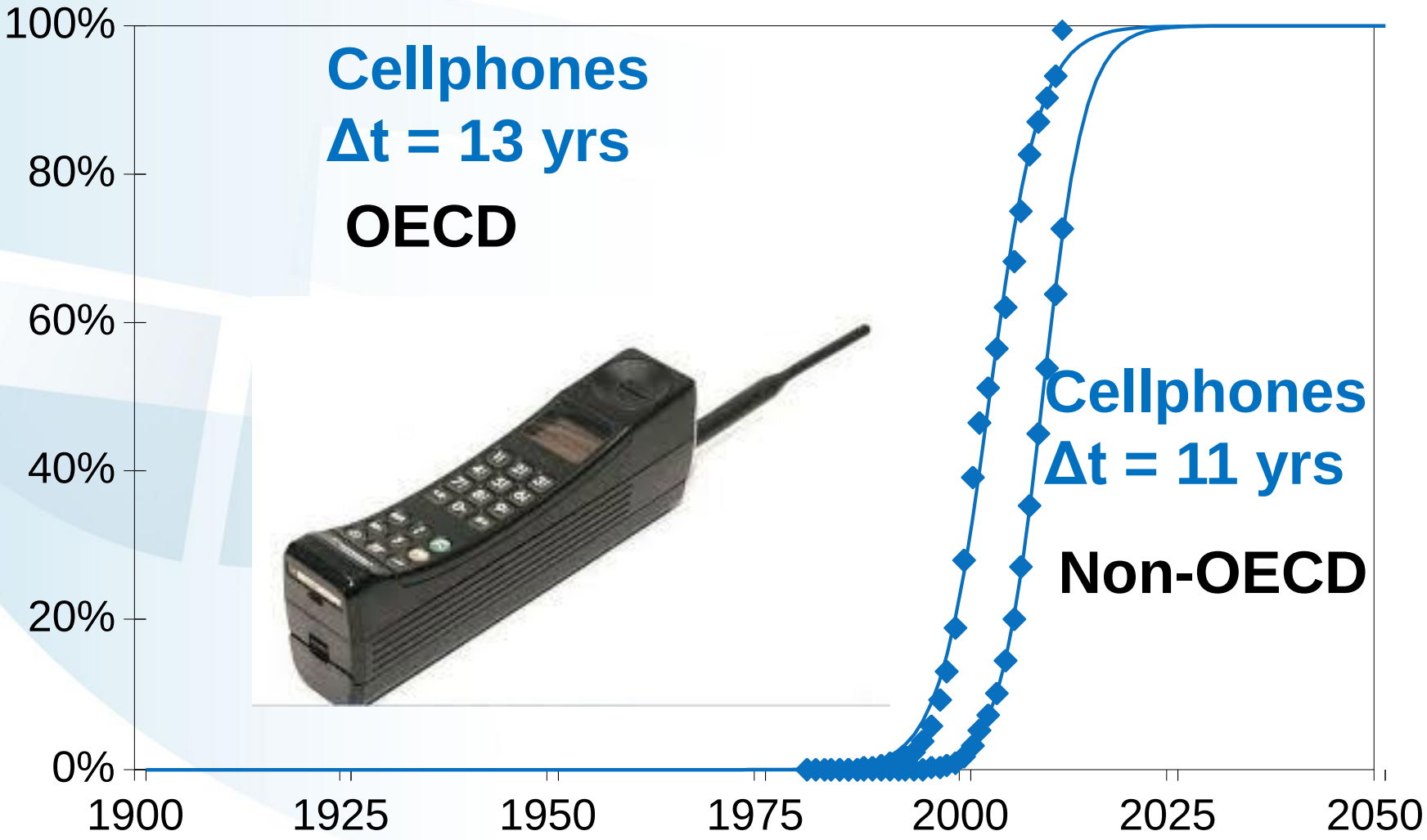
-> more opportunities to experiment

-> more learning

Healey, S. (2015). Separating Economies of Scale and Learning Effects in Technology Cost Improvements. IR-15-009., IIASA

Disruptive Technology Diffusion

(access to cellphones)

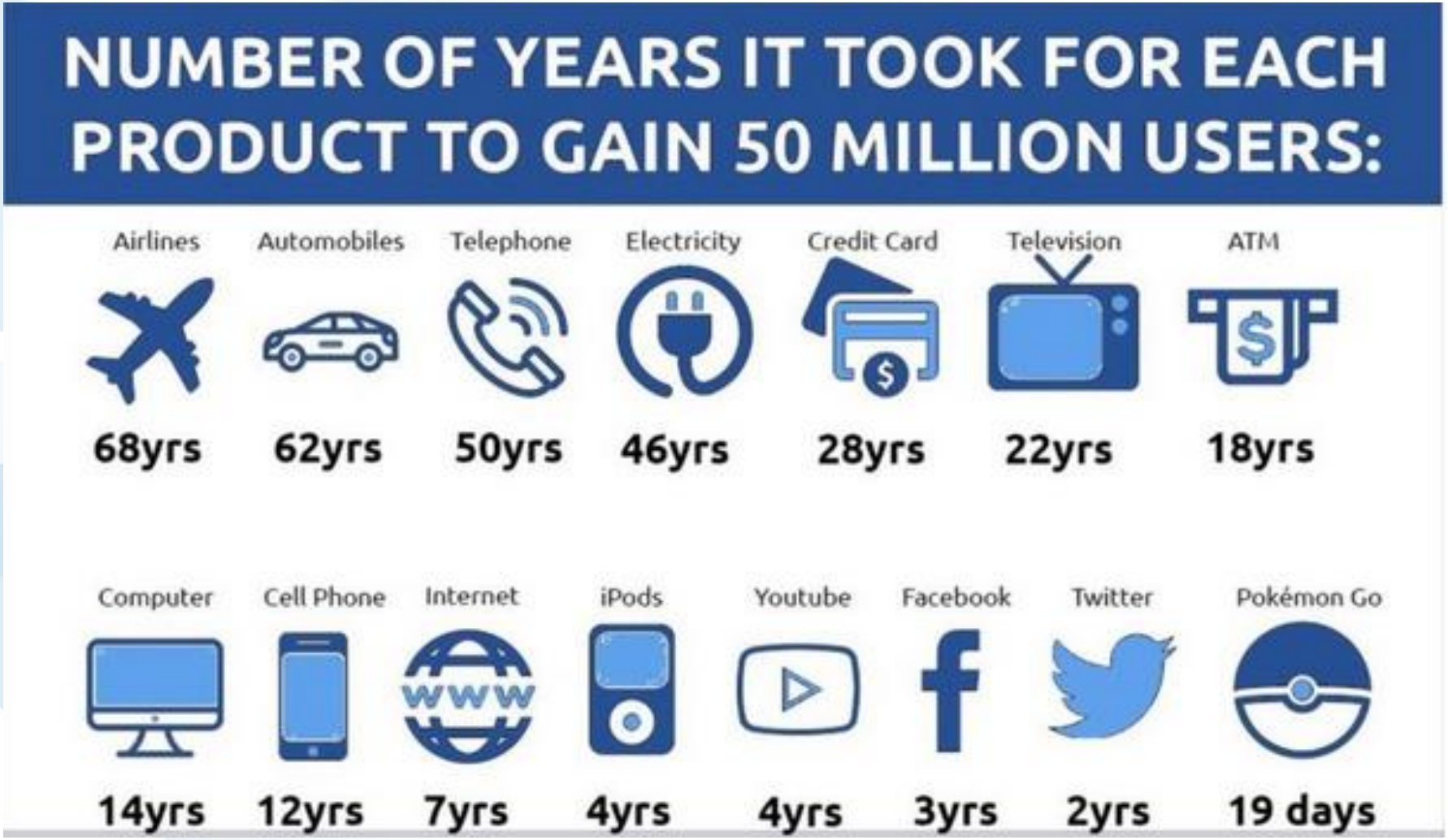


“Everyone” in the World has a Mobile Phone

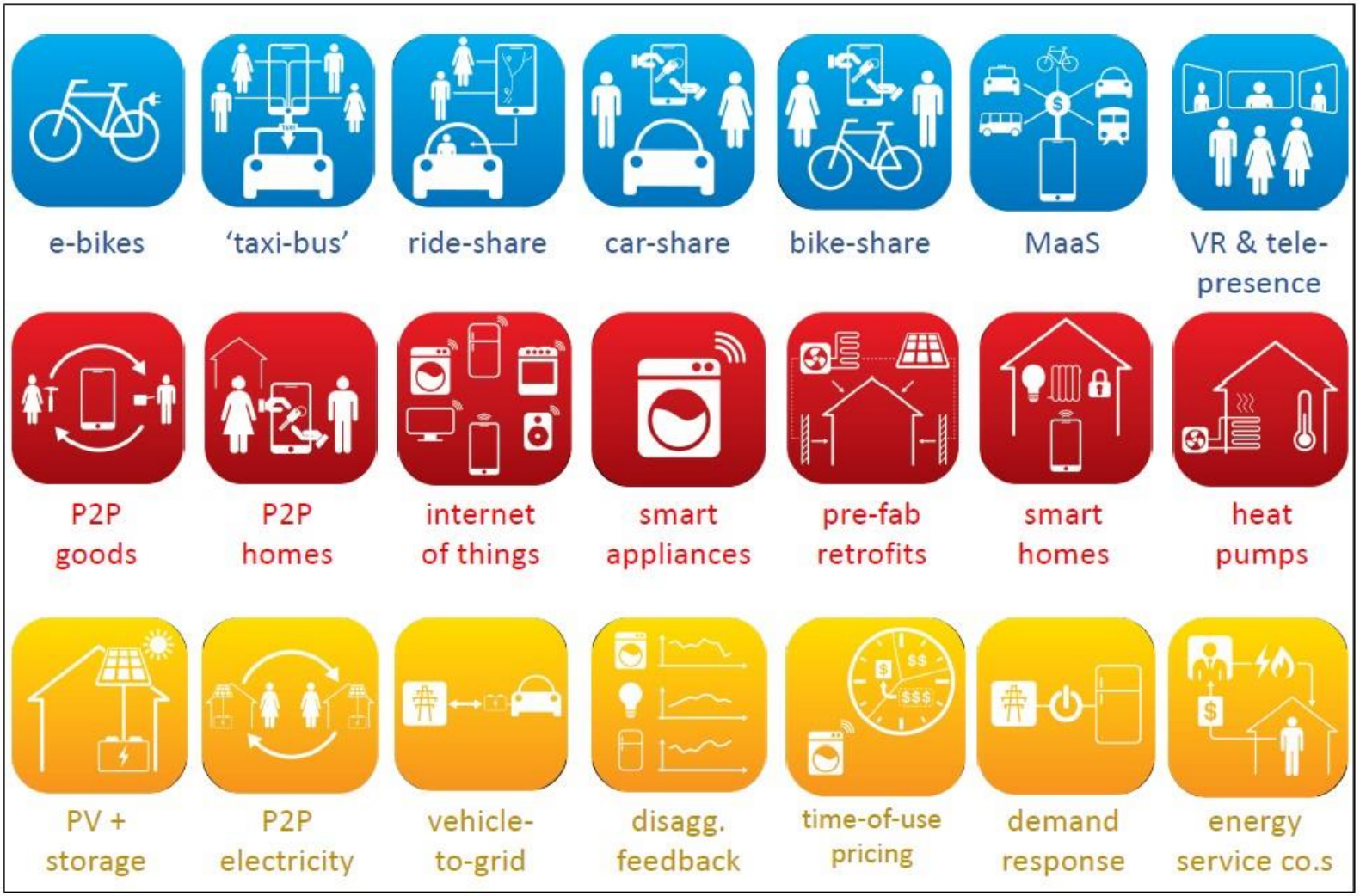
- Motorola 3200
  first GSM phone in 1992

- After less than there decades of diffusion
  There are now over 9.32 billion phones (GSMA) for 7.74 billion people, but ….

Acceleration of Initial Diffusion



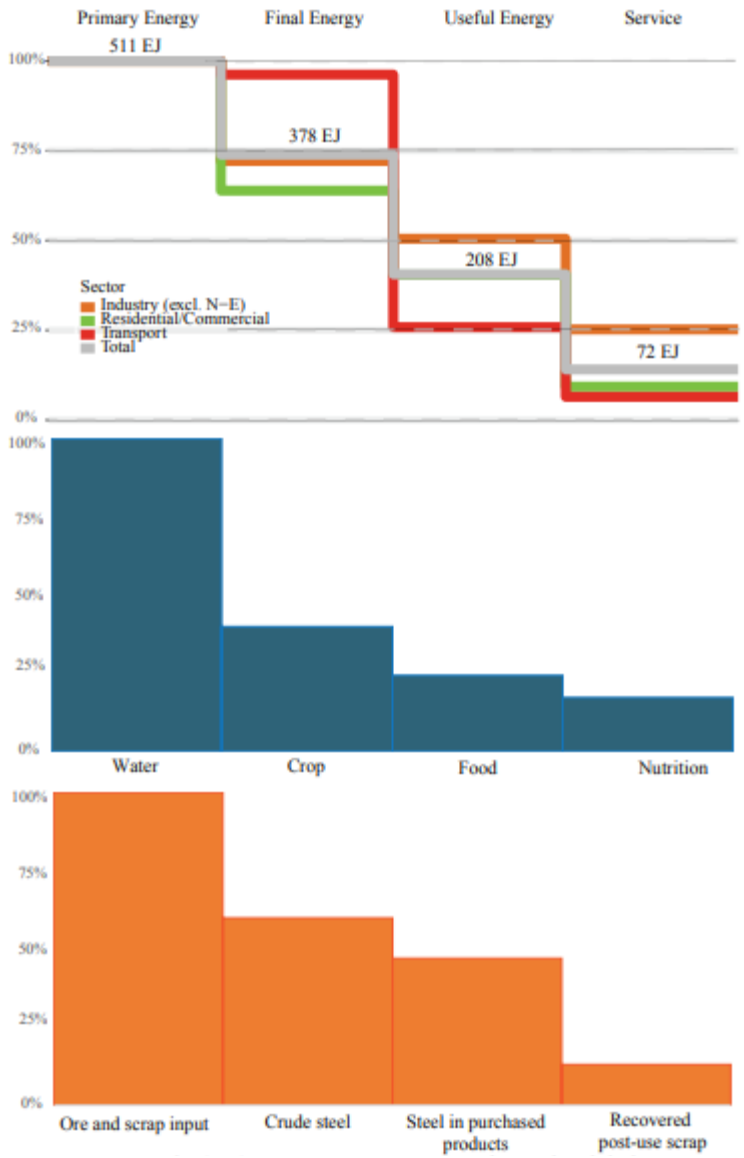
Disruptive End-user Innovations



(1) From ownership to usership – (2) Sharing Economy – (3) From atomized to connected

Source: Charlie Wilson

End-use and Supply Efficiencies and Upstream Leverage Effect of Savings at Service Level



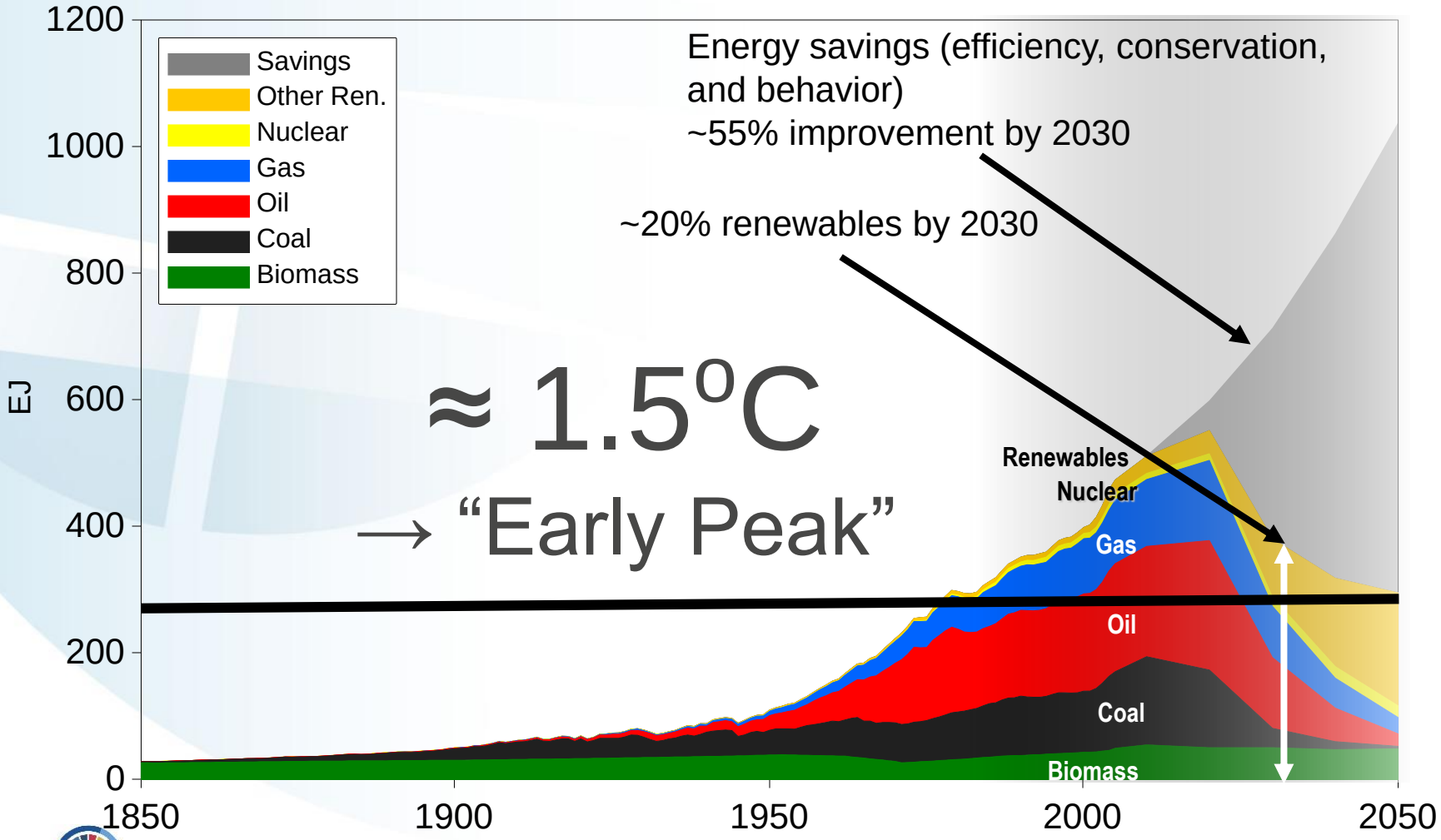
Energy (all services)
aggr. eff.: 14%
1 EJ saved =
7 EJ primary energy

Water (ex. irrigation)
aggr. eff.: 17%
1 m^3 saved =
6 m^3 water withdrawn

Materials (ex. steel)
aggr. eff.: 13%
1 ton saved =
8 tons ore mined

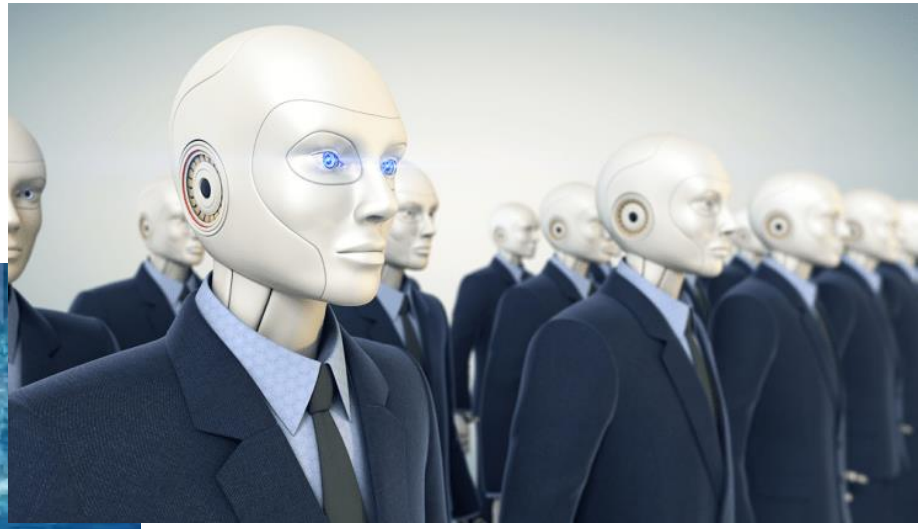
Global Primary Energy

ALPS Low Energy Demand (LED)

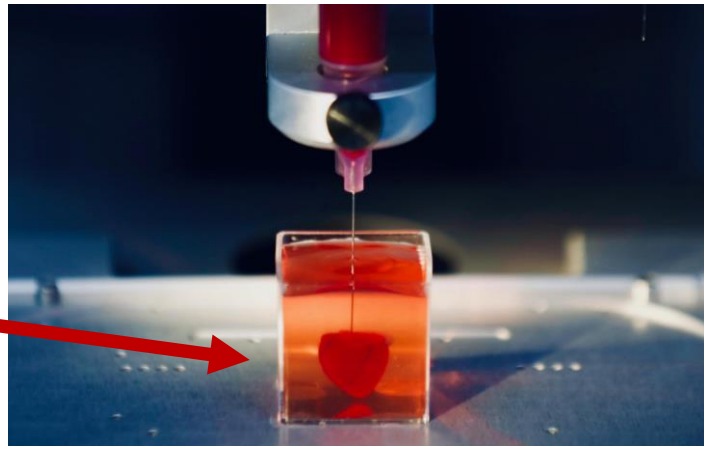


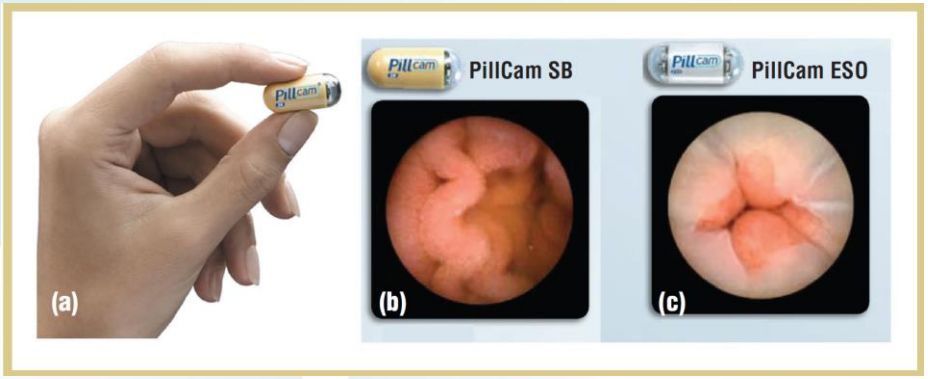
Digital Revolution – Convergence

Artificial Intelligence, Deep Learning, Big Data, Robotics, Nanotechnology, Quantum Computing, Synthetic Biology The Internet of Things, 3D Printing, Block Chain, Autonomous Vehicles, Augmented Reality



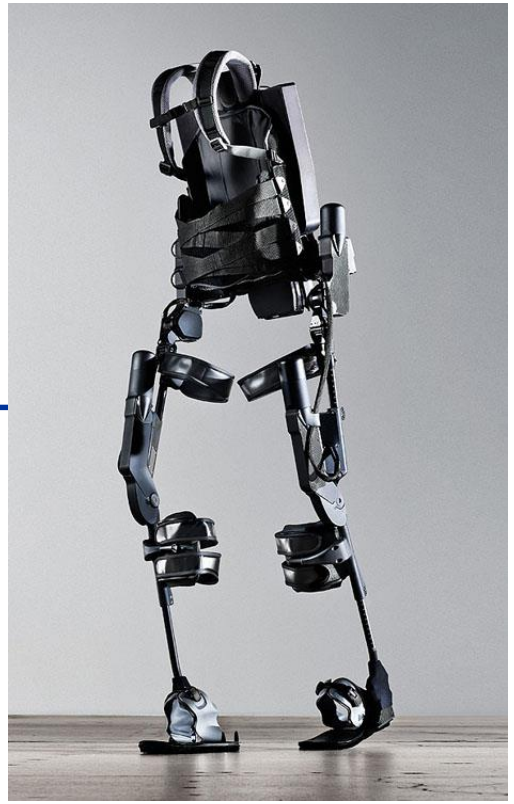
3D-printed vascularized-engineered heart at Tel Aviv University using human tissue, vessels and other biological materials (Wieley-VCH, 2019)





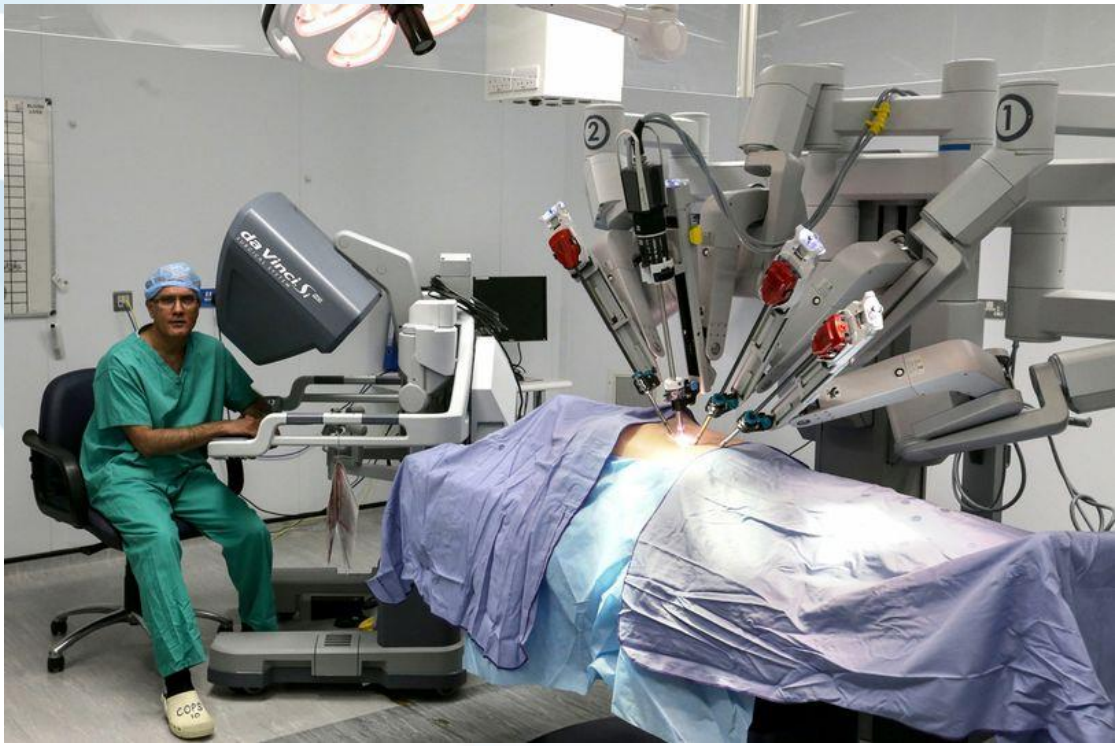
PilCam swallobable-capcule technogy (cs.cmu.edu)

Who is responsible for authnomous weapons? (https://futureoflife.org/2016/11/21/peter-asaro-autonomous-weapons/)



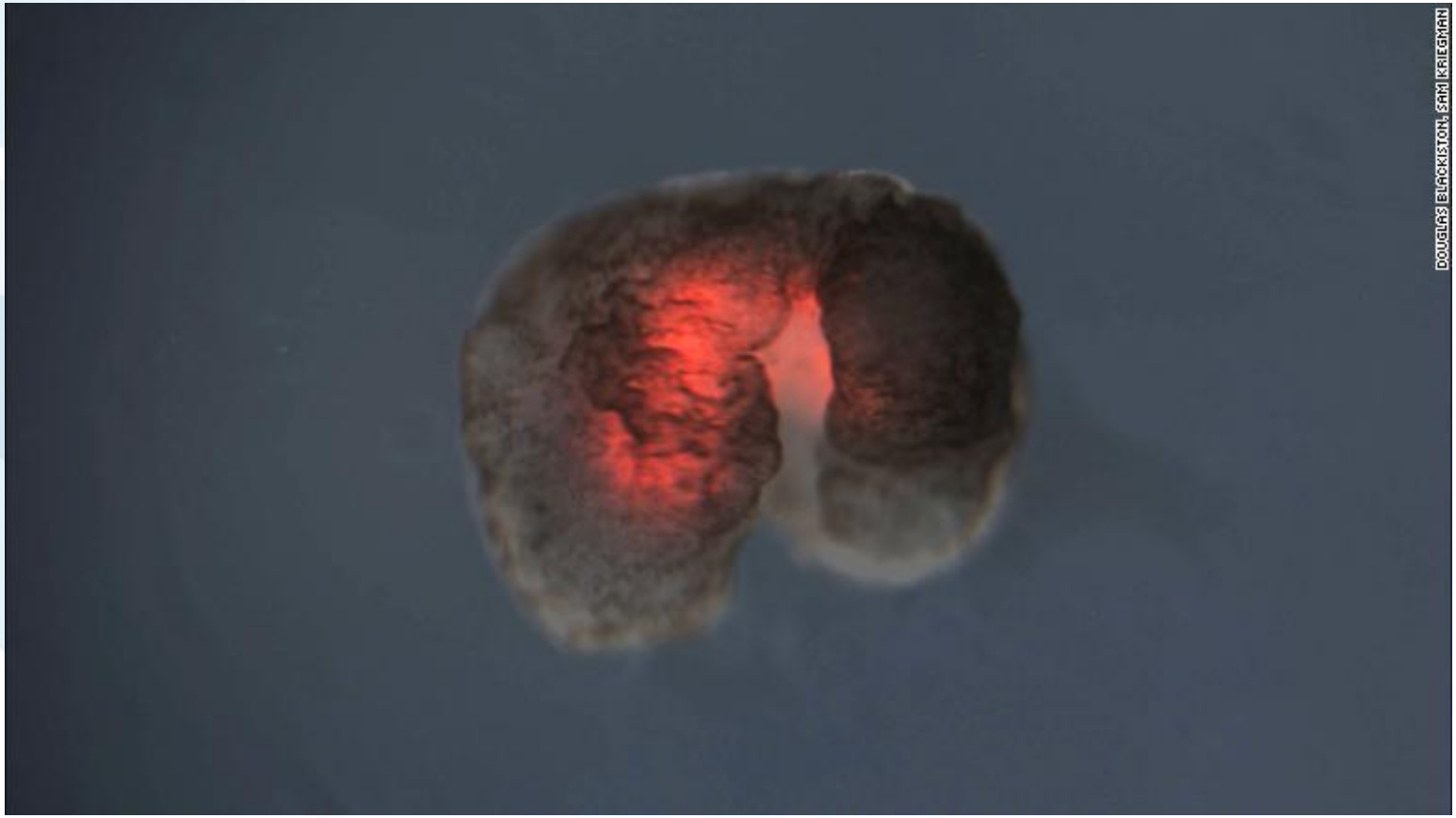
Robotic exoskeleton that will enable paraplegics to do the unthinkable or make heavy tools feel weightless (https://eksobionics.com/eksoworks/)

Augmented reality is an interactive experience of a real-world environment where the objects that reside in the real world are enhanced by computer-generated perceptual information



"Futuristic surgery" that helped young woman become first to have lung cancer removed by Da Vinci robot by Intuitive Surgical

Xenobot: world's first living, self-healing robots created from frog stem cells– they are less than a millimeter (0.1 millimeter) wide – small enough to travel inside human bodies. They can walk and swim, survive for weeks without food and work together in groups. The cells were cut and reshaped into specific "body forms" designed by a supercomputer – forms "never seen in nature," according to a news release from the University of Vermont.

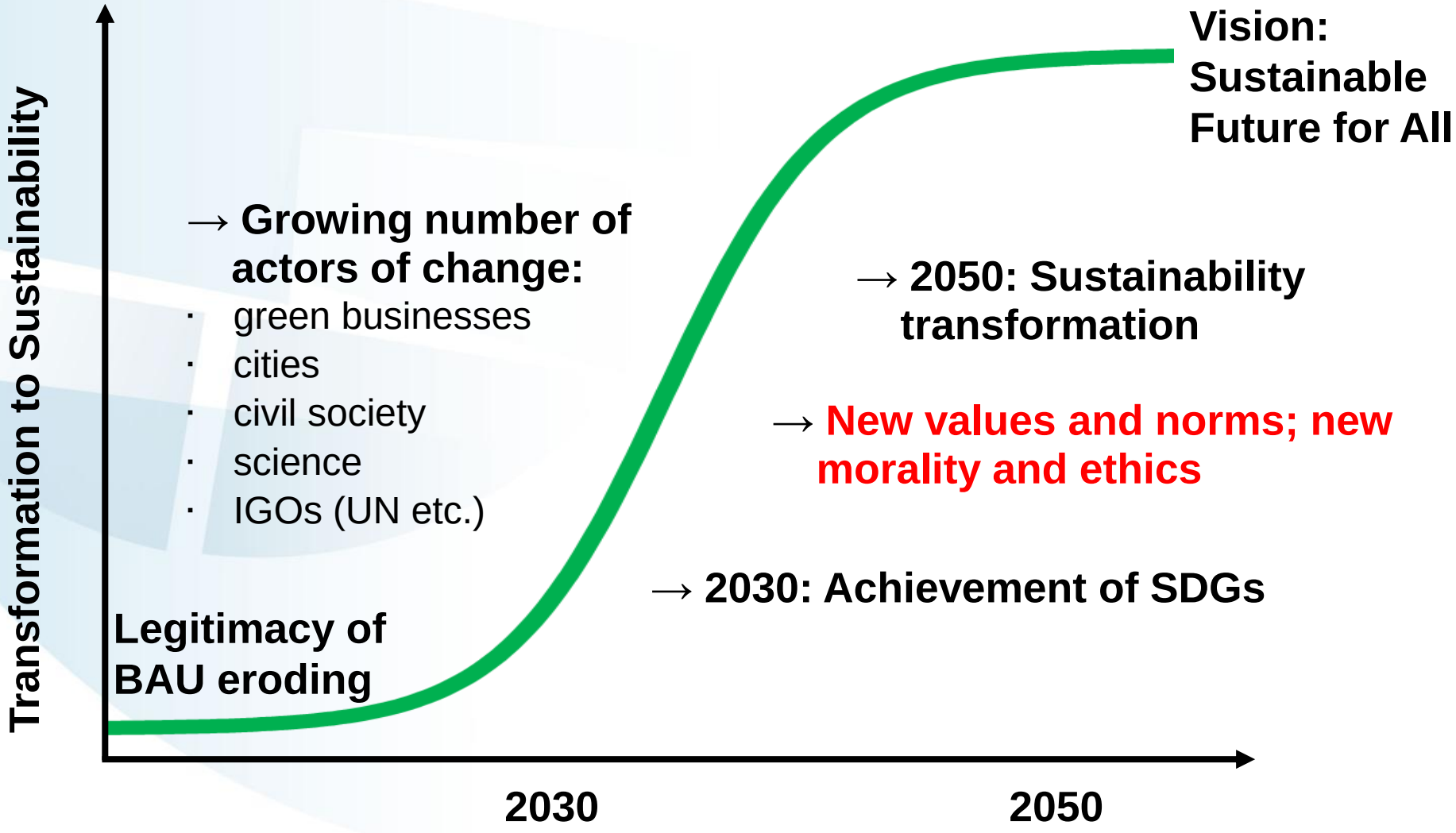


The Map of Artificial Intelligence Ethical Issues

	Short Term	Long Term
AI as agents	Structural unemployment Fairness in algorithms Machine ethics Proliferation of autonomous weapons	Finalizing human values for machines to propagate Status of humanity in a world dominated by artificial agents Controlling artificial general intelligence and creating friendly superintelligence
AI as subjects	Legal status of autonomous systems Suffering in reinforcement learners	Consciousness in artificial intelligence Well-being of AIs Moral status of mind uploads

The World in 2050 (TWI2050.com)

"Doing More with Less" within Planetary Boundaries



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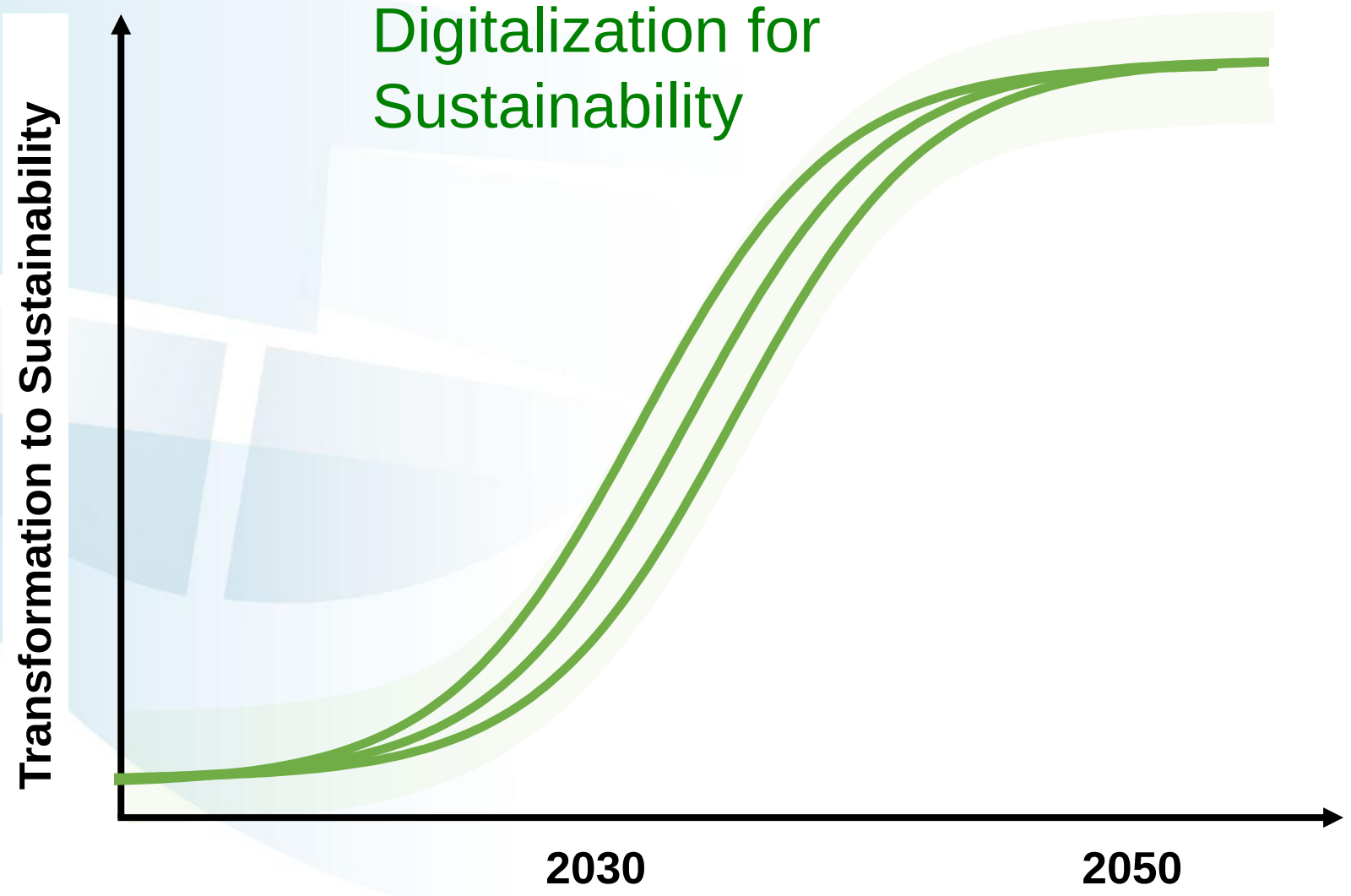

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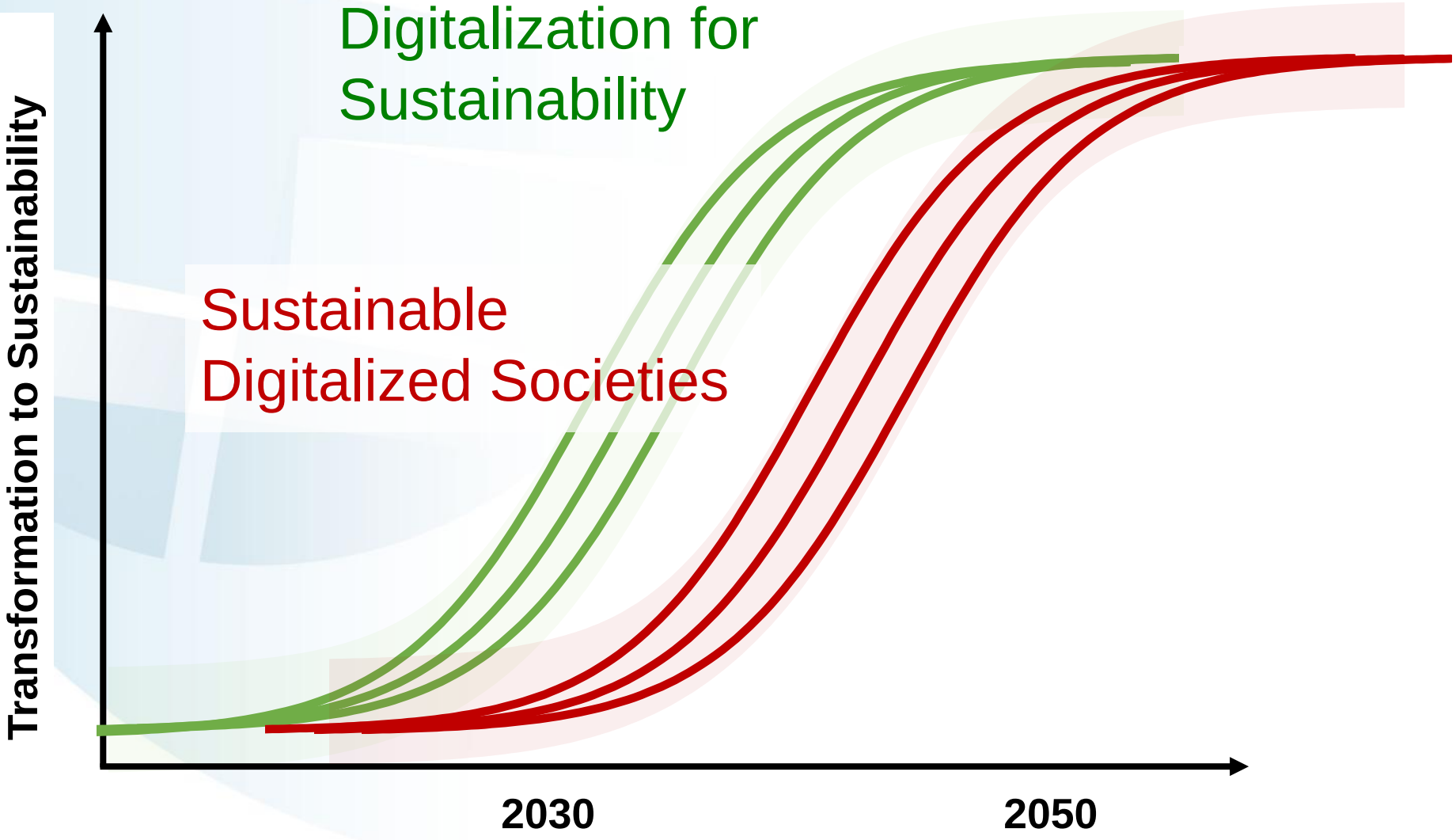

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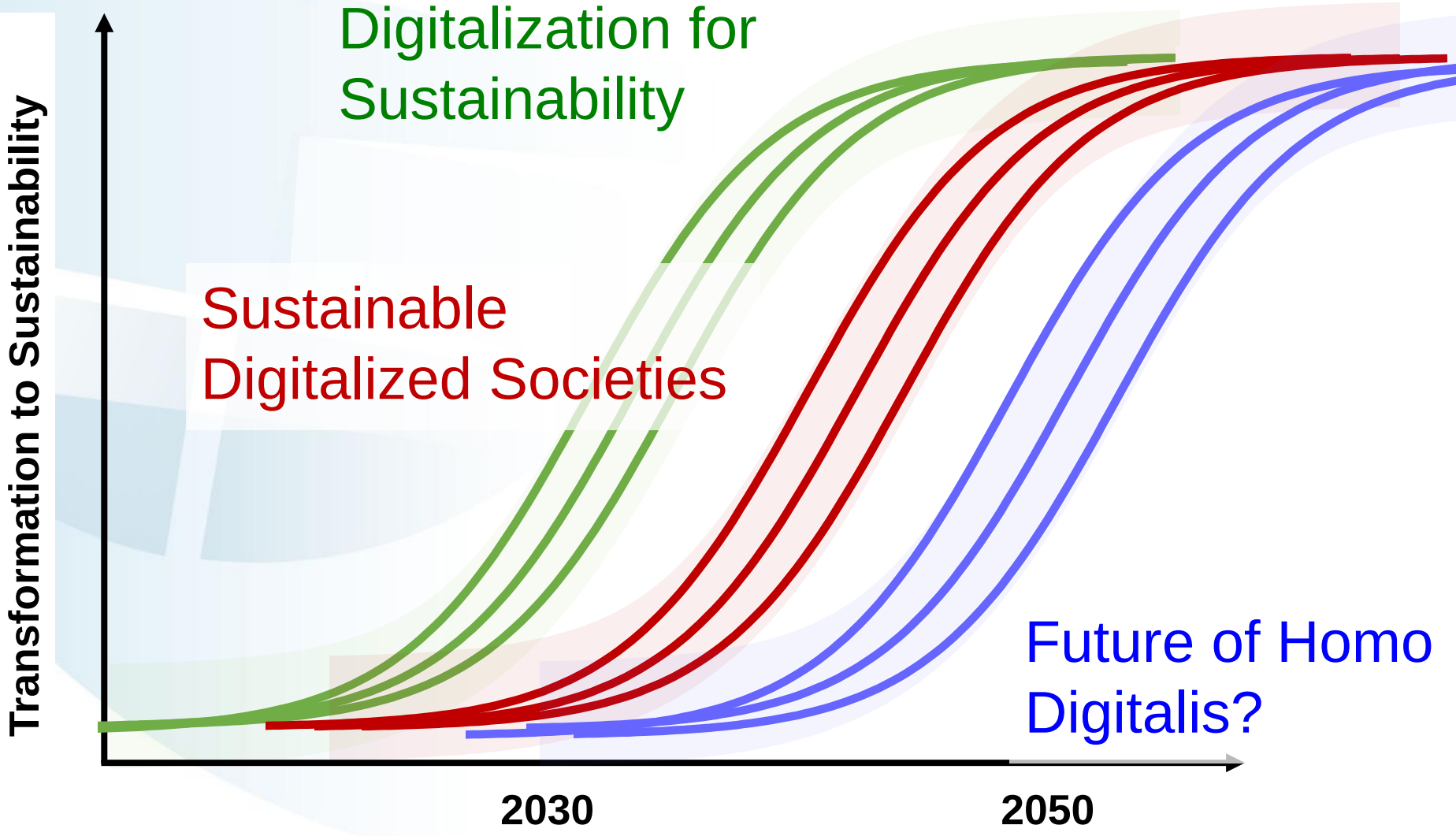

Some Key Messages

- A **new era in human history** is emerging! After Neolithic & Industrial, the **Digital Revolution** is the next era**.**
- Digitalization can **enable a disruptive revolution** toward a Digital Anthropocene – a **quantum leap for civilization**!
- The paradox of the Digital Anthropocene – digitalization essential for achieving the **Six Major Transformations** & is **challenging the absorptive capacity of society**.
- Build **responsible knowledge societies** capable of taking action towards sustainability in the Digital Age – **governance urgently needed in Digital Anthropocene**!.
- There are **only 10 years** to 2030!

Taipei Construction at Laan Station

Welcome to the Digital Anthropocene

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ありがとう

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