**Reported annual workplace emissions, per researcher**

Legend:
- Scope 1 (direct)
- Scope 2 (indirect, purchased)
- Travel (business)
- Travel (commuting)
- Food
- Procurement
- Waste treatment
- Upstream energy

} Scope 3

Labels: ETHZ DPHYS, Nikhef, MPIA, CERN (LHC shut down), FNAL

X-axis: GHG emissions (tCO$_2$e), values 0, 2.5, 5, 7.5, 10, 12.5, 15, 17.5, 20, 35, 40, 45

Markers: Budget to 2050, Global average
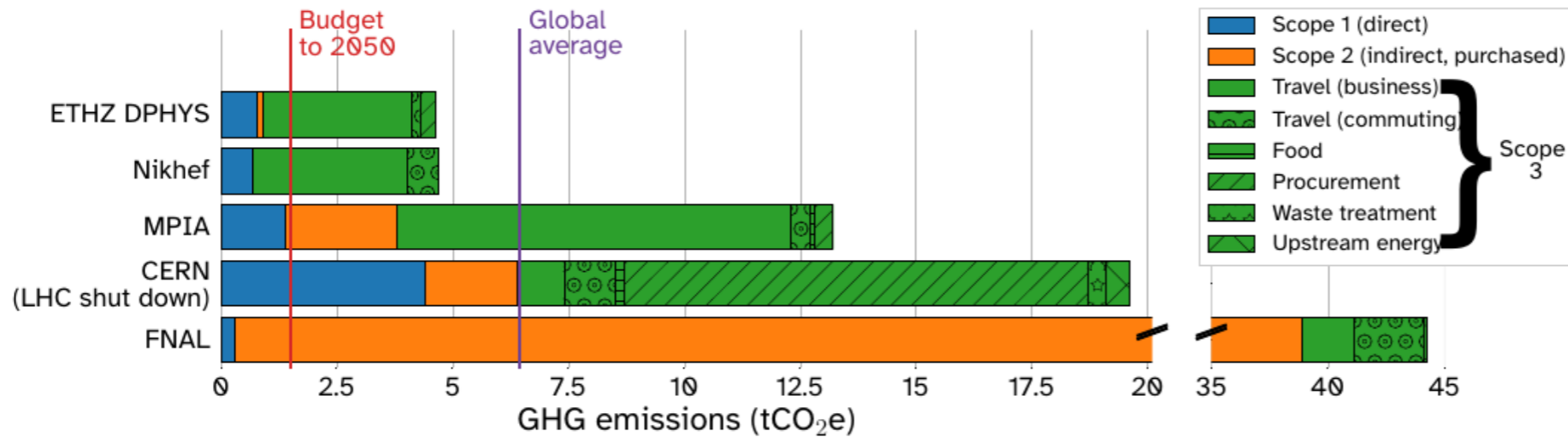
2019 data, save MPIA (2018), and ETHZ business travel (average 2016-2018).

...account to the energy inputs required if they had the same conversion losses as fossil fuels.

Read HECAP+ report!

https://sustainable-hecap-plus.github.io/

Options:

1) Expand CO2-free energies
→ factor ~12 in 7 years required;

2) Increase energy efficiency
→ factor ~2 in 7 years
e.g. Electrification of engines (factor 3-5 vs. combustion engine)
e.g. LEDs for lighting (factor 10 vs. light bulb)

3) Save energy
→ factor ~2 in 7 years
e.g.Less travel: online conferences, holidays nearby
e.g. Fewer consumer items, more repair options
e.g. Energy priority for essential things

For options 2)+3) an increase in renewables of a factor of 3 needed to cover increase from naive extrapolation is needed



ENERGY/SECOND

COP 27

naive Extrapolation

Saving

The Energy Gap

CO$_2$-free Production

Hydro Nuclear

...fuels, etc.

Gas

Oil

50%

Coal

F o s s i l

Traditional Biomass

2010, 2021, 2030, 2040, 2050 Jahr

...view of World Energy   OurWorldInData.org/energy · CC by 4.0

Science and Technology Facilities Council
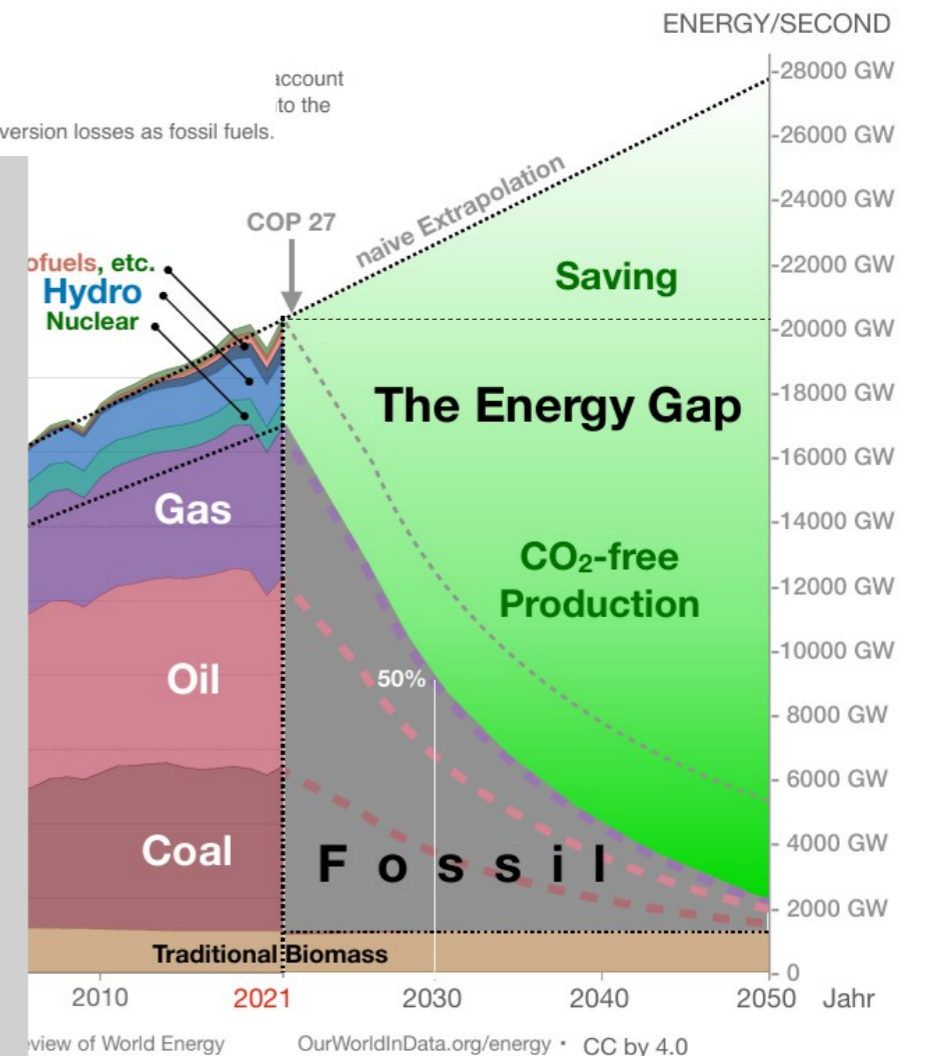
▸ **LDG working group on "Sustainability assessment of accelerators" will define and identify:**

  ▸ Key indicators to be reported

    ▸ Peak / instantaneous lifetime- and performance specific (per luminosity) energy consumption

    ▸ Lifetime and specific Global Warming Potential (GWP) including construction

    ▸ Include margins of uncertainty and possibly an assessment of the potential for improvement

  ▸ Methodology and assumptions allowing a transparent and objective determination and comparison of these metrics across the proposals.

    ▸ The maturity of a proposal should be determined, for example early concept phase, CDR, TDR or TRL levels

  ▸ Other high level environmental impacts that may be relevant for all or specific collider proposals.

  ▸ Application to accelerators of European best practices for defining GWP

▸ **Convenors now appointed**

  ▸ Maksym Titov (Saclay), Caterina Bloise (Frascati)

  ▸ Panel now being assembled, will become active in 2024

# Sustainability

‣ Other (more technical) objectives:

  ‣ Treatment of future carbon intensity of electricity and materials: what scenarios should be assumed?

  ‣ Assessing the potential for dynamic operation of the various facilities, i.e. the ability to adapt to a fluctuating energy supply

  ‣ Treatment of regional vs global parameters: How to treat differences e.g. in carbon intensity between different host countries?

  ‣ Carbon intensity / lifecycle inventory (LCI) studies of materials specific to accelerator projects: high-purity niobium, permanent magnet alloys etc

  ‣ Use of open-source LCI databases and Lifecycle Assessment (LCA) tools to ease/automate the assessment for future research infrastructures

  ‣ Extending the recommendations for colliders to other scientific endeavours related to HEP

  ‣ How HEP labs can share/build up expertise jointly

‣ Connects directly to R&D work on sustainable technologies

‣ To be carried out in close conjunction with ICFA sustainability panel