

EU Policies to be the First Carbon-Neutral Continent in the Transforming World

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Nebojsa Nakicenovic

Distinguished Emeritus Scholar



Group of Chief Scientific Advisers



Energy Economics Emeritus Professor



The Key Challenges of Energy, Pollution, and Climate Transformation



Energy Access



Climate Change



Energy Security



**Air Pollution
Health Impacts**

Wood for Cooking



Source: Modi, 2011 and Yumkella, 2013

Mobile Phones Charging



Source: Modi, 2011

Lack of Decent Work and Employment



Lack of Decent Work toward Decent Life



The World is at Crossroads

Great acceleration benefited many but increased inequalities and dangers of tipping elements

- ➔ Since 1800 global economy increased 100-fold, energy 50 times and CO₂ 30 times
- ➔ Temperature increased to 1.5°C and about 8 million die due to indoor and regional air pollution
- ➔ Many suffering famine, war, and conquest
- ➔ Achievement of 2030 Agenda and Paris Agreement would bring multiple co-benefits for people and the planet

Global Average Temperature

(compared to the average 1850-1900)

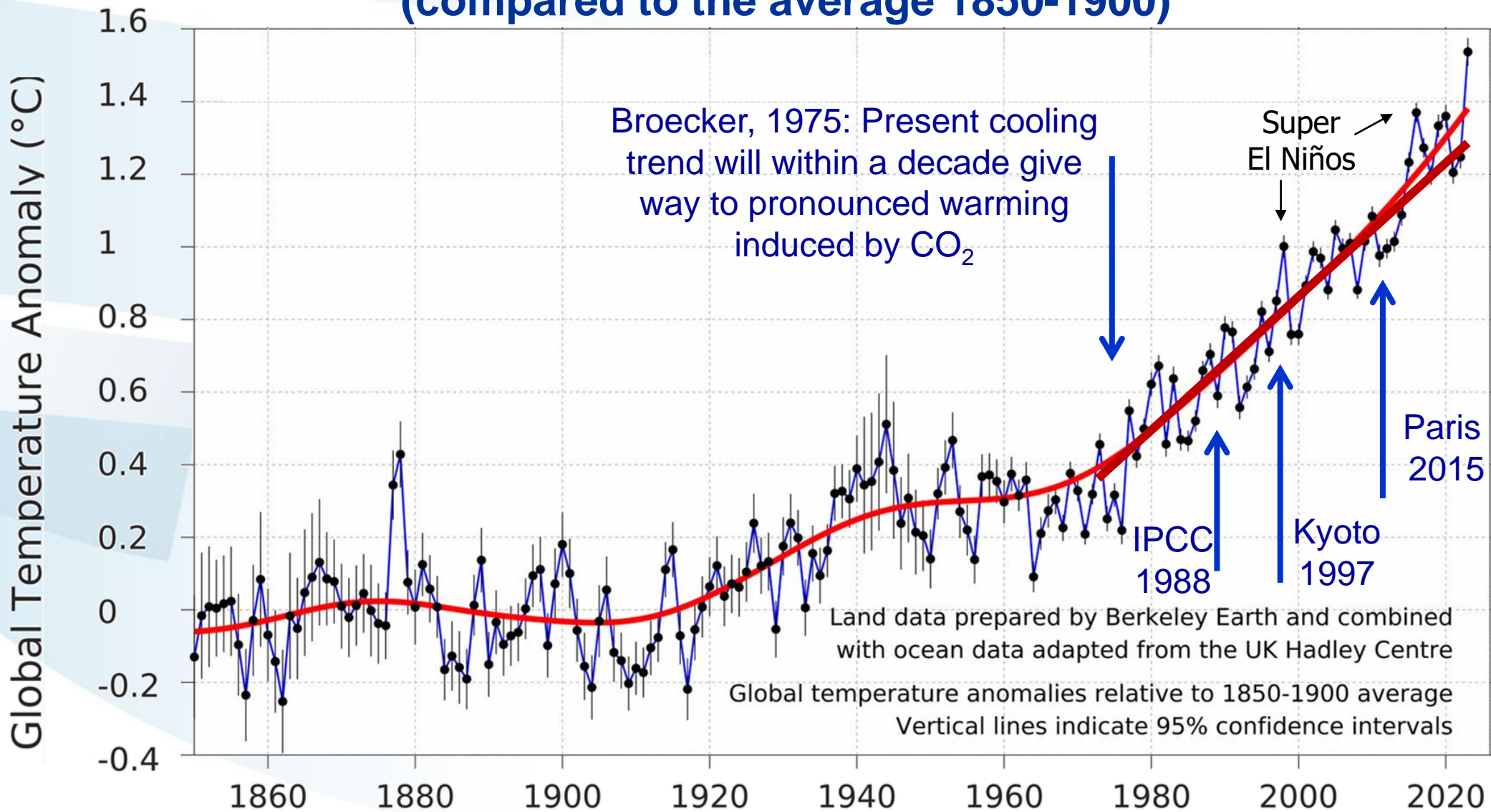
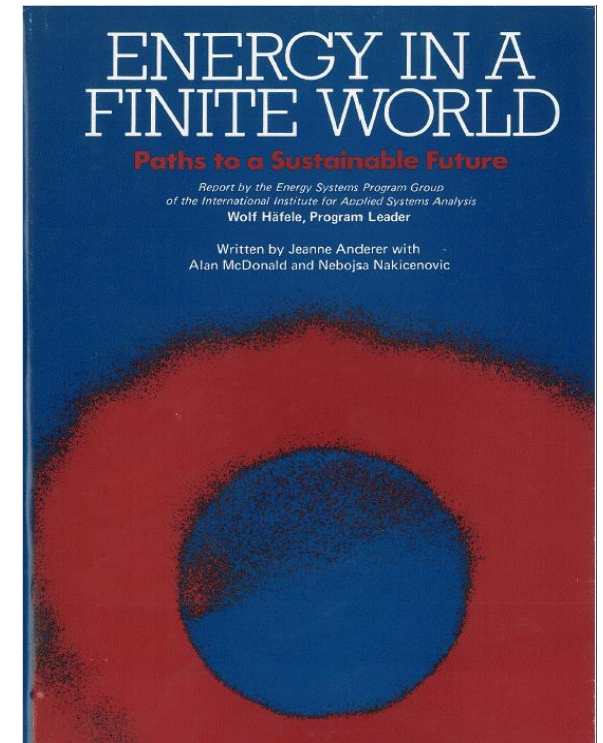
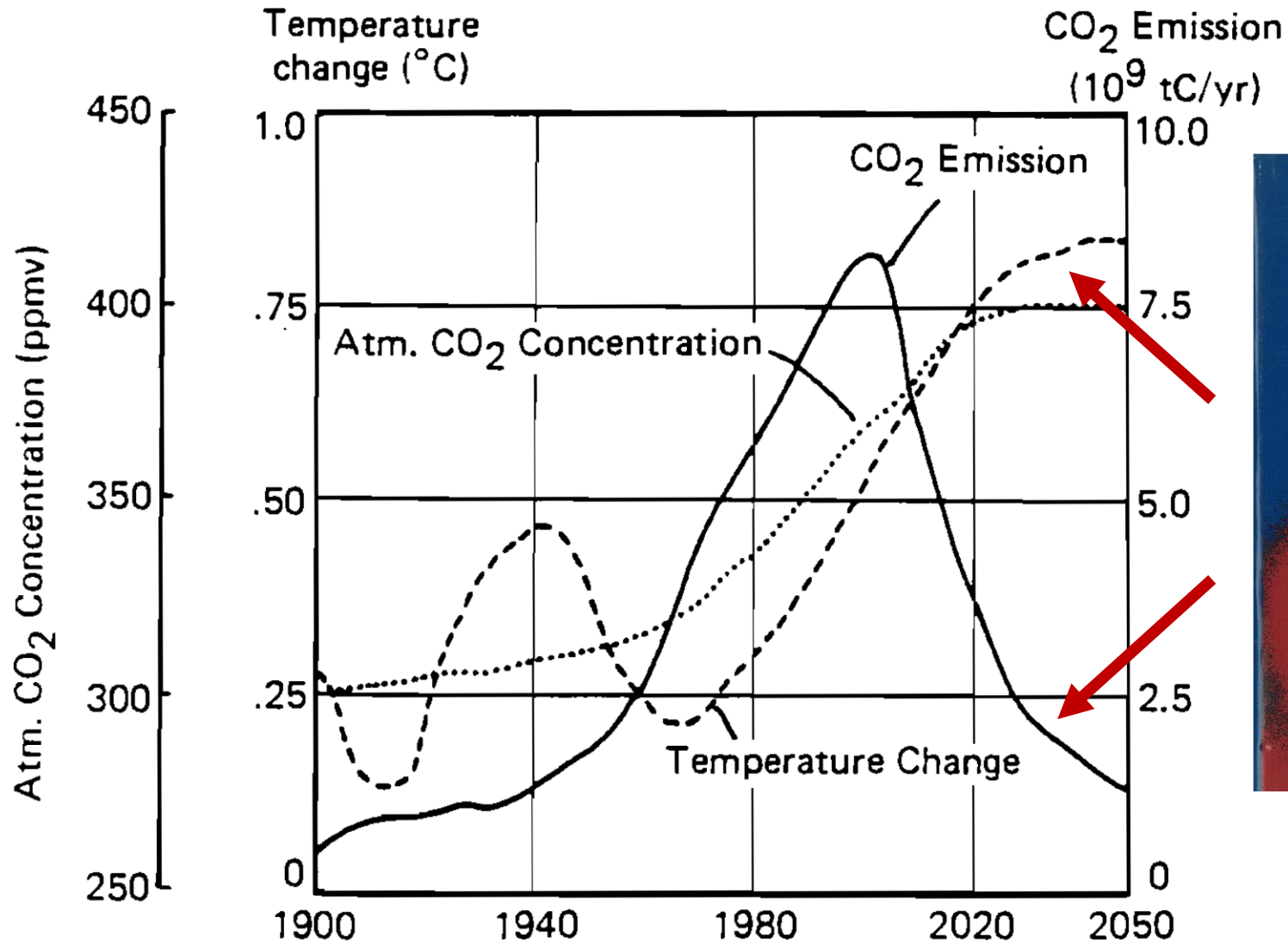


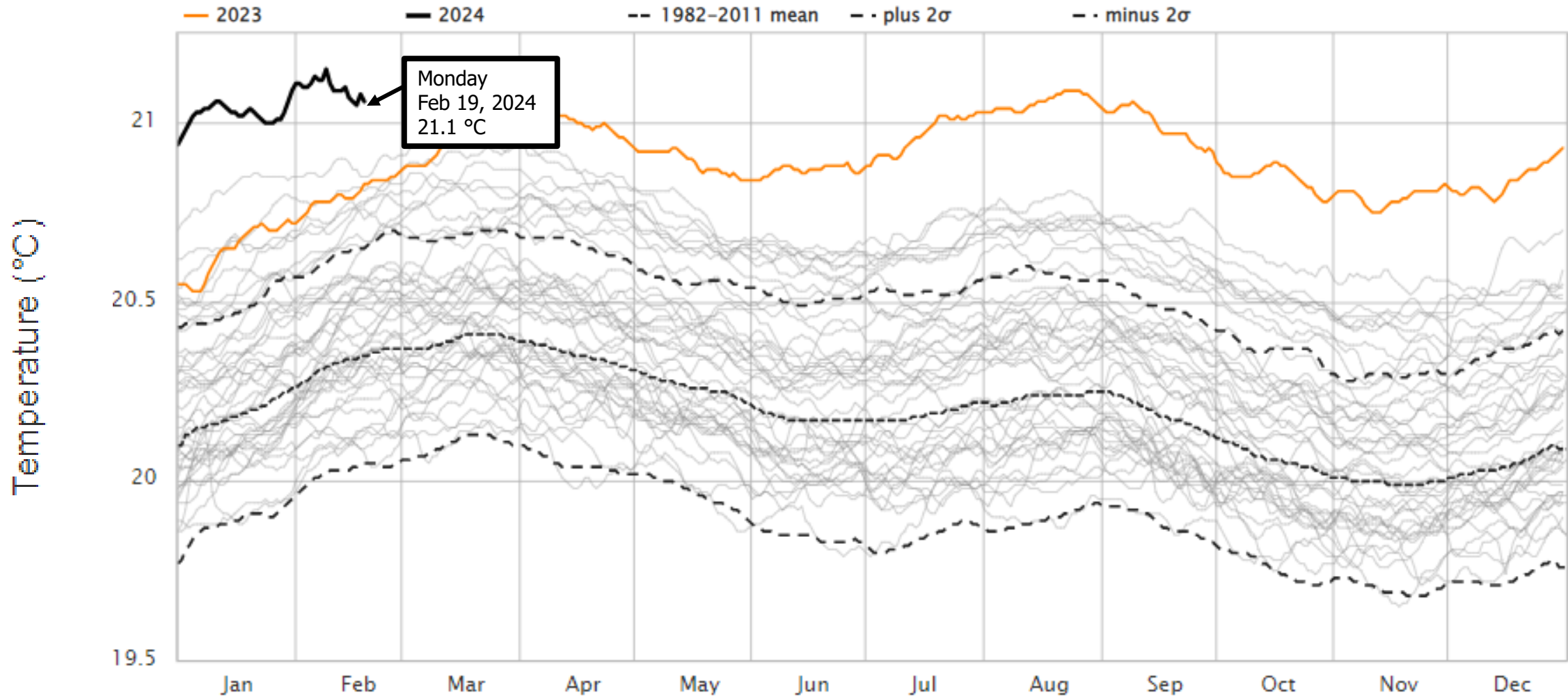
Figure 7-8. CO₂ emissions, atmospheric CO₂ concentration, and temperature change for 30 TWyr/yr solar and nuclear strategy. *Source: Niehaus and Williams (1979).*



1981

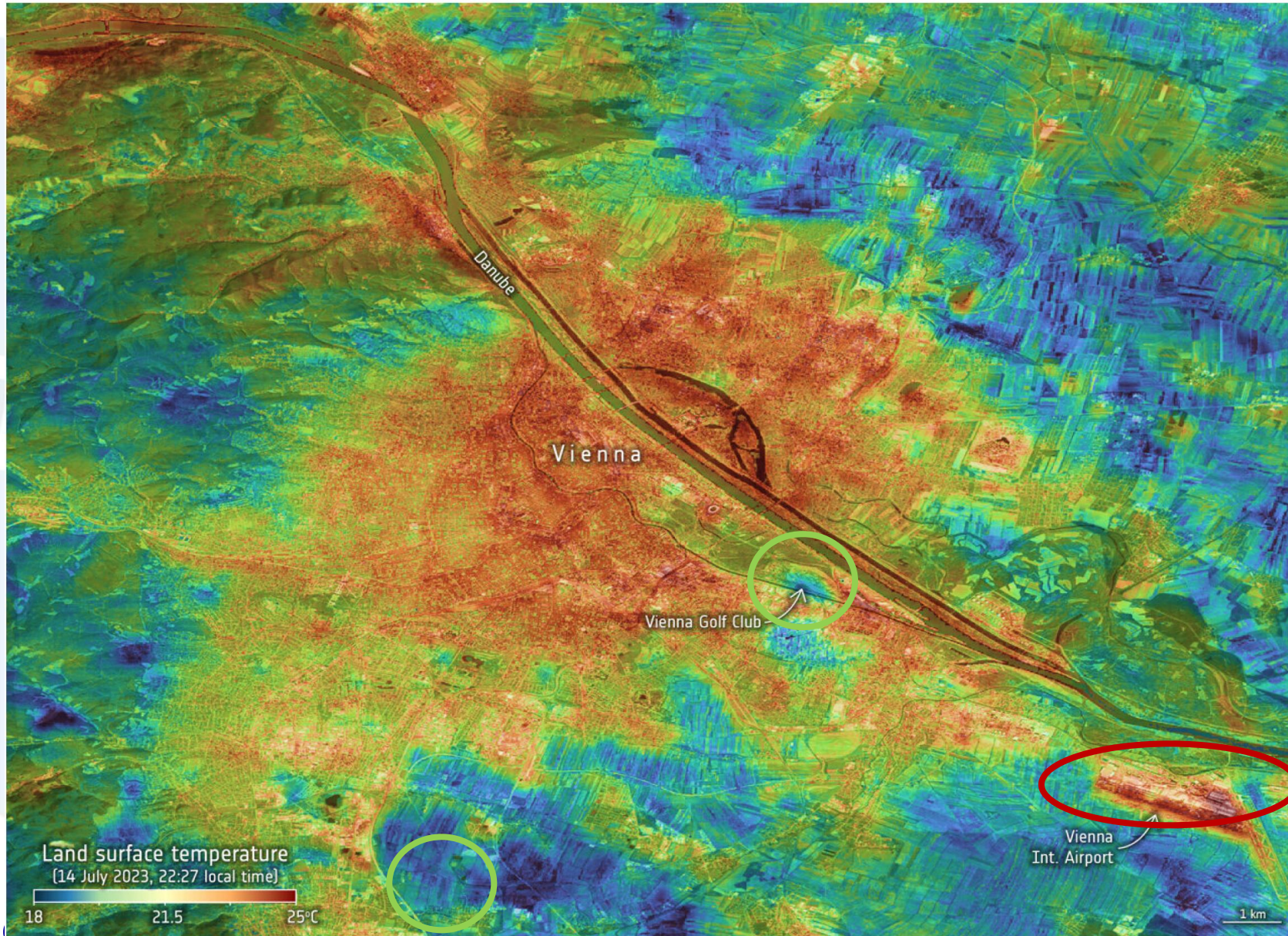
2024 #9

Daily Sea Surface Temperature



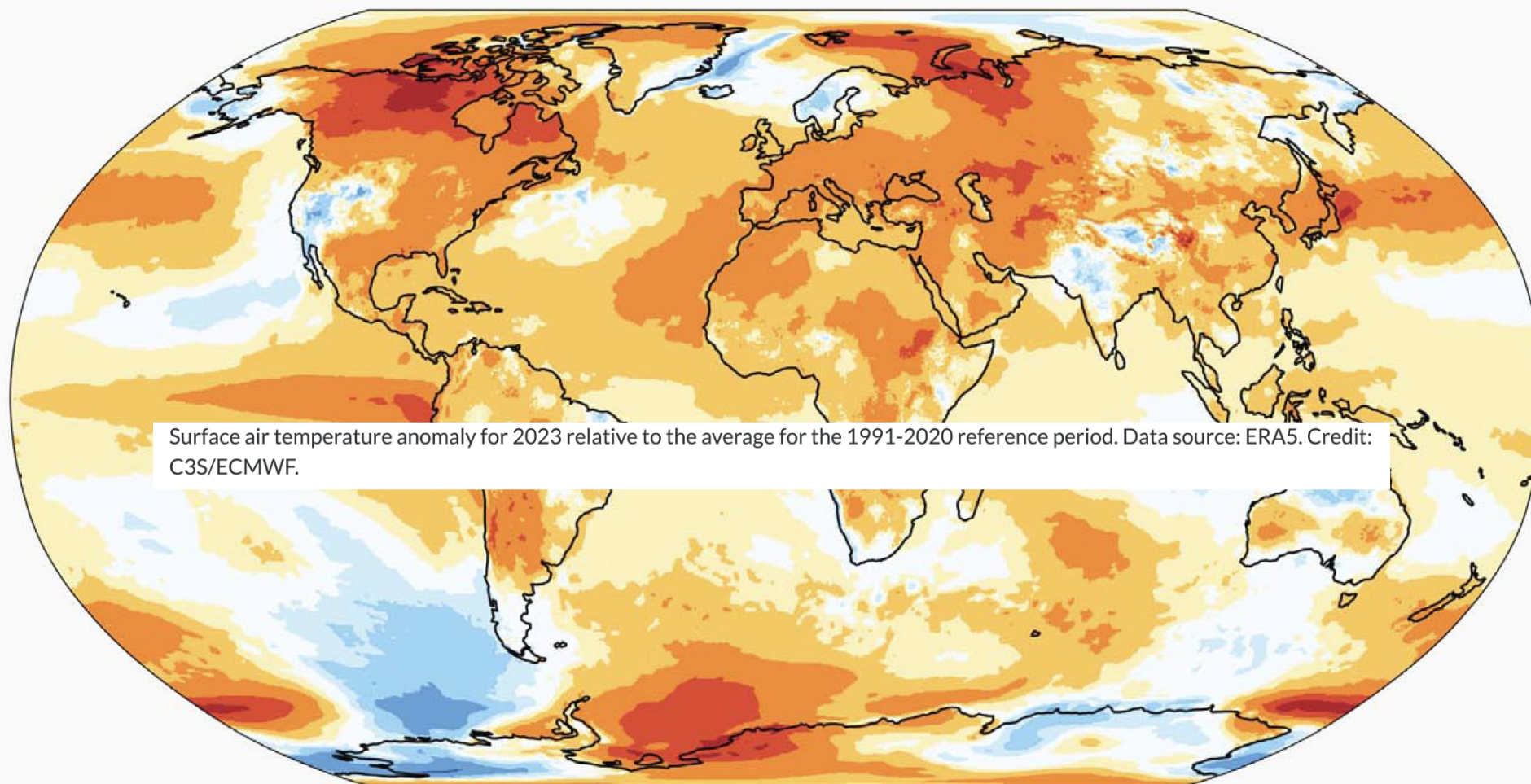
Vienna Land-Surface Temperatures 14 July 2023

At 22:27 CEST recorded by NASA's Ecostress instrument which is carried on the International Space Station

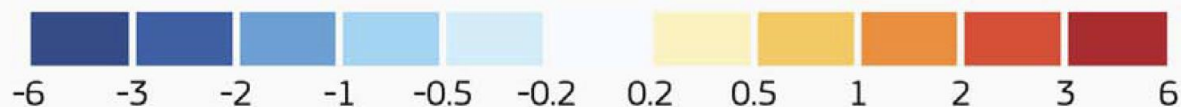


SURFACE AIR TEMPERATURE ANOMALY • 2023

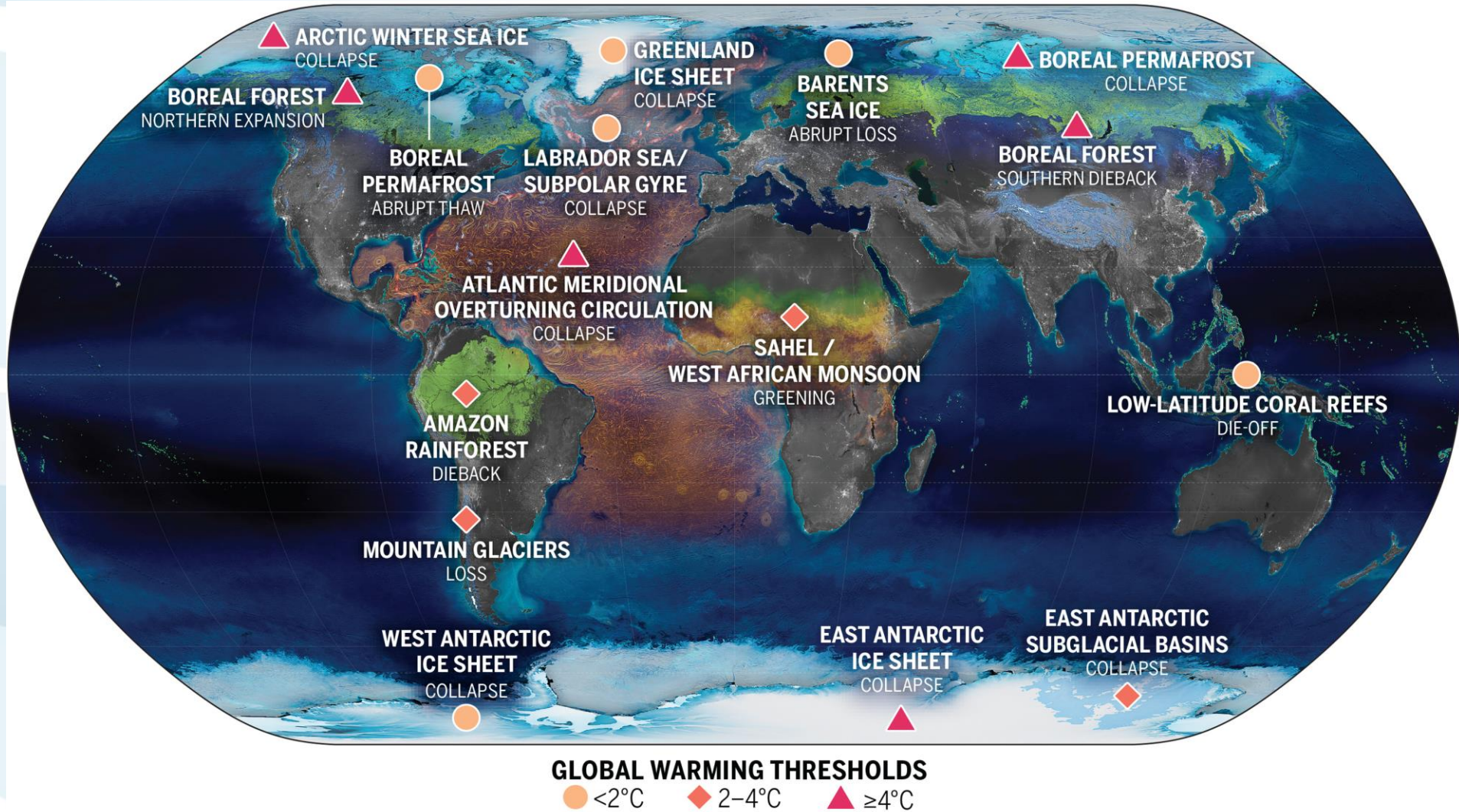
Reference period: 1991–2020 • Data: ERA5 • Credit: C3S/ECMWF



Temperature anomaly (°C)

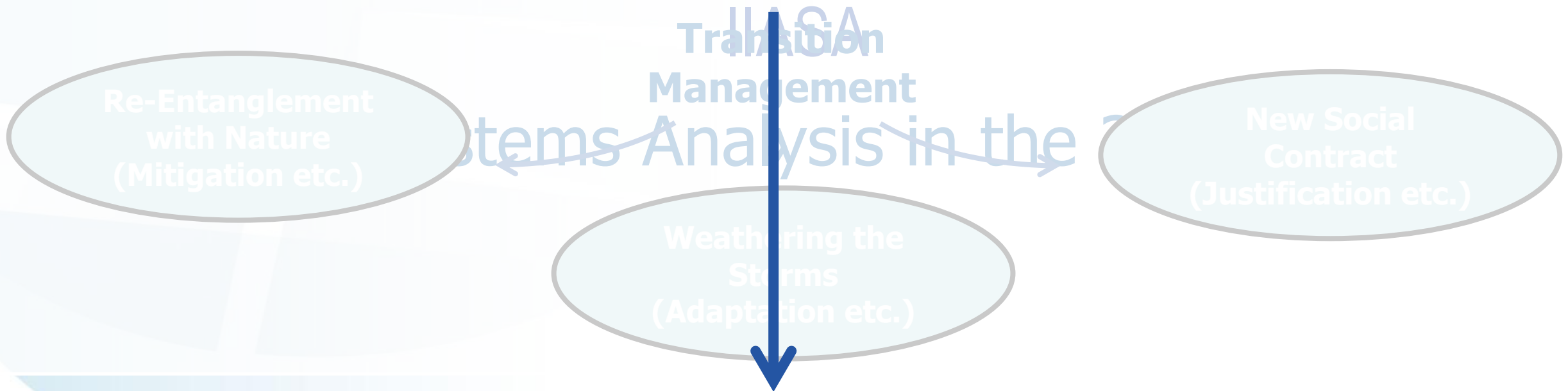


16 Earth System Tipping Elements



How to Survive the Anthropocene – with a Little Help of IIASA

Anthropocene Earth System Dynamics



**Regenerative Civilization
in Co-Evolution with Nature**

Six Major Transformations (TWI2050.org)

Digital Revolution

Artificial Intelligence, Big Data, Biotech, Nanotech, Autonomous Systems



Human Capacity & Demography

Education, Health, Ageing, Labor Markets, Gender, Inequalities



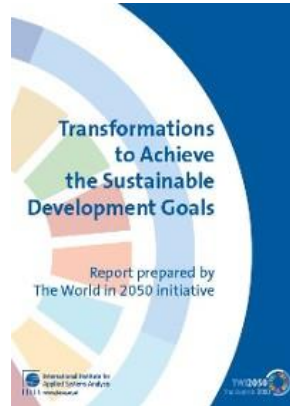
SDGs:

Prosperity
Social Inclusion
Sustainability



Consumption & Production

Resource Use, Circular Economy, Sufficiency, Pollution



Smart Cities

Decent Housing, Mobility, Sustainable Infrastructure, Pollution



Food, Biosphere & Water

Sustainable Intensification, Biodiversity, Forests, Oceans, Healthy Diets, Nutrients

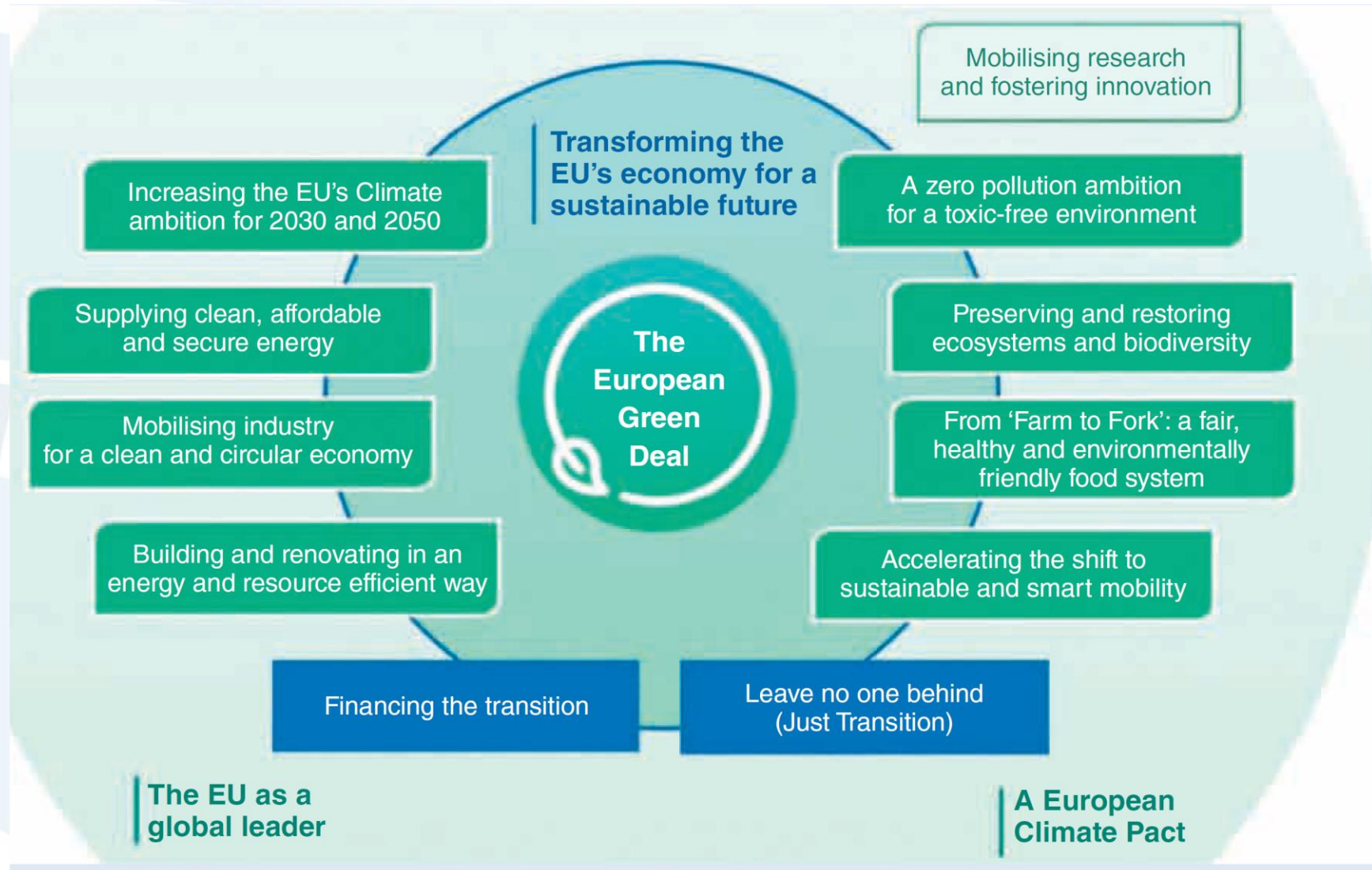


Decarbonization & Energy

Energy Access, Efficiency, Electrification, Decent Services



The European Green Deal





Scientific Advice Mechanism

to the European Commission

Group of Chief
Scientific Advisors

SAM secretariat

SAPEA consortium
of academy
networks



Scientific opinions



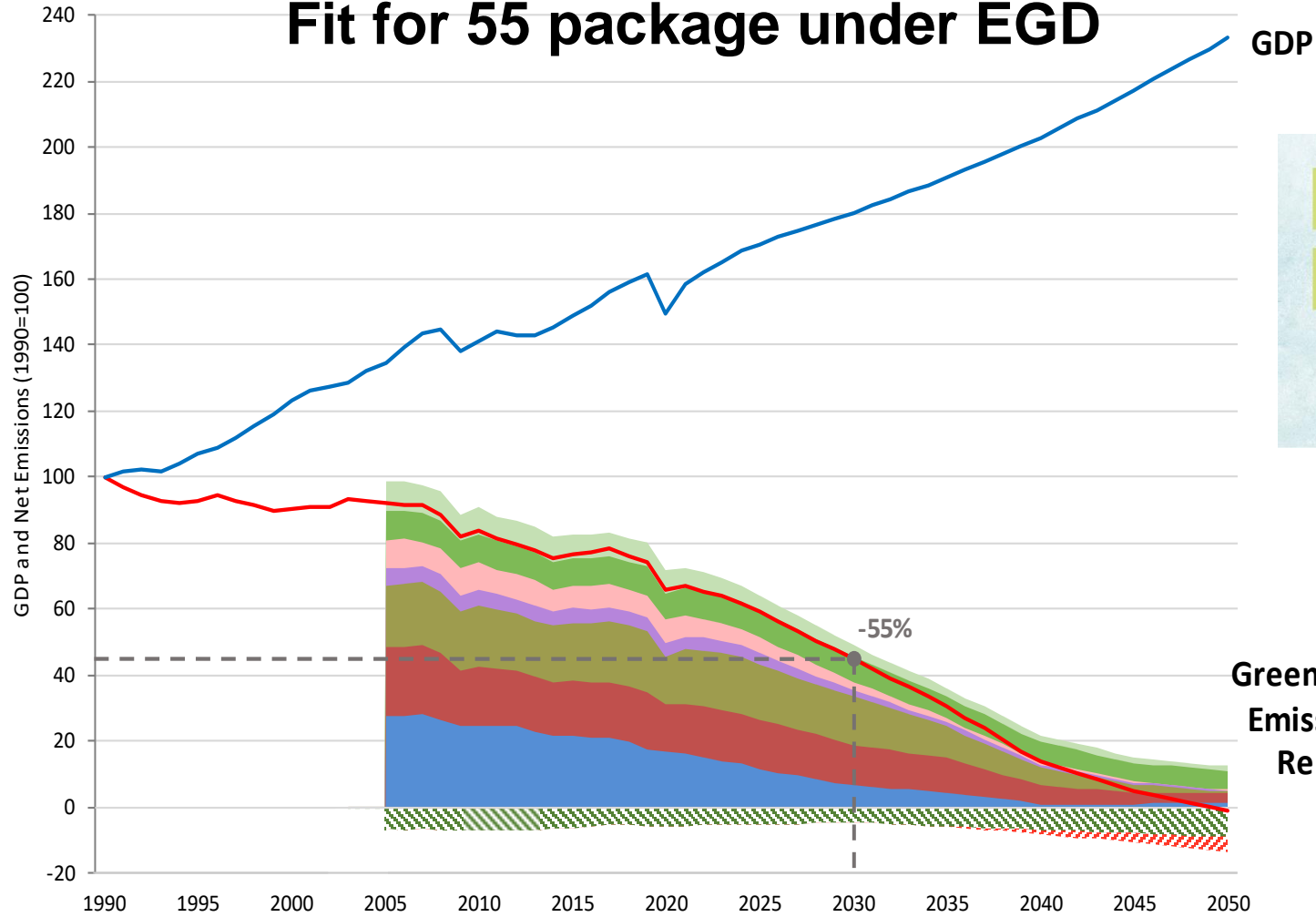
Science advice for a clean and fair energy transition: A challenge and a call for action



1. Develop **flexible, efficient, and resilient EU energy systems** for delivering clean, accessible, and affordable energy services by integrating decarbonised energy sources, electrification and the use of blue and green hydrogen.
2. Recognise the roles of all actors and stakeholders in **creating an inclusive and participatory environment** that incentivises and supports low-carbon energy choices.
3. Support a coordinated combination of policies, measures and instruments, including carbon pricing as a driving force, to **shape an effective, consistent and just regulatory system**.

EU pathway to prosperity & climate neutrality

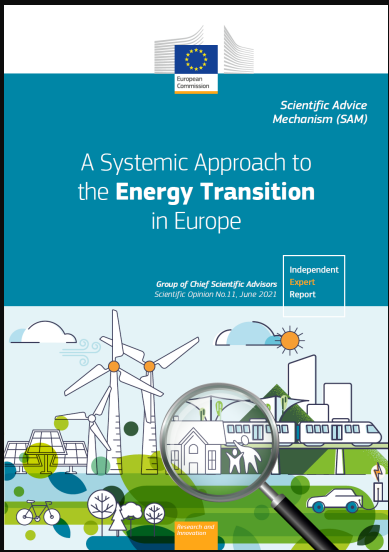
Fit for 55 package under EGD



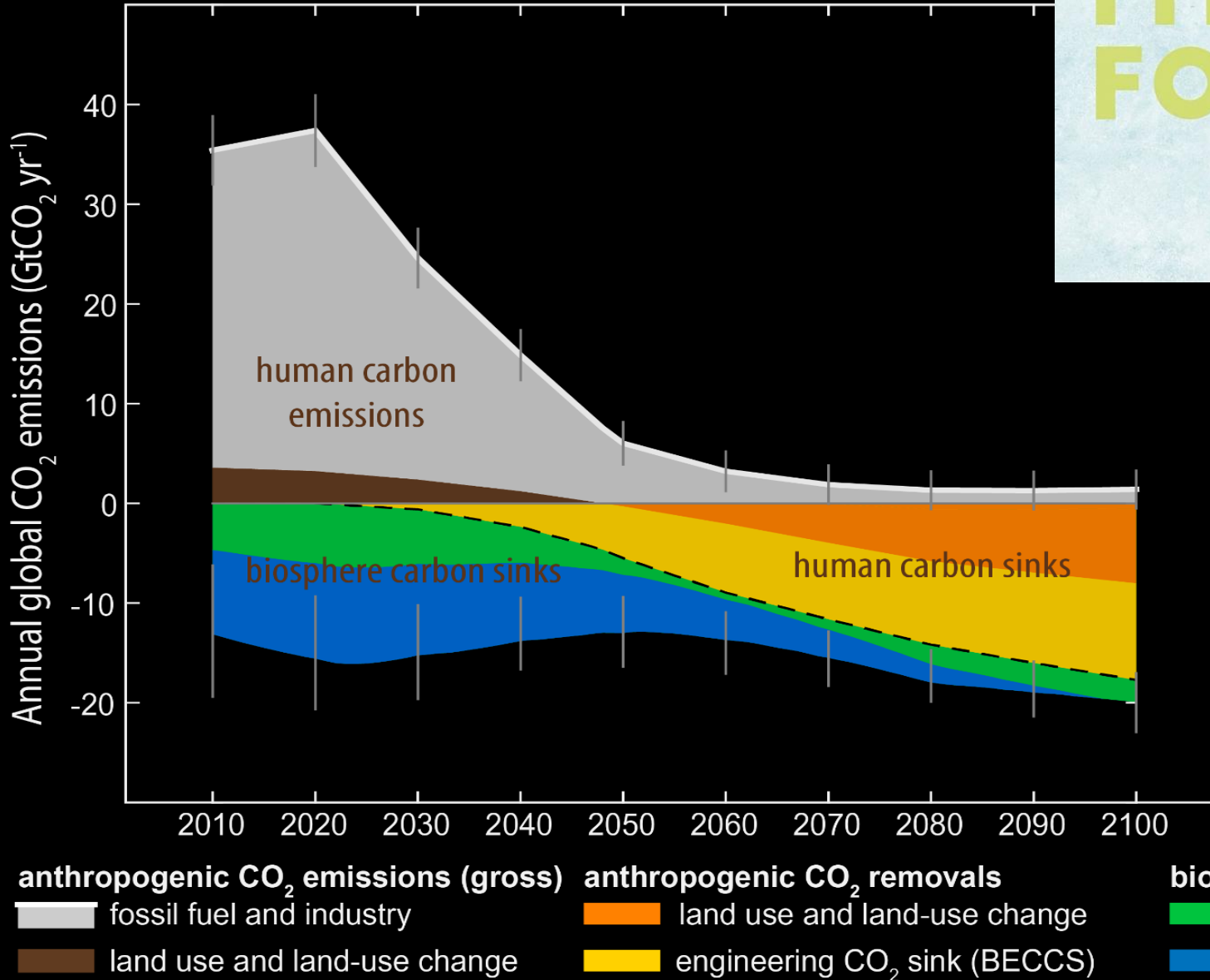
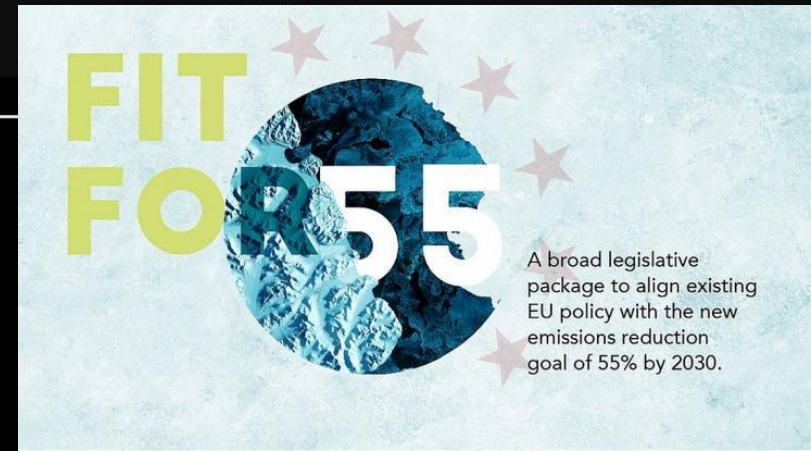
Greenhouse Gas Emissions and Removals

- Non-CO2 other
- Non-CO2 Agriculture
- Residential
- Tertiary
- Transport
- Industry
- Power
- Carbon Removal Technologies
- Land use and forests
- Net emissions
- GDP



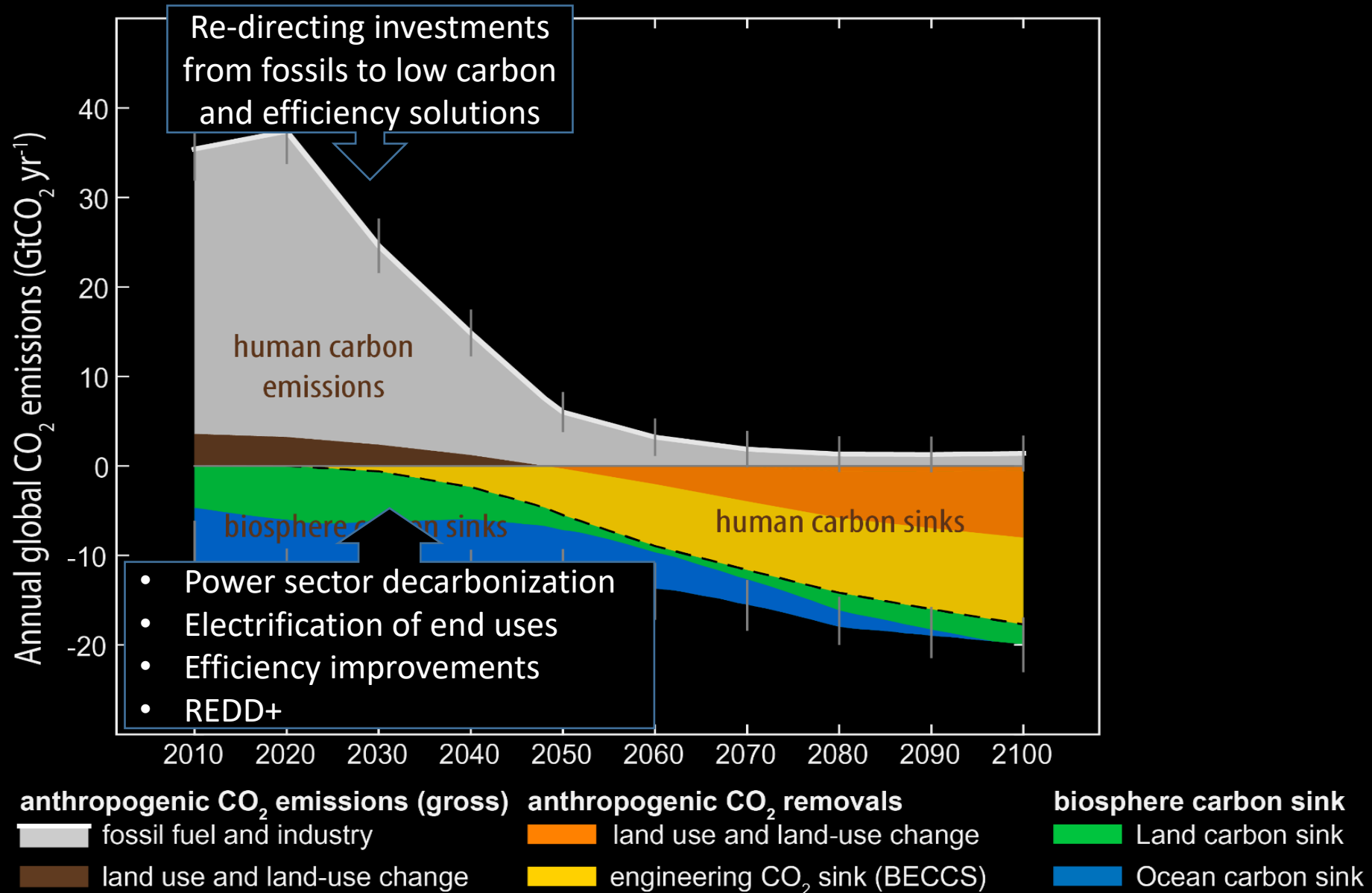


“Carbon Law”

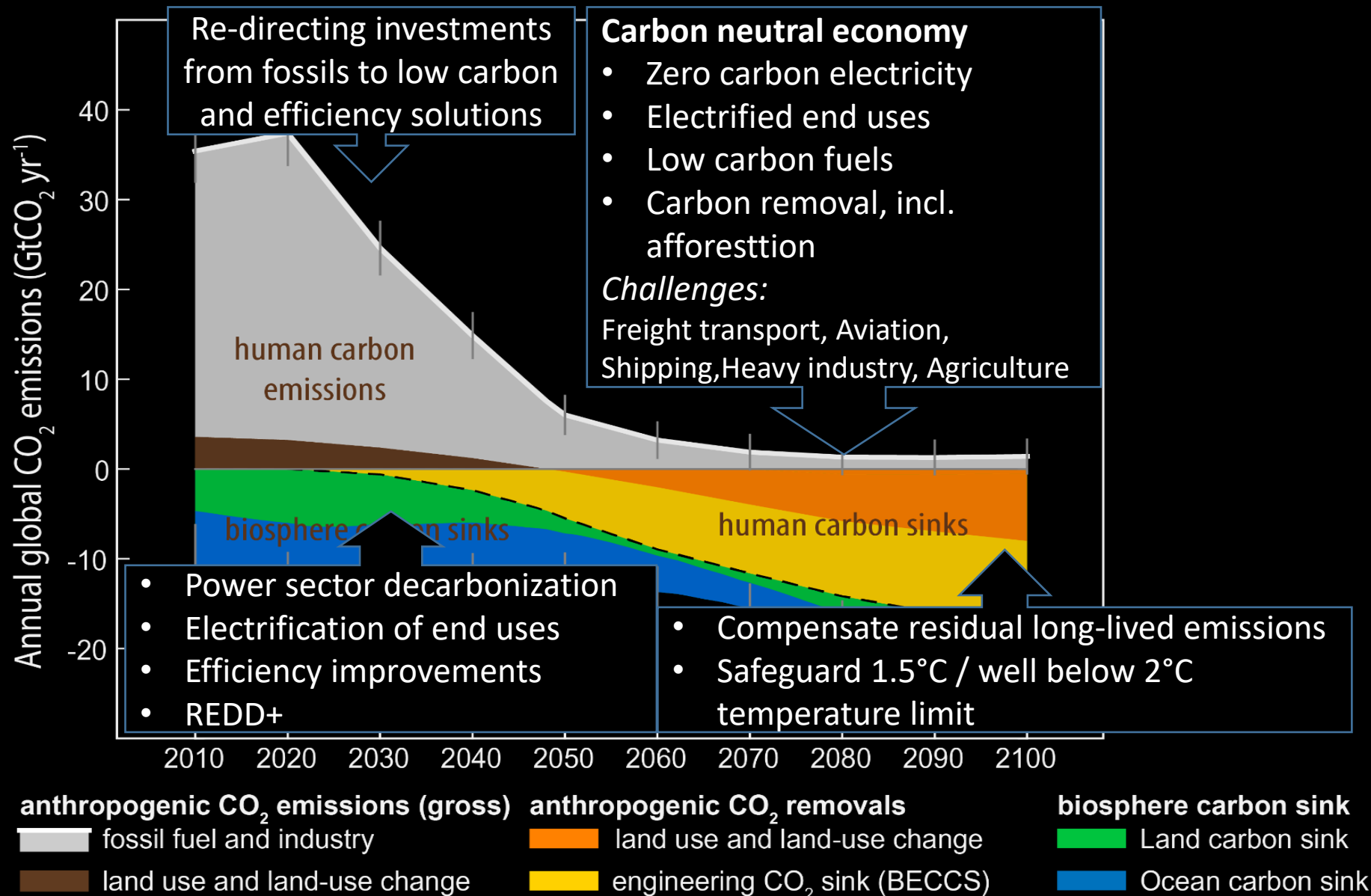


Source: Rockström, Gaffney, Rogelj, Meinshausen, Nakicenovic, Schellnhuber, 2017; IPCC SR1.5, 2019; Kriegler, 2019

“Carbon Law”



“Carbon Law”

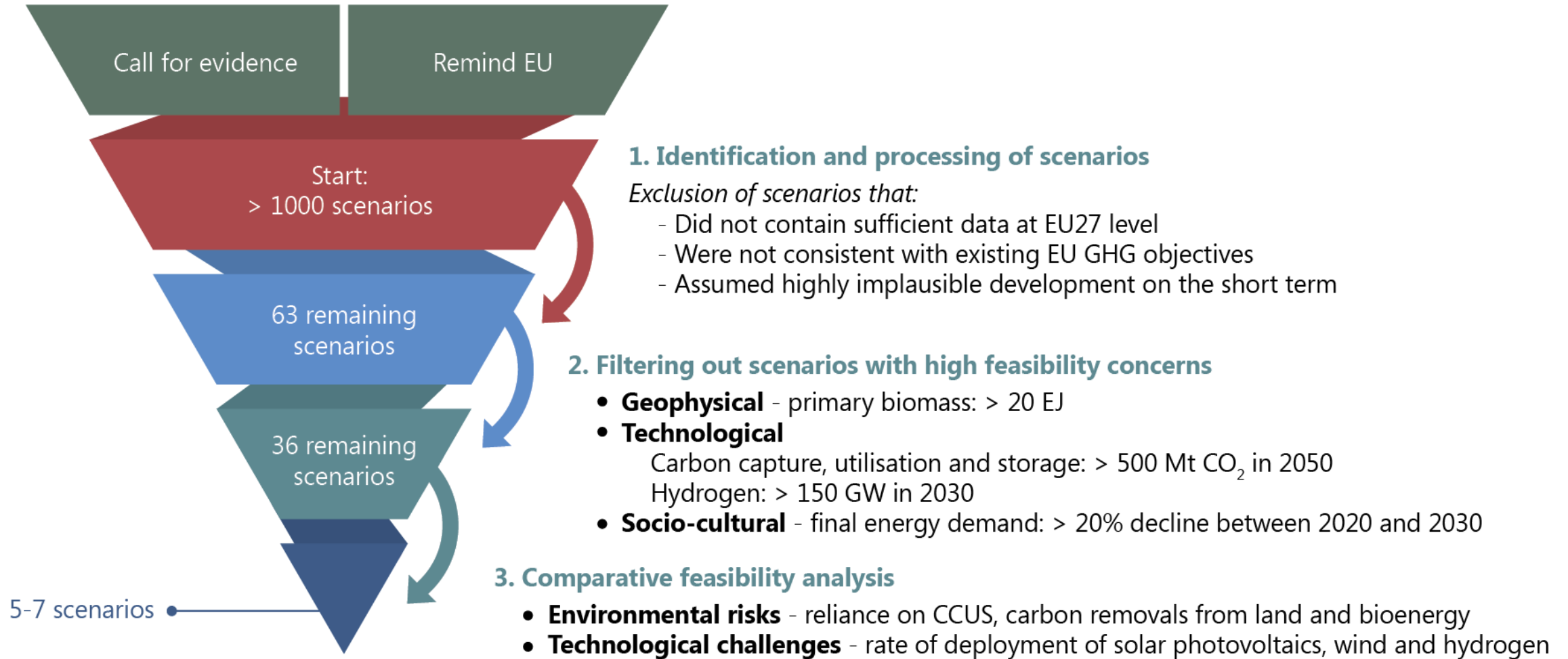


The Advisory Board recommends keeping the EU's greenhouse gas emissions budget within a limit of 11 to 14 Gt CO₂e between 2030 and 2050.

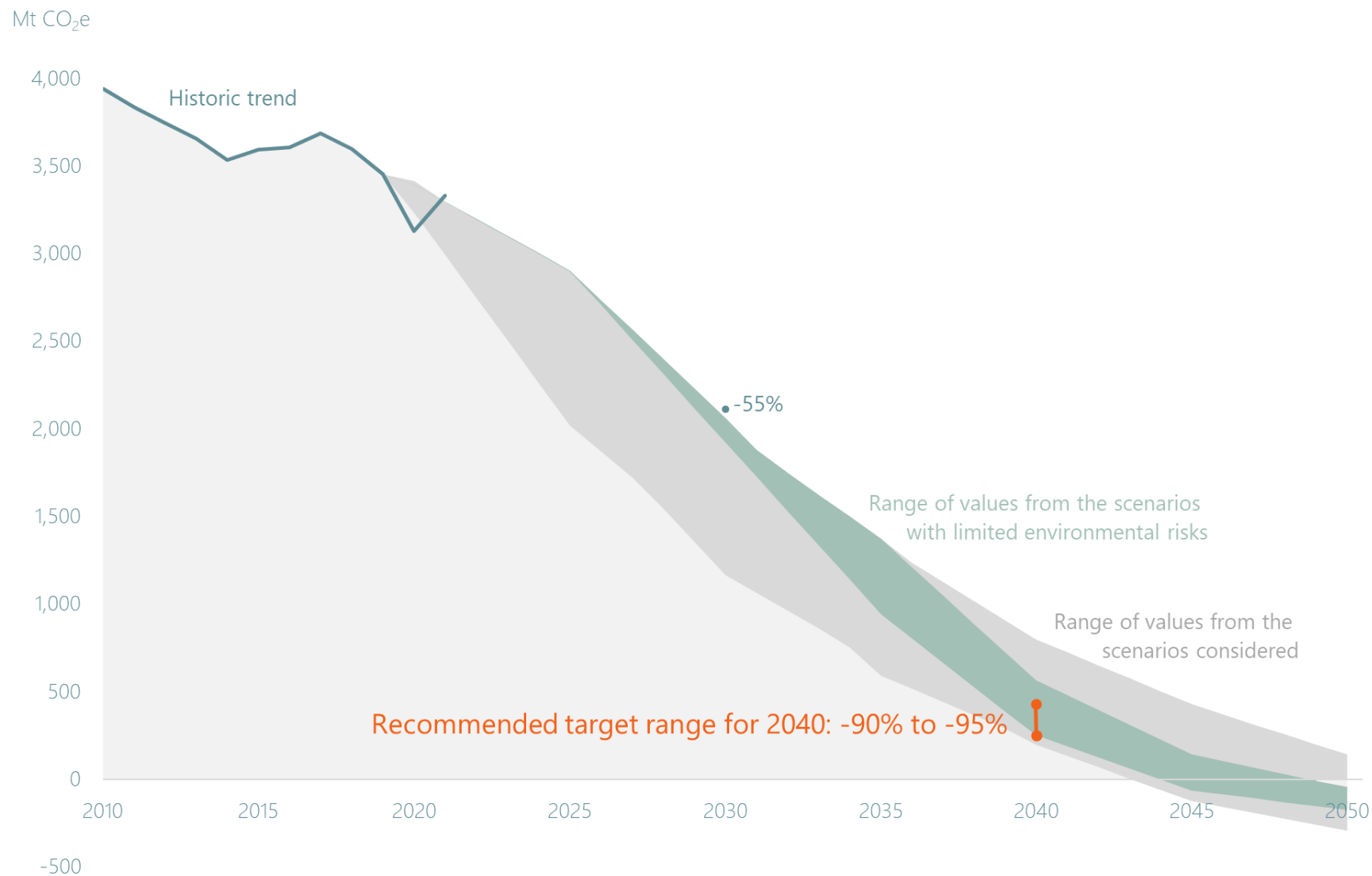
Staying within this budget requires emission reductions of 90–95% by 2040, relative to 1990.

This range considers multiple dimensions of fairness and feasibility of the emission reductions.

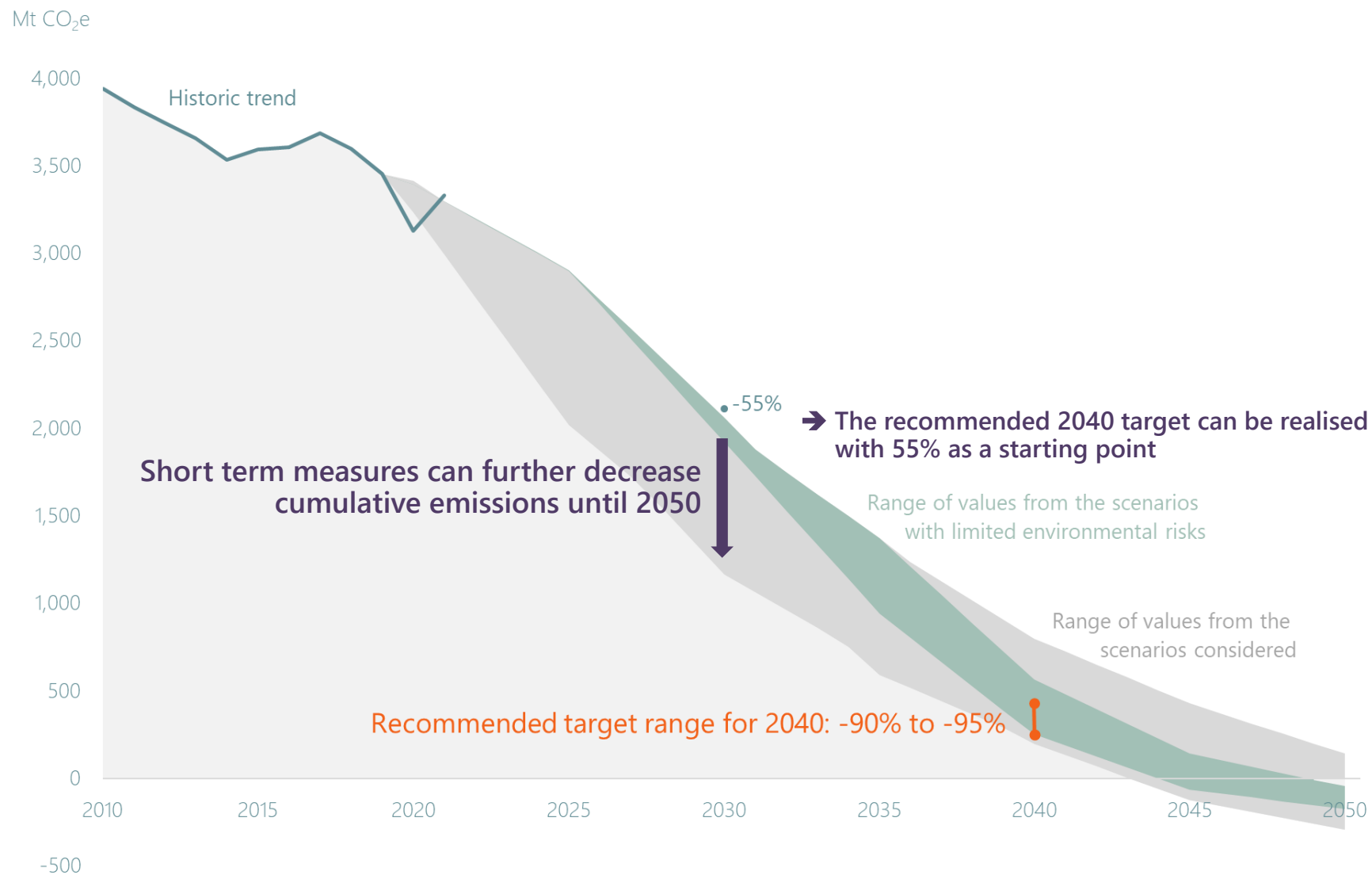
Considering the latest scientific evidence on emission scenarios compatible with 1.5°C and EU targets



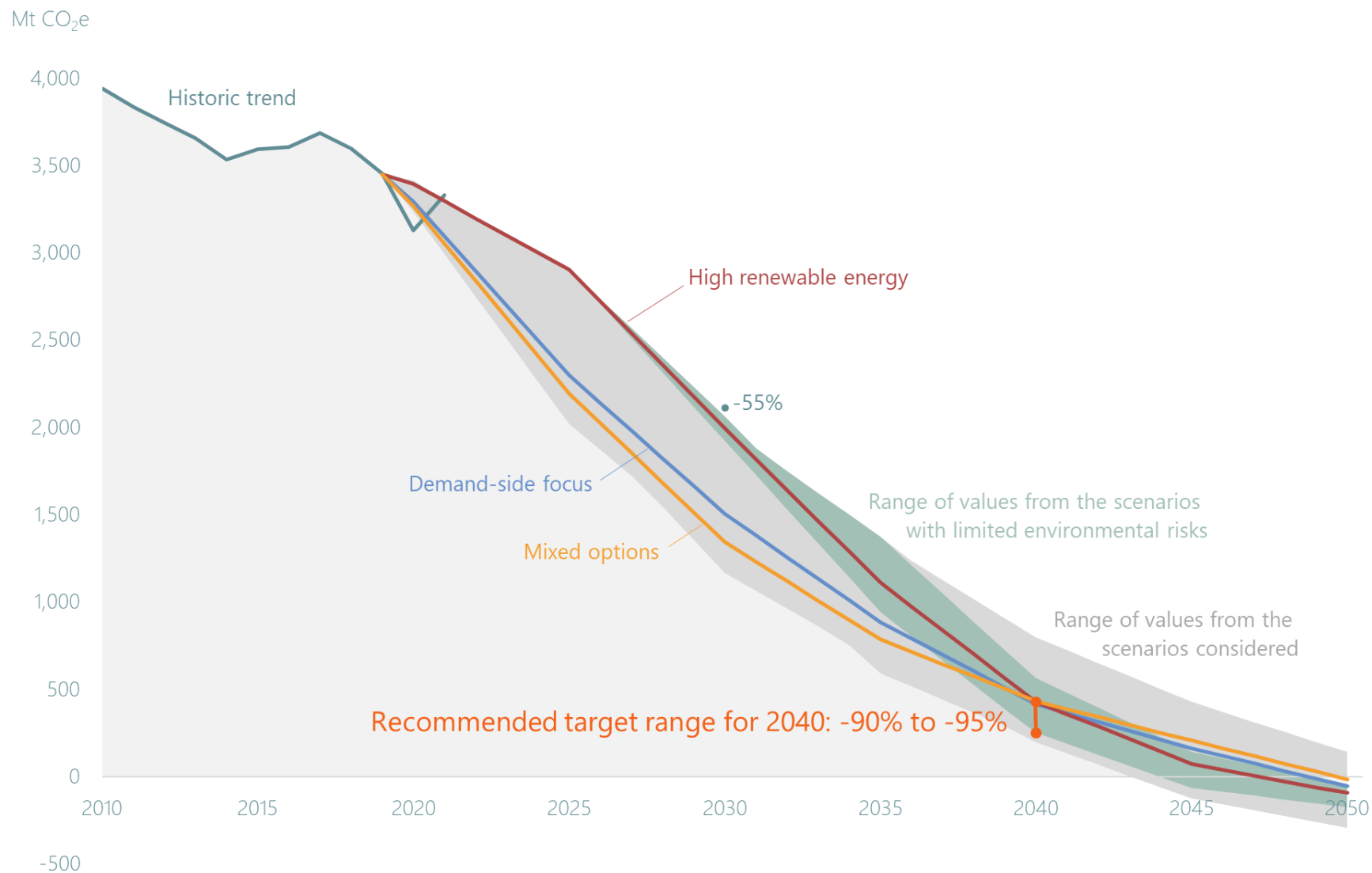
Recommended range of 2040 greenhouse gas emission reductions, and iconic pathways



55% is an appropriate milestone towards climate neutrality



Recommended range of 2040 greenhouse gas emission reductions, and iconic pathways



Europe's 2040 climate pathway

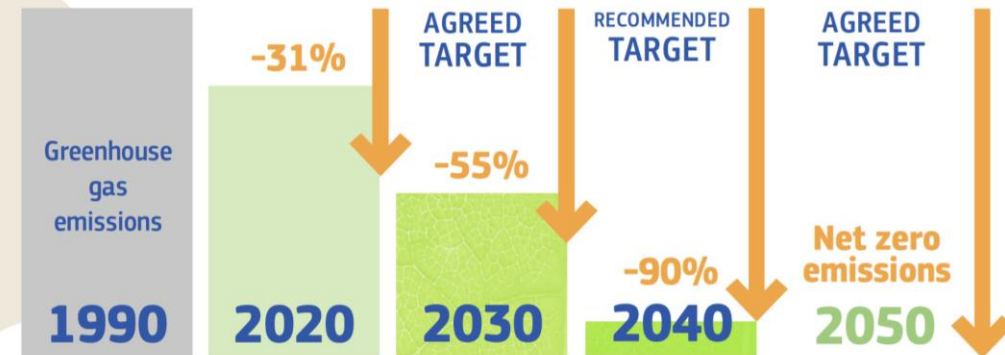
A path to climate neutrality by 2050



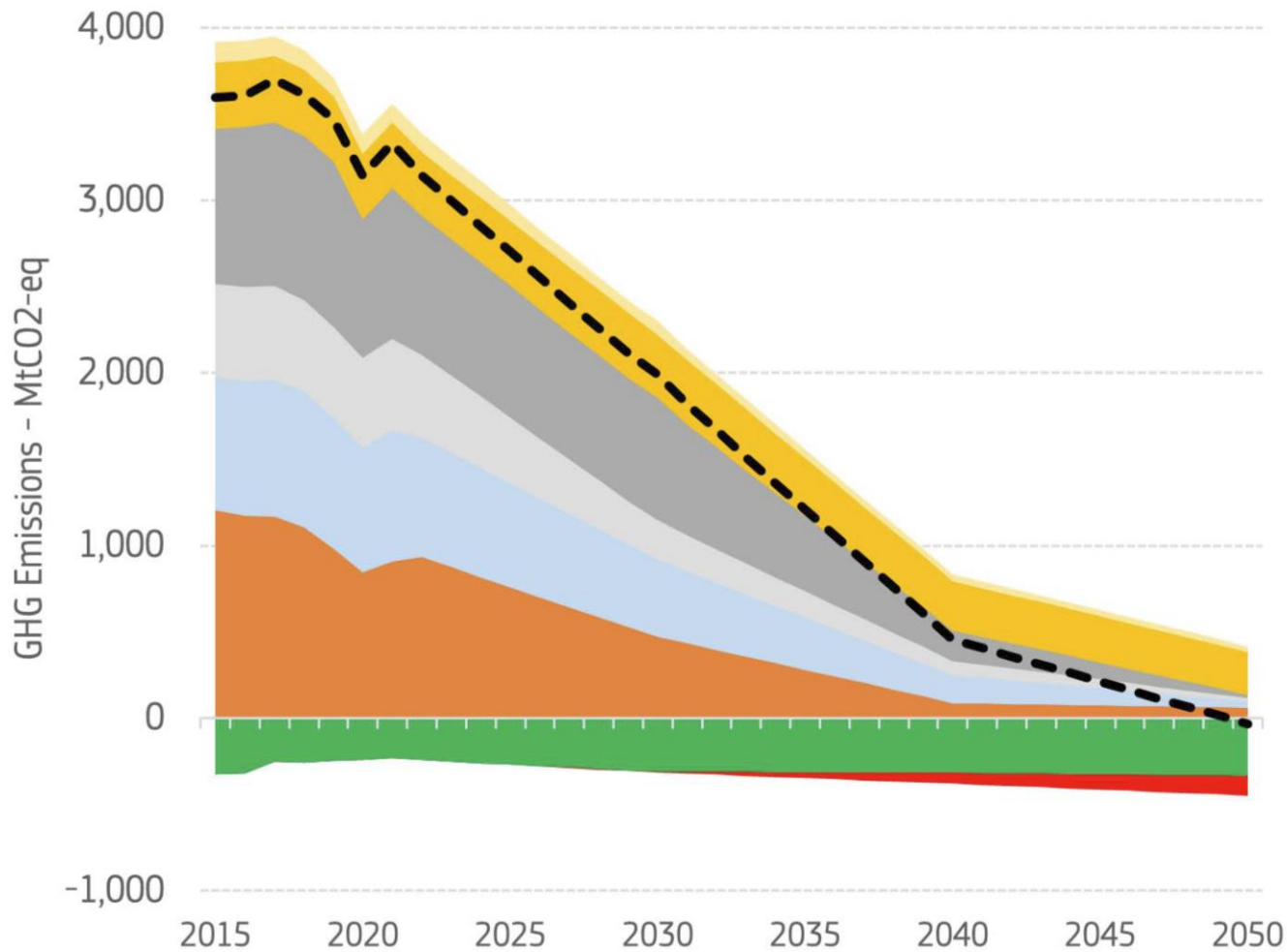
As a global leader in climate action, the EU has committed to **climate neutrality by 2050**. On the path to net-zero emissions, we must now build momentum for a **sustainable and competitive economy** and a **healthier and safer future for Europeans**.

The EU needs to stay the course set by the EU Climate Law and the Paris Agreement, and build an economy resilient to climate hazards, free of fossil fuels and other critical dependencies, with a competitive clean tech industry, and a transition that is fair for all.

The Commission is recommending that the EU sets a **90% net greenhouse gas emissions reduction target for 2040**, as compared to 1990 levels, **in line with scientific advice**. This recommendation is **the start of a political debate and an open dialogue with all stakeholders** in the process. The political and legislative decision on the 2040 target will need to be taken by the next Commission, after this year's European elections.



Historical and Projected GHG Emissions



Industrial removals

LULUCF

Waste

Agriculture

Transport

Buildings

Industry*

Energy Supply**

Net GHG emissions



Energy, Climate change, Environment

Climate Action

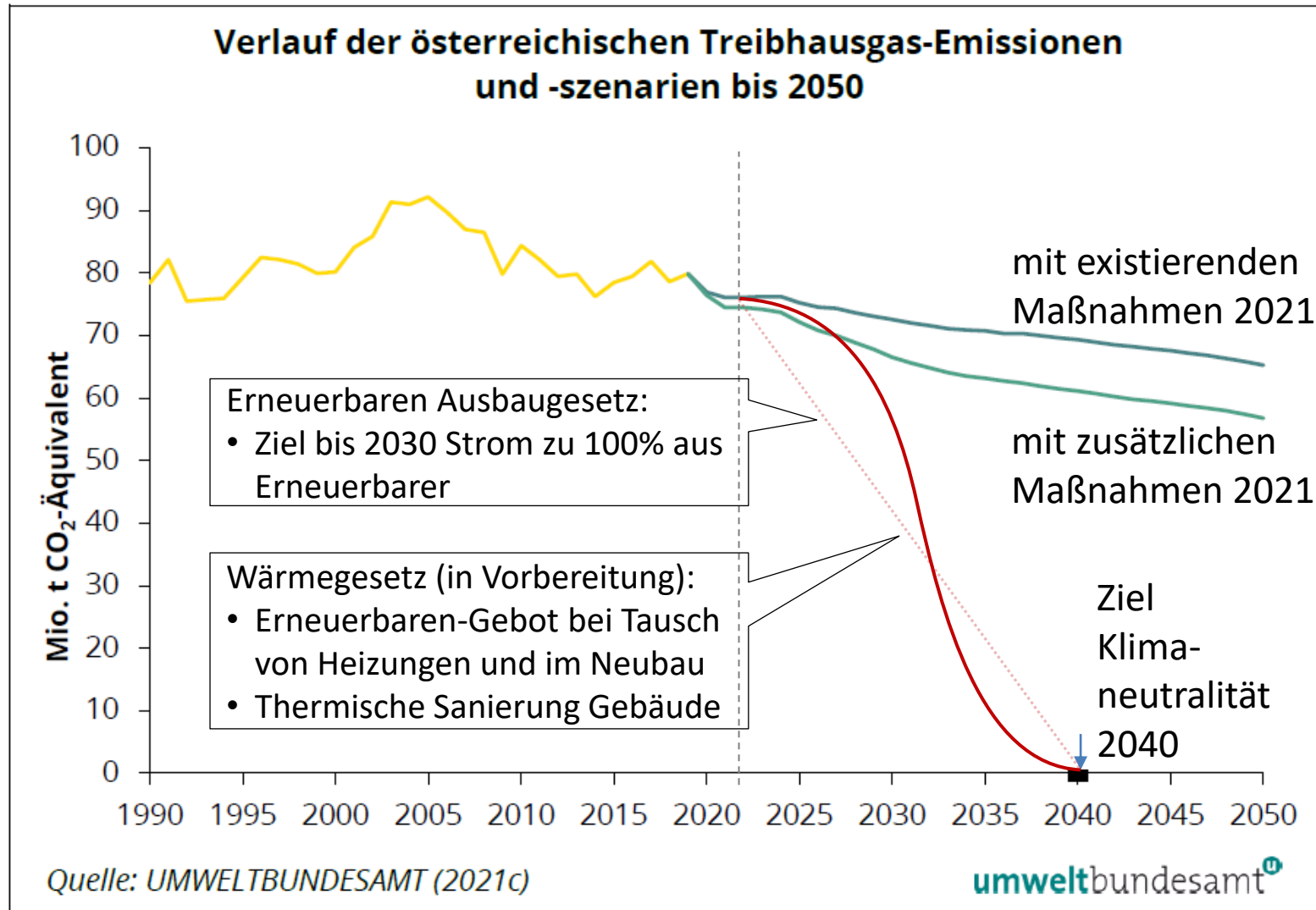
2040 climate target

Reducing net emissions by 90% by 2040

*Excluding non-BECCS industrial removals

**Including bioenergy with carbon capture and storage (BECCS)

Wo steht Österreich? Aktuelle Emissionen und Ziele



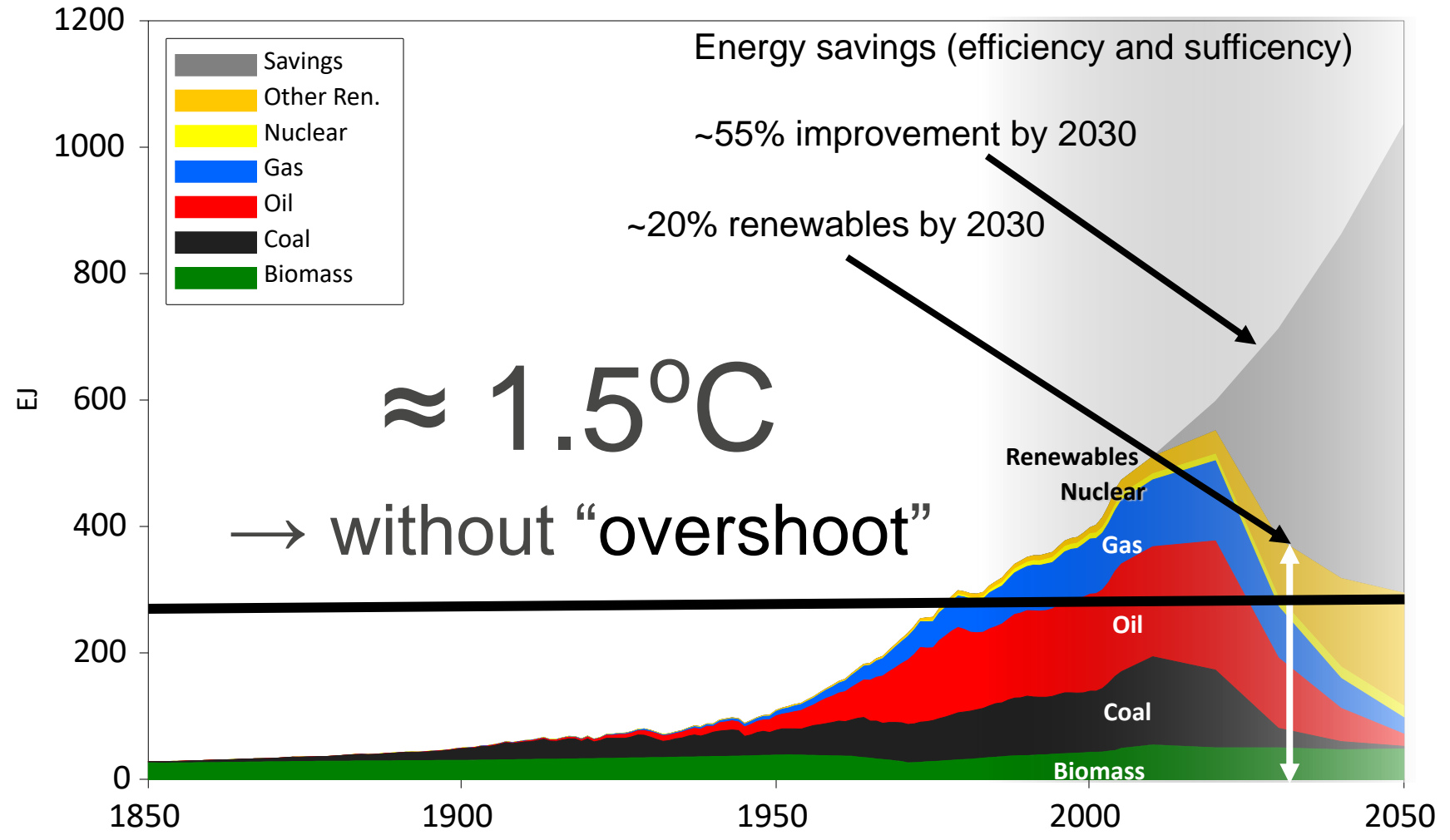
Background to Demand-Side Options



- **Recurrent theme in energy research and scenarios:** Lovins 1976; IIASA-EFW, 1981; IIASA-WEC, 1998; GEA, 2012; TWI2050, 2018-2020
- **Renewed interest reduce emissions 'overshoot'** Smith et al. 2016; SDGs (e.g., SDG12 consumption & production); benefits of granular solutions that can be replicated at scale with learning, Wilson et al., 2020
- **LED scenario** of Grubler et al., 2018 as input to IPCC Special Report on 1.5°C, IPCC, 2018; IPCC AR6 Chapter 5, Creutzig et al., 2022
- **Energy Demand changes Induced by Technological and Social innovations (EDITS)** network formed in 2018, co-organized by IIASA and RITE with funding from METI
- **EDITS** activities include thematic working groups, quarterly and annual meetings, fast-track research projects, scenario narratives and models

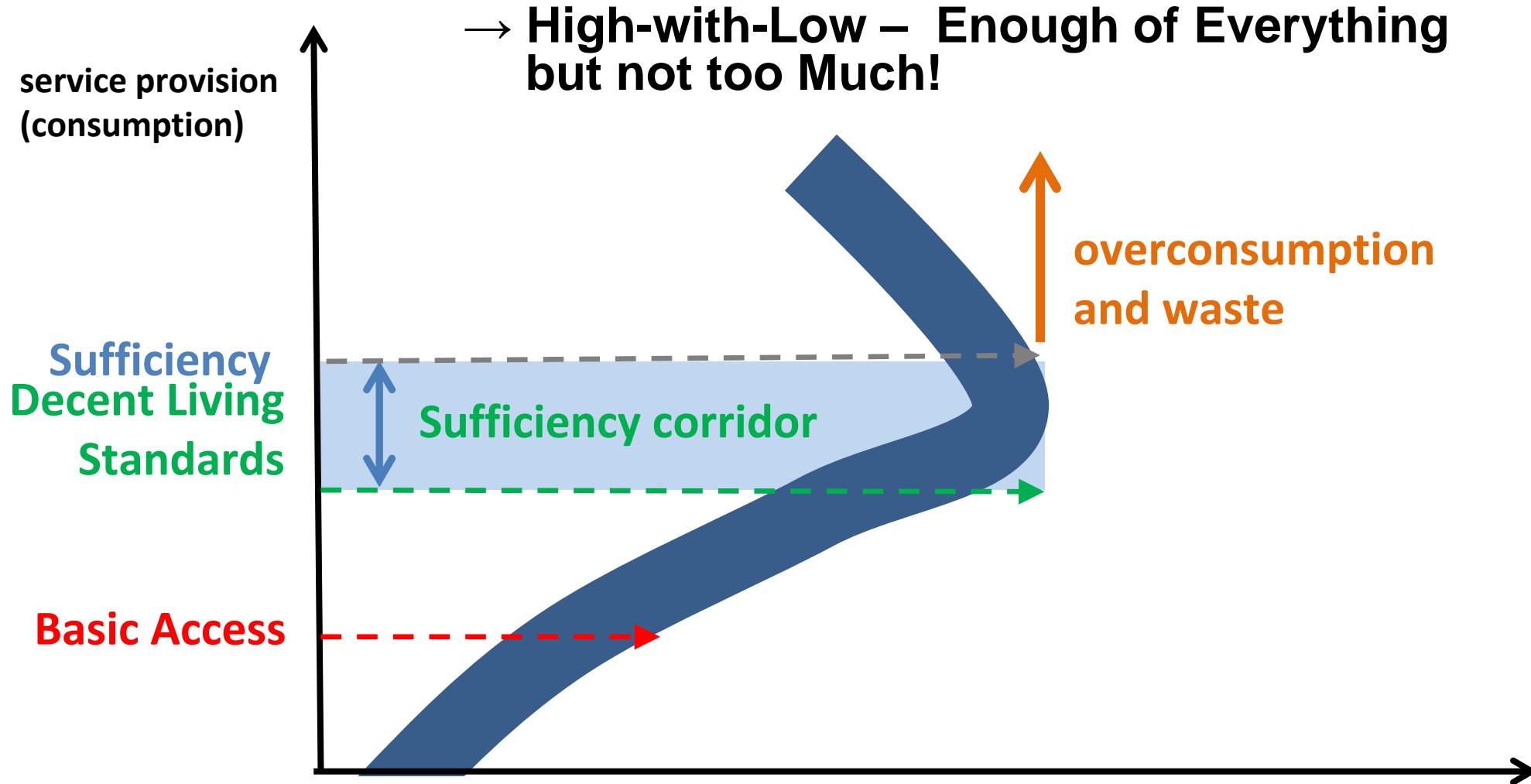
Global Primary Energy

EDITS Low Energy Demand (LED)



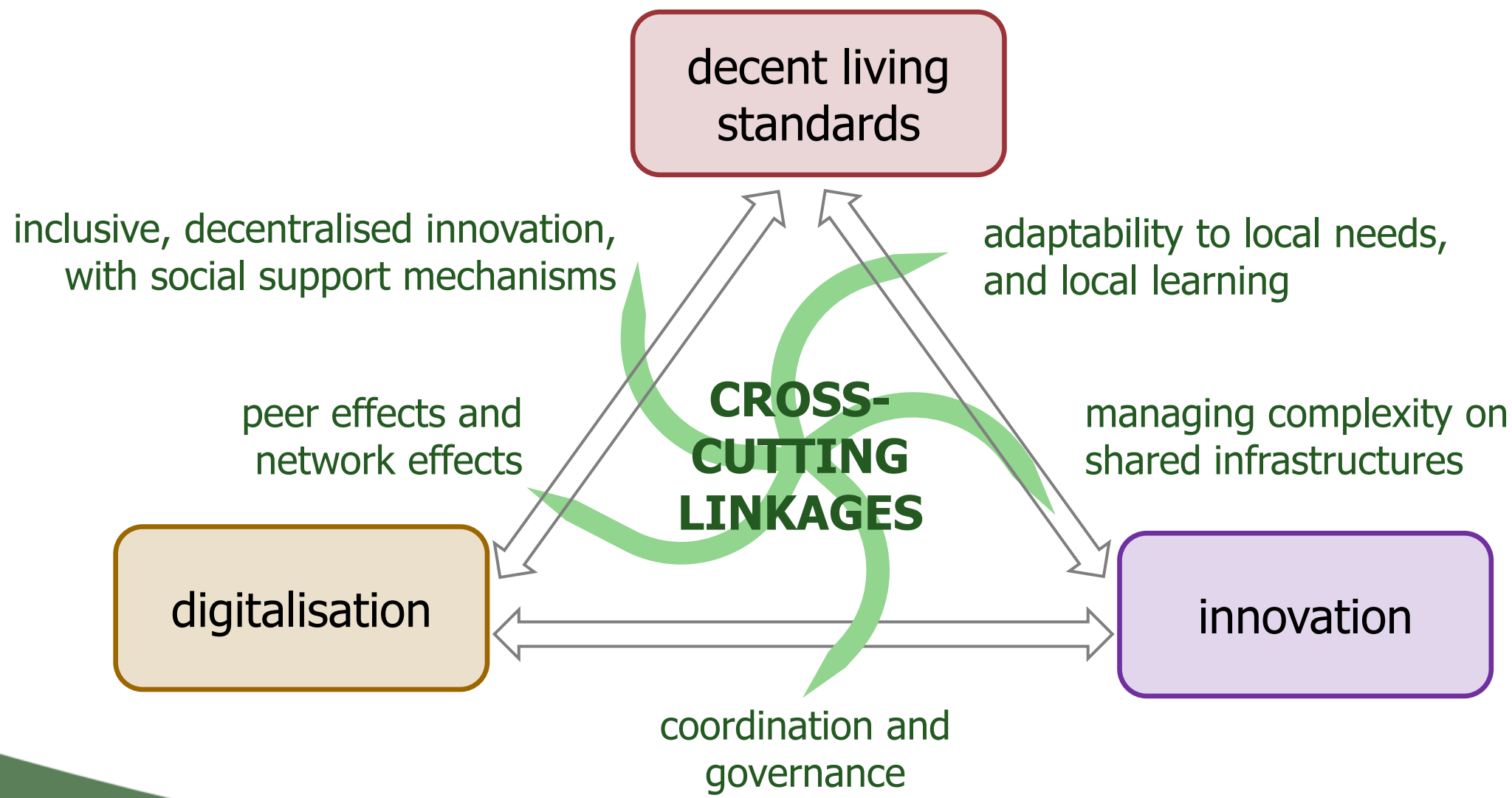
Source: After Grubler et al, 2018

Decent Living and Sufficiency



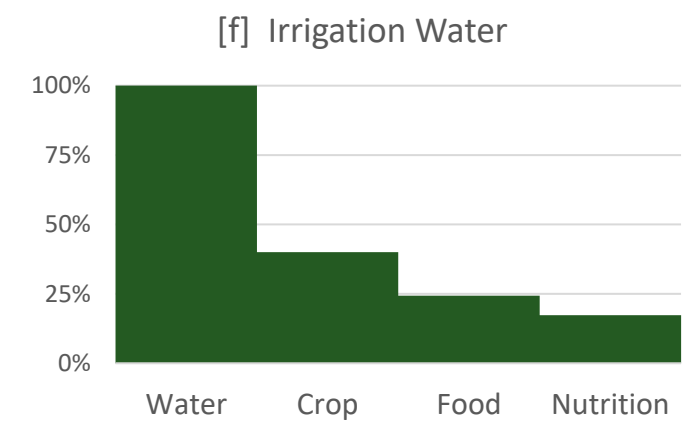
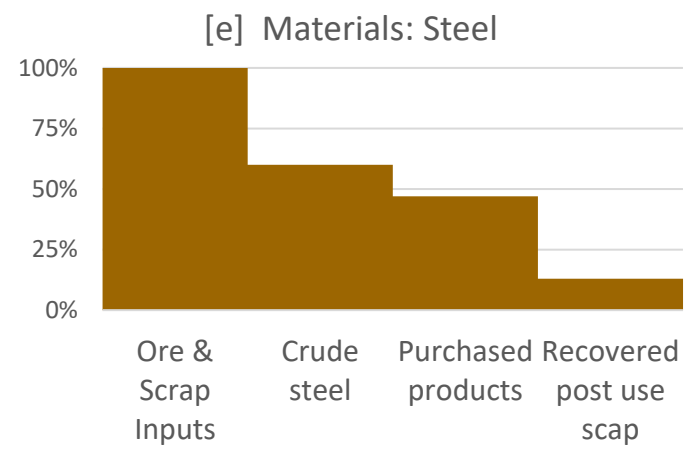
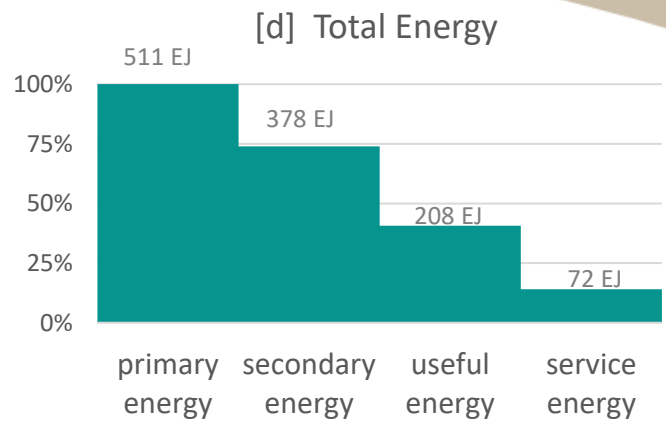
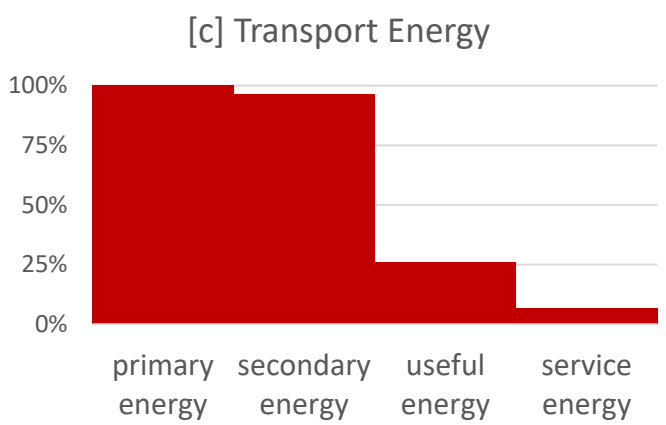
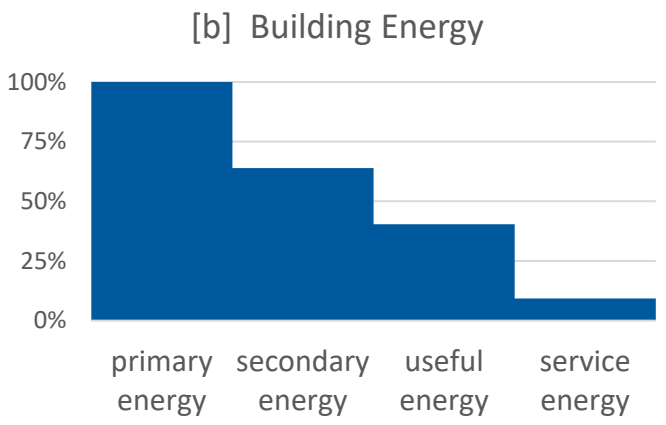
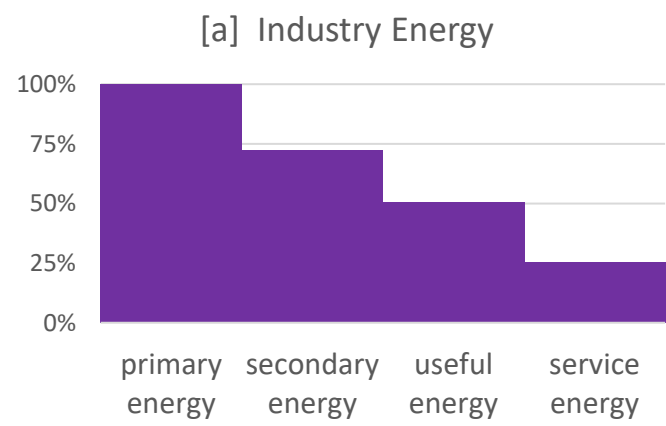
→ **New values and norms; new morality and ethics for a just, safe and beautiful future for all**

'High-with-Low' scenario further develops 3 key themes from LED ... and cross-cutting linkages



Tapping the enormous potential for services-led transformation

Source: Wilson, Grubler, and Zimm (2022). Energy-Services Led Transformation. In: *Routledge Handbook of Energy Transitions* (Ed: Araujo).
 Data from: Grubler et al. (2018), De Stercke (2014), Nakicenovic et al. (1993), Nakicenovic (1990).

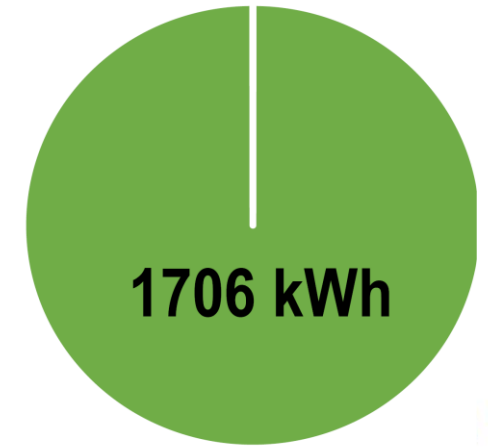


← savings
 ← amplify back up through resource conversion cascade ...
 and provide more flexibility, security, and resilience in resource conversion and provision of services.

Impact of IC Technology Convergence



	Camera		iTunes
	E-mail		Maps
	Sirius radio		White noise
	Phone		Netflix
	Alarm clock		Contacts
	New York Times		Hulu
	Photo album		Video camera
	Voice recorder		Compass
	Weather station		Dictaphone

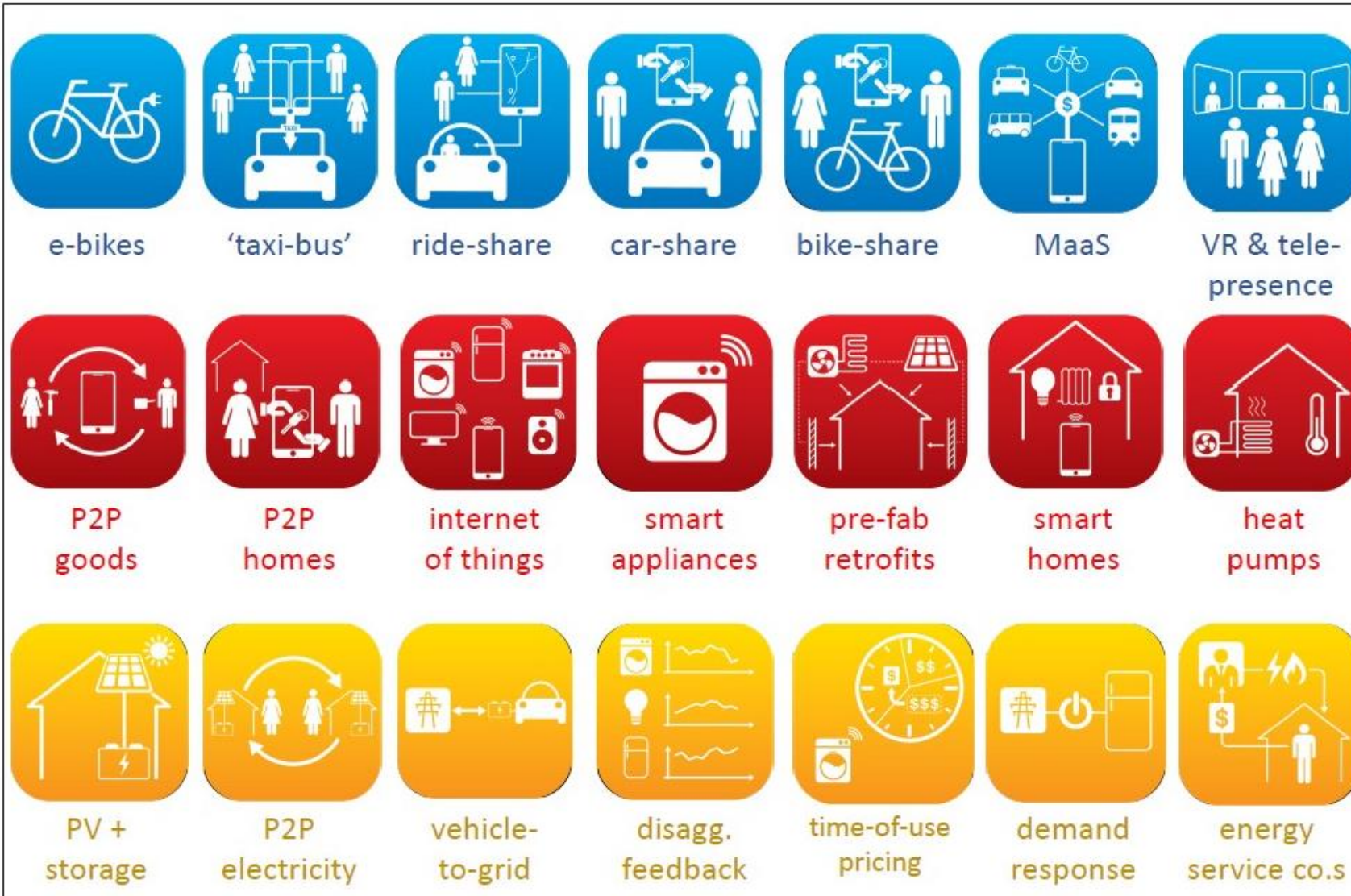


Embodied energy



Weight

Disruptive End-User Innovations

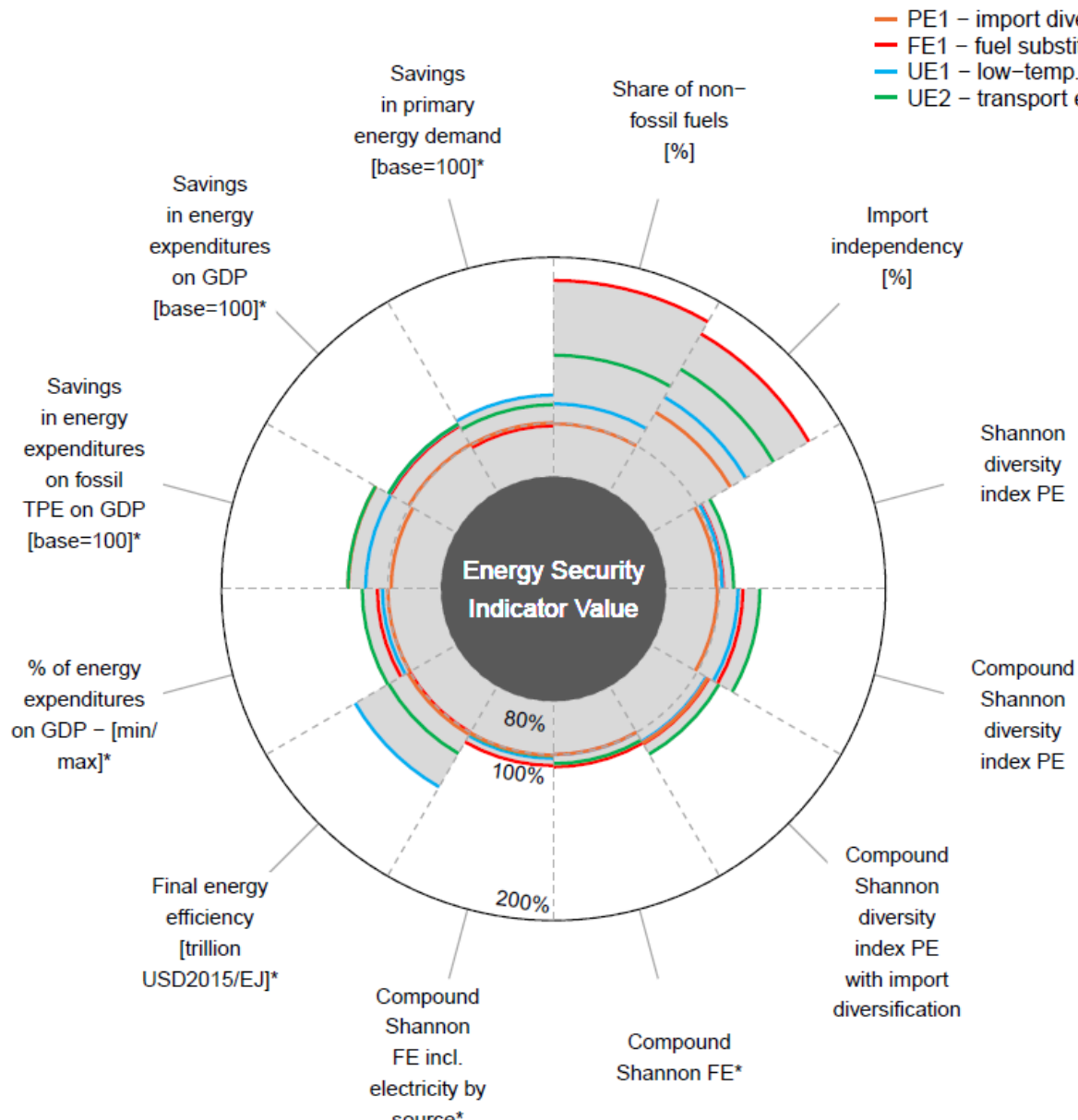


✓ Ownership to usership

✓ Sharing economy

✓ Automated to connected

Demand-side policies help energy security

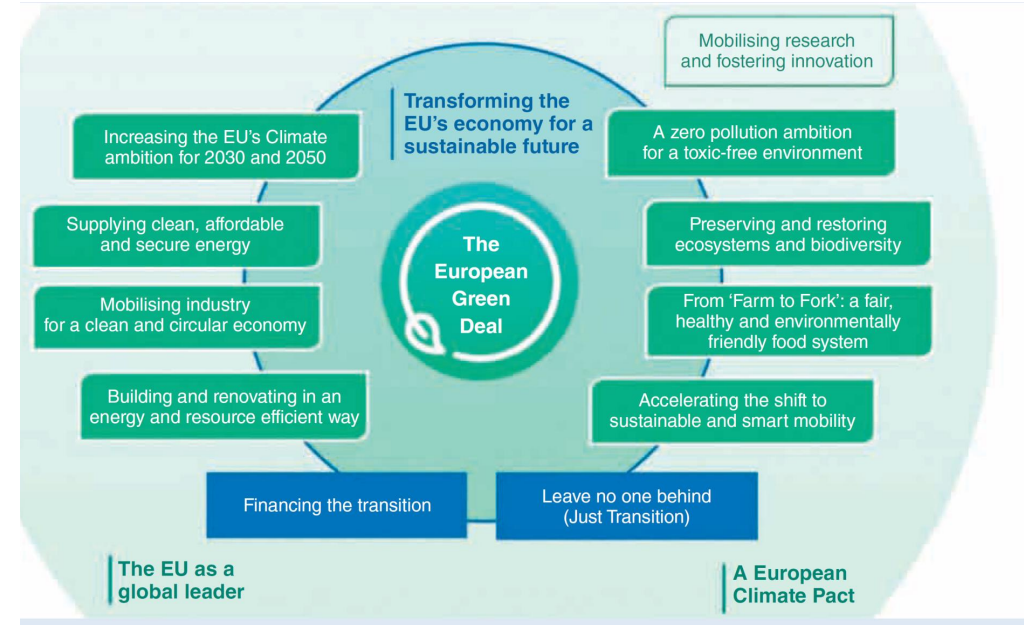


- Usual energy-security policy response is to change fuel supplier or fuel switch, while end-use technology and behavior changes are rarely utilized
- We show that energy-demand interventions deliver better on national and individual energy security
 - electrification of transport, e.g. EVs or electric rail
 - performance improvement of buildings, e.g. insulation or construction of passive houses
- Energy security is not the same as supply security
 - supply-side policies (e.g. fuel substitution) score well on the share of non-fossil fuels and import independency
 - Demand-side policies improve longer term resilience and vulnerability to further crises

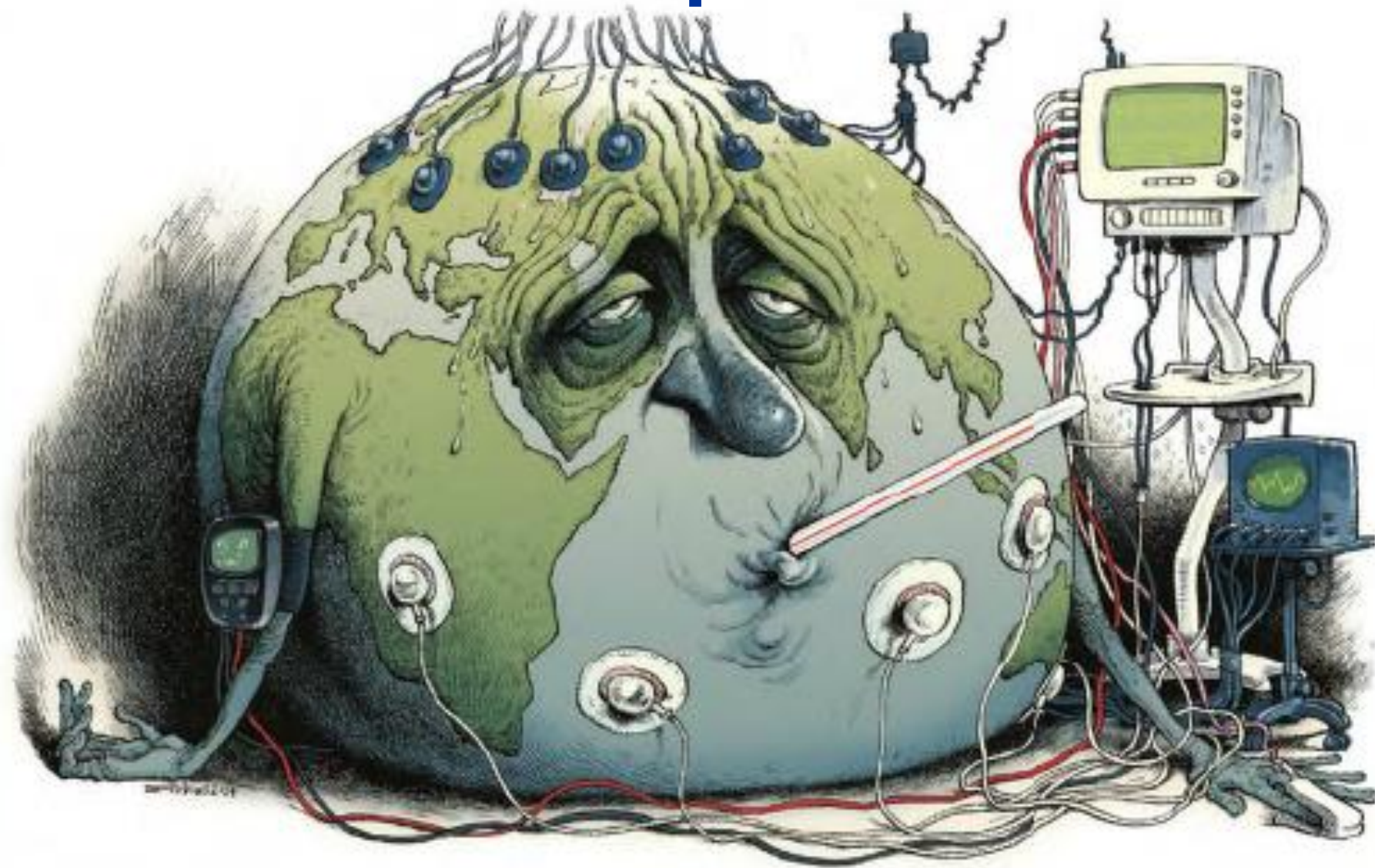
Source: Bento, Grubler, Boza-Kiss, De Stercke, Krey, McCollum, Zimm, Alves. Leverage demand-side policies for energy security. Science Policy Forum. Science, 2024

The New Bauhaus World

- The New European Bauhaus translates the European Green Deal into a tangible, positive experience in which all Europeans can participate and progress together.
- It inspires a movement to facilitate and steer the transformation of our societies along three inseparable values:
 - **Sustainability**, from climate goals to circularity and biodiversity
 - **Inclusion**, from valorising diversity to accessibility and affordability
 - **Beauty**, from aesthetics of experience to style beyond functionality
- The approach is multi-level from global to local, participatory and transdisciplinary.



Collective Responsibility in the Anthropocene





© Jasmin Dobrovsky
My balkony in 2050
EDITS arts competition
2022

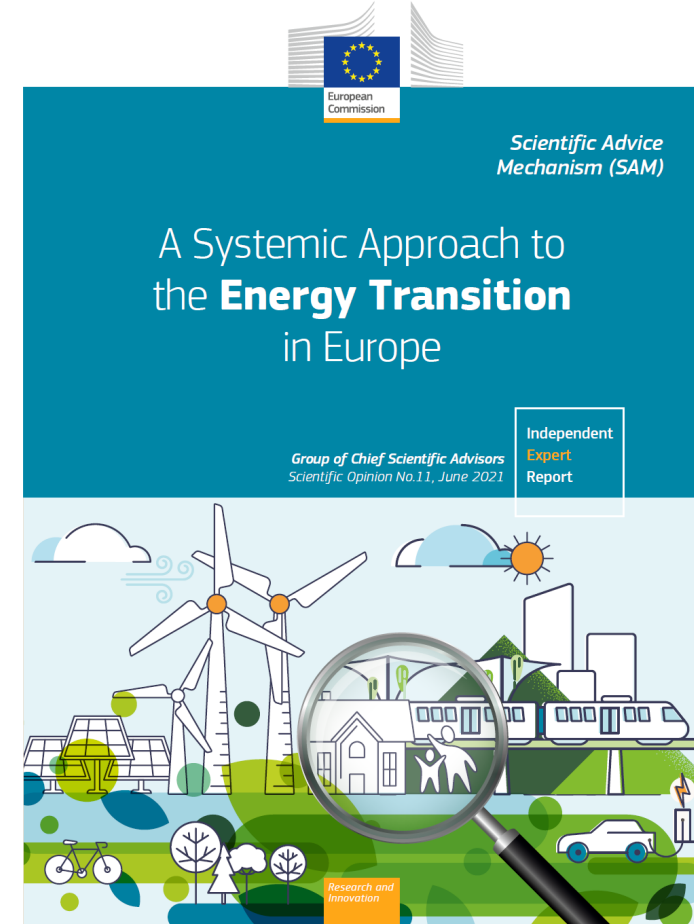


ありがとう

Visit: <https://iiasa.ac.at/winners-of-edits-arts-2022-competition-life-in-2050-with-much-less-energy>

ありがとう

science for global insight



www.TWI2050.org **SAM**

naki@eeg.tuwien.ac.at

