

# Phase out of Fluorescent Light Tubes – what's the status?

Lighting days 2024-11-20

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The Swedish Energy Agency

# Background

# On the Jevon's paradox – rebound effects

- Higher efficiency or productivity will lead to something in between
  - Same benefit, using less amount of resources, or
  - Increased benefit, using the same amount of resources
  - *Resources*: Materials (including energy), money, time, brain power
- In practice you will see all variants in between the boundaries
- Naturally, since companies are driven by profit (classic Marx) it's a big chance you'll see a tendency towards more "benefits"
- There is also an *abundance* of money because of a loan-based economy sustaining that tendency
- If you want to avoid that, you need *complementary* guides, policies and regulations

# For lighting

- You need to be careful of what you are talking about:
    - Input: Use of electricity [kWh] and of material, such as CRM, aluminum etc [kg]
    - Output, the benefit/service: Provided light, in lumenhours [lmh]
  - Global trend:
    - 2005: 135 petalumen-hours of delivered light, using approximately 18% of the global electricity consumption
    - 2024: 240 petalumen-hours in 2024, using around 12% of the global electricity consumption (slightly higher than 2005 in absolute numbers)\*
- > Strong decoupling: Providing more light (for good and bad) while at the same time using only little more energy

Material use: Remains to be analysed. *NB*: Materials not used as fuel are *in principle* possible to recycle over and over again

\* 2024-ILDC-1087 *Lighting, Energy, Environmental Impacts and Associated Regulations*. M. Scholand, J. N. Bardsley, N. Borg, P. Bennich and G. Zissis.



# Discussions today on the role of capitalism

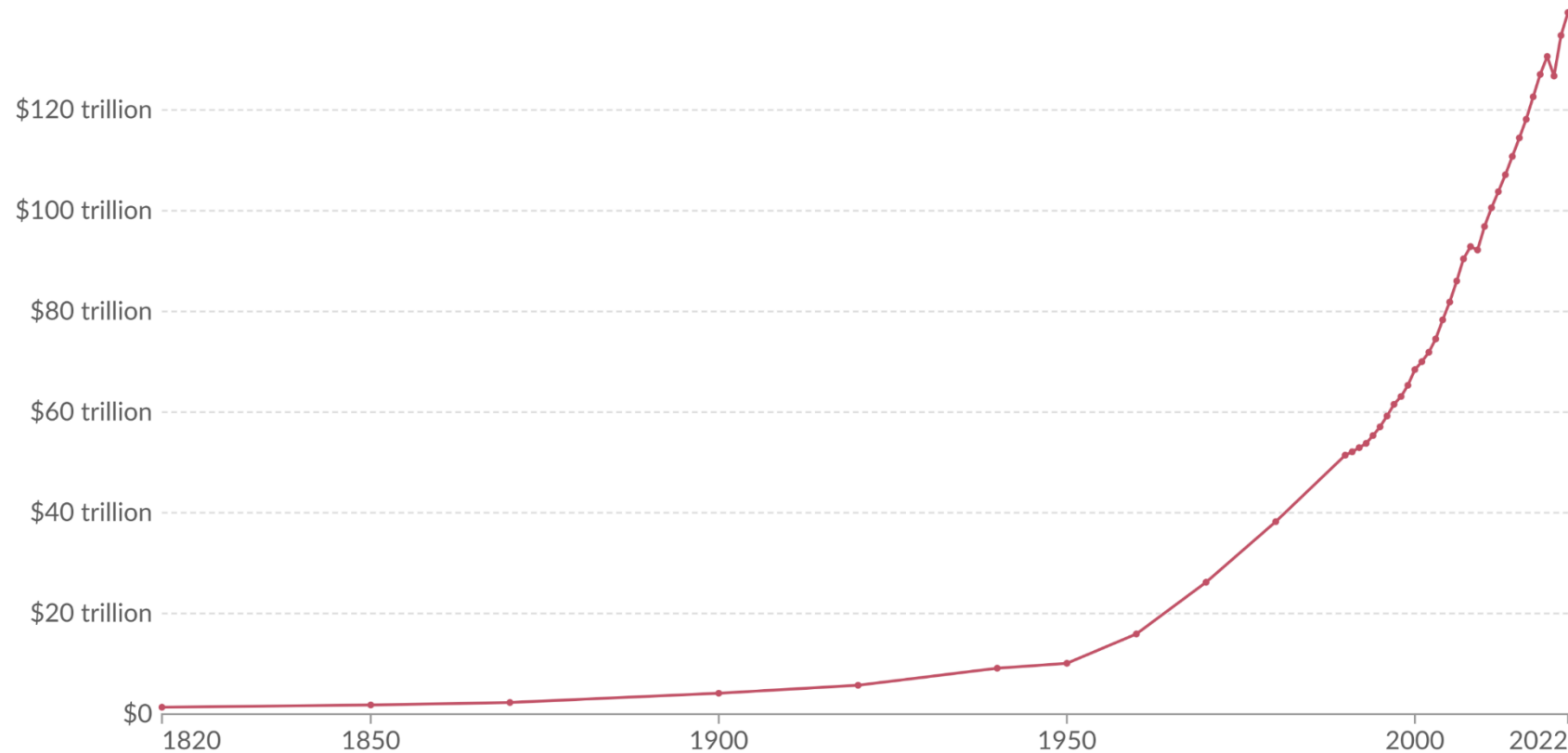
- Green (clean) growth: Just switch to fossil free energy and continue as usual, i.e. decoupling of growth and emissions
- Green deal = Green growth with a large degree of public interventions through regulations and finance. E.g. EU
- Steady-state economy: No more growth, switch to fossil free energy supply, and (probably) no more virgin material supply
- Degrowth: Since capitalism causes crisis in the economy and the ecological systems due to intrinsic mechanisms (profit, accumulation, etc – classic Marx), we need to use less resources  
-> we need to shrink the economy

# GDP Globally 1820 – 2023

## Global GDP over the long run



Total output of the world economy. These historical estimates of GDP are adjusted for inflation. We combine three sources to create this time series: the Maddison Database (before 1820), the Maddison Project Database (1820–1989), and the World Bank (1990 onward).



Data source: World Bank (2023); Bolt and van Zanden - Maddison Project Database 2023; Maddison Database 2010

Note: This data is expressed in international-\$1 at 2017 prices.

[OurWorldInData.org/economic-growth](https://OurWorldInData.org/economic-growth) | CC BY

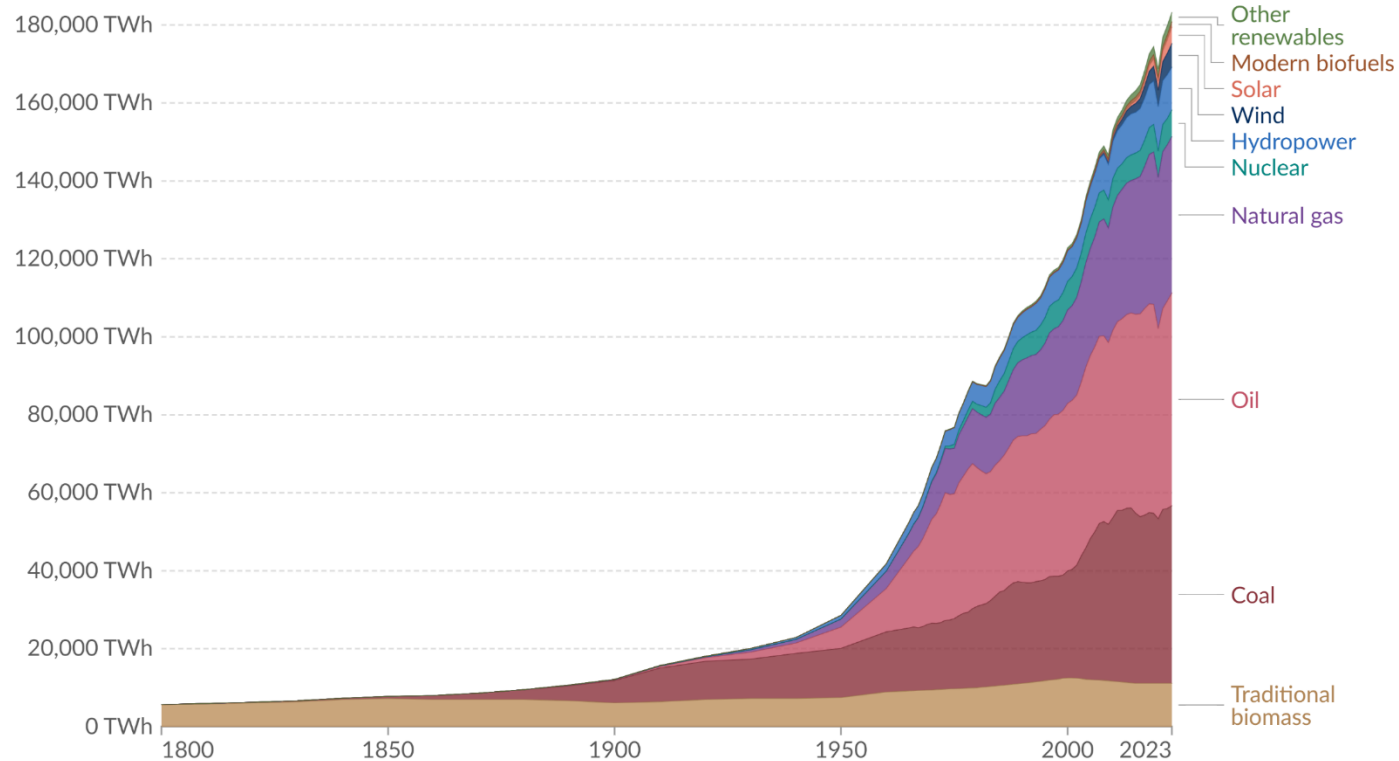
# Global energy mix 1800 – 2024

## From 1950: *The great acceleration*

### Global primary energy consumption by source

Primary energy<sup>1</sup> is based on the substitution method<sup>2</sup> and measured in terawatt-hours<sup>3</sup>.

Our World  
in Data



Data source: Energy Institute - Statistical Review of World Energy (2024); Smil (2017)

Note: In the absence of more recent data, traditional biomass is assumed constant since 2015.

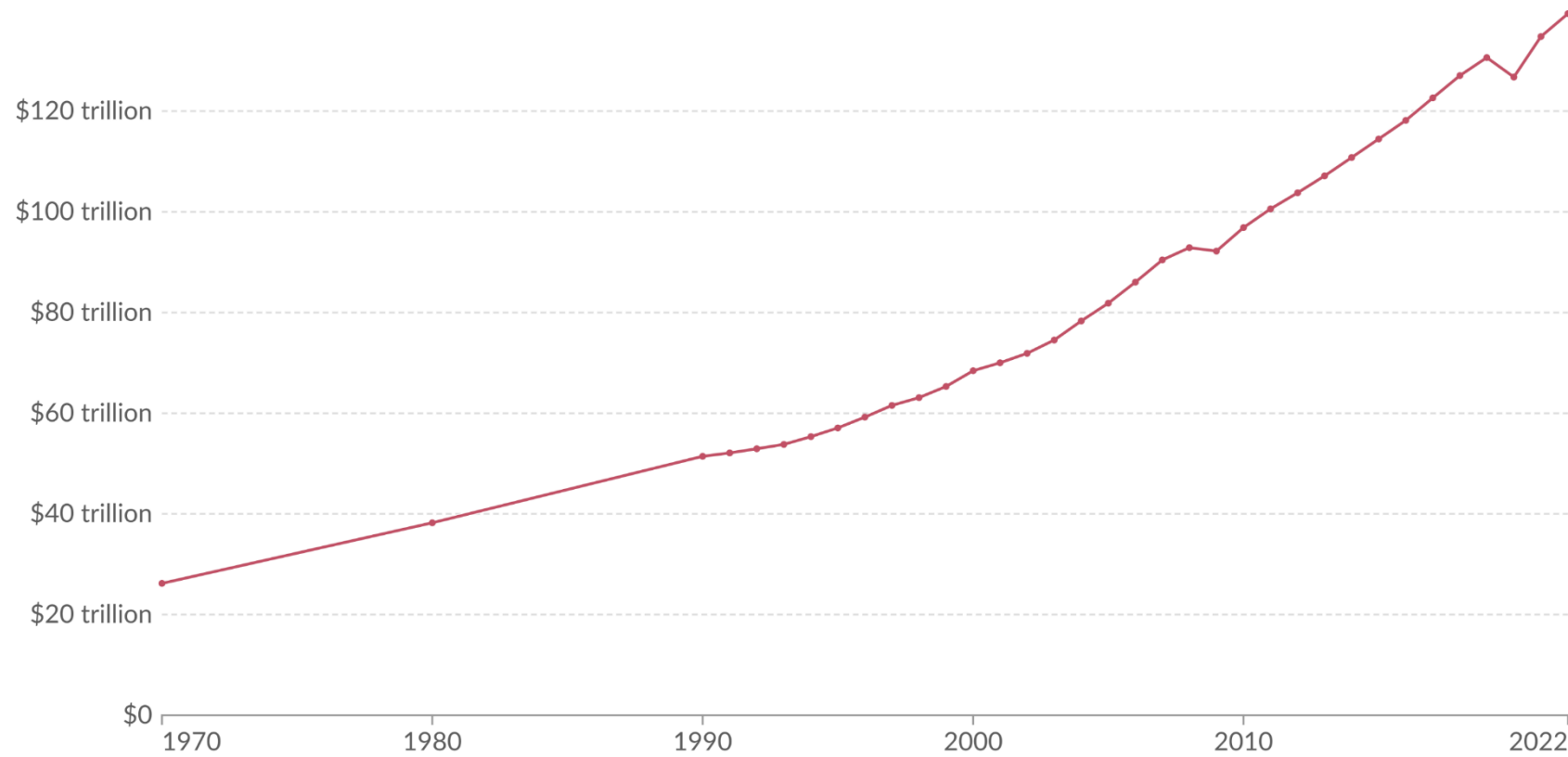
OurWorldInData.org/energy | CC BY

# GDP Globally 1970 – 2023

## Global GDP over the long run



Total output of the world economy. These historical estimates of GDP are adjusted for inflation. We combine three sources to create this time series: the Maddison Database (before 1820), the Maddison Project Database (1820–1989), and the World Bank (1990 onward).



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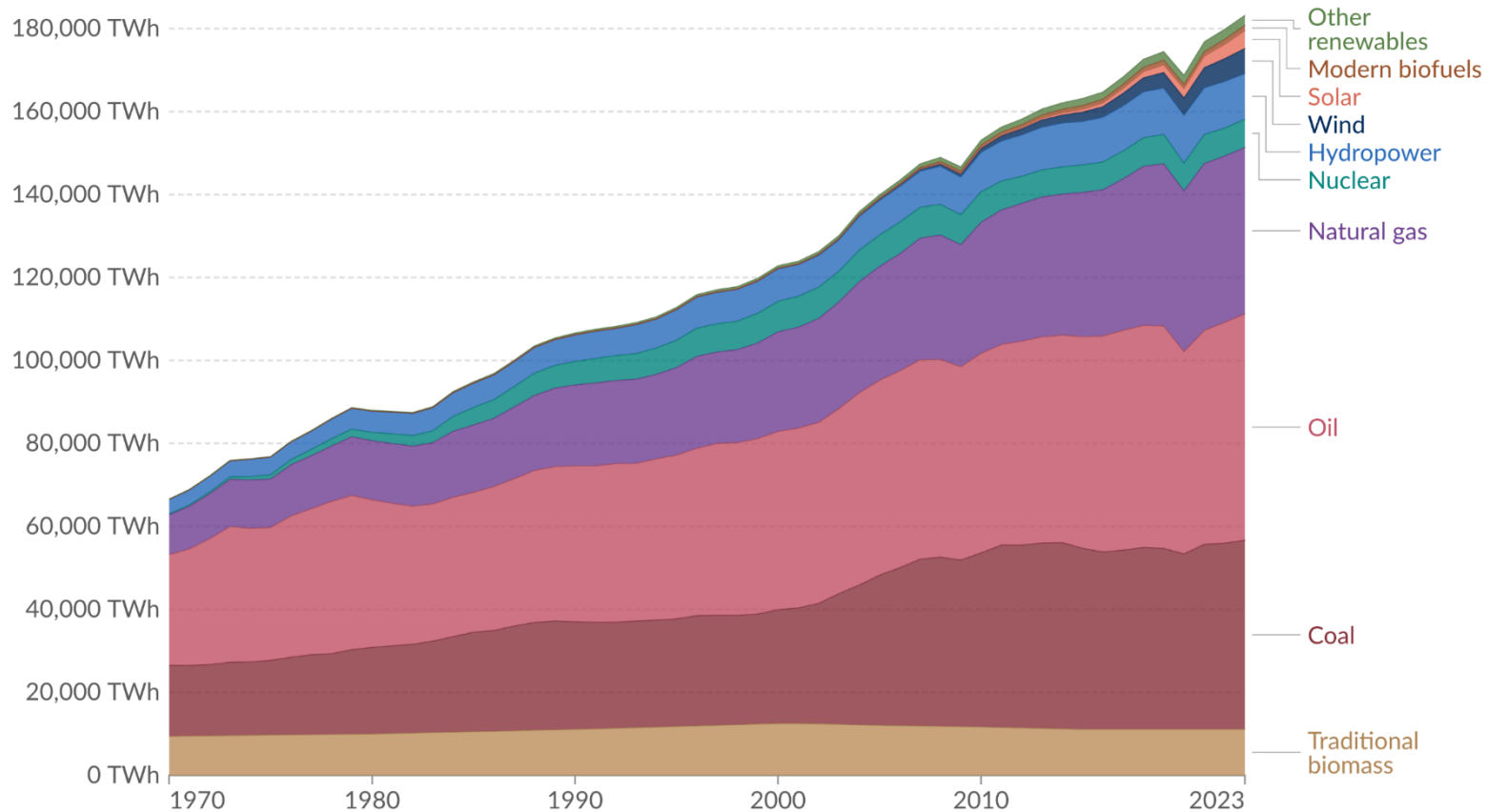


# Global energy mix 1970 - 2024

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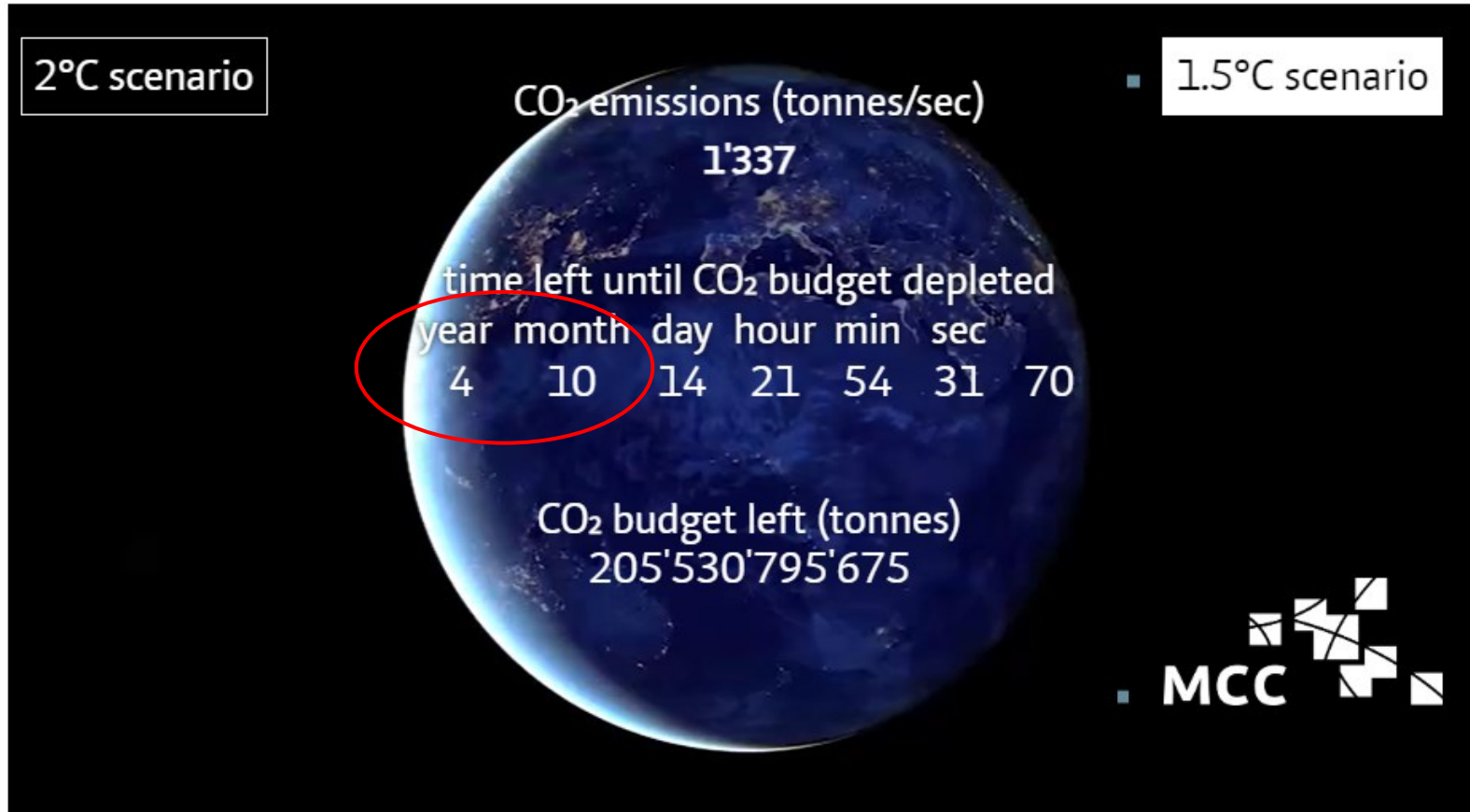
OurWorldInData.org/energy | CC BY

# Global population (2017)



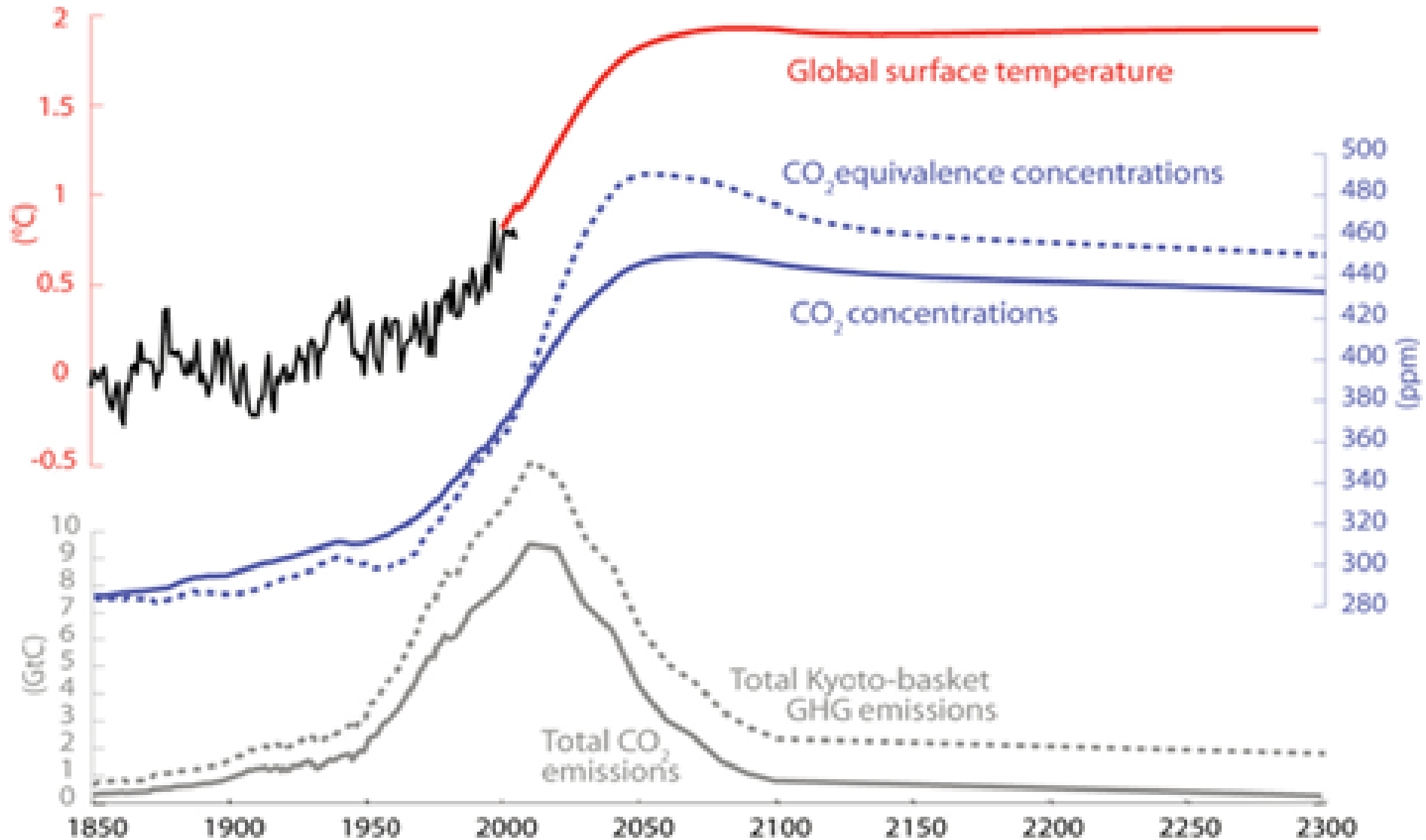
Drygt **8 miljarder** människor. Totalt sett fortfarande en pågående ökning, men inbromsande samt *ojämnt* distribuerad – ökar dramatiskt i Afrika medan den planar ut eller to m minskar i andra regioner. Källa: [Population Growth - Our World in Data](https://ourworldindata.org/population-growth)

# Time is short: the CO<sub>2</sub>-budget is shrinking fast



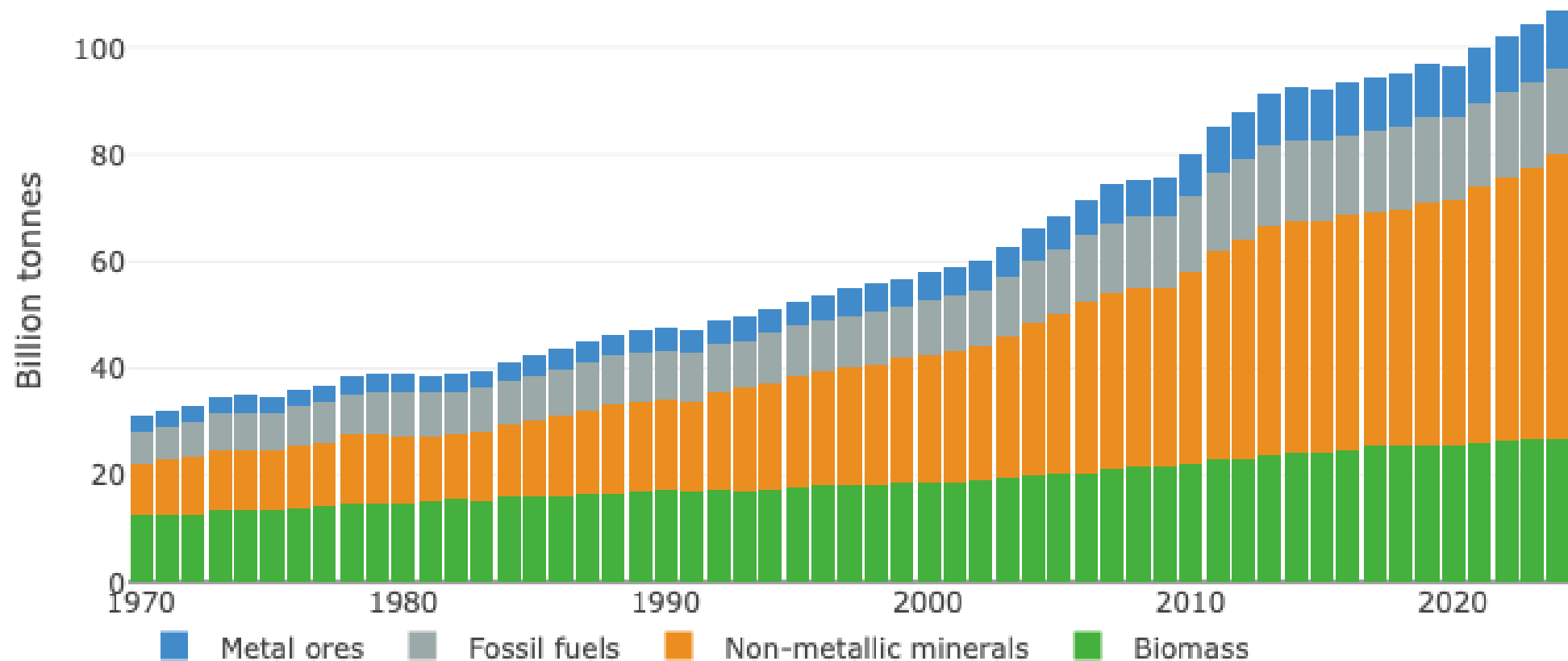
Harsh message: Only 205 Gt CO<sub>2</sub> left in the budget, the emissions are ca 42 GtCO<sub>2</sub>/yr -> ca **5 years left...** **26 ton/capita!**

# How does the emissions/yr relate to the CO<sub>2</sub> levels and the temperature?



# But the use of materials in all do also correlate with the GDP growth

Domestic extraction of the world in 1970-2024, by material group



# Challenges

## 1. Energy:

- Really hard to substitute all the fossil energy to fossil free energy (even considering the differences in primary energy factors) -> *energy efficiency* required to reduce the need for substitution
- Nevertheless: Future energy supply need a lot of investments. IEA: PV, wind power and energy storage (including batteries) will dominate

## 2. Material:

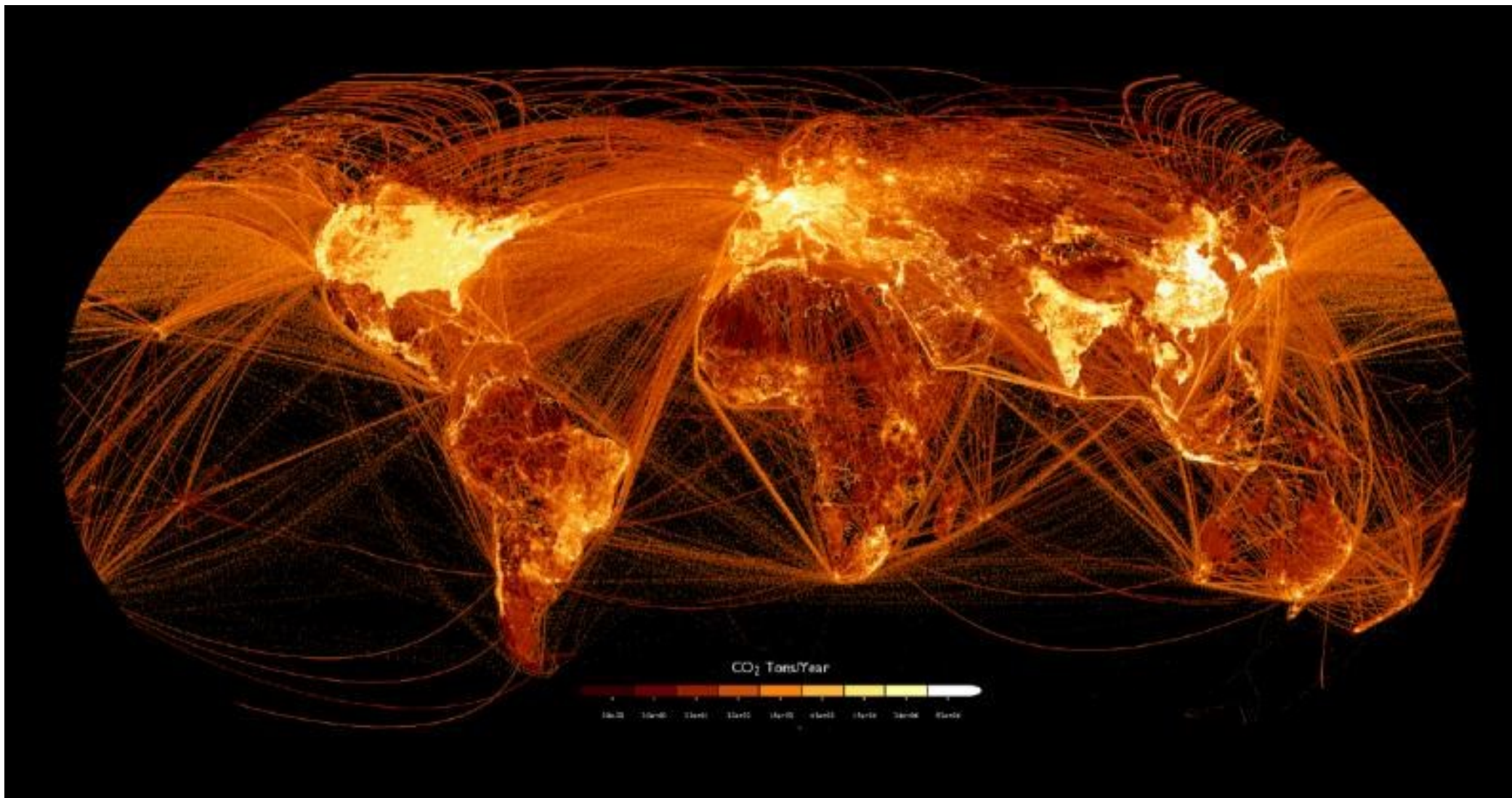
- Have to be much more careful in the extraction and use of materials (mines, use of land etc)
- Requirements on longer lifetimes, repairability, reusability, recyclability, and other measures that fosters a circular economy

## 3. Time

- Very scarce... the order of the investments matters



# The emissions are extremely unequally distributed



<https://www.visualcapitalist.com/cp/mapped-carbon-dioxide-emissions-around-the-world/>

# The IPCC Assessment report nr 6 (AR6)

## AR6 Synthesis Report: Climate Change 2023

REPORT

The IPCC finalized the Synthesis Report for the Sixth Assessment Report during the Panel's 58th Session held in Interlaken, Switzerland from 13 - 19 March 2023.

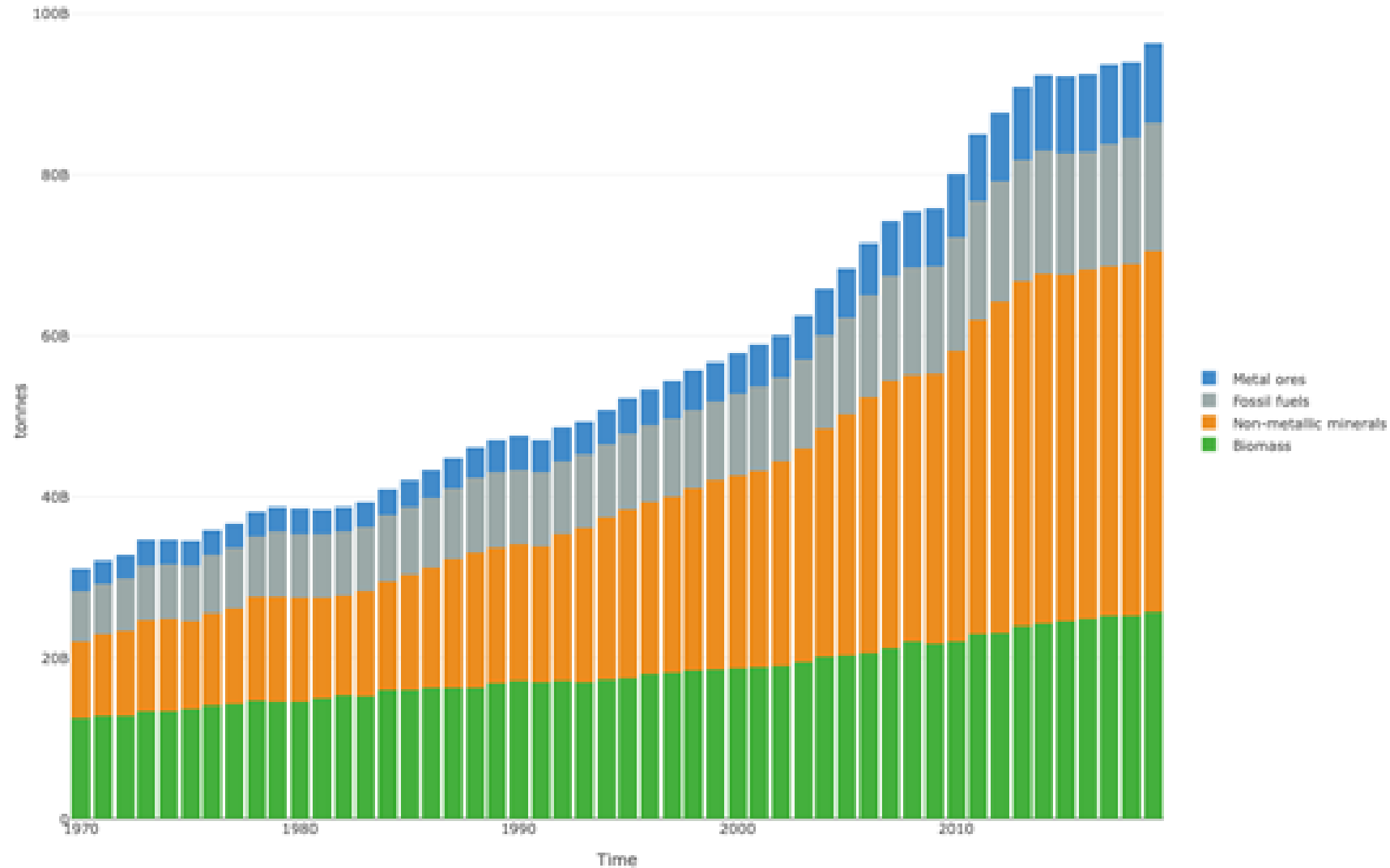
[READ THE REPORT](#)

[CORE WRITING TEAM](#)

[AR6 Synthesis Report: Climate Change 2023 — IPCC](#)

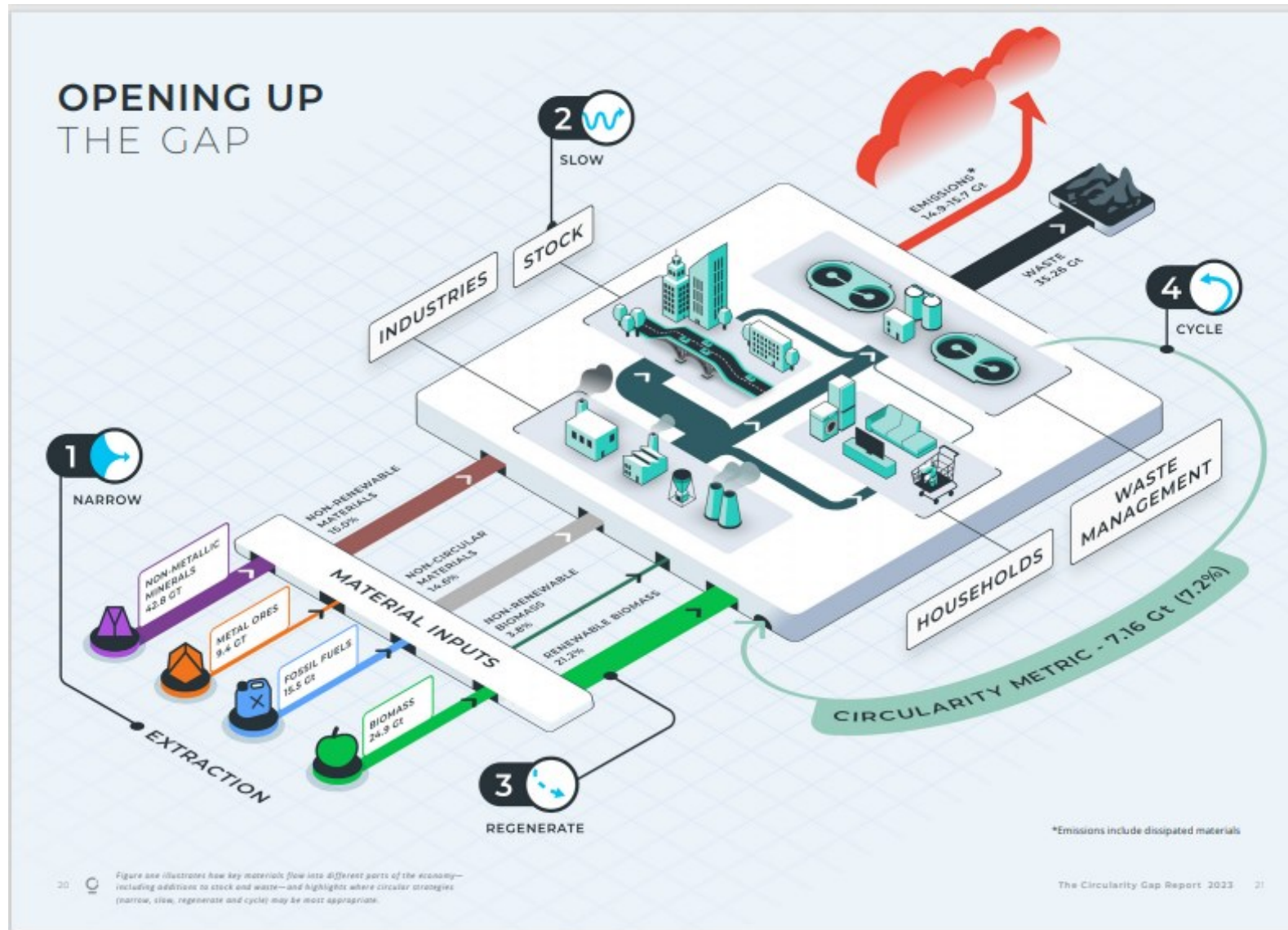
# Material use 1970-2019

Domestic Extraction of World in 1970-2019, by material group

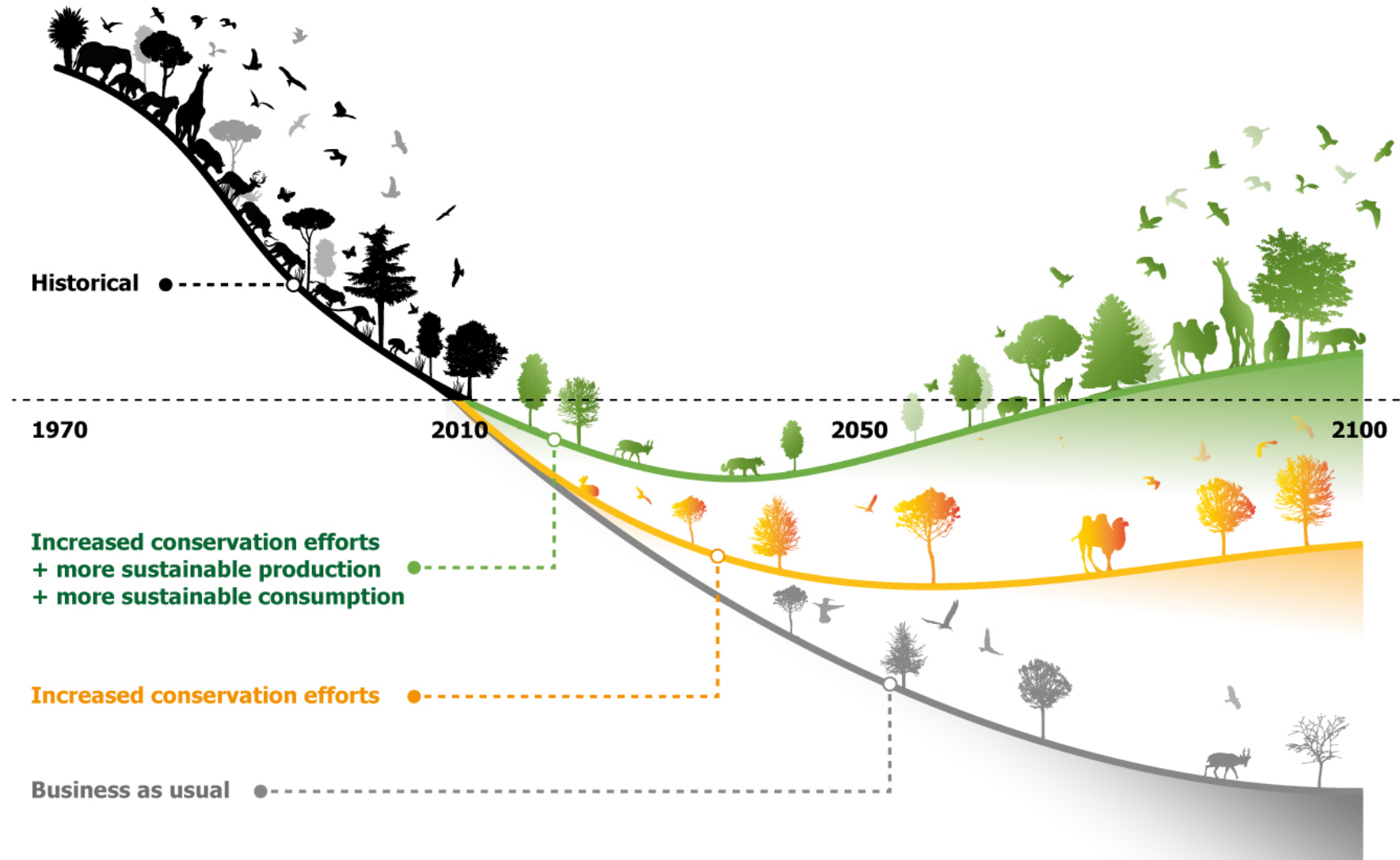




# Supply, use and recycling of materials



# Loss of biodiversity increases as well: The 6<sup>th</sup> mass extinction



# Observations

1. The GDP, use of energy, particularly fossil energy, *and* the material use, all *correlate* with each other
2. All curves gets steeper *upwards* after the millenium shift
3. Renewable energy has only been *added* to the energy mix, not *substituting* any fossil energy
4. On the contrary, today we are using *more* fossil energy than ever, and hence have *record high* emissions... ca 42 GtCO<sub>2</sub>/yr



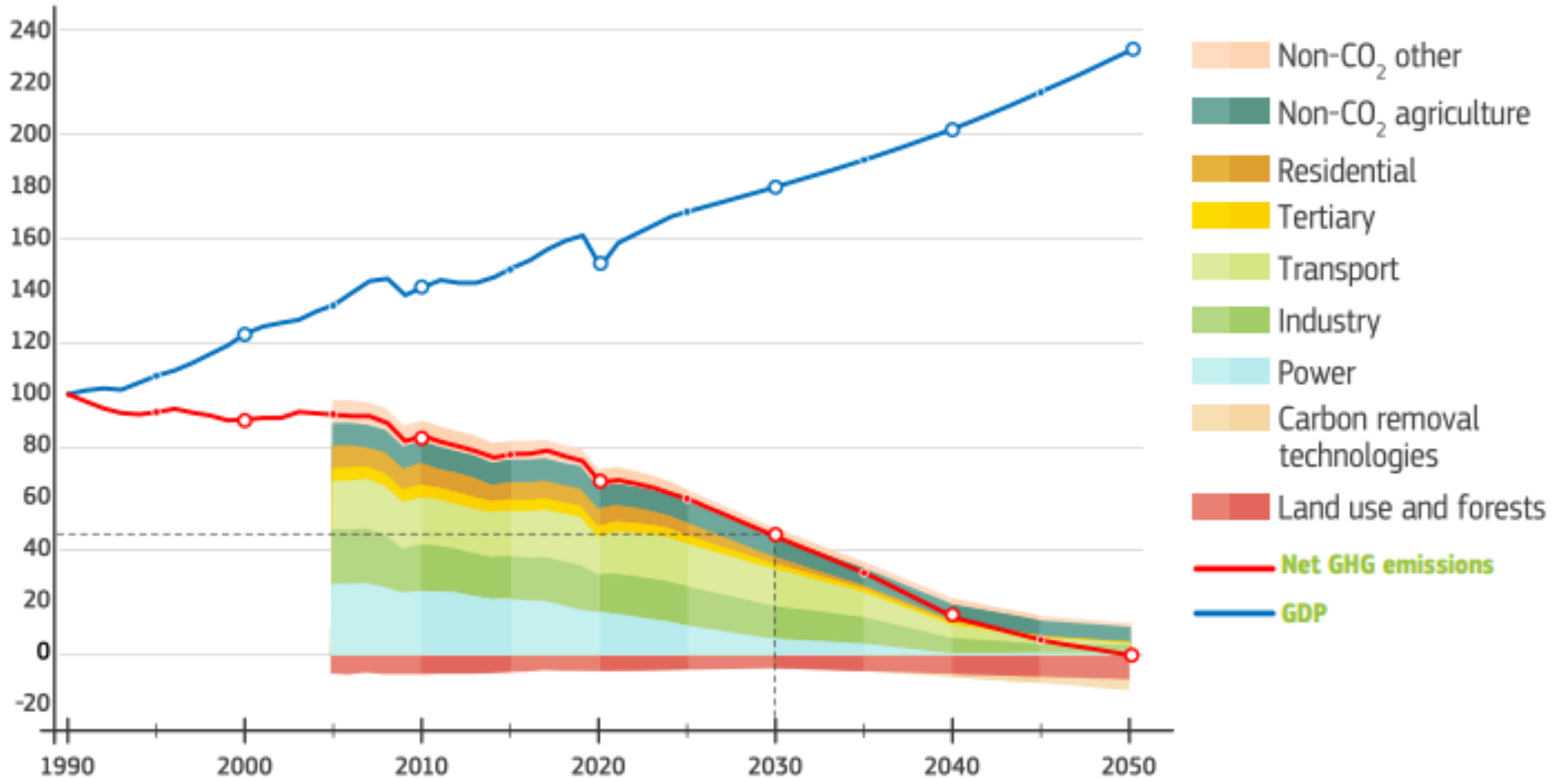
# Critical questions

1. Is it *really* possible to achieve *de-coupling* between GDP-growth and the use of energy and material (often forgotten)? – The whole question of (physical) Limits to (economic) Growth (L2G)
  - If yes: how fast can it go, given the remaining CO<sub>2</sub>-budget?
  - If no: what to do... but to decrease the consumption dramatically?
2. EU: Assumes decoupling *is* possible

The response in EU:  
Reduce CO<sub>2</sub>-emissions by 55 % to 2030  
*The Fit for 55 package*

# Action is needed in *all* sectors to achieve decoupling

Europe has a strong track record of **cutting emissions whilst growing its economy**. Achieving our new target of 55% greenhouse gas emissions by 2030 will require action across all sectors.



# ... which requires a *broad* set of policies



## EU Emissions Trading System (ETS)

- A strengthened cap on overall emissions under the EU ETS
- Aim to expand the use of emission trading to the maritime, buildings and road transport sectors
- Look into the integration of all emissions from fossil fuel combustion



## Energy Efficiency

- Review the current EU energy efficiency target of 32.5% by 2030
- Launch a renovation wave to improve housing quality in the EU
- Strengthen the role of Eco-design standards to ensure EU consumers have access to efficient products



## Renewable Energy

- Review the current target of 32% of renewables in the EU energy mix by 2030
- Review and revisit the biomass sustainability criteria
- New European terminology and certification system for all renewable and low-carbon fuels



## Road transport CO<sub>2</sub> emissions

- Revisit and strengthen the CO<sub>2</sub> standards for cars and vans for 2030 and beyond
- Reflection on phase-out target date for internal combustion engines



## Agriculture, Land Use, Land Use Change and Forestry (LULUCF)

- Integrated approach to reduce emissions from agriculture, provide bio-based materials for our economy, protect and enhance the natural carbon sink and improve the resilience of the EU's forests and agriculture to climate change



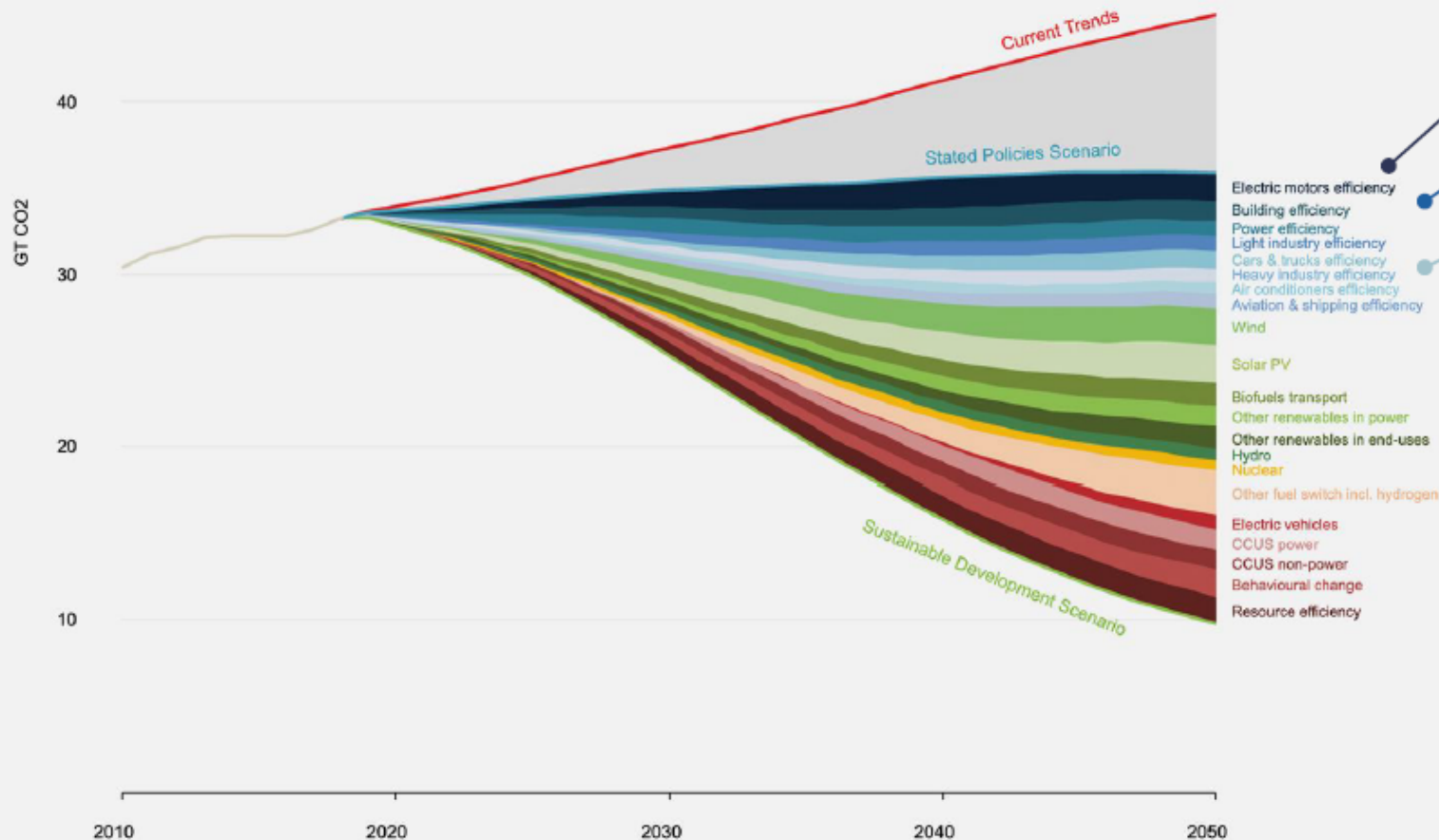
## Effort Sharing

- Options range from reduced scope to potential future repeal if all emissions are covered by other policy instruments, while taking into account distributional concerns between Member States



# Product efficiency plays a key role in ensuring a 1.5-2°C pathway, accounting for more than a third of current global electricity consumption

Energy-related CO<sub>2</sub> emissions and reductions by source



Which ones are key for this initiative?

Electric motors efficiency

Building efficiency,  
incl. lighting  
and refrigeration

Air conditioners efficiency

Industrial electric motors, along with residential lighting, cooling and refrigeration are responsible for more than **a third of current global electricity consumption.**

UNEP Emissions Gap Report (2017) notes that efficient appliances is one of the six areas with **highest potential of closing emissions gap to Paris.**

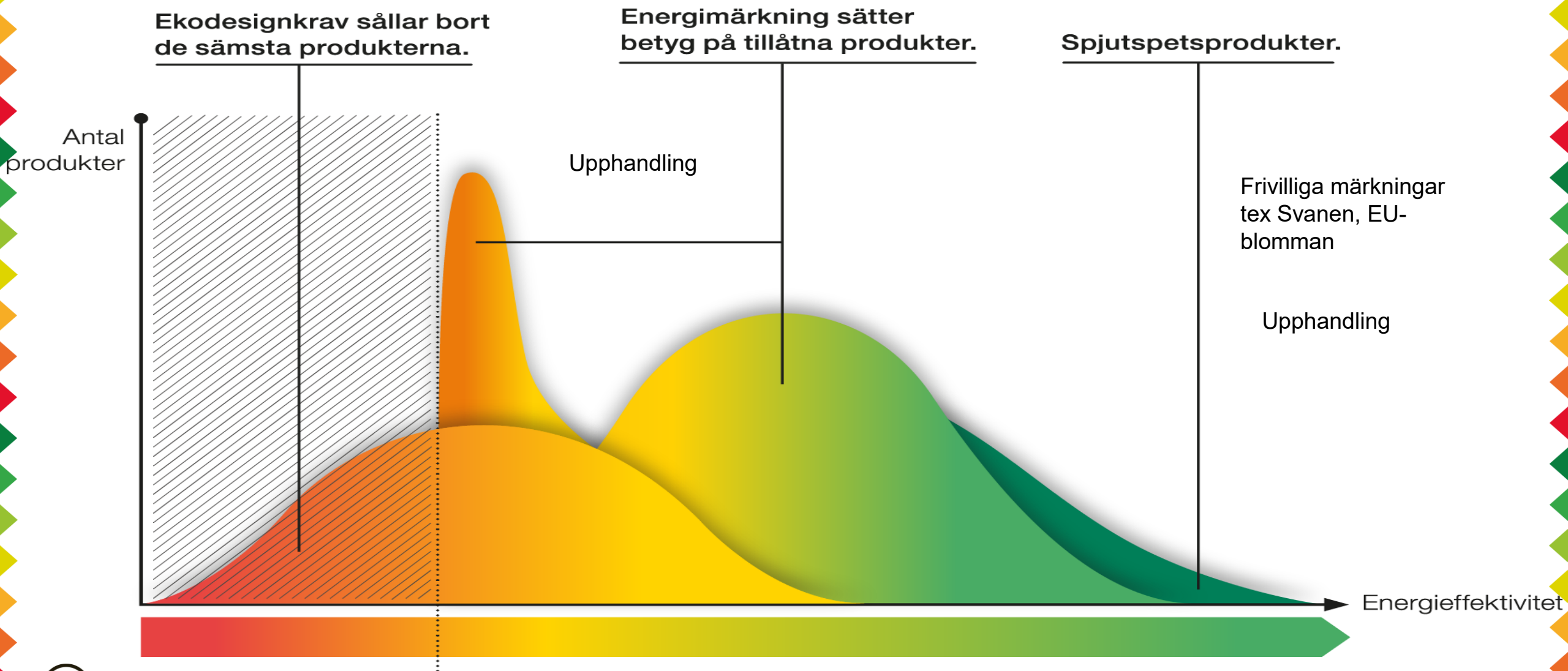
Therefore, improving energy efficiency for these products is a key source of emissions reductions to achieve the Paris targets.

# Ecodesign and energy labelling

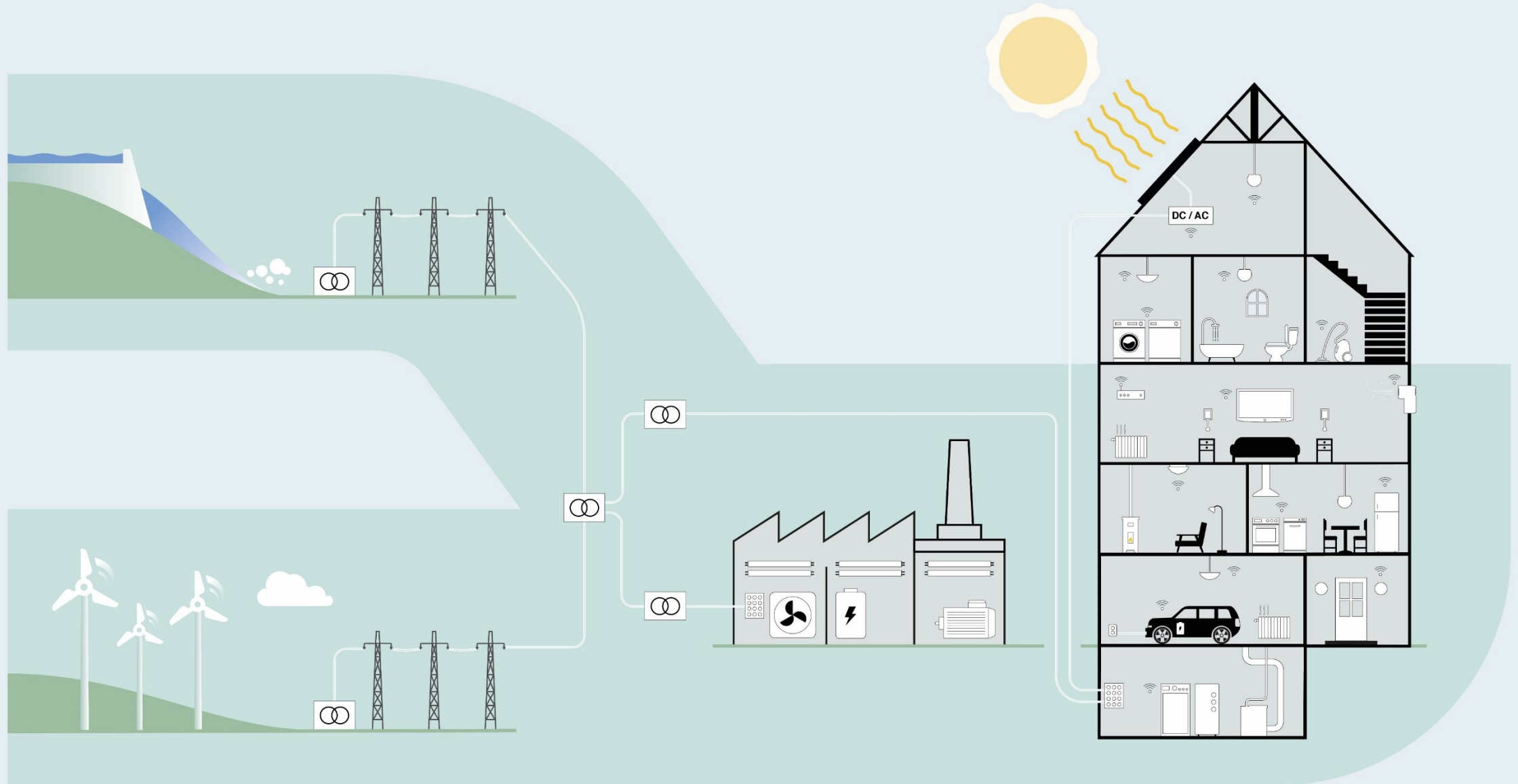
- The main policy tools to achieve energy efficient products



# Ecodesign is a process that drives innovation



# Ca 30 products are regulated by ecodesign and/or energy labelling

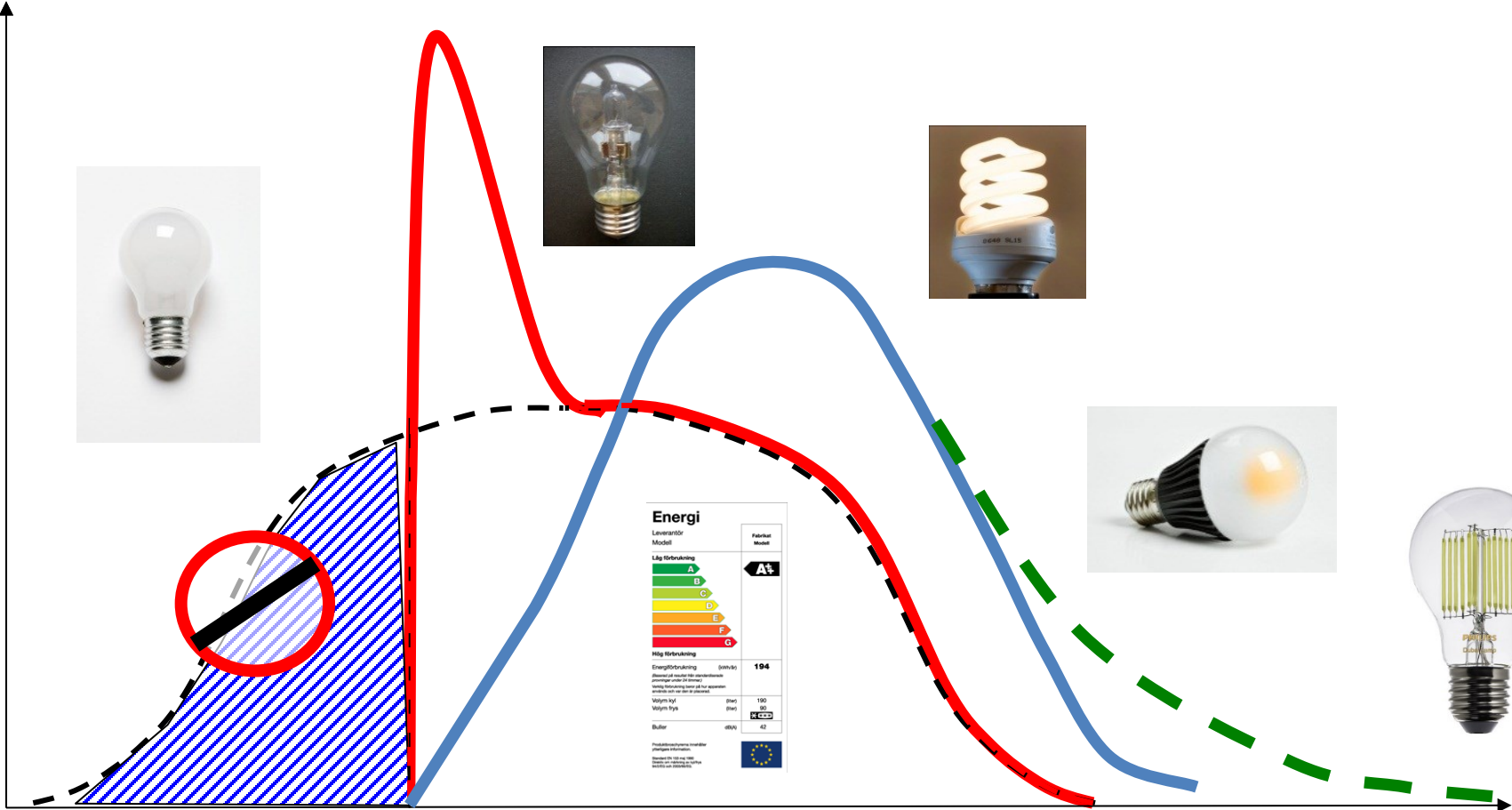


# Example: Lighting – snapshot from 2012

Ekodesign

Energimärkning

Grön upphandling



Energieffektivitet

# Lighting – snapshot from 1 September 2021

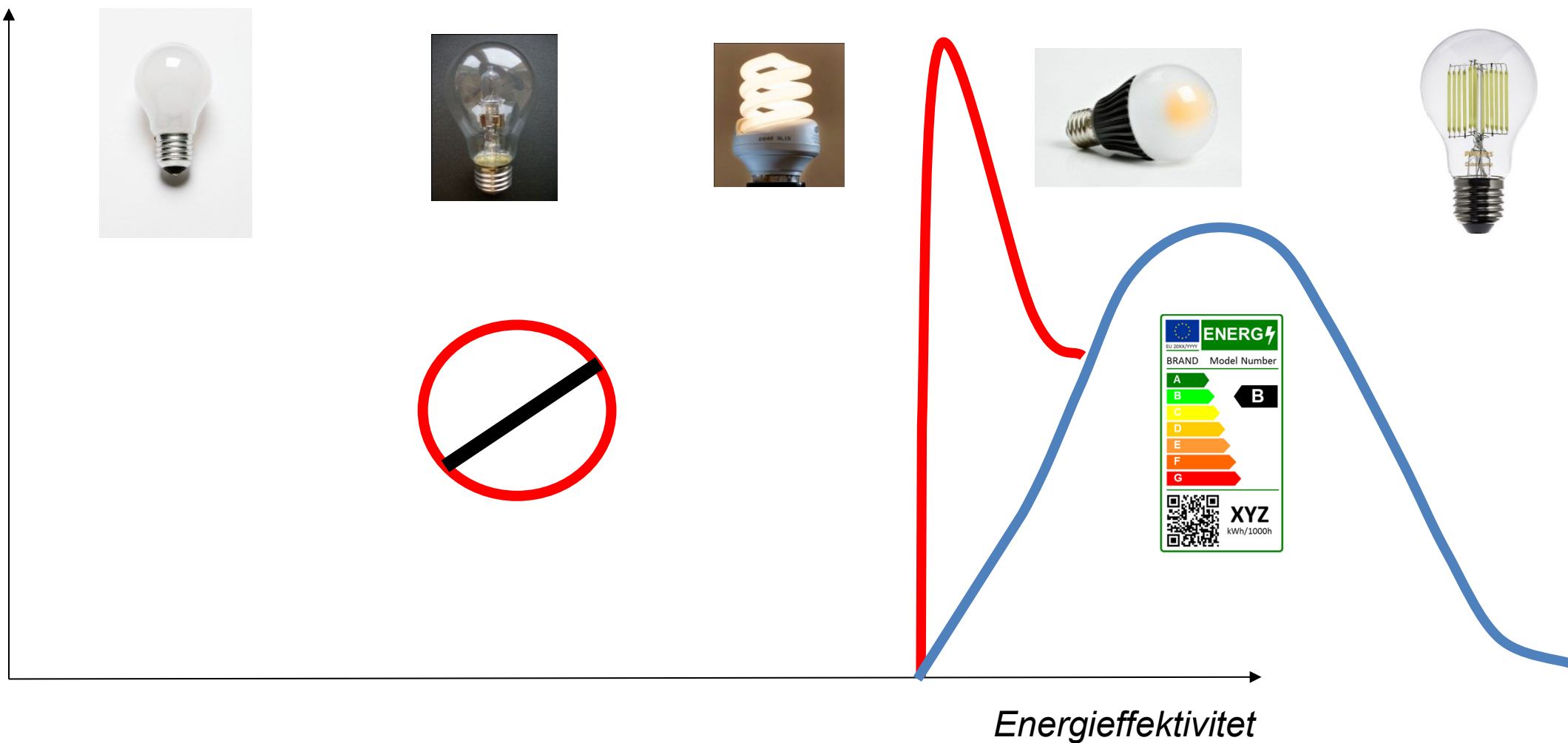
Ekodesign



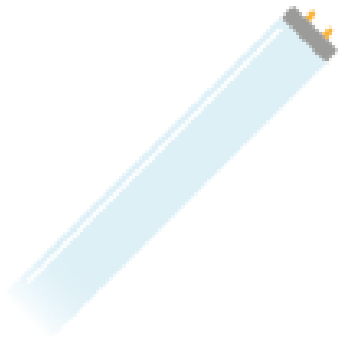
Energimärkning



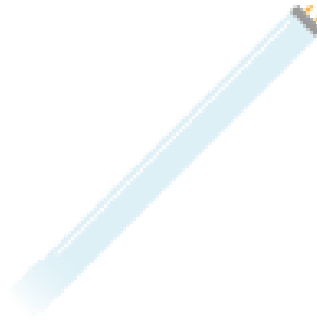
Grön...->



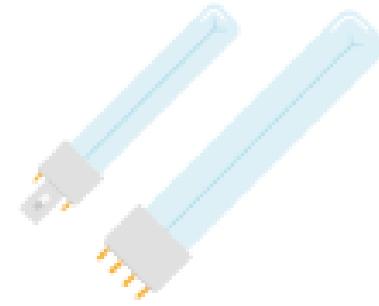
## 2023: Fluorescent lighting starts to get phased out



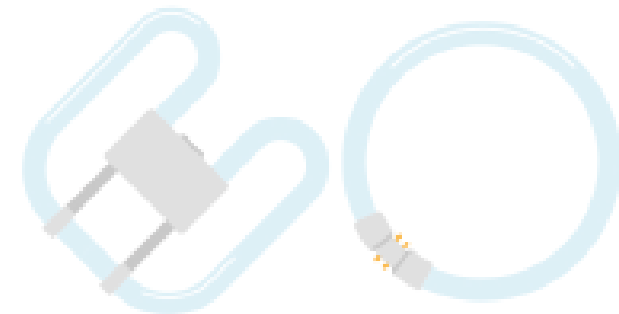
Lysrör T8



Lysrör T5



Kompaktlysror, 2- samt 4-stift



Cirkelformade och kvadratiska lysrör

# Ecodesign and RoHS are complementary tools

- EU-27 and the European Economic Area have adopted policy-measures over a decade to keep transforming the European lighting market
- **ECODESIGN Regulation – based on LCC**
  - Incandescent: 2009-12; halogen spot lamps: 2015 and halogen non-directional: 2018 [EC No 244/2009](#)
  - Halophosphate fluorescent: 2010-12; [EC No 245/2009](#)
  - CFLi, T2 and T12 Linear Fluorescent: 1 September 2021; [EU No 2019/2020](#)
  - T8 Linear fluorescent in 60 cm, 120 cm and 150 cm: 1 September 2023; [EU No 2019/2020](#)
- **RoHS Regulation – based on toxicity**
  - Removes fluorescent lighting from virtually all general purpose lighting applications on either 24 February 2023 or 24 August 2023.
  - CFLni – all base-types (single capped): 2023; [EU No 2022/276](#) (RoHS)
  - T8, T5 – all lengths and diameters: 2023; [EU No 2022/284](#) (RoHS)





# Minamata COP-5 in November: Phase out fluorescent lighting in 147 countries



# Plans for a revision of the ecodesign regulation for lighting

# EU Ecodesign Lighting Regulation ([EU No. 2019/2020](#))

## Starting 2024 at the earliest

### Article 9

#### Review

The Commission shall review this Regulation in the light of technological progress and shall present the results of this review, including, if appropriate, a draft revision proposal, to the Consultation Forum no later than 25 December 2024.

This review shall in particular assess the appropriateness of:

- (a) setting more stringent energy efficiency requirements for all light source types, in particular for non-LED light source types, and for separate control gears;
- (b) setting requirements on lighting control parts;
- (c) setting more stringent requirements on flicker and stroboscopic effects, while extending them to separate control gears;
- (d) setting requirements on dimming, including the interaction with flicker;

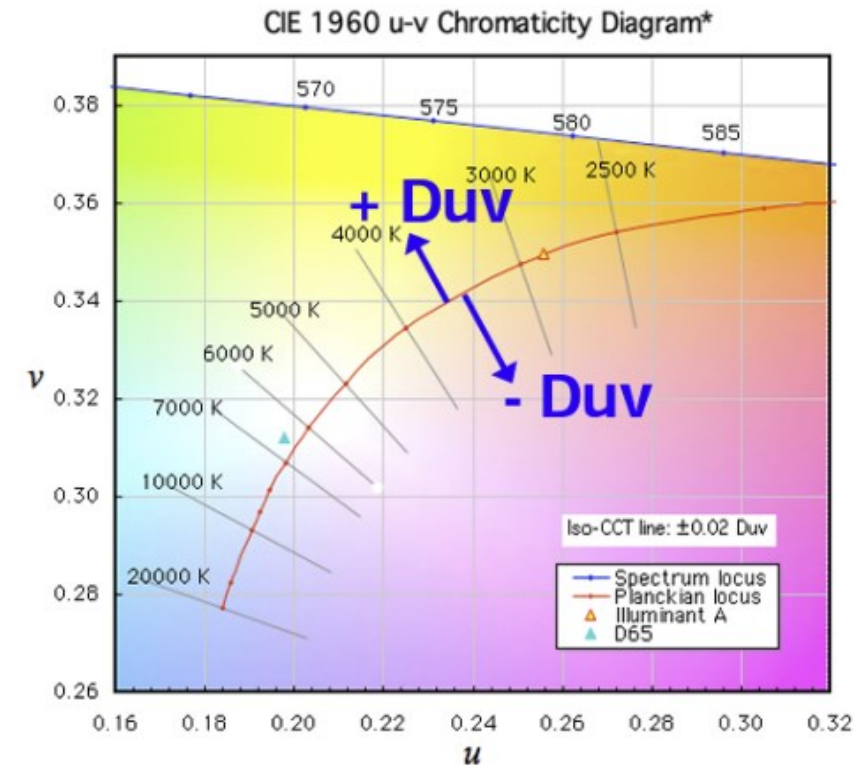
### Areas where the SSL Annex could engage

- (e) setting more stringent requirements on (networked) standby power;
- (f) lowering or abolishing the power bonus for colour-tuneable light sources and removing the exemption for high colour purity;
- (g) setting lifetime requirements;
- (h) setting improved information requirements concerning lifetime, including for control gears;
- (i) substituting the CRI colour rendering metric by a more adequate metric;
- (j) verifying the adequacy of lumen as a stand-alone metric for the quantity of visible light;
- (k) the exemptions;
- (l) setting additional resource efficiency requirements for products in accordance with the principles of the circular economy, especially concerning the removability and exchangeability of light sources and control gears.



# Updating the colour-related metrics?

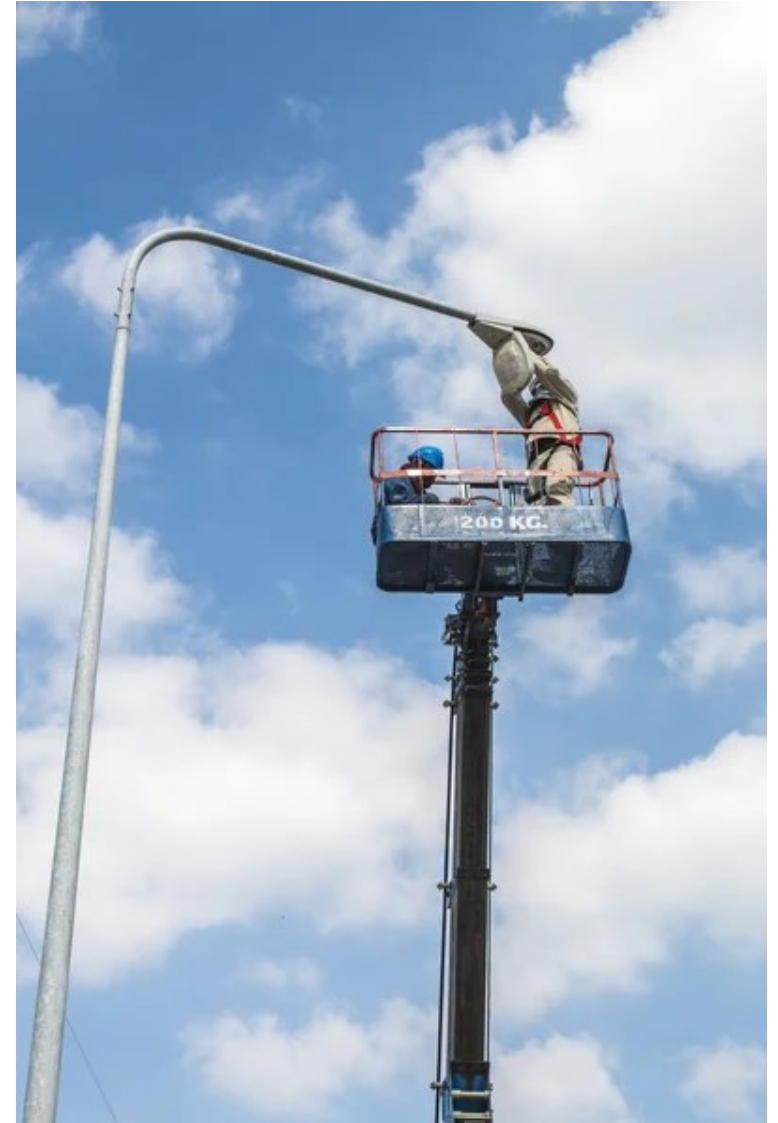
- CRI Ra and x,y chromaticity are outdated
- Industry opposed new colour metrics in 2019 because it was inconsistent with IEC standards
- IEC SC 34A – a new standard IEC 63221, replacing IEC 62612:
  - (x,y) and (u',v') chromaticity coordinates are supported
  - n-step u'v' circles from CIE TN001
  - CCT and Duv are supported
- No change to colour metric, still using CRI Ra





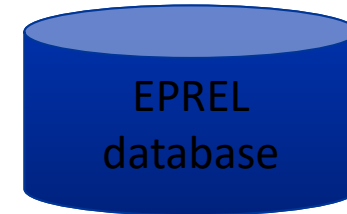
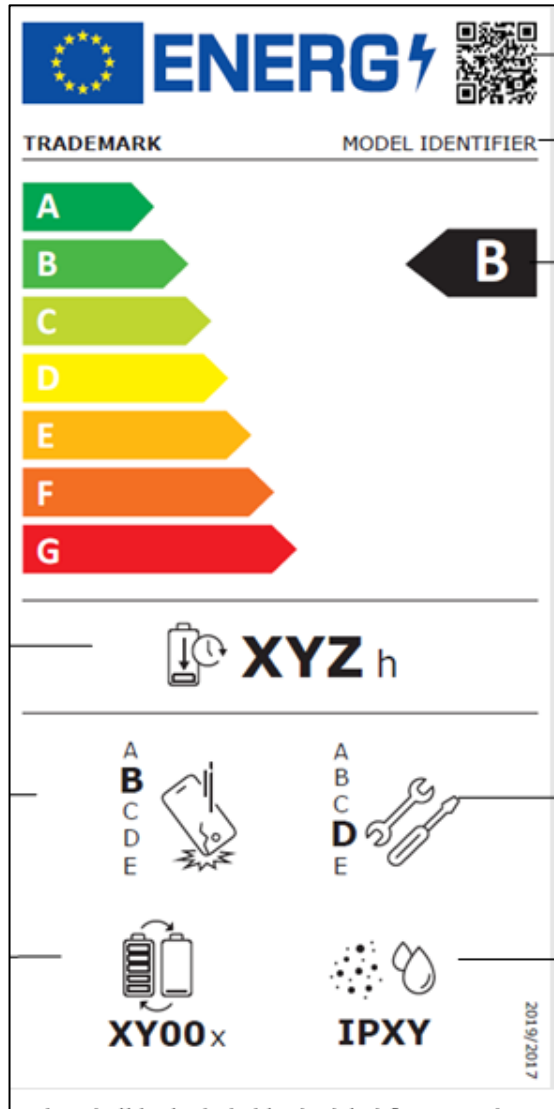
# More Resource Efficiency Requirements for Light sources?

- Set requirements in accordance with the principles of the circular economy
- Climate impact expressed as kg CO<sub>2</sub> per some suitable normalising parameter, maybe total lumenhours, or hours (lifetime)
  - inspired by the current draft regulation for PV-panels in EU (kg CO<sub>2</sub>/total generated kWh)
- Degree of repairability (light sources, control gear), upgradeability, recyclability, cf the newly adopted regulation for mobiles



# Cf Mobiles and tablets – energy labeling

Energieffektivitetklass



QR-koden ger access till en databas med mer information

Batteriets uthållighet per laddning

Förmåga att klara ett fall

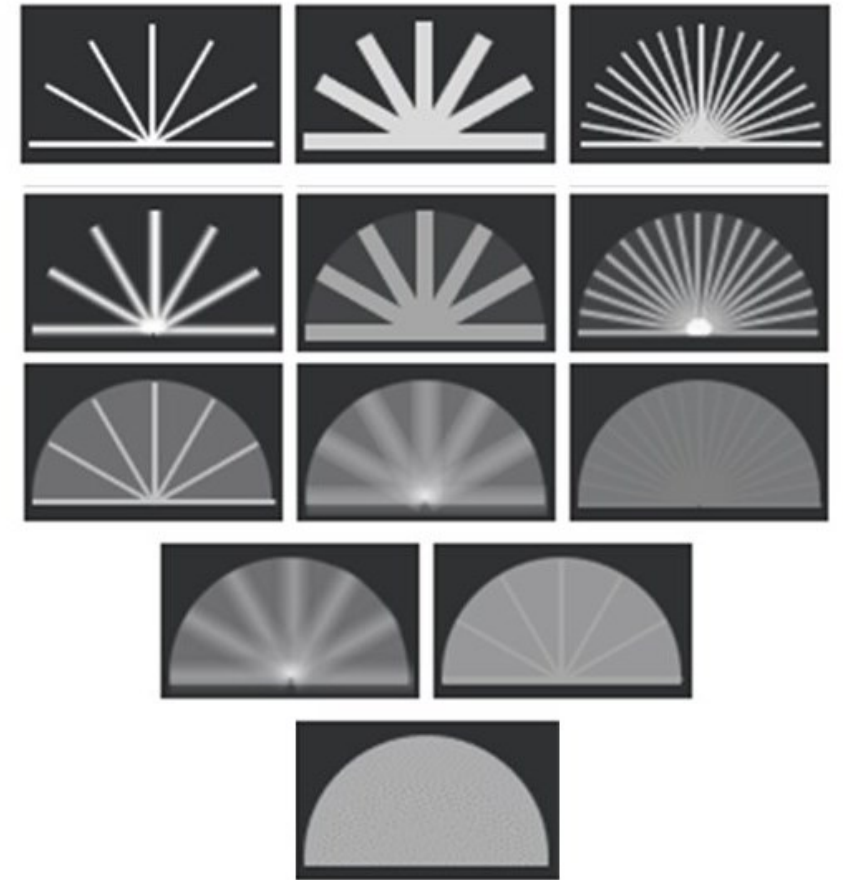
Reparationsklass (hur lätt det är att reparera mobilen)

Batteriets uthållighet i antal cykler av upp- och urladdning

IP-klass

# TLM (Flicker) Requirements revisited

- More stringent requirements?
- Include test results from SVM testing in Sweden: 500+ products
- Investigate how dimming affects flicker and make recommendations on requirements



(c) setting more stringent requirements on flicker and stroboscopic effects, while extending them to separate control gears;

(d) setting requirements on dimming, including the interaction with flicker;

# More stringent Lifetime Requirements?

- Underscore the importance of having lifetime requirements in Ecodesign
- Summarise research findings from on-going Task 2 activities on accelerated lifetime testing (Australia, Sweden) as well as other work conducted (Denmark)
- Investigate potential to purchase LED lamps across Europe to conduct lifetime testing (January 2024 – Lifetime Testing Summit)
- Consider opportunity of having Prof. Narendran in Sweden, May 2024





# EU and beyond – the need for international collaboration

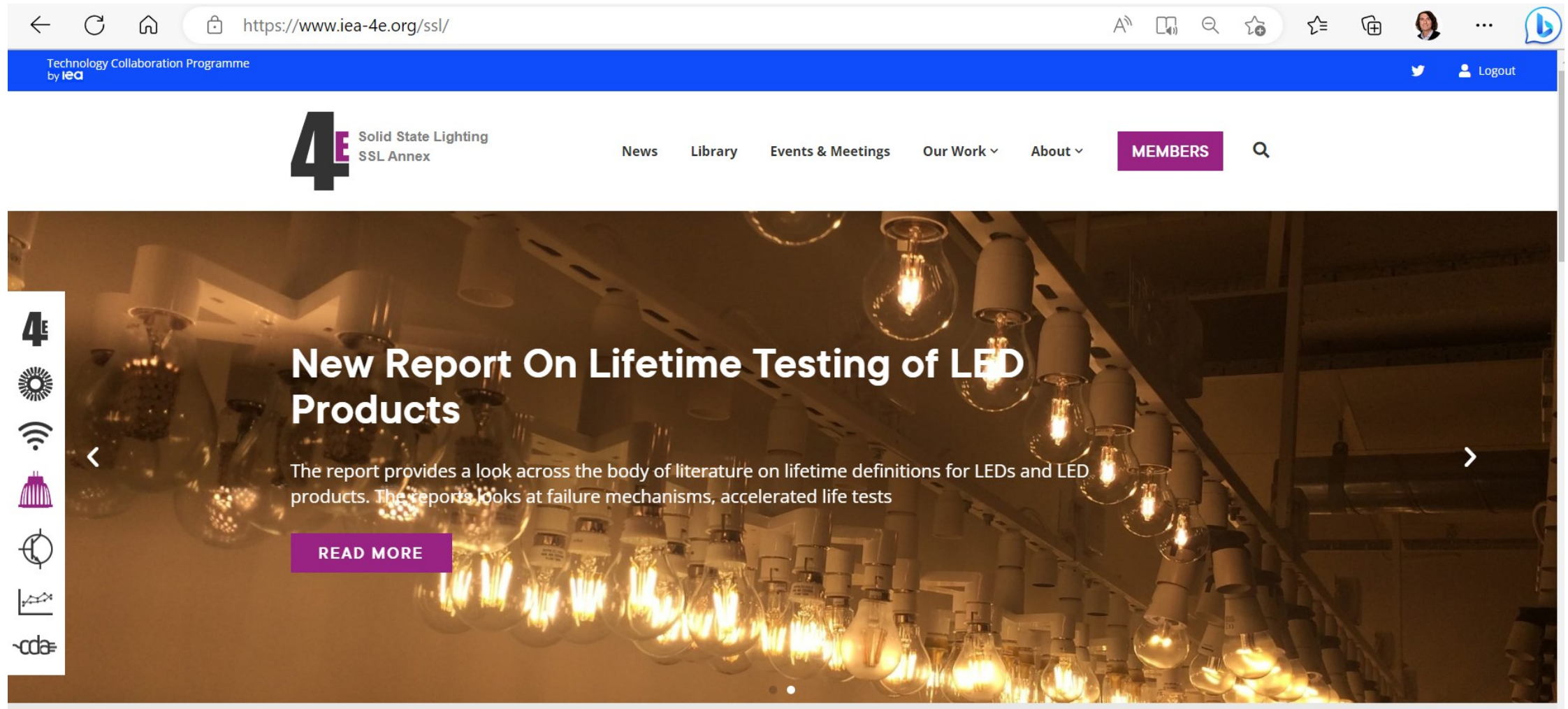


Global challenges are the *same* – make sense to collaborate

A global market but different market conditions in the various regions

- Aligned analyses of markets and technologies
- Standardisation work
- Policy work
- Capacity building work

# International collaboration crucial – such as the IEA 4E SSL



The screenshot shows the website for the IEA 4E Solid State Lighting (SSL) Annex. The browser address bar displays <https://www.iea-4e.org/ssl/>. The page header includes the IEA Technology Collaboration Programme logo and a 'Logout' link. The main navigation menu contains 'News', 'Library', 'Events & Meetings', 'Our Work', 'About', and a highlighted 'MEMBERS' button. The central banner features a photograph of numerous glowing light bulbs in a testing facility. The text on the banner reads: 'New Report On Lifetime Testing of LED Products'. Below this, a sub-headline states: 'The report provides a look across the body of literature on lifetime definitions for LEDs and LED products. The reports looks at failure mechanisms, accelerated life tests'. A purple 'READ MORE' button is positioned below the sub-headline. On the left side of the banner, there is a vertical sidebar with icons for '4E', a sun, Wi-Fi, a light bulb, a clock, a graph, and the IEA logo.

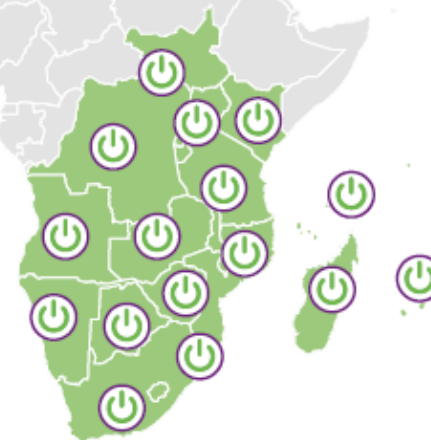
# Capacity building projects, such as EELA:

- EELA: Energy Efficient Lighting and Appliances
- Financed by Swedish SIDA, led by UNIDO
- 21 countries, ca 500 million people
- Partners:
  - SACREEE – The SADC Centre for Renewable Energy and Energy Efficiency. *Regional key player in Southern Africa*
  - EACREEE – The East African Centre of Excellence for Renewable Energy and Efficiency. *Regional key player in Eastern Africa*
  - CLASP – global non-profit NGO specialized in product policies
  - The Swedish Energy Agency (sharing experiences on policy making, lab testing, market screening and surveillance)

The EELA project will be delivered through the Regional Platforms.

The key executing partners are the East African Centre of Excellence for Renewable Energy and Efficiency (EACREEE) and the Southern African Development Community Centre for Renewable Energy and Energy Efficiency (SACREEE). These Platforms will also convene different stakeholders, provide a growing knowledge hub and proactively share information with the private sector and all stakeholders.

Through guidelines, workshops, best practice documentation and other activities, the Platforms will also support national governments and stakeholders to take action in their countries.



# The multiple benefits of Energy Efficient Lighting and Appliances

Efficient electricity use promotes energy security, which lies at the heart of achieving the regions' economic and human development goals as well as many of the globally agreed Sustainable Development Goals (SDGs). The EELA programme is directly supporting this on many fronts.

## SUSTAINABLE DEVELOPMENT GOALS

**PRIVATE SECTOR SUPPORT**  
To help ensure better access to energy services across East and Southern Africa, EELA is forging partnerships with key stakeholders and will particularly engage with the private sector to inject new investment and build the capacity of governments and public officials to expand energy services.



**CLIMATE ACTION**  
EELA contributes to a climate action in many ways such as reducing emission through the widespread use of more energy efficient products, while also limiting the use of substances in inefficient cooling products.



**RESPONSIBLE PRODUCTION AND CONSUMPTION**  
Through its focus on safe environmental management of products, development of MEPS and promotion of energy management systems by large power users, EELA also supports responsible production and consumption.



**SUSTAINABLE CITIES**  
By promoting energy efficient street lighting, alongside the use of less electricity to run appliances, EELA supports sustainable cities and communities.



**POVERTY ERADICATION**  
Access to clean affordable sustainable energy remains key for eradicating poverty. By making more energy-efficient products readily available on the market, the EELA project will reduce household energy bills and expand the provision of clean energy services to households across East and Southern Africa.



**HEALTH AND WELLBEING**  
Air pollution led to some 7 million deaths worldwide in 2016. The shift to energy efficient lighting and appliances, promoted through EELA, contributes to health and wellbeing across East and Southern Africa by enabling people to access clean lighting and appliances.



**GENDER INCLUSIVENESS**  
Women are often most affected by low quality products in households. EELA will empower women by expanding their access to quality products and by supporting women entrepreneurs to become more active in markets for energy efficient lighting and appliances.



**ENERGY FOR ALL**  
As energy consumption accounts for around 60 percent of total global greenhouse gas emissions, according to the UN, achieving climate safe universal access to electricity will require a doubling of energy efficiency improvement rates. The potential for energy saving across East and Southern Africa is huge. EELA estimates that introducing MEPS in the regions through the project could save the equivalent of five to eight times Kenya's total electricity consumption.



**JOB CREATION**  
EELA promotes activities that stimulate local markets to produce, assemble and distribute quality energy efficient lighting and appliances, creating new employment opportunities.



**SUSTAINABLE INDUSTRIALIZATION**  
Through its investments, EELA will also stimulate better infrastructure and industrial production. Energy accounts for a large amount of production costs and EELA will support local industries to become more competitive. At the same time, local manufacturing of products will be promoted.



# Thank you

## Tests:

- Hans Arvidsson
- Jörgen Eriksson
- Ileana Hagelin
- Ermias Mebreku

## Policy, International collaboration

- Peter Bennich

## Communication:

- Carl-Martin Johborg

Besök oss på

[www.energimyndigheten.se](http://www.energimyndigheten.se)

Prenumerera på nyheter, nyhetsbrev,  
utlysningar med mera på  
[www.energimyndigheten.se/prenumerera](http://www.energimyndigheten.se/prenumerera)

