Climate sustainability of research operations

Workshop on carbon emissions at future facilities, Nov 9, 2021

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allea | All European Academies

Working group: Climate sustainability in the academic system

CP3 CP3-Origins

SDU University of Southern Denmark

THE VELUX FOUNDATIONS
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Greenhouse gas emissions from research operations

Scope 1: direct emissions from owned sources

Scope 2: indirect emissions from purchased energy

Scope 3: all indirect emissions not included in 2
(“upstream” and “downstream”)

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Just like any other public/private enterprise

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- construction and maintenance of buildings
- purchases of supplies
- commuting

Greenhouse gas emissions from research operations

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- emissions from owned vehicle fleet
- greenhouse gas emissions from detectors

Just like any other public/private enterprise

Scope 2: indirect emissions from purchased energy

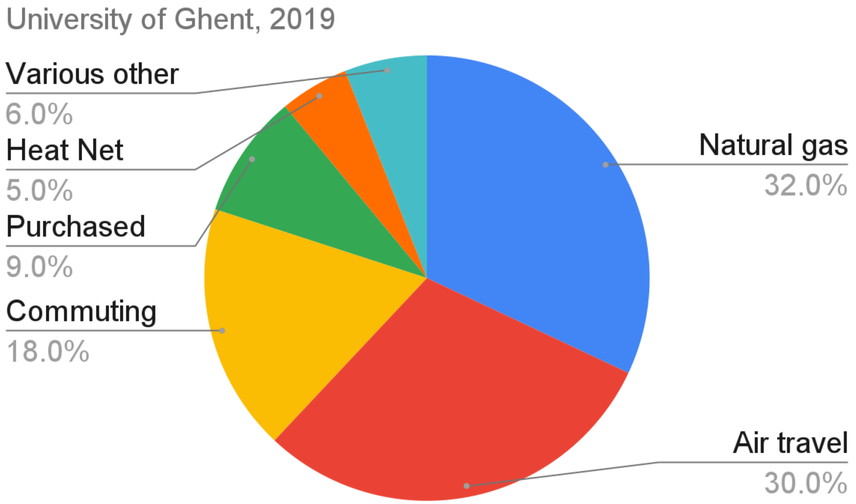
- electricity and heating
- electricity for computing or particle accelerators

Research specific

Scope 3: all indirect emissions not included in 2 ("upstream" and "downstream")

- construction and maintenance of buildings
- purchases of supplies
- commuting
- air travel for conferences, collaboration meetings, shifts…

GHG emissions from research operations at European universities



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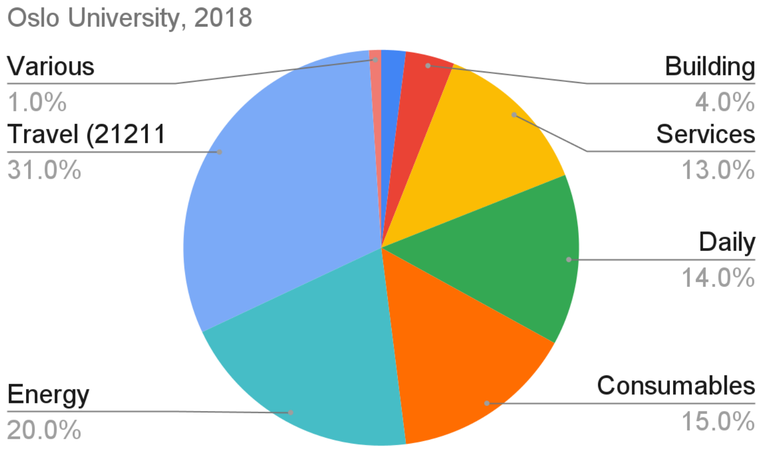
[data from U Ghent Sustainability report 2020]



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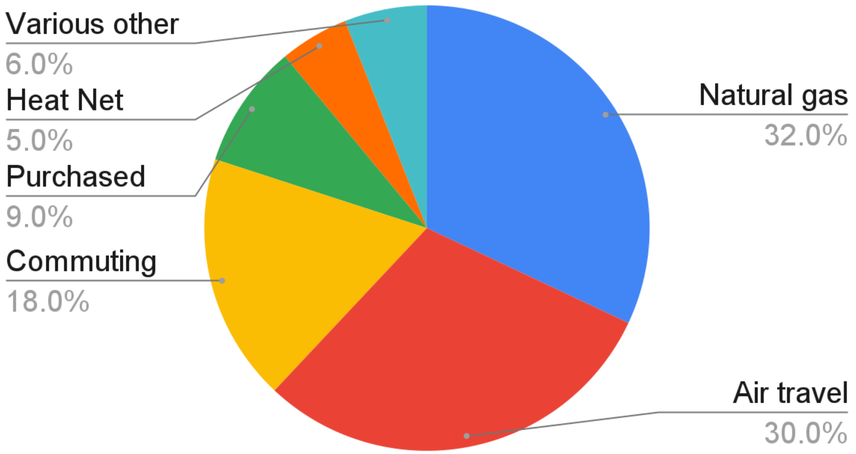

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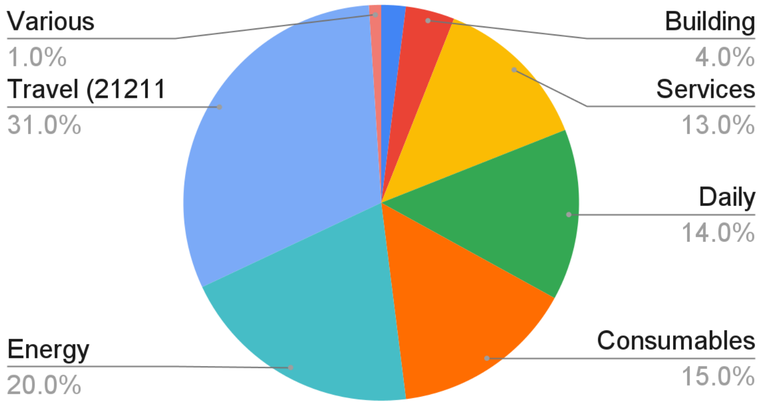

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10-78 % of total emissions
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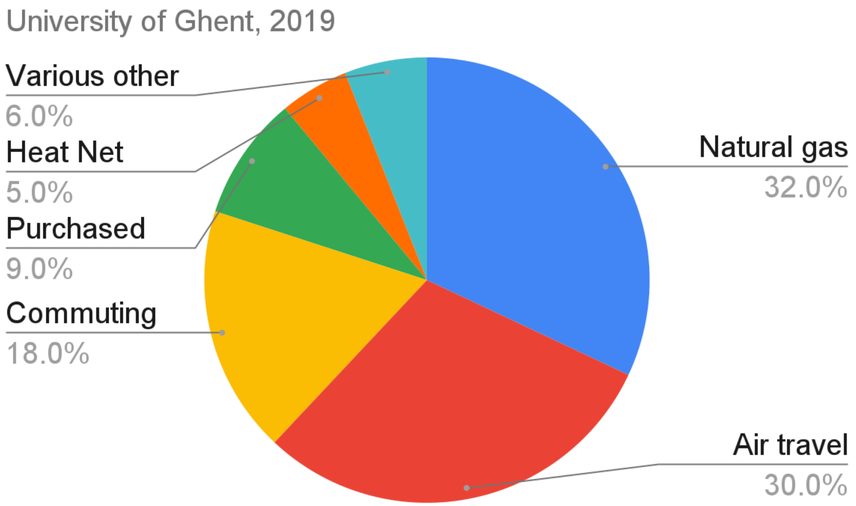

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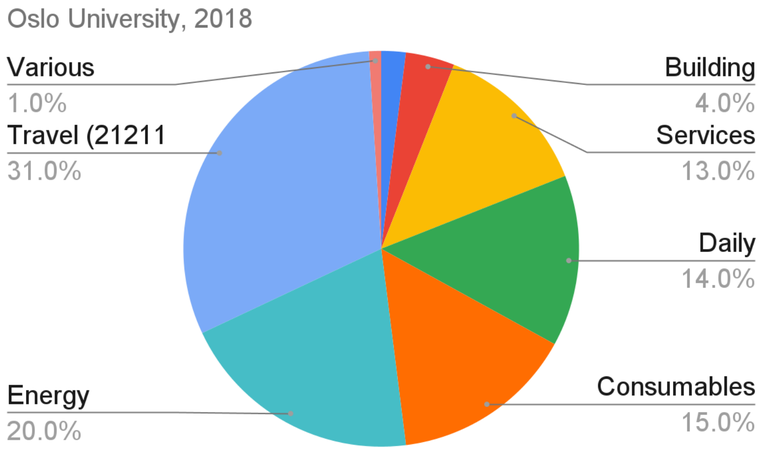

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(incomplete list of) European universities that have declared carbon reduction targets/ net zero target:

University of Aarhus, Denmark
University of Amsterdam, The Netherlands
Free University of Berlin, Germany
University of Bournemouth, UK
Cambridge University
University of Copenhagen, Denmark
University of Edinburgh, UK
ETH Zürich, Switzerland
University of Gloucestershire, UK
University of Gothenburg, Sweden
University of Graz, Austria
University of Helsinki, Finland
Imperial College, UK
KU Leuven, Belgium
Leuphana University Lueneburg, Germany
University College London, UK
University of Lund, Sweden
University of Münster, Germany
University of Nottingham
University of Oxford, UK
University of Plymouth, UK
University of Southern Denmark, Denmark
Stockholm University, Sweden
University of Warsaw, Poland
….

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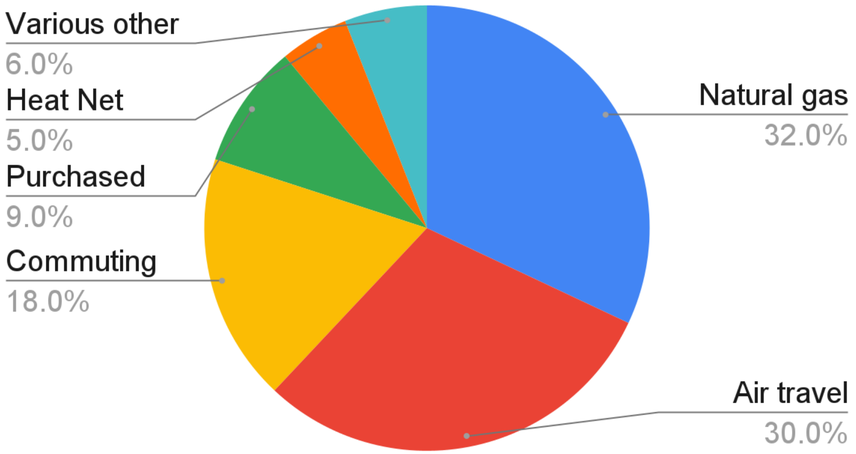

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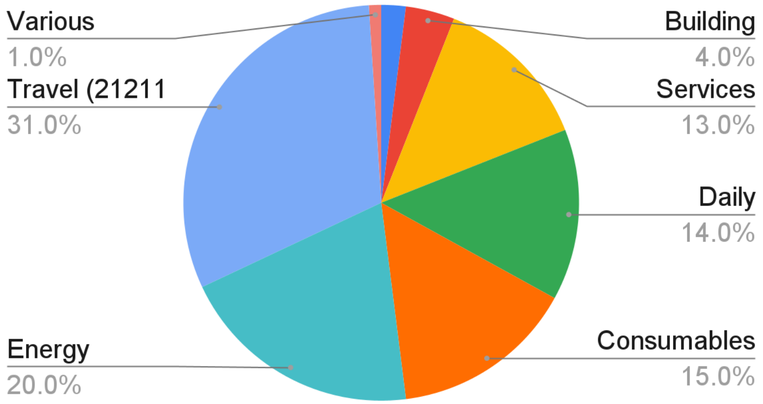

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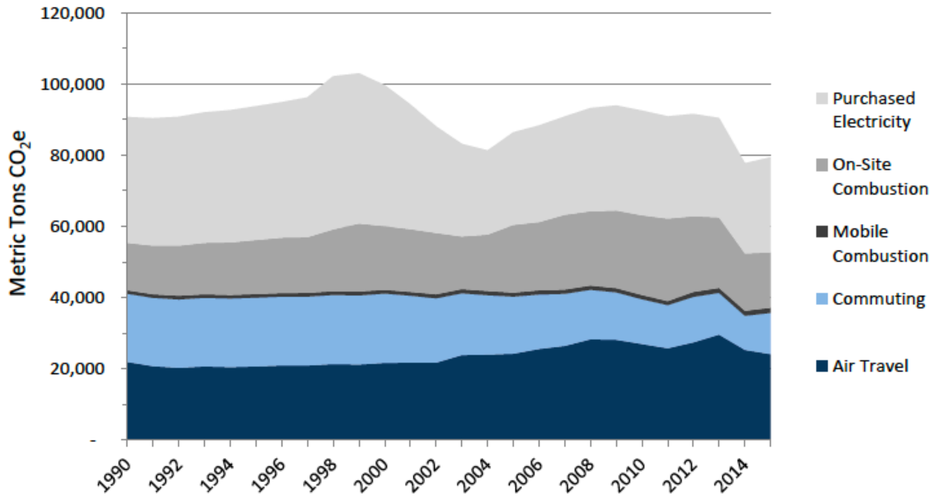
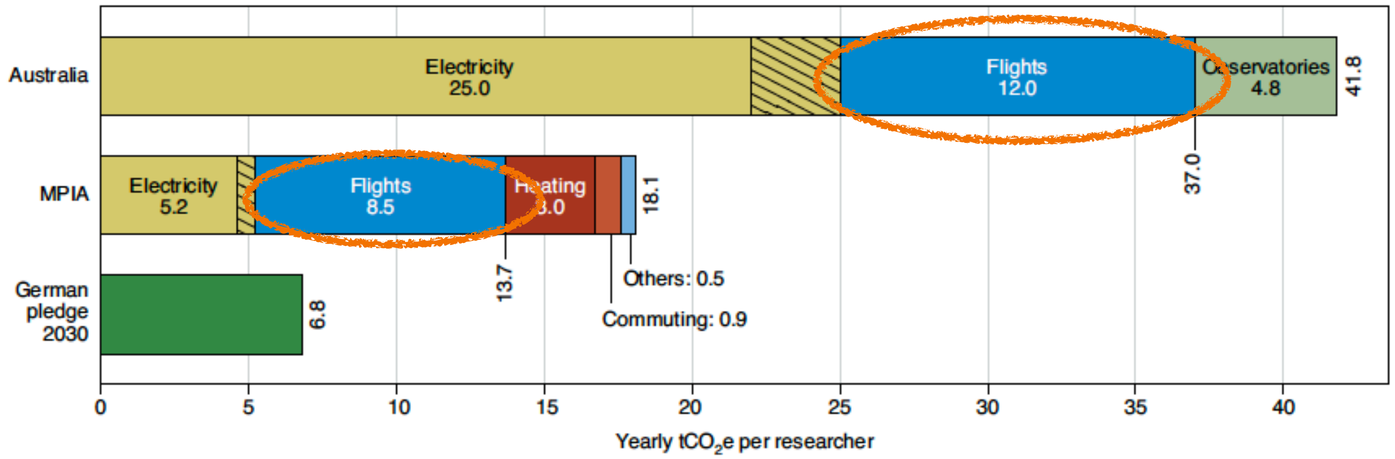


US comparison: UCSB
[figure from UCSB climate action plan 2016]

GHG emissions from research operations at a research institute

example: Astronomy



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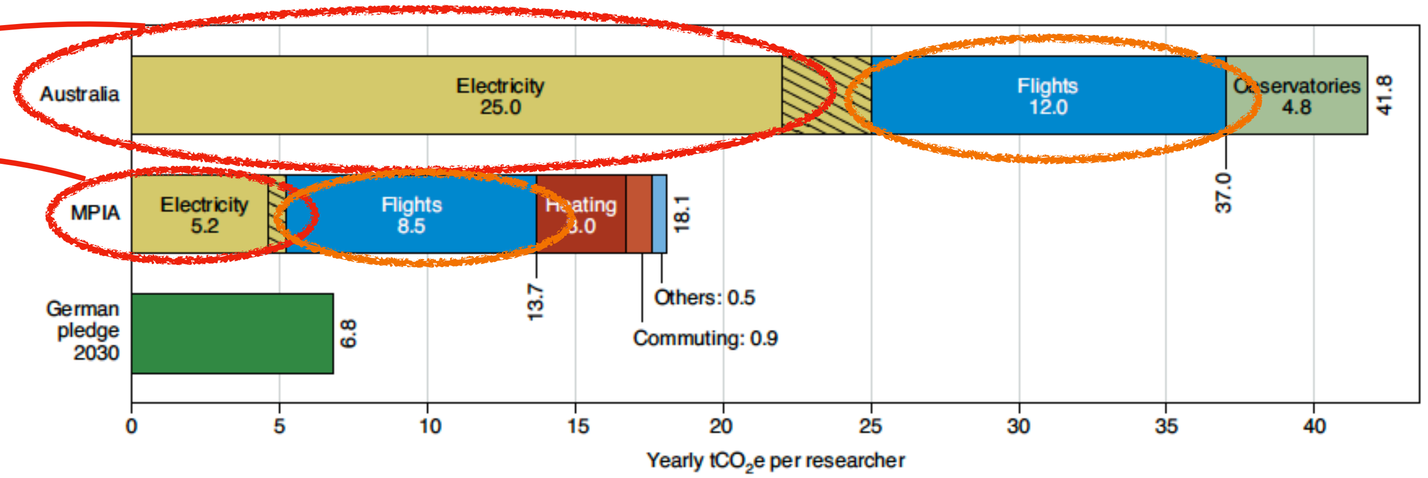
GHG emissions from research operations at a research institute

example: Astronomy

88 % from computing

75 - 90 % from computing



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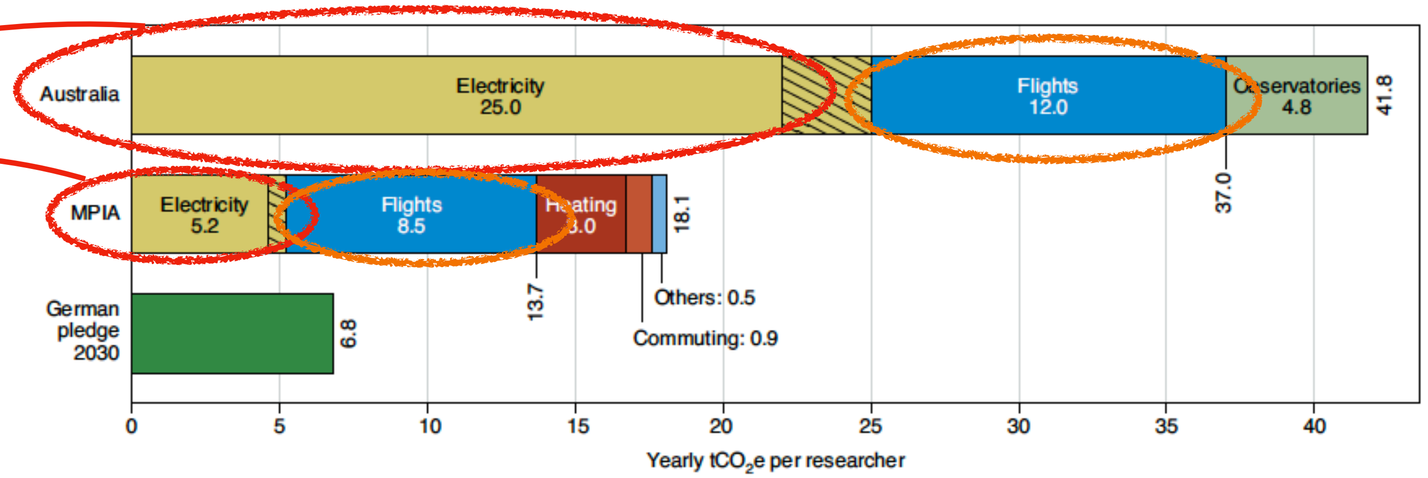

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in perspective:

2019 IPCC report: ~ 500 Gigatonnes carbon emissions remaining before truly irreversible effects

per person per year until 2050: ~ 1.8 t

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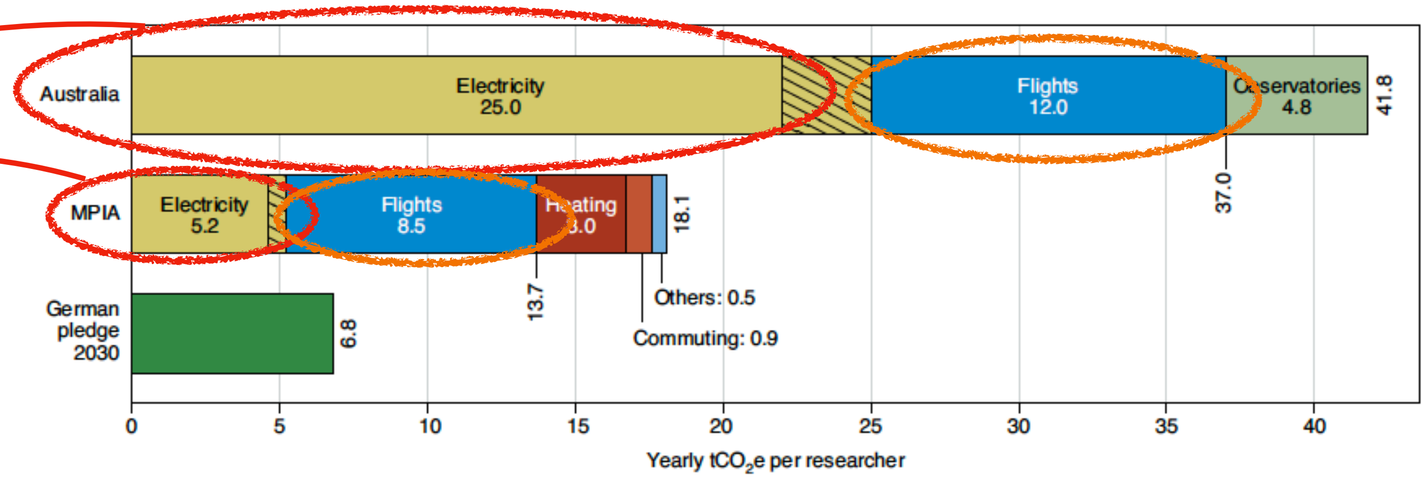

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challenges:
research thrives on international collaboration & exchange;
computing necessary in astronomy/particle physics…

Focus on computing

- devising efficient measures based on solid evidence base:
  data on carbon emissions from computing in particle physics required
- building awareness: require carbon budget for applications for supercomputer time?
- new supercomputing facilities in locations with “green” electricity
- reduce idle times → cloud computing?
- efficient codes

Focus on air travel

Conferences:

- typically ~ 1 t emissions per participant [Spinellis, Louridas, PLoS ONE 8(6) (2013) e66508]
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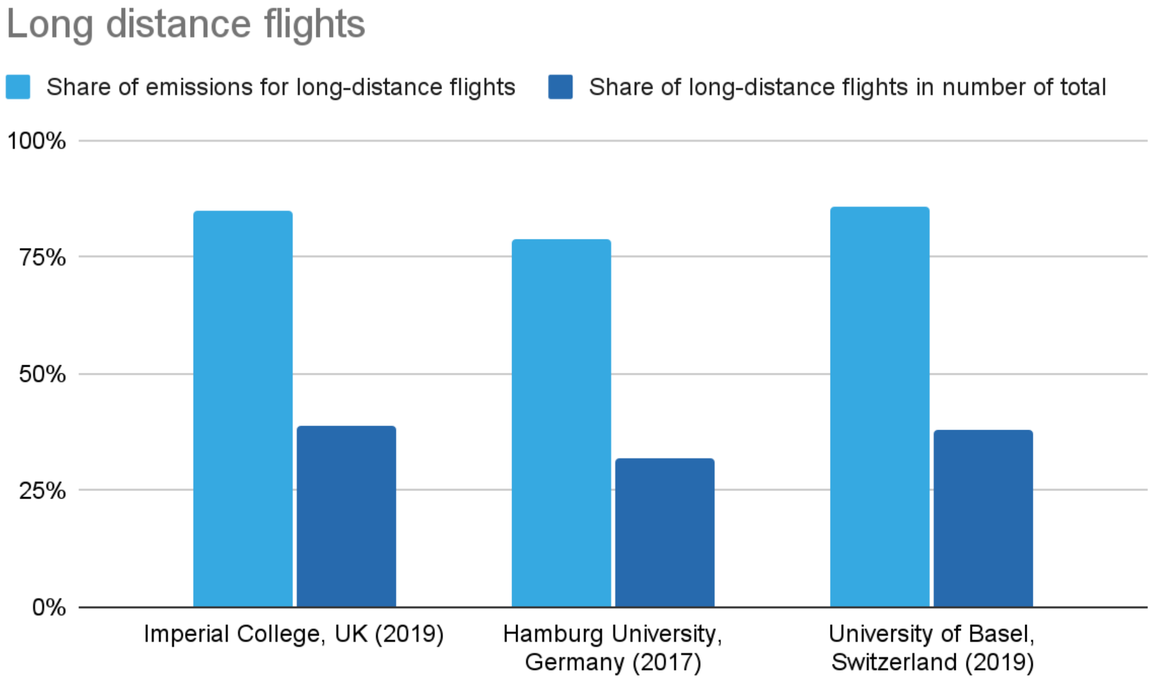

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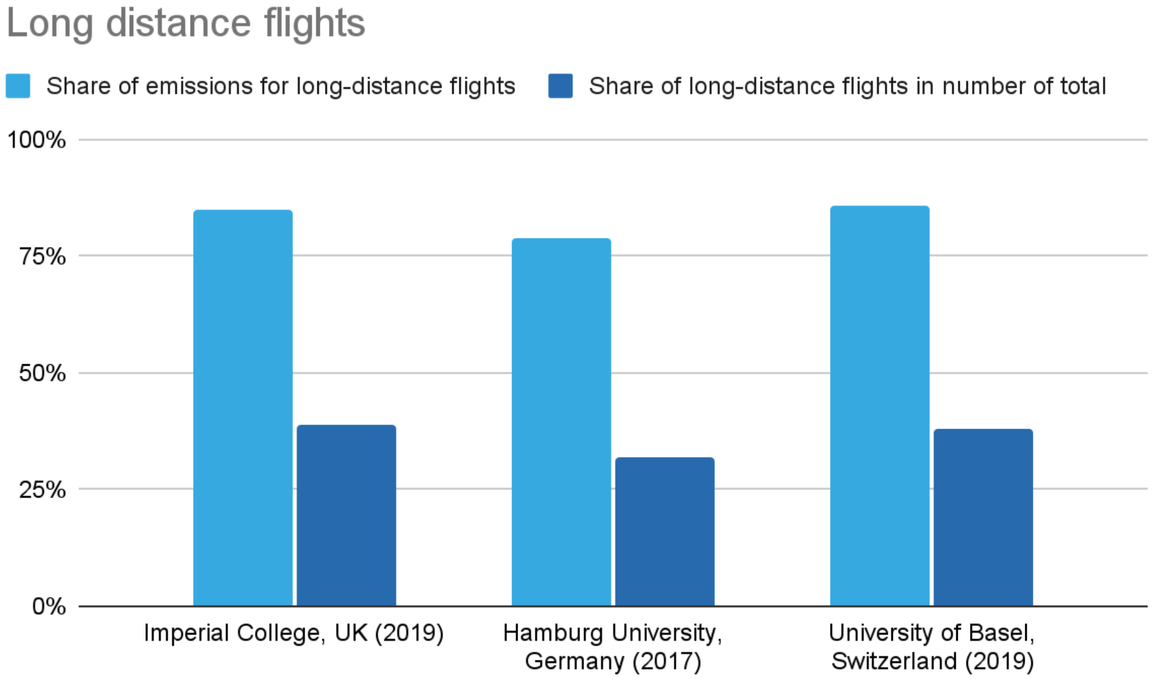

Incentive to travel to many conferences:

- invited conference presentations as a metric for research impact

Correlation with research impact?

- study at University of British Columbia:
  no correlation between h-index and emissions from air travel
  [S. Wynes et al. / Journal of Cleaner Production 226 (2019), 959)]

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Online/hybrid conferences and global inclusivity

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- reseachers who cannot travel for health or personal reasons
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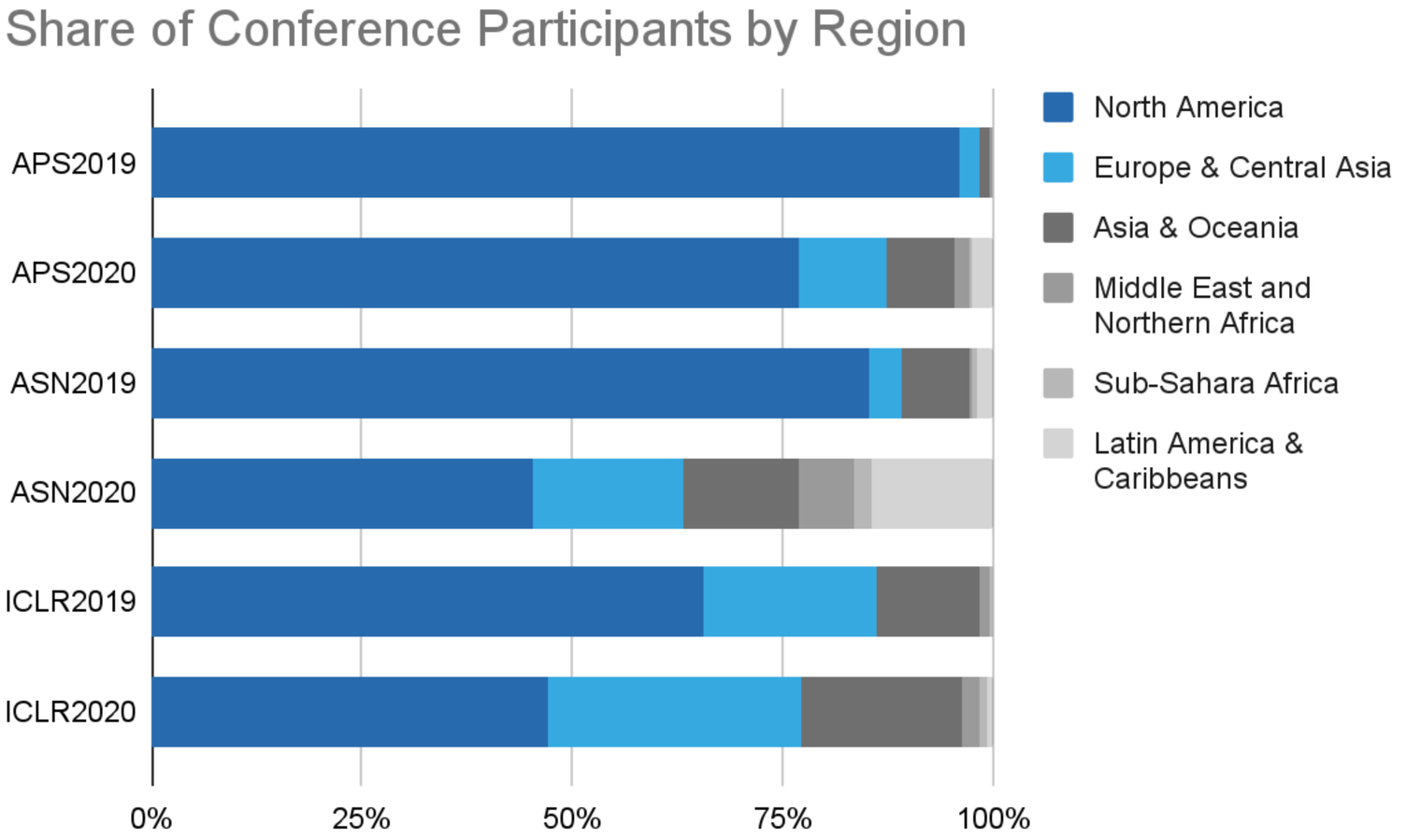

Data from (https://elifesciences.org/articles/62668#fig3s1).

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	online	hybrid	hub-based	traditional w. optimized location	traditional
emissions					
networking/ social aspects					
global inclusivity/ access					

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no “one size fits all” solution; different formats work for different goals → mix & match

Towards net zero for research institutions - a necessary and useful goal?

- Is research special and therefore exempt?

  How to weigh claims of “specialness” from different sectors?
  Research part of the solution - but also part of the problem?

- Can we afford to wait?

  Now research institutes can find their own ways of reducing emissions without harming research quality; policymakers might later impose across-the-board rules and restrictions

- Are reductions in carbon emissions from research symbolic?

  No, see individual numbers.
  Also: don’t underestimate the power of symbolic gestures.

- Is there a link to scientific credibility on the climate crisis?

  If scientists don’t act on the climate crisis, how seriously should the general public and policymakers take it?

Summary

- research institutions:
  - emissions just like other public/private enterprises, with the same solutions (e.g. switching to renewable energy)
  - emissions which are deeply intertwined with research activity (e.g., from experiments, computing, travel)

- conferences:
  - online/hybrid format: more climate sustainable and more socially just
  - hub-format: more climate sustainable
  - traditional format: choice of location matters