flyingless

Module 3
Backgrounds & Arguments
"What backgrounds should I know?"

Module 3.1
Relevance

Relevance of the topic

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ifeu INSTITUT FÜR ENERGIE- UND UMWELTFORSCHUNG HEIDELBERG

TdLab GEOGRAPHIE

UNIVERSITÄT HEIDELBERG ZUKUNFT SEIT 1386

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Bundesministerium für Wirtschaft und Klimaschutz

NATIONALE KLIMASCHUTZ INITIATIVE

aufgrund eines Beschlusses des Deutschen Bundestages

Toolbox content

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- **3.4** Success factors & stumbling blocks
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- **4.3** Strategy development

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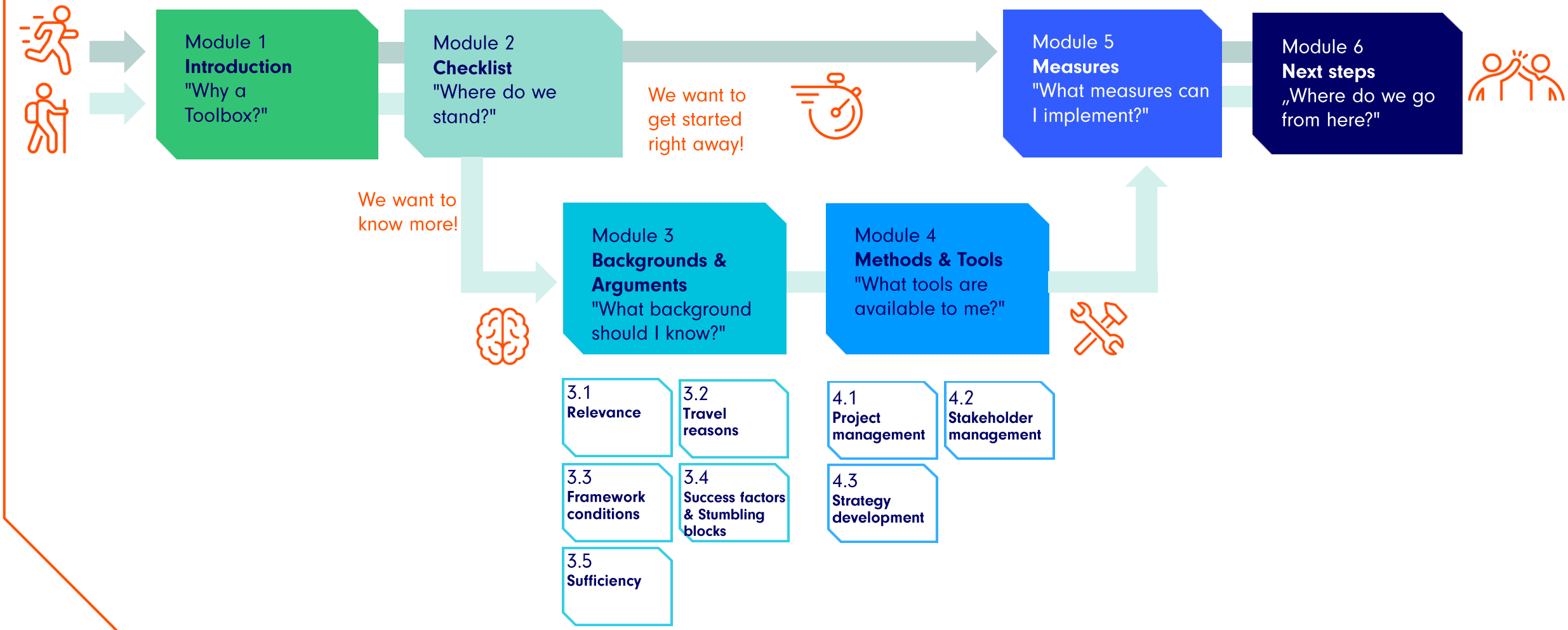
6 **Module 6** Next steps: "Where do we go from here?"

Flowchart Toolbox



How to use the toolbox?

The **FlyingLess Toolbox** is a modular collection of content and methods on the topic of reducing air travel.

Depending on the occasion or need, suitable modules or individual modules or individual slides can be selected and used.
The order of the modules is only a recommendation.

Depending on your level of knowledge and interest, you can start with different modules.

The FlyingLess logo and the link to the website (www.flyingless.de) should remain on the slides.

On some slides, questions that can be discussed in the institution are listed in green.

Module 3.1: Relevance

What do I find in the module?

- This module contains a wealth of information and sources on the relevance of flight reduction and the overarching theme of net zero

What can I use the module for?

- Depending on the question, the various information and sources on the topic of the relevance of reducing air travel can be used
- Collect arguments to increase awareness and willingness to act on the issue of reducing flight emissions

Overview module 3.1

1. Why do we need to reduce emissions?
2. The concept of climate neutrality/GHG neutrality, net zero
3. Net zero targets (states, academic institutions)
4. What does net zero mean for science?
5. Who has what responsibility?
6. Why is flight reduction relevant in academia?
7. FlyingLess Survey Scientists and Students
8. Emotions
9. Technological solutions
10. Conclusion

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1 Why do we need to reduce emissions?

- Global warming of 1.2 degrees already today compared to pre-industrial times (6th IPCC Assessment Report (2022), p. 248)
- Paris Climate Agreement of 2015: Keep warming < 1.5-2 degrees
- The **CO_2** budget would be used up in approx. 8 years (1.5 degree target) or 25 years (2 degree target) if emissions remain constant*.
- The world population can still emit a maximum of 235 Gt **CO_2** in order to remain within the 1.5 degree target with a high probability**.
- Or: 29.8 t **CO_2** per person in total, if the remaining **CO_2** budget is distributed equally among all 7.9 billion people***.
- I.e. if someone emits more than approx. 30 t of **CO_2** during their lifetime and thus uses up their budget, the budget of the other people is reduced.

*Remaining carbon budget - Mercator Research Institute on Global Commons and Climate Change (MCC) (mcc-berlin.net)
**6th IPCC Assessment Report (2021), p. 27
***https://branch.climateaction.tech/issues/issue-4/the-fermi-problem-of-climate-change/

1.1 Examples of emission calculations per person

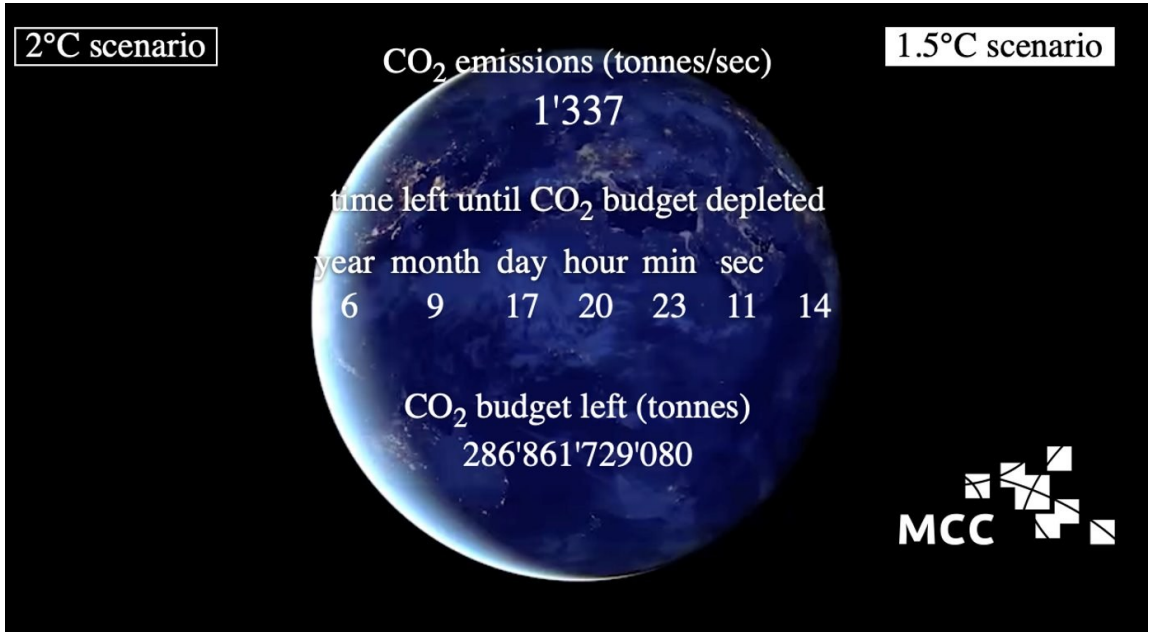
From: Frankfurt/Main Airport (return flight)*

- London Heathrow : 0.53 t CO_2
- Boston: 3.9 t CO_2
- San Francisco: 6.56 t CO_2
- Sydney: 17.93 t CO_2

Source: FlyingLess GHG Monitoring Tool, calculation according to EWF100. Further information: https://flyingless.de/en/ghg-monitoring-tool

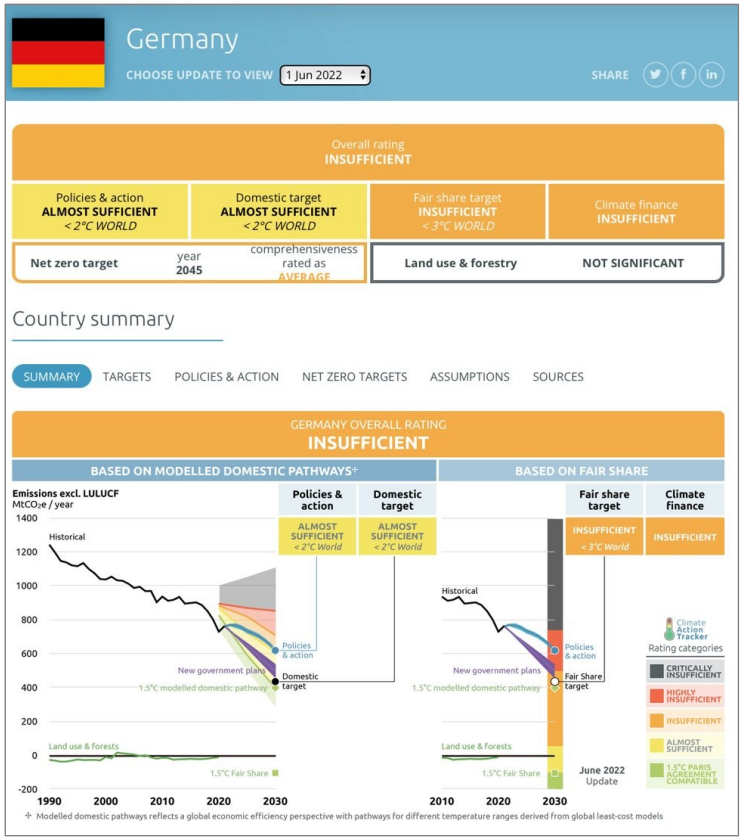
1.2 References to online sources for illustration

Live graphic "This is how fast the CO_2 clock is ticking".



Mercator Research Institute on Global Commons and Climate Change MCC
https://www.mcc-berlin.net/forschung/co2-budget.html

Climate Action Tracker



Current implementation Climate protection; e.g. country profile Germany:
https://climateactiontracker.org/countries/germany/

Image source: right image CO_2 clock by MCC, further information www.mcc-berlin.net/co2-uhr; left image © Climate Analytics and NewClimate Institute

2. The concept of climate neutrality, GHG neutrality or net zero

Image source: © Lucia Fabiani

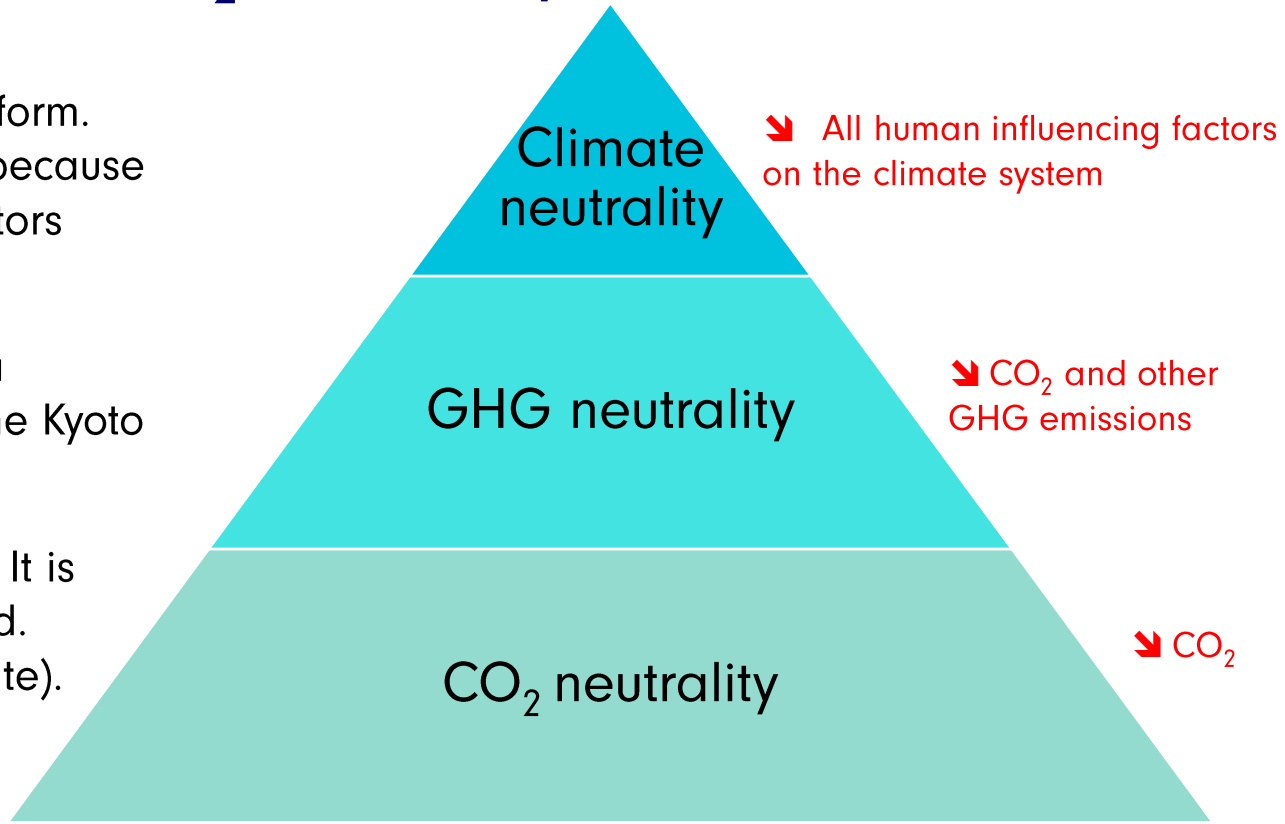
2.1 What does climate neutrality, greenhouse gas neutrality or net zero mean?

- There are different terms: climate neutrality/greenhouse gas neutrality/net greenhouse gas neutrality or net zero
- Definition IPCC*:
  - "Net zero **CO_2** and carbon neutrality have different meanings in this assessment, as is the case for net zero GHG and GHG neutrality. They apply to different boundaries in the emissions and removals being considered.
  - Net zero (GHG or **CO_2**) refers to emissions and removals under the direct control or territorial responsibility of the reporting entity.
  - In contrast, (GHG or carbon) neutrality includes anthropogenic emissions and anthropogenic removals within and also those beyond the direct control or territorial responsibility of the reporting entity.
  - At the global scale, net zero **CO_2** and carbon neutrality are equivalent, as is the case for net zero GHG and GHG neutrality."
- Oxford University has a website with explanations and examples** and the Stay grounded website has a factsheet

*6th IPCC Assessment Report (2021), p. 27 https://www.ipcc.ch/report/ar6/wg3/downloads/report/IPCC_AR6_WGIII_Chapter_03.pd
**https://netzeroclimate.org

2.2 Conceptual distinction between climate neutrality, greenhouse gas neutrality and CO_2 neutrality*:

- **Climate neutrality** describes the most comprehensive form. The global average temperature remains unchanged because all natural and anthropogenic temperature-related factors balance each other out.
- **GHG neutrality** "describes the state in which there is a balance of sources and sinks of all GHGs defined in the Kyoto Protocol and Doha Amendment".
- **CO_2 neutrality** is the least ambitious form of neutrality. It is achieved when all **CO_2** sources and sinks are balanced. Climate warming continues (albeit at a much slower rate).



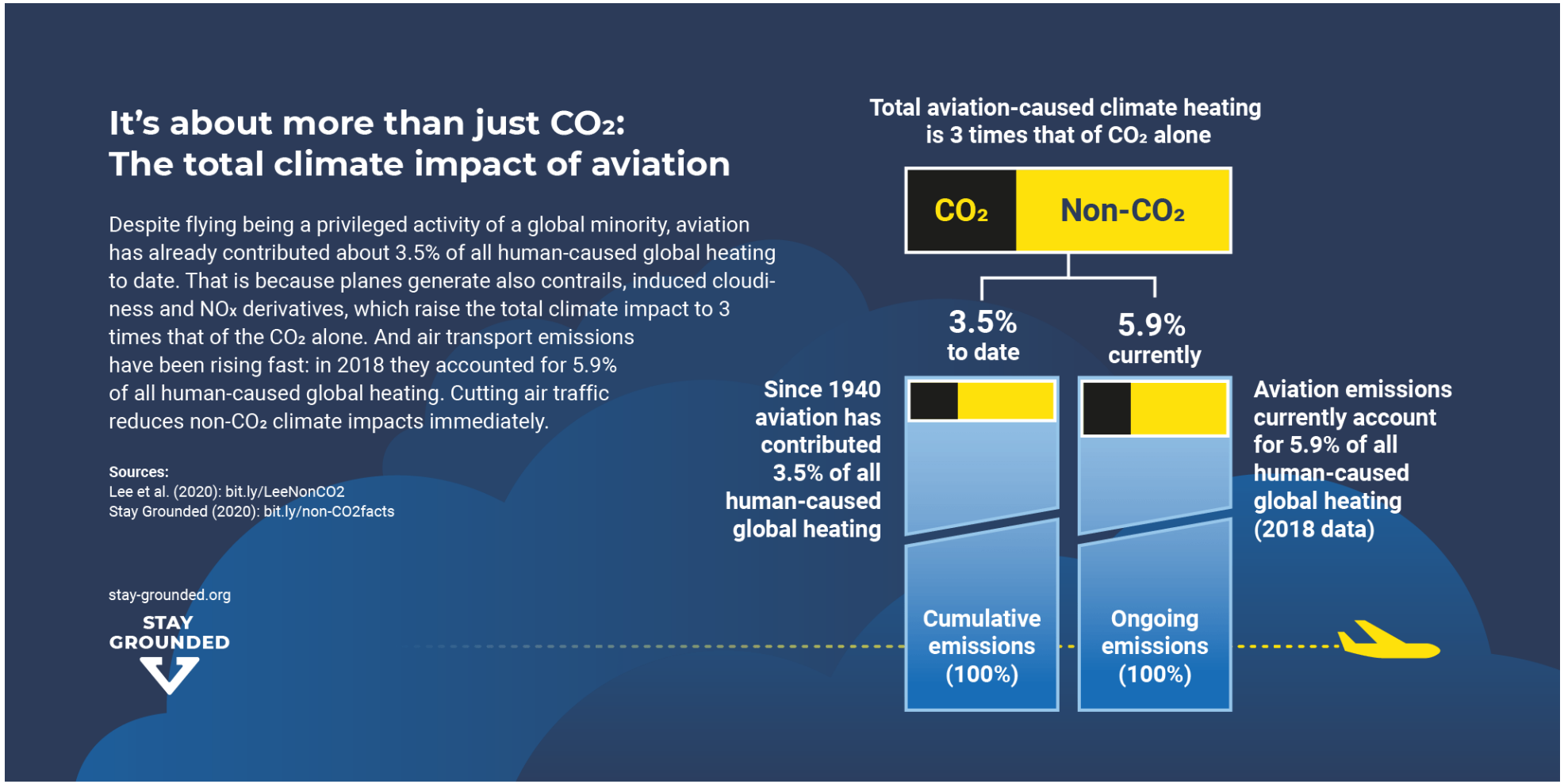
Graphic: Own illustration based on data from https://www.zora.uzh.ch/id/eprint/195545/1/ZORA195545.pdf

2.3 What does climate neutrality or net zero mean for air travel?

- In aviation, it is not only GHG emissions that play a role, but also other effects due to the formation of contrails and the resulting cirrus clouds; **these non-GHG effects increase the climate effect by a factor of 2-5.**
- These non-GHG effects remain with alternative fuels (Brazzola et al., 2022, NatureCC). Therefore, sustainable aviation fuels (SAF) can be GHG neutral, but they are not climate neutral.
- Brazzola et al. therefore propose to speak of climate neutrality in air travel instead of GHG neutrality

Brazzola, N., Patt, A. & Wohland, J. Definitions and implications of climate-neutral aviation. *Nat. Clim. Chang.* **12**, 761–767 (2022). https://doi.org/10.1038/s41558-022-01404-7

2.4 What does climate neutrality or net zero mean for aviation?



3. Examples of climate neutrality or net zero of states

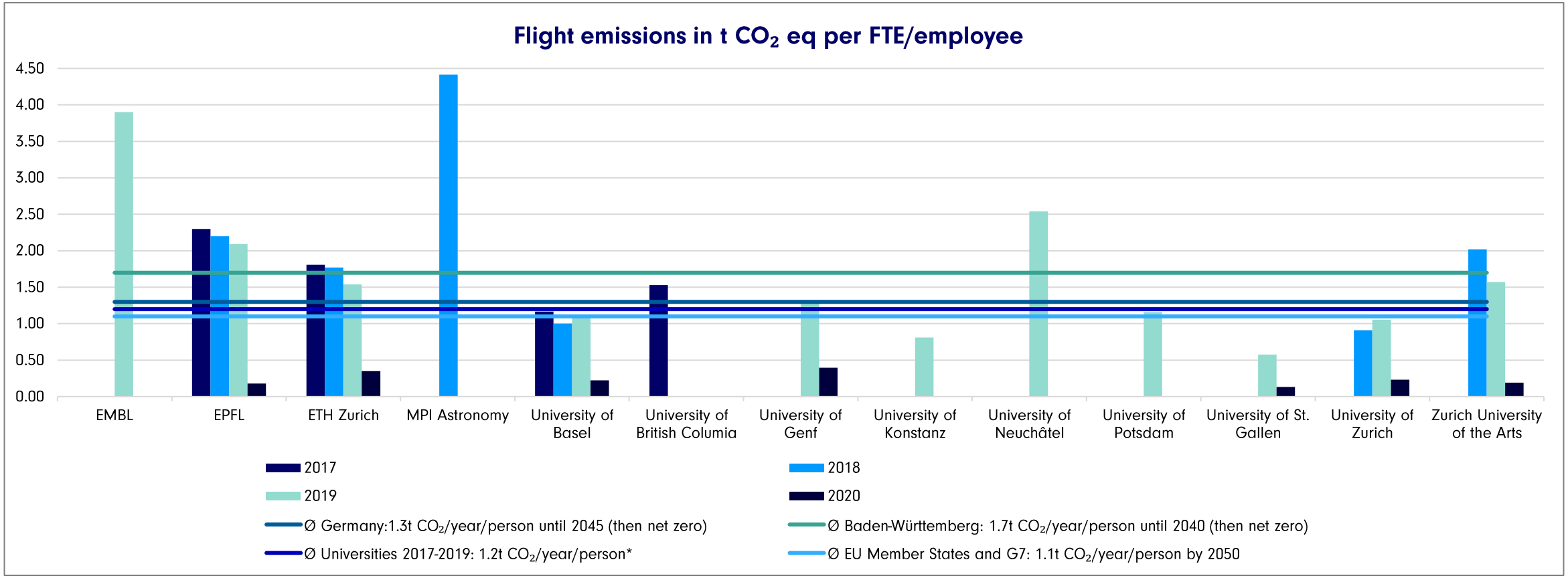
- GHG emission reduction targets on the way to net zero:
  - Green Deal EU: Reduction of 55% compared to 1990 by 2030
  - Germany: Reduction of 65% compared to 1990 by 2030

- Example net zero targets:
  - **Baden-Württemberg until 2040:** everyone still has 1.7 t **CO_2** /year/person until 2040, after which emissions must be zero or offset
  - **Germany until 2045**, from 2050 negative emissions: 1.3 t **CO_2** /year/person until 2045
  - **EU, Switzerland, all members of the G7, South Korea and South Africa by 2050:** each still has **approx. 1.1 t CO_2 /year/person by 2050**
  - PR China until 2060

Net emissions must be zero, i.e. remaining emissions must be offset by removing CO_2 from the atmosphere.

3.1 Comparison of emissions from different research institutions

Emissions per person and year, for the years 2017-2020 and, in comparison the emissions per person and year to achieve net zero goals (see slide 15)



System boundaries and calculations of emissions differ between institutions.
Graphic: Own illustration, ifeu.

3.2 Examples of climate neutrality or net zero from academic institutions (1/2)

2025

- **FU Berlin:** climate neutral
- **University of California:** carbon neutral
- **University of Melbourne:** carbon neutral (climate positive by 2030)

2030

- **ETH Zurich:** Net zero
- **HU Berlin:** climate neutral
- **University of St. Gallen:** climate neutral
- **University of Vienna:** climate neutral
- **University of Zurich:** climate neutral

What are your organization's net-zero targets, by when should climate neutrality be achieved?

Do at least the target and the date of the corresponding federal state apply (e.g. 2040 for BW) or 2045 for Germany?

What are the interim goals?

3.2 Examples of climate neutrality or net zero from academic institutions (2/2)

2035

- **Alliance of Science Organisations** (Alexander von Humboldt Foundation, German Research Foundation, Fraunhofer Society, German Rectors' Conference, Leibniz Association, Leopoldina National Academy of Sciences, German Academic Exchange Service, Helmholtz Association, Max Planck Society, German Science Council): climate neutral

2040

- **University of Edinburgh:** Net zero
- **Boston University:** Carbon neutral
- **EPFL:** carbon neutrality through offsetting

2045

- **University of Neuchâtel:** Net zero

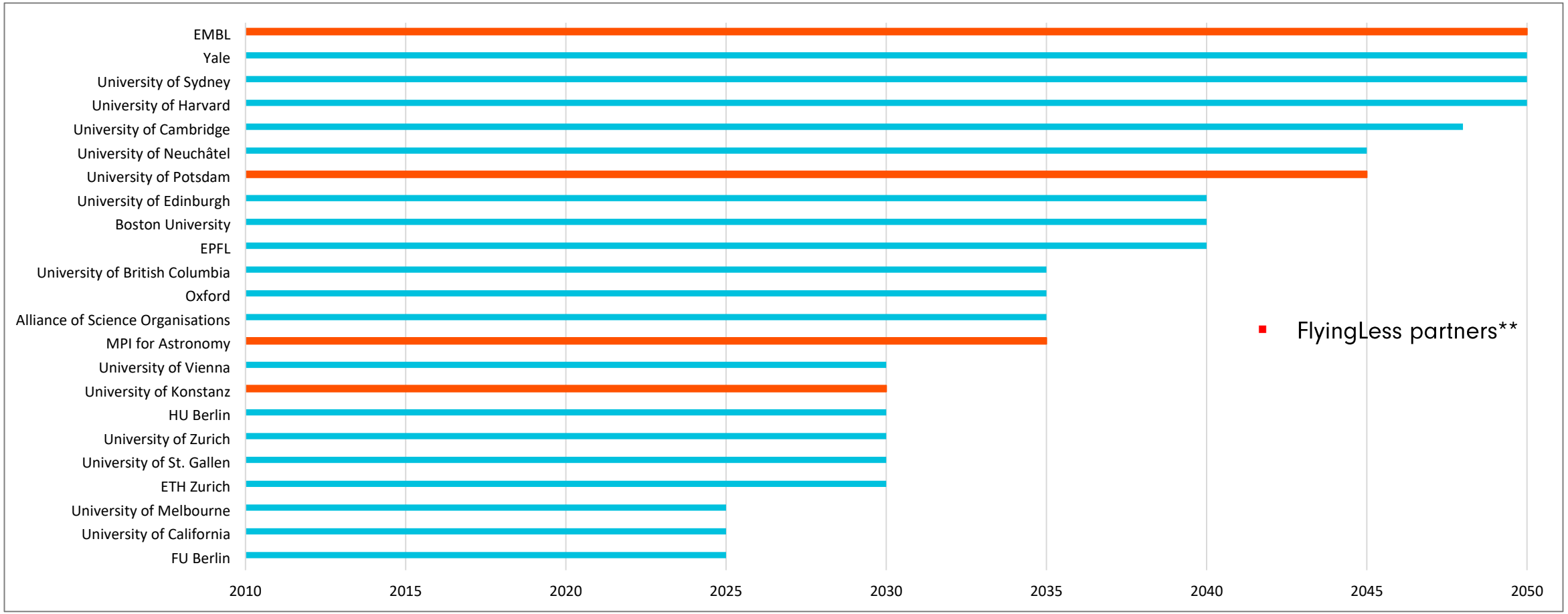
2048

- **University of Cambridge:** Net zero

2050

- **University of Harvard:** Fossil fuel-free (fossil fuel-neutral by 2026)
- **University of Sydney:** Global emissions neutrality
- **Yale:** zero actual carbon emissions (net zero emissions by 2035)

3.3 Net zero targets of the FlyingLess partners and various academic institutions*



FlyingLess partners, if they do not have net-zero targets or if they deviate from higher-level targets, the higher-level net-zero targets were assumed here.
Graphic: Own illustration based on data from ifeu and Allea Report https://doi.org/10.1007/978-981-16-4911-0

4 What does climate neutrality or net zero mean for science?

- Universities and research institutions are (mostly) (co-)financed by public funds and are therefore subject to the social and political framework conditions (including the net-zero target)
- Many academic institutions have set themselves a more ambitious net zero target
- This also includes the flight emissions
- These must therefore be drastically reduced, i.e. either
  - no flight emissions or
  - the (few) aviation emissions must be removed from the atmosphere to the same extent

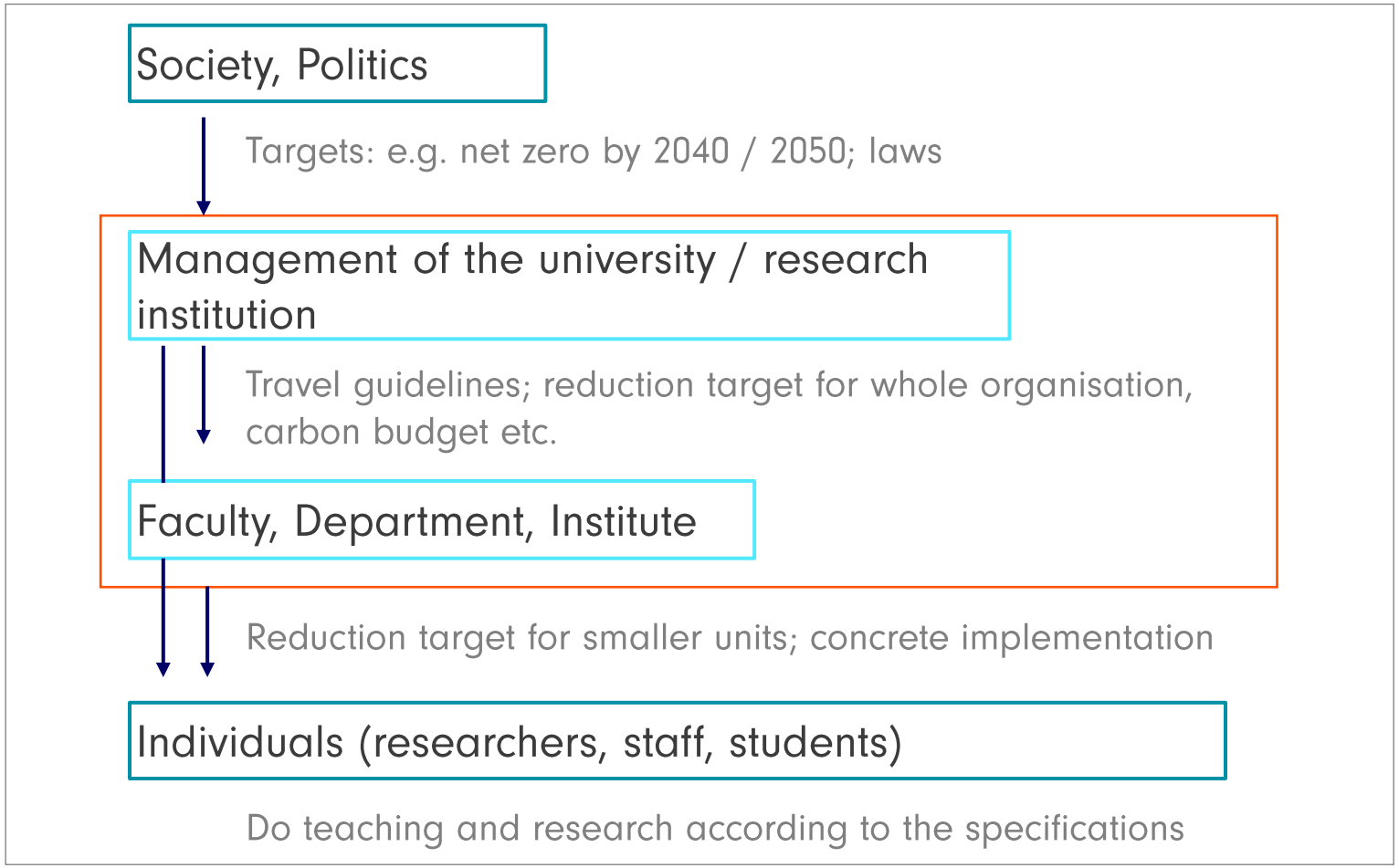
Who will "receive" these emissions in the future, who will be allowed to fly?

4 What does climate neutrality or net zero mean for science?

- How do you do excellent science in the future under the conditions of climate neutrality/net zero, i.e. with (almost) no flights?
- What does this science look like, i.e. how are individual scientific activities and science organisations affected?
- How do you make the transition?
- Who is responsible for initiating and steering this process (responsibility and accountability)?

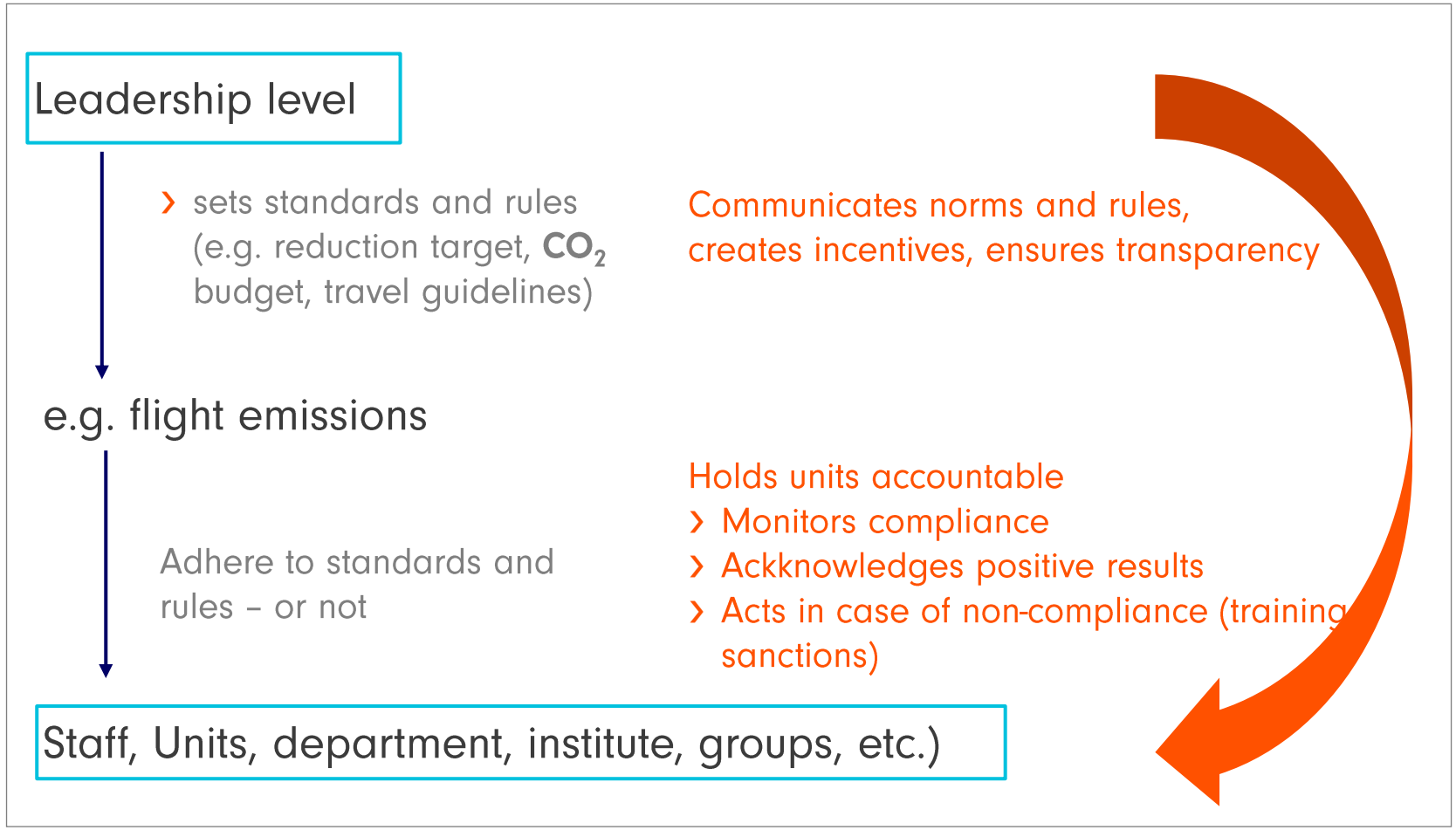
5 Who has what responsibility?

5.1 Who is responsible for what?



Slide adapted from Hirsch-Hadorn, Baumberger, ETHZ. The slide only represents the top-down and not the participatory bottom-up version. Each level can therefore hold the next level accountable.
Graphic: Own illustration adapted from Hirsch-Hadorn, Baumberger, ETHZ.

5.2 Who can hold whom responsible and how (internal control)?

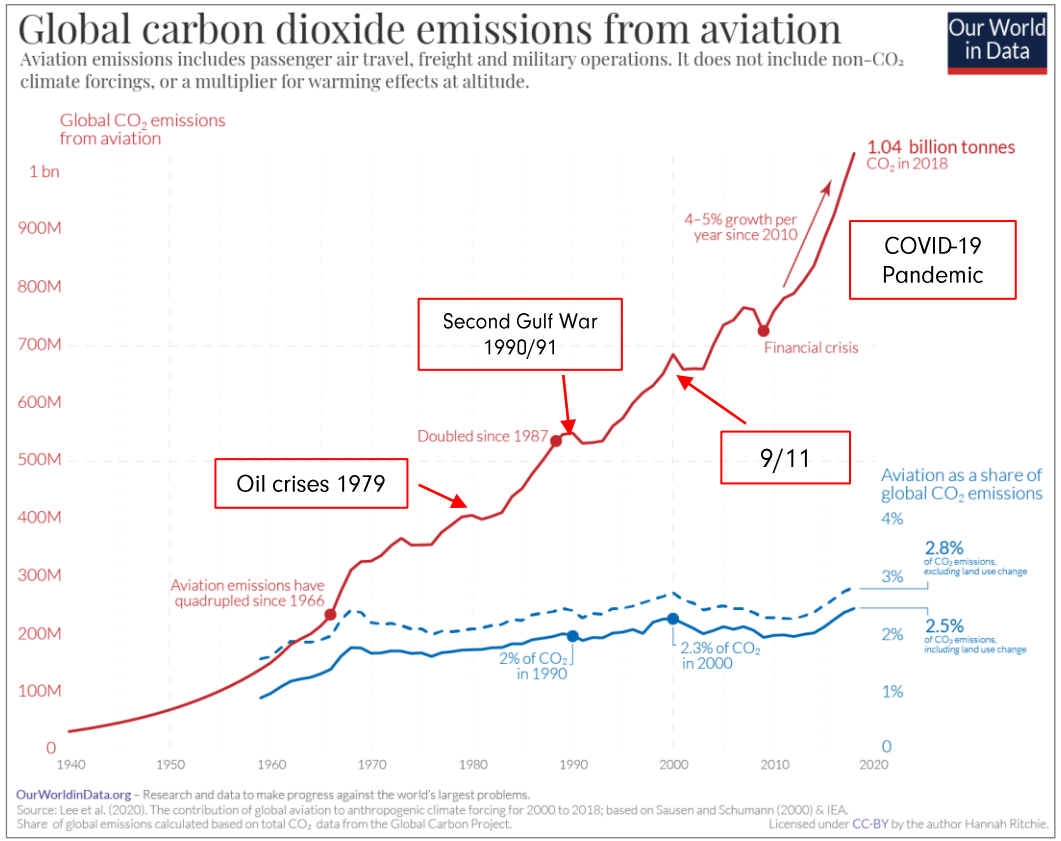


In order to prevent "organised irresponsibility" (Beck 1988), institutions must be so designed that responsibility becomes clear and can be claimed.

Graphic: Own illustration adapted from Hirsch-Hadorn, Baumberger, ETHZ.

6 Why is flight reduction relevant in academia?

6.1 Development of worldwide flights since 1940 and increase in air traffic at universities in Baden-Württemberg



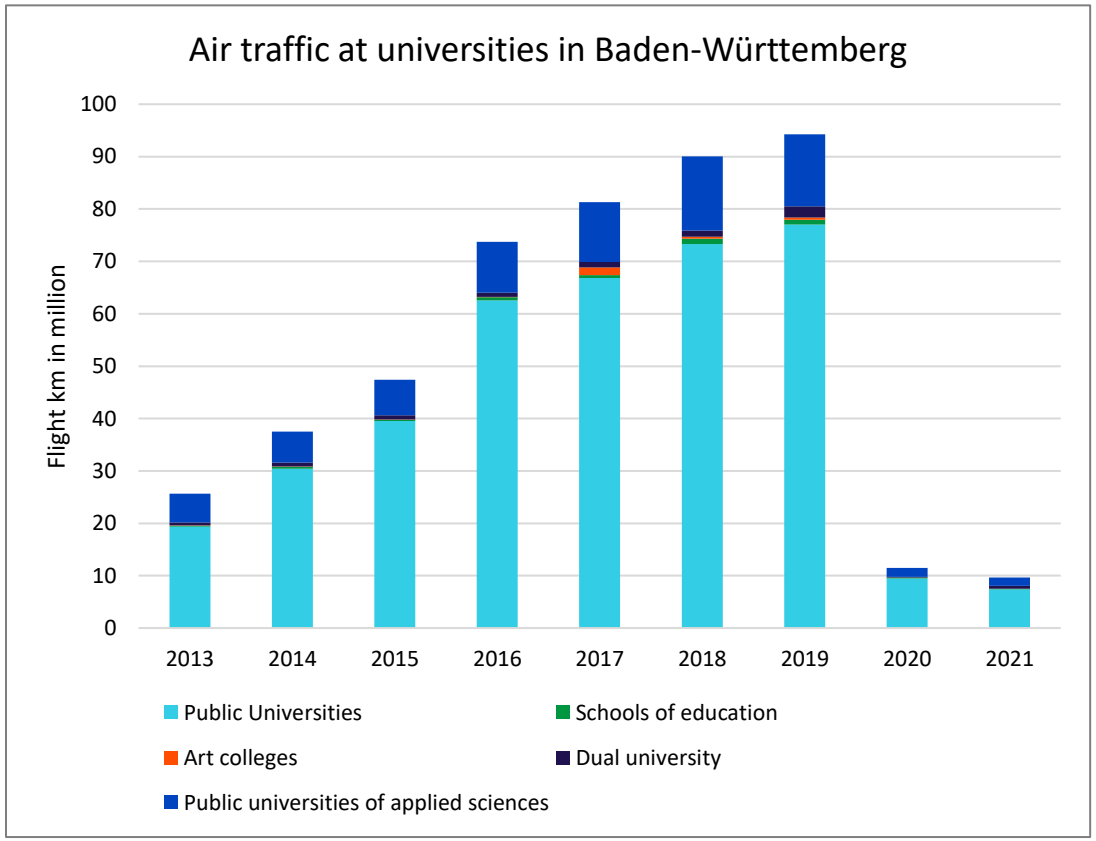
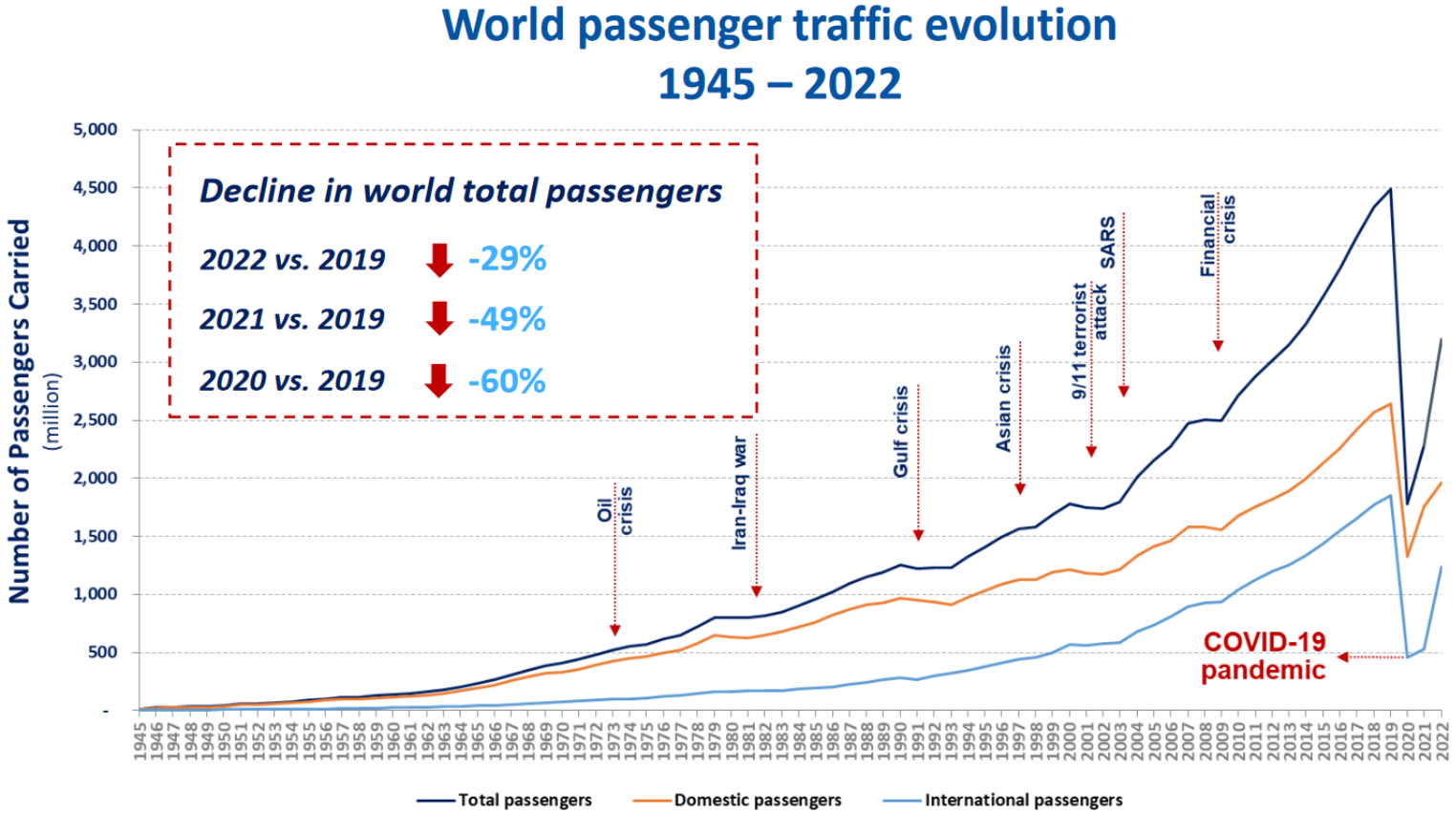


Image source: Author Hannah Richie, License: CC BY 4.0. https://ourworldindata.org/co2-emissions-from-aviation

Graphic: Own illustration based on data from Drucksache 16/6716 – Antrag SPD – Entwicklung des Flugaufkommens der Landesverwaltung (16.9.2019)

6.2 Development of air passengers since 1945

Despite decline during COVID-19, passenger numbers in 2020 are as high as 20 years ago!



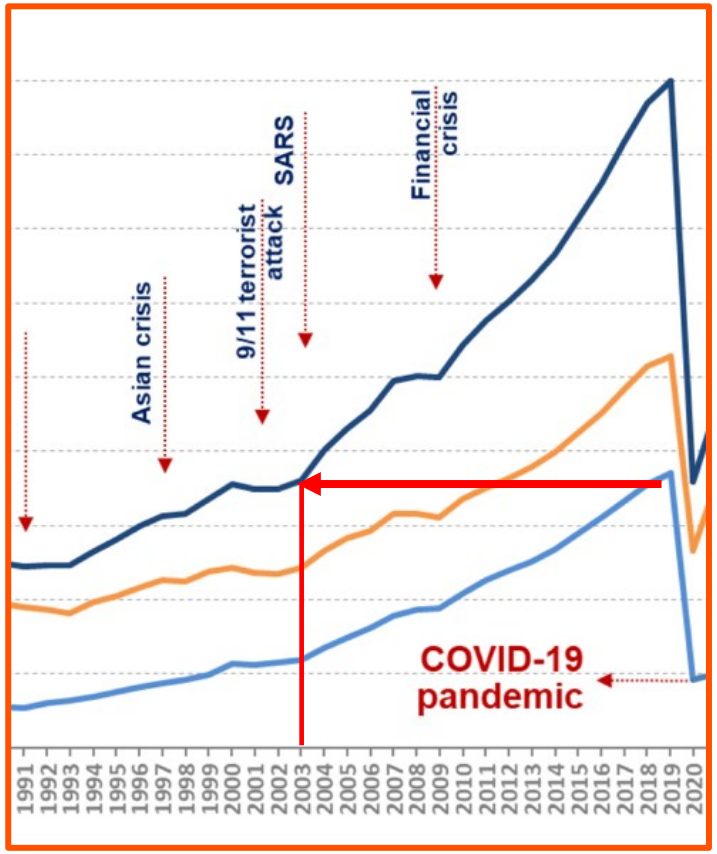


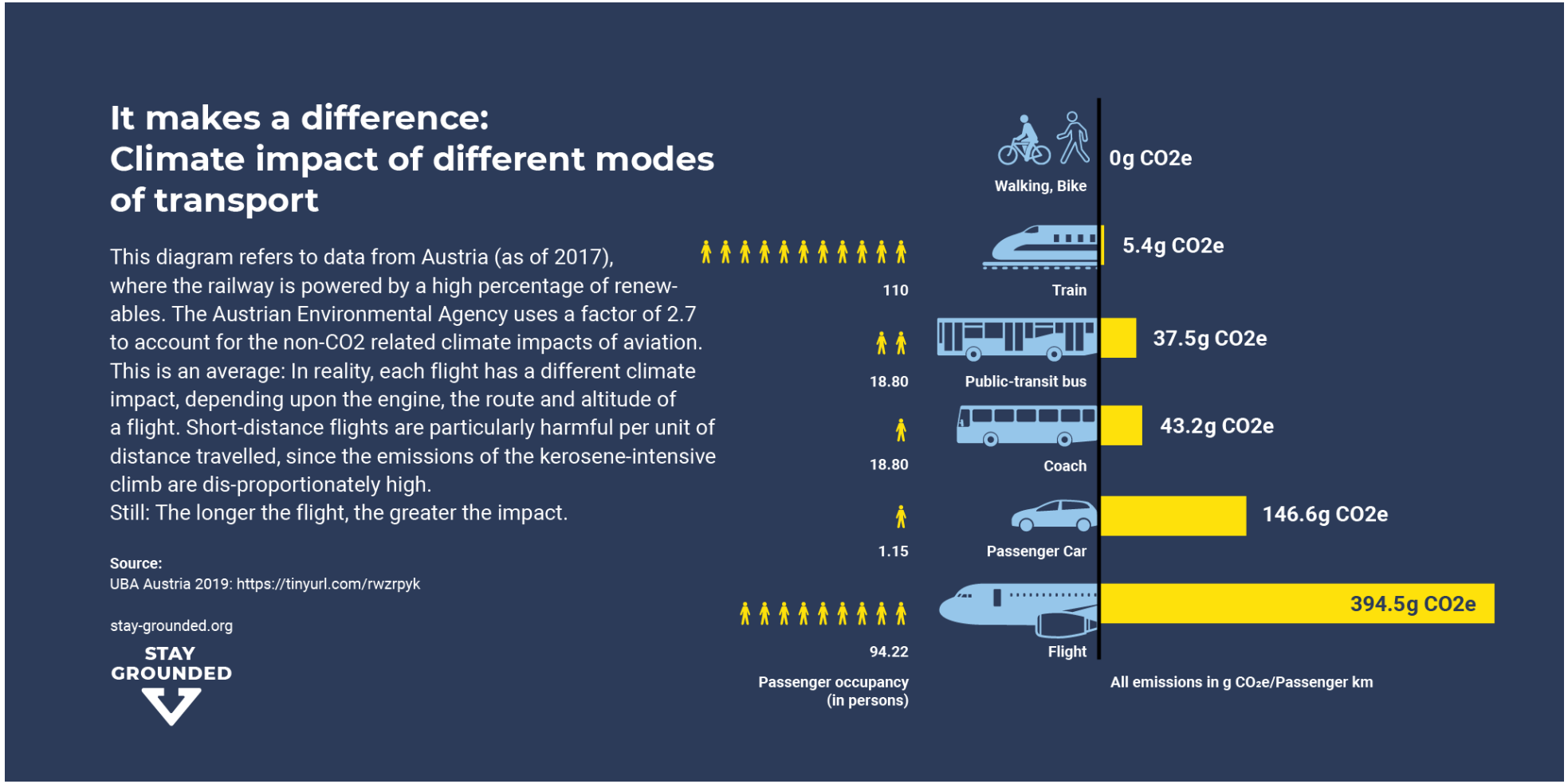
Image source: © ICAO, https://www.icao.int/sustainability/Documents/COVID-19/ICAO%20COVID-19%20Economic%20Impact_2023%2004%2027.pdf

6.3 Global air traffic and the (short-term) corona effect

- Global air traffic has increased sharply in recent decades. From 310 million passenger flights in 1970, the number grew to 4.3 billion* in 2018.
- By 2018, global aviation emissions had risen to 1,034 Mt CO_2 per year (increase by a factor of 6.8 compared to 1960). In 2018, global aviation emissions thus accounted for around 2.4% of anthropogenic CO_2 emissions**.
- Taking into account non-CO_2 emissions (with their uncertainties), the total warming caused by aviation amounts to about 0.04 ± 0.02°C by 2019, i.e. about 4% of the current human-induced warming of the planet of just under 1.2°C*.
- Due to the COVID-19 pandemic, air traffic decreased dramatically in 2020***.
- However, Gudmundsson et al. (2020) predicted that the pandemic will only temporarily slow down the air traffic growth curve by 2.4 years.

*Klöwer et al. 2021; **Lee et al. 2021, S. 2; ***Le Quéré et al. 2020

6.4 Climate impact of different modes of transport



6.5 Why is the reduction of air travel relevant? (1/3)

1. **Researchers fly significantly more than the average population** (Burian, 2018)
2. **Few fliers are responsible for most emissions**
   - Study by Wynes and Donner (2018) about the flight emission of around 1500 persons at 8 departments of the University of British Columbia:
     - 1/3 did not fly
     - 80% of the emissions were caused by 25% flyers
     - 50% of the emissions were caused by 8% flyers

- Inequality of flight emissions is a topic in further studies (Gössling and Humpe, 2020; Hopkinson and Cairns, 2020)

6.5 Why is the reduction of air travel relevant? (2/3)

3. **Fairness**
   Increased air travel has increased **inequality as** not everyone has the same opportunities to travel (finances, visa requirements, remote regions, caring responsibilities)

4. **Leading by example and credibility**
   "Researchers lose public credibility if they do not follow their own advice" (Attari et al., 2016)

6.5 Why is the reduction of air travel relevant? (3/3)

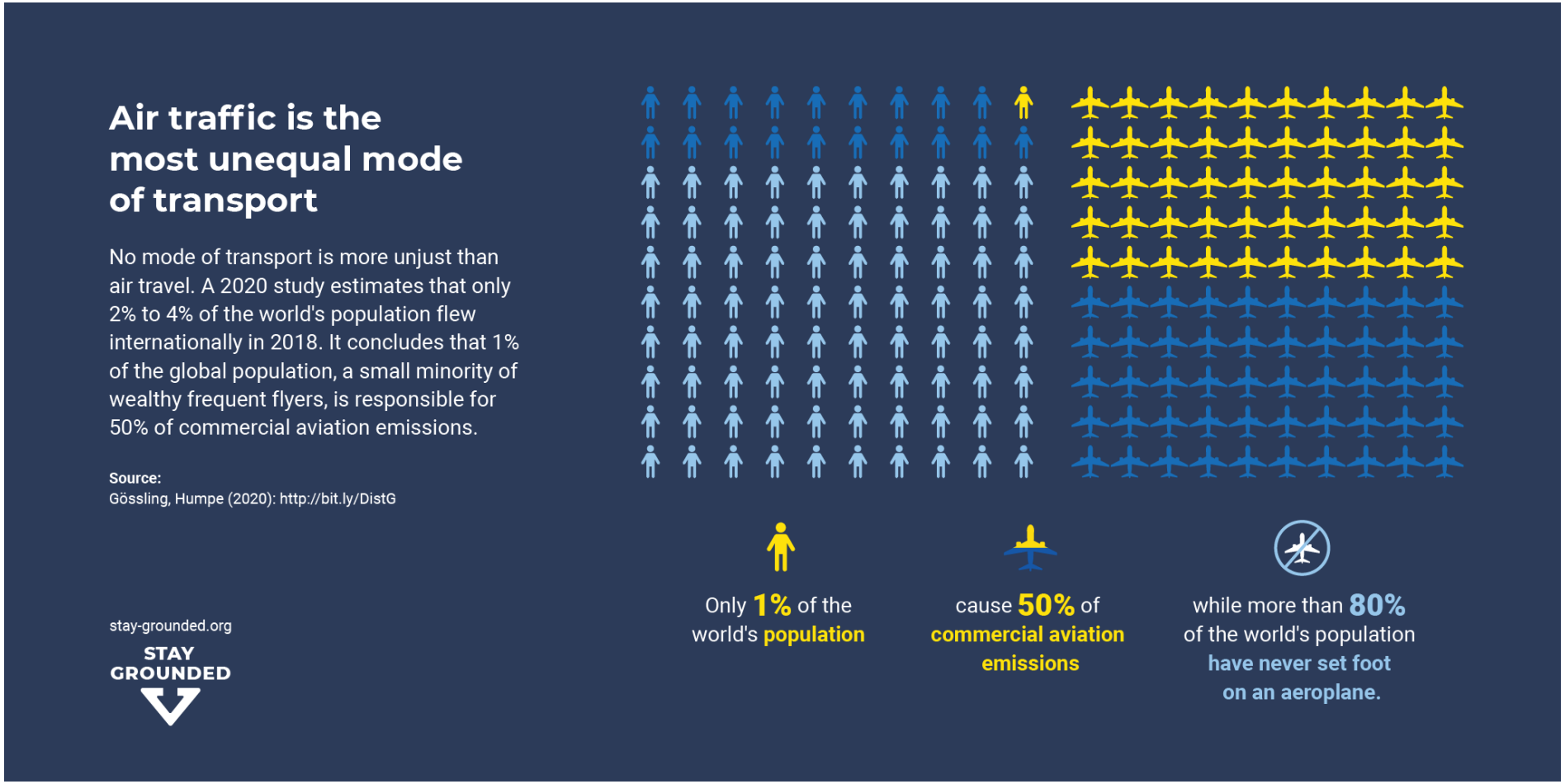
5. **Scientific success**
   Air travel has a small impact on:

- scientific success (h-index) (Wynes et al., 2019),
- number of citations (Chalvatzis and Ormosi, 2021),
- academic social capital, i.e. beneficial academic relationships (Schaer et al., 2021)

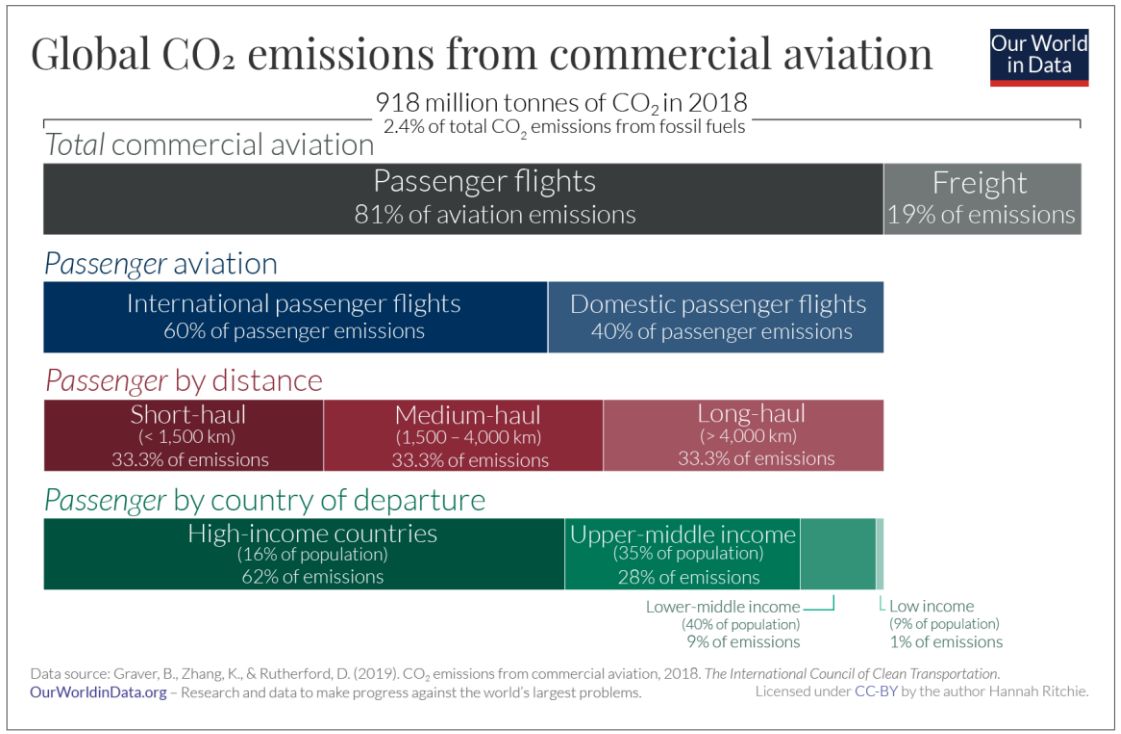
However, Berné et al. (2022) find a correlation between flights and h-index, but raise the following question, if there is also a causality:

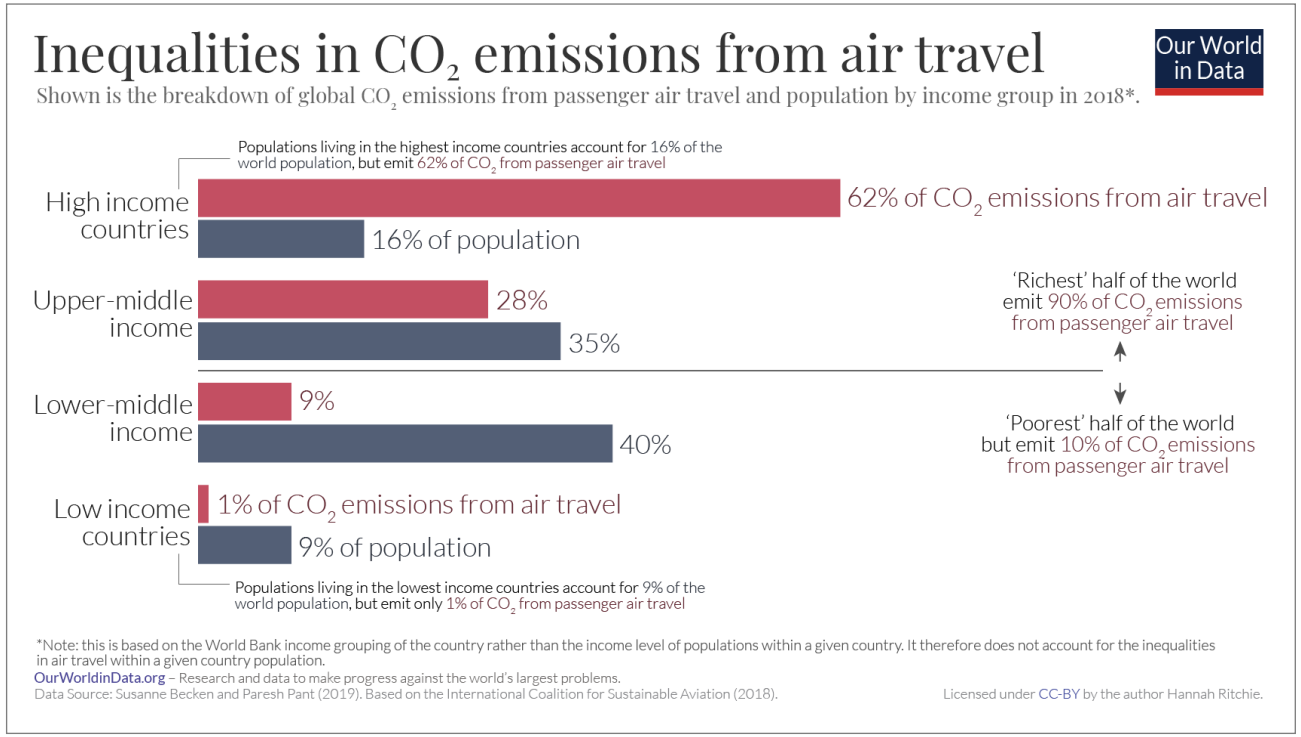
"Is it that scientists who travel more obtain more scientific visibility and hence get more citations, collaborations and papers (exposure effect), or is it instead that scientists who are more visible because of their work get to travel more (reputation effect)?"

6.6 Who flies?



6.7 Breakdown of global aviation emissions and inequalities in aviation emissions consumption between low-to-high-income countries

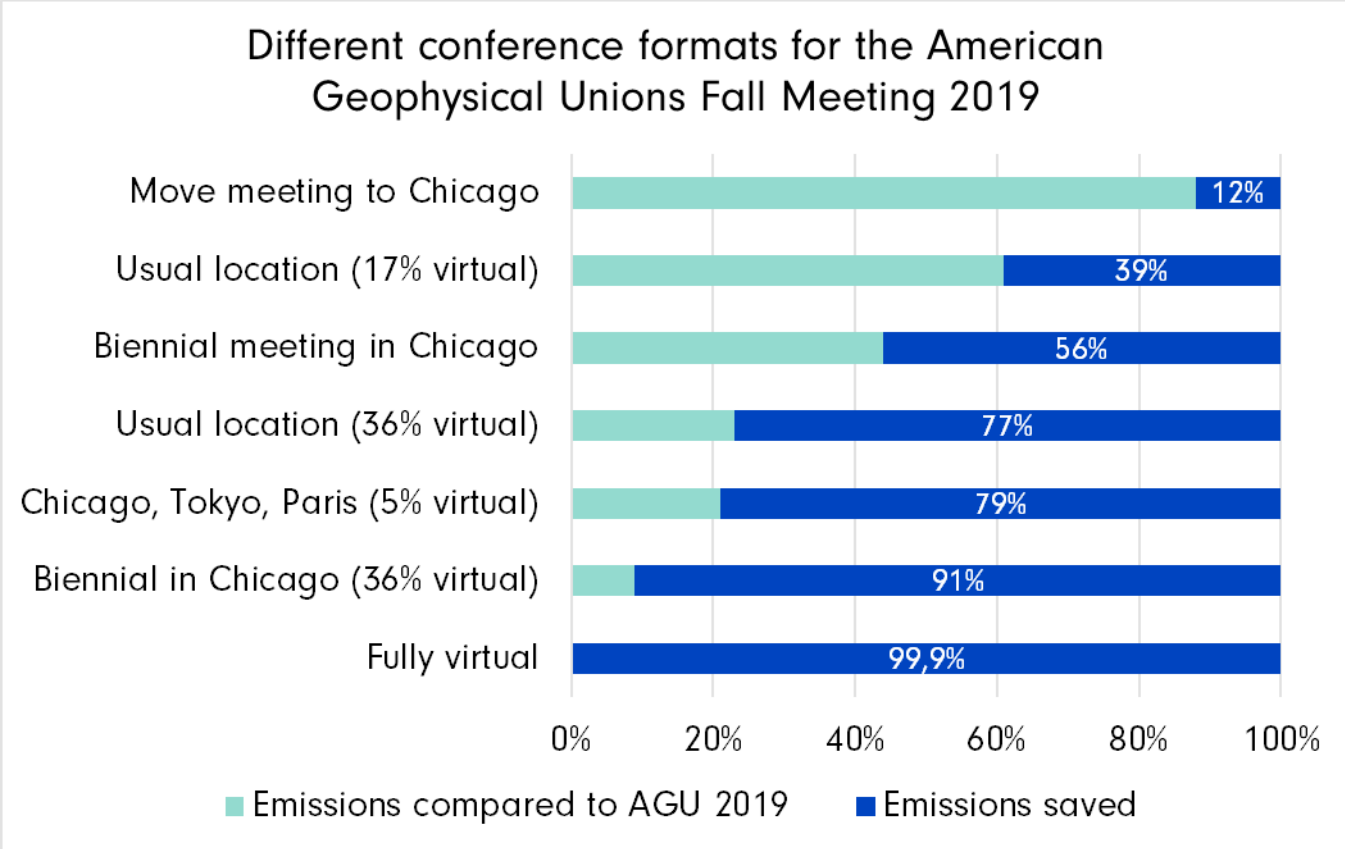




6.8 Scientists a travellers
Example international conferences

American Geophysical Unions Fall Meeting 2019

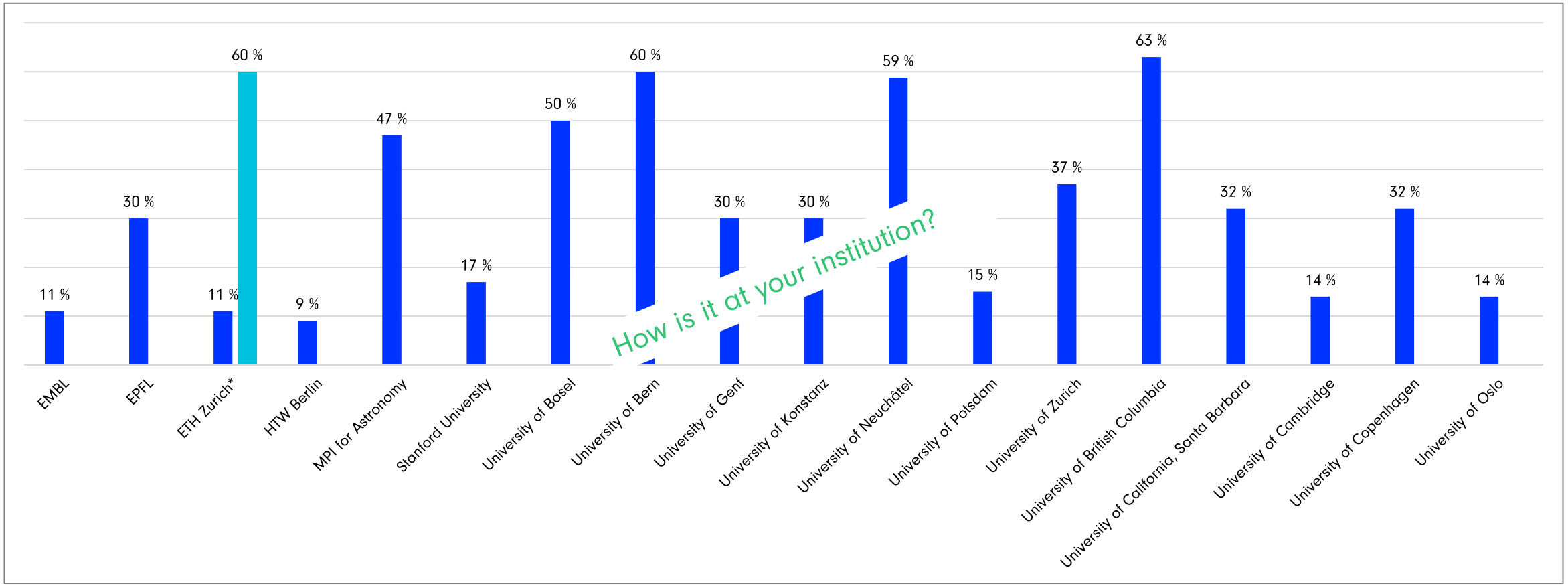
- 28,000 participants, 80,000 t CO2 equivalent
- 75% of which from flights over 8,000 km
- 20% (>2 months) of the annual emissions of the city of Constance



Graphic: Own illustration based on data from Klöwer 2020, https://doi.org/10.1038/d41586-020-02057-2

6.9 Contribution of flights to total emissions

Different research institutions



*ETH Zurich: the contribution of flights to total emissions varies between 11 % and approx. 60 %, depending on system limit.
Graphic: Own illustration, ifeu.

7 FlyingLess Survey

7.1 FlyingLess survey scientists and students
Methodology

2022 project, a survey was conducted at eight different academic institutions (in Germany).

Target:

› Capture a broad behavioural and opinion picture on academic air travel within the academic community and among students.

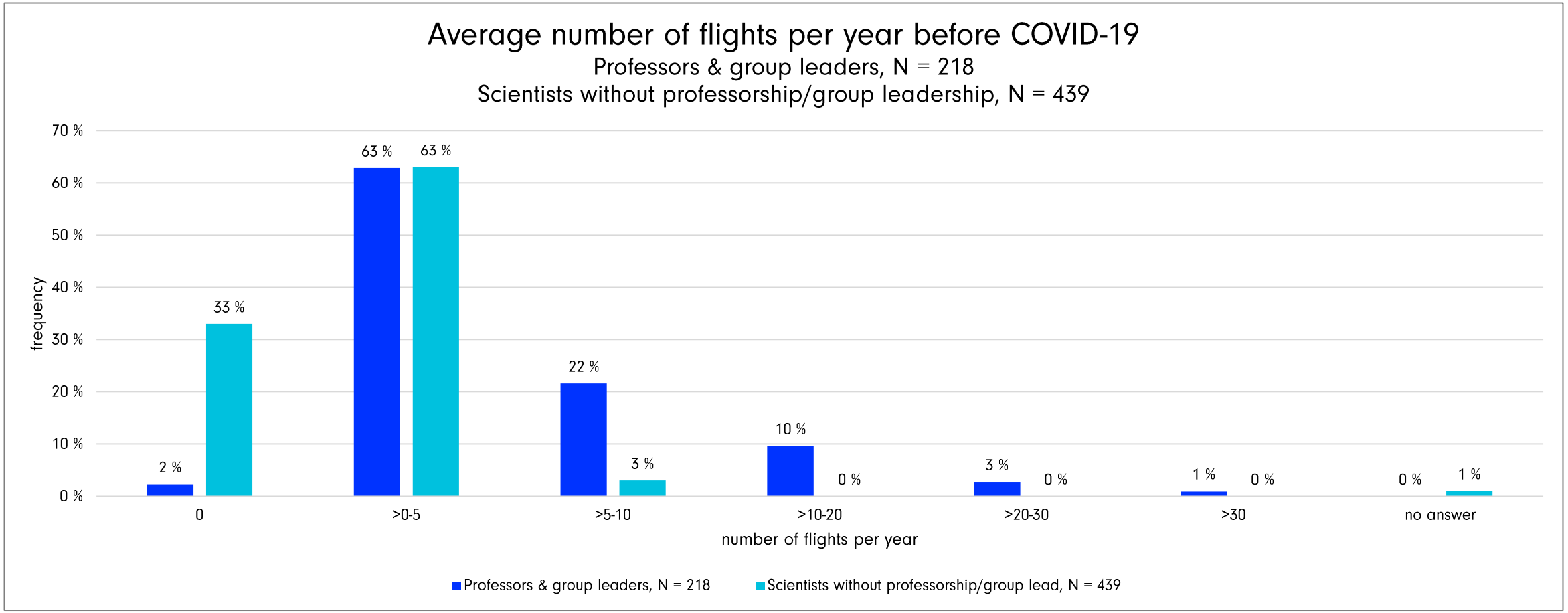
Content

› Mobility behaviour in relation to academic long-distance travel and student air travel
› Reasons for the corresponding mobility behaviour
› Factors related to travel (resource) decisions
› Assessment of potential flight reduction measures & internal framework conditions
› Behavioural changes with regard to future academic missions

Response

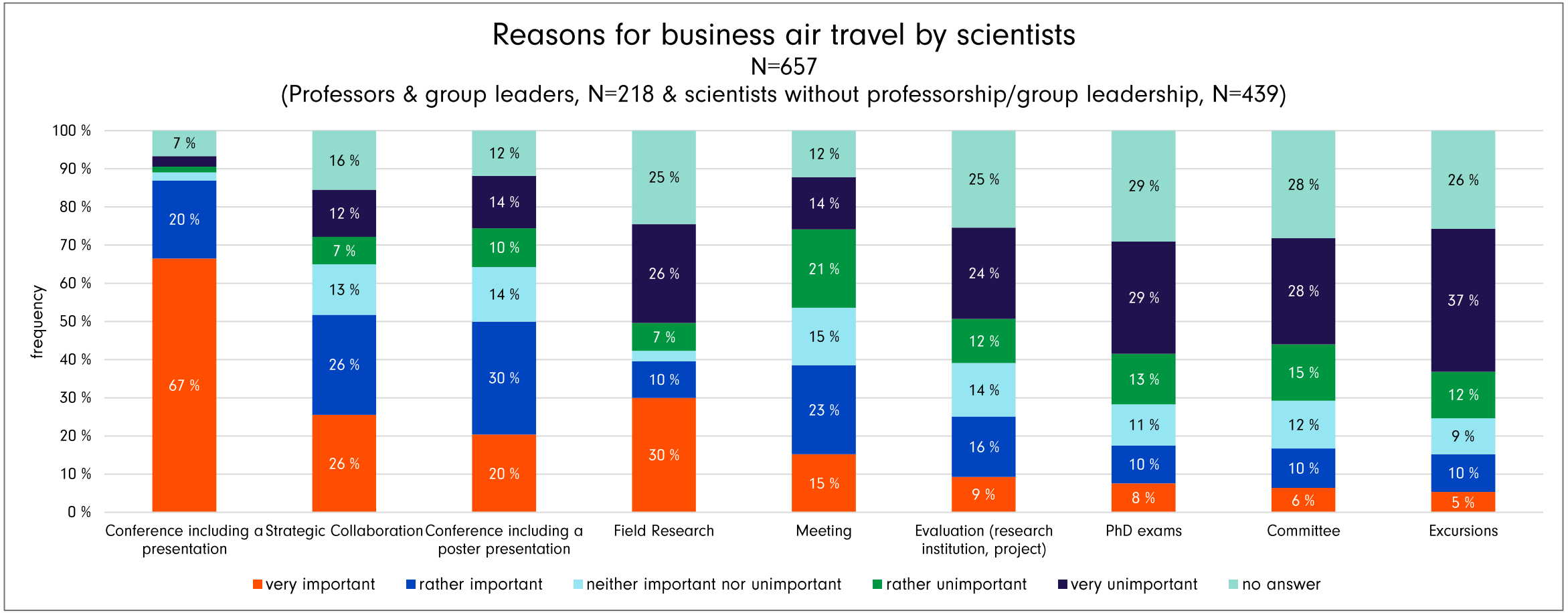
› Scientists, N = 657
  → Professors & group leaders, N = 218
  → Scientists without professorship/group leadership, N = 439
› Students, N = 525

7.2 FlyingLess survey - scientists (1/8)



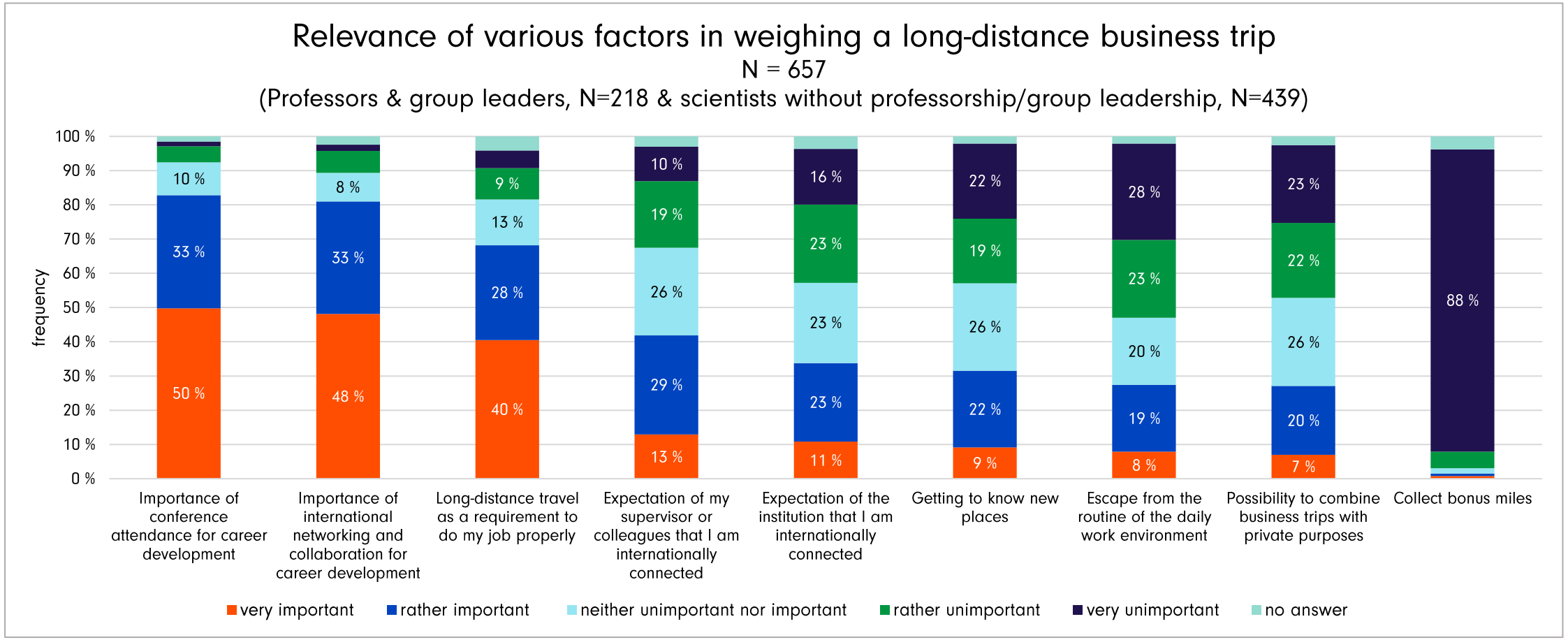
Graphic: Own illustration, FlyingLess Survey 2022: C. Merrem, ifeu.

7.2 FlyingLess survey - scientists (2/8)



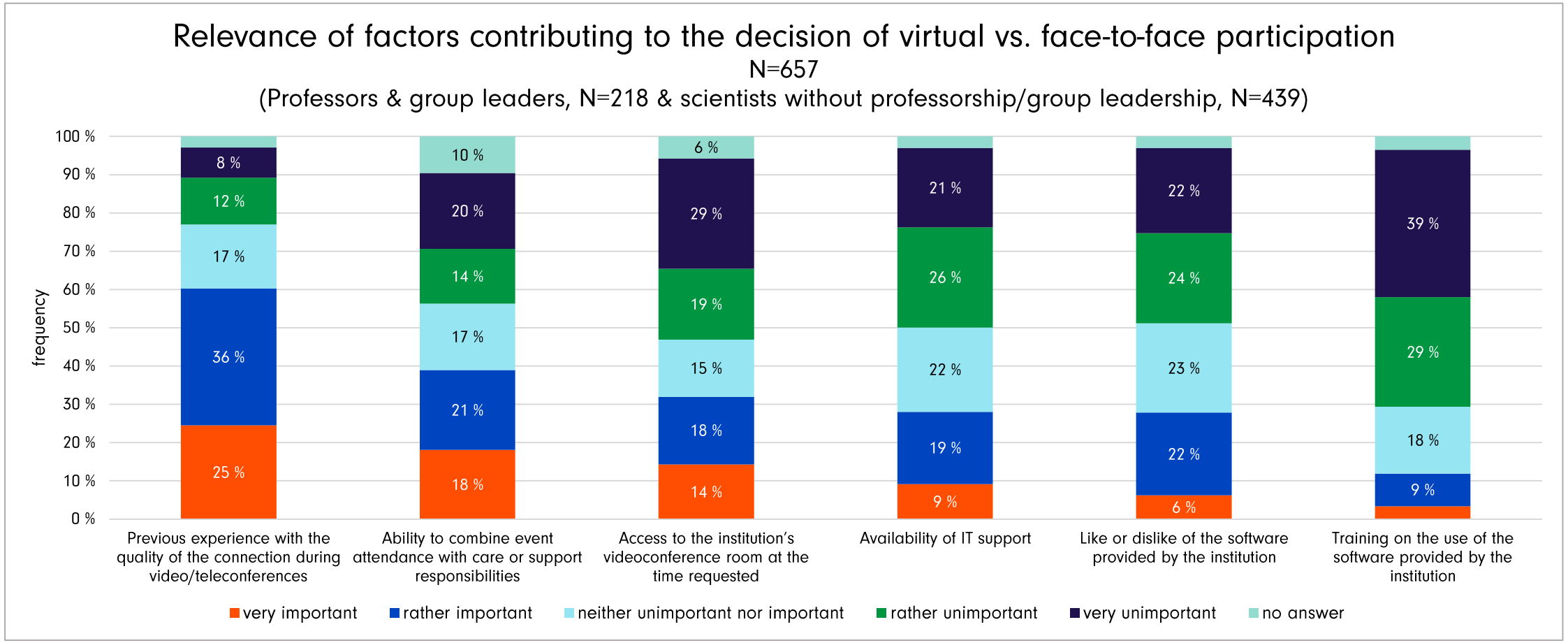
Graphic: Own illustration, FlyingLess Survey 2022: C. Merrem, ifeu.

7.2 FlyingLess survey - scientists (3/8)



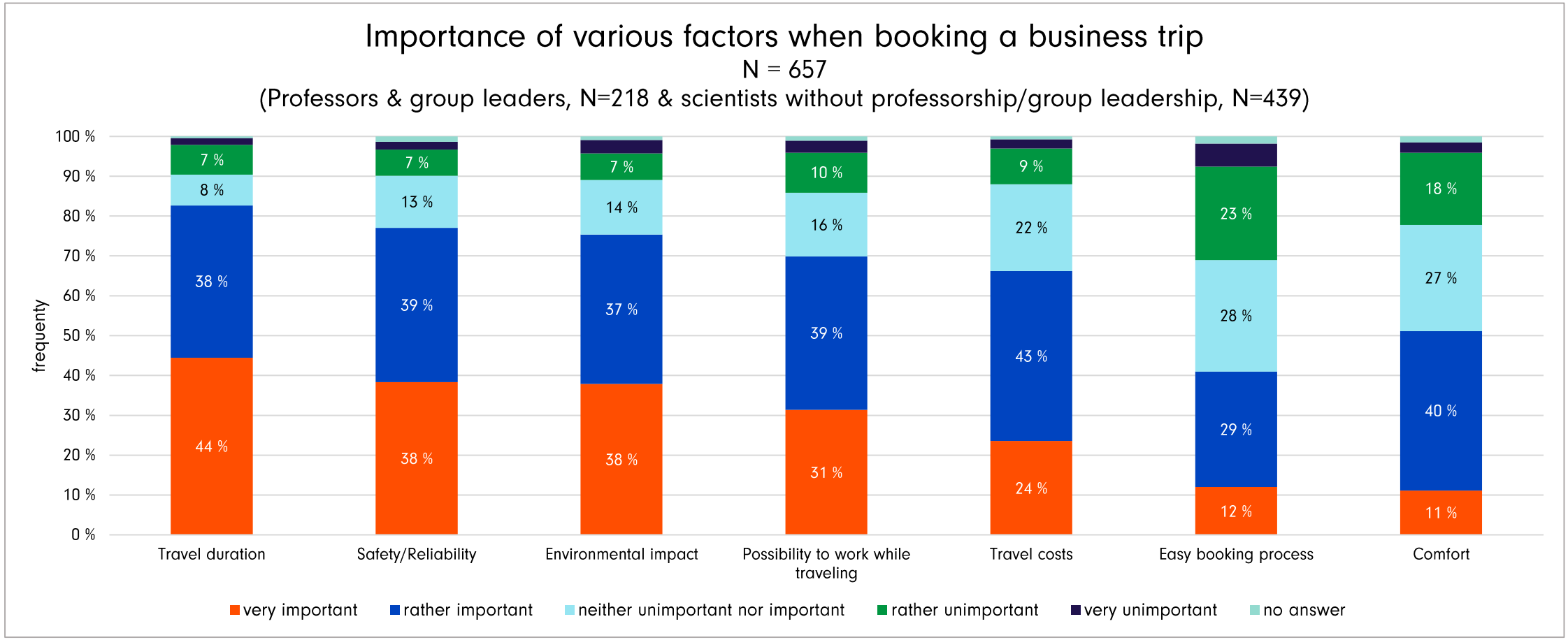
Graphic: Own illustration, FlyingLess Survey 2022: C. Merrem, ifeu.

7.2 FlyingLess survey - scientists (4/8)



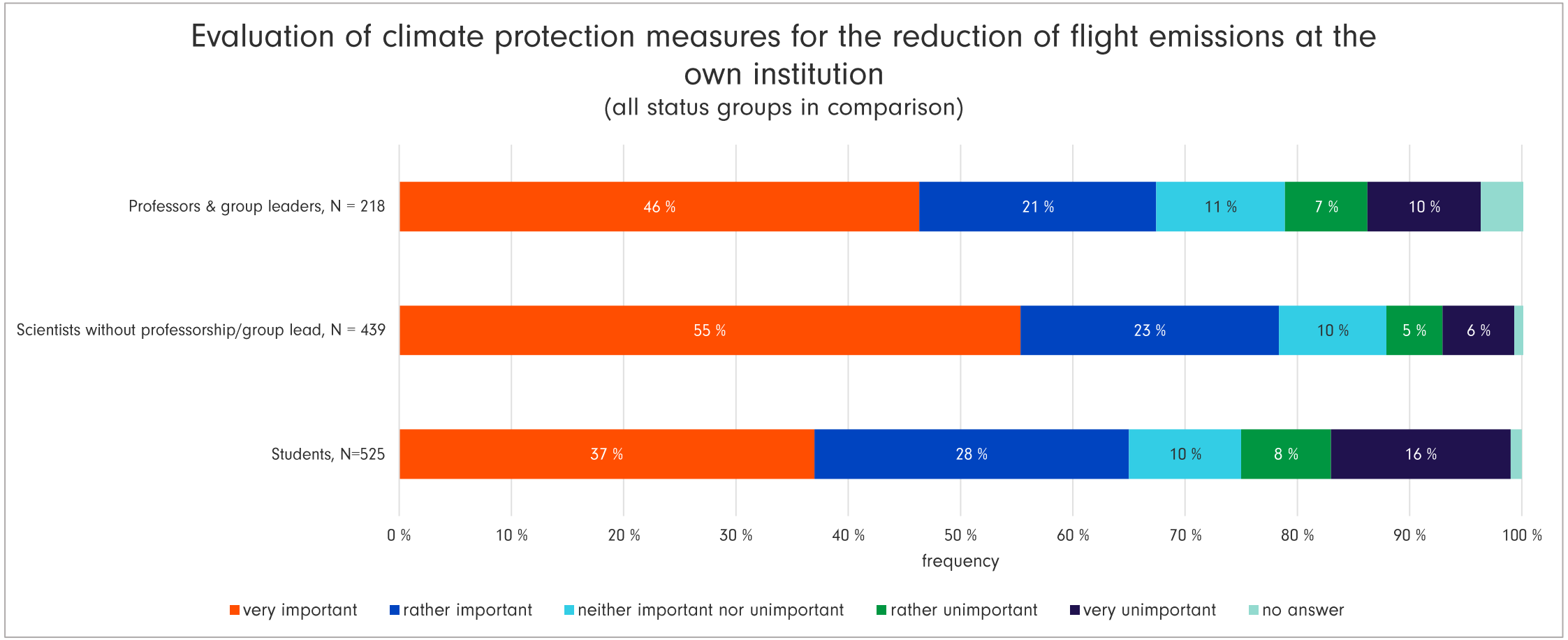
Graphic: Own illustration, FlyingLess Survey 2022: C. Merrem, ifeu.

7.2 FlyingLess survey - scientists (5/8)



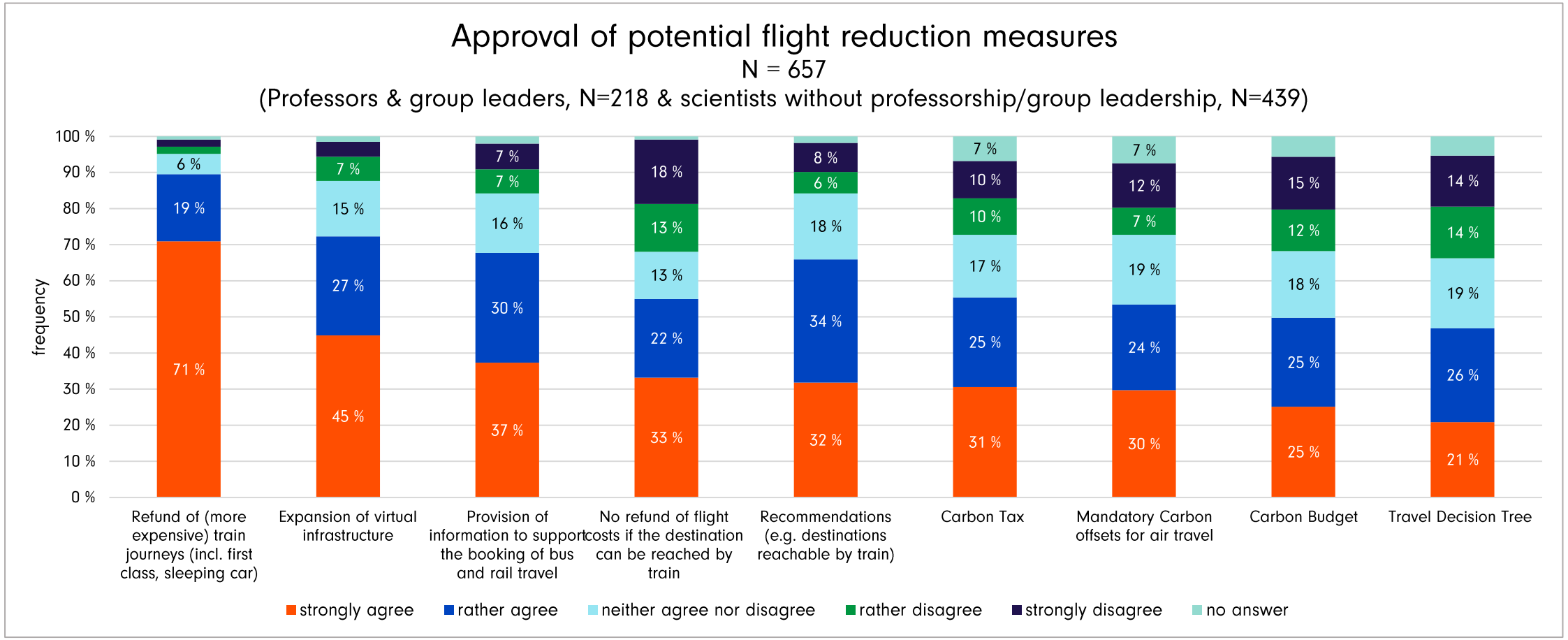
Graphic: Own illustration, FlyingLess Survey 2022: C. Merrem, ifeu.

7.2 FlyingLess survey - scientists (6/8)



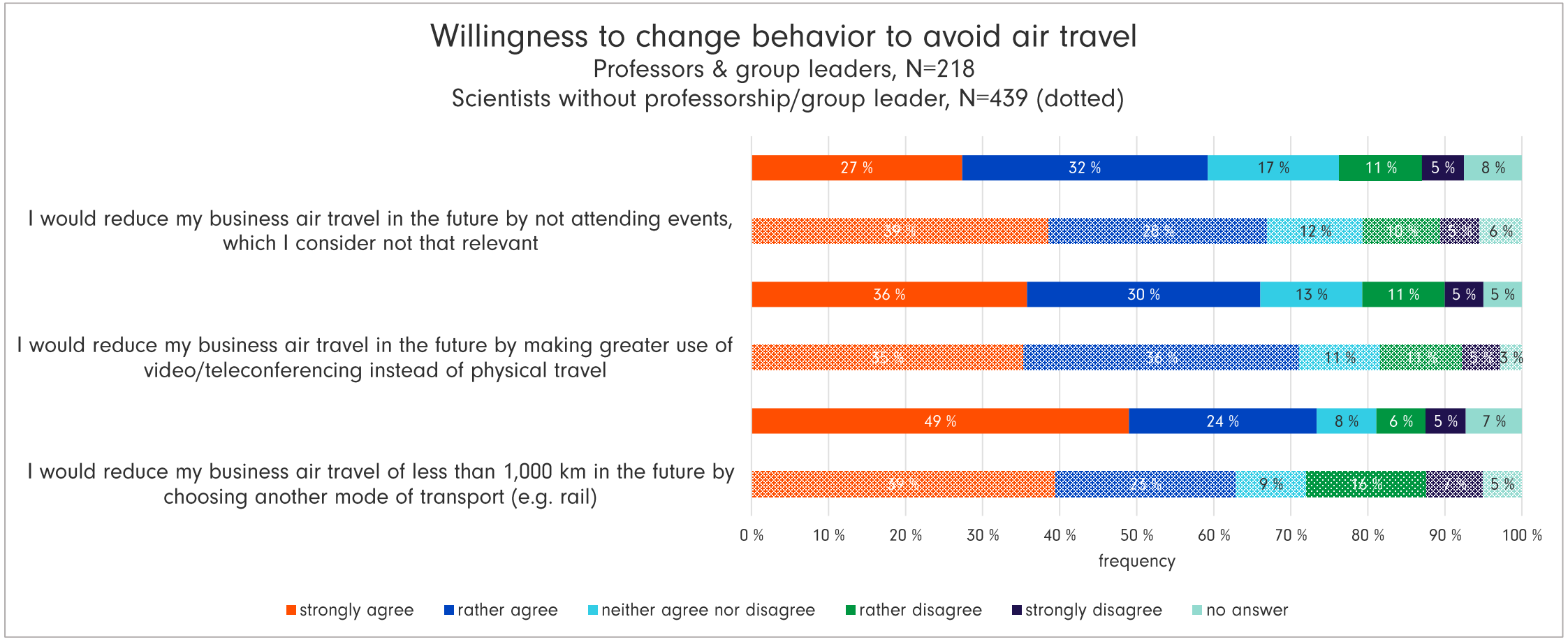
Graphic: Own illustration, FlyingLess Survey 2022: C. Merrem, ifeu.

7.2 FlyingLess survey - scientists (7/8)



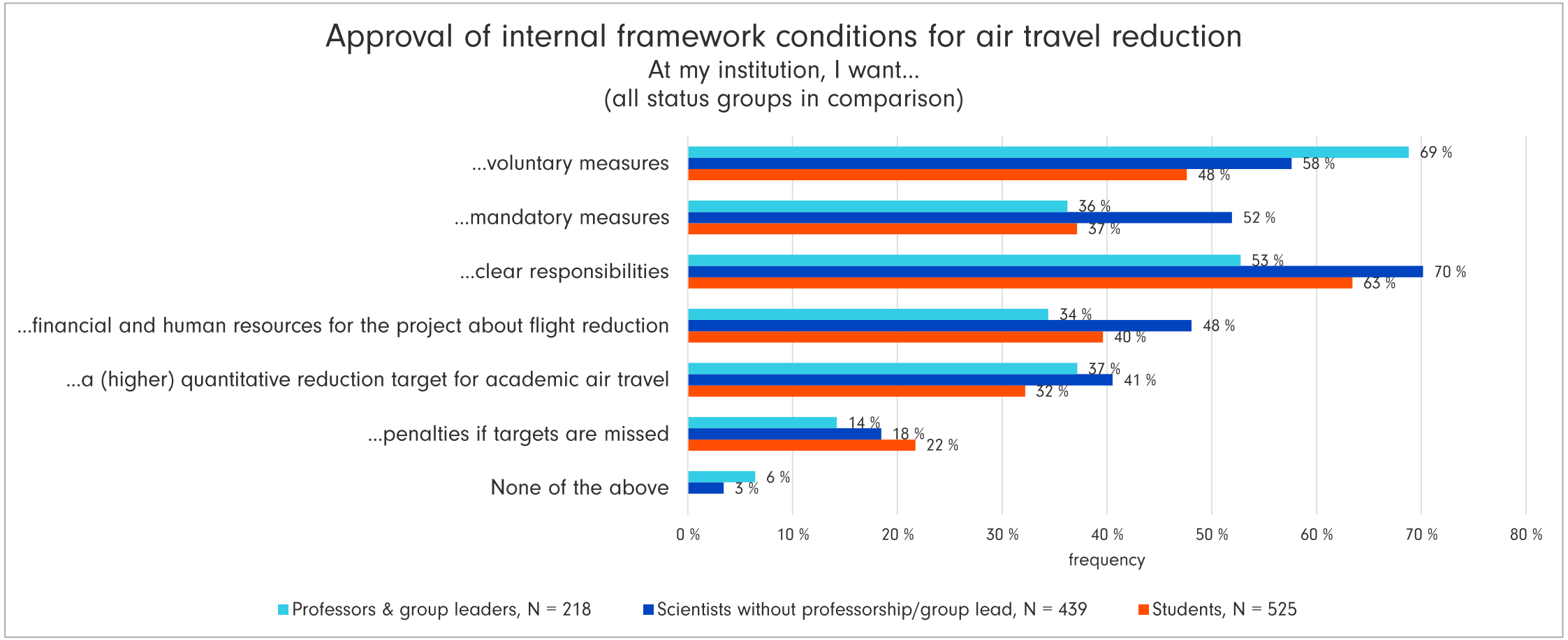
Graphic: Own illustration, FlyingLess Survey 2022: C. Merrem, ifeu.

7.2 FlyingLess survey - scientists (8/8)



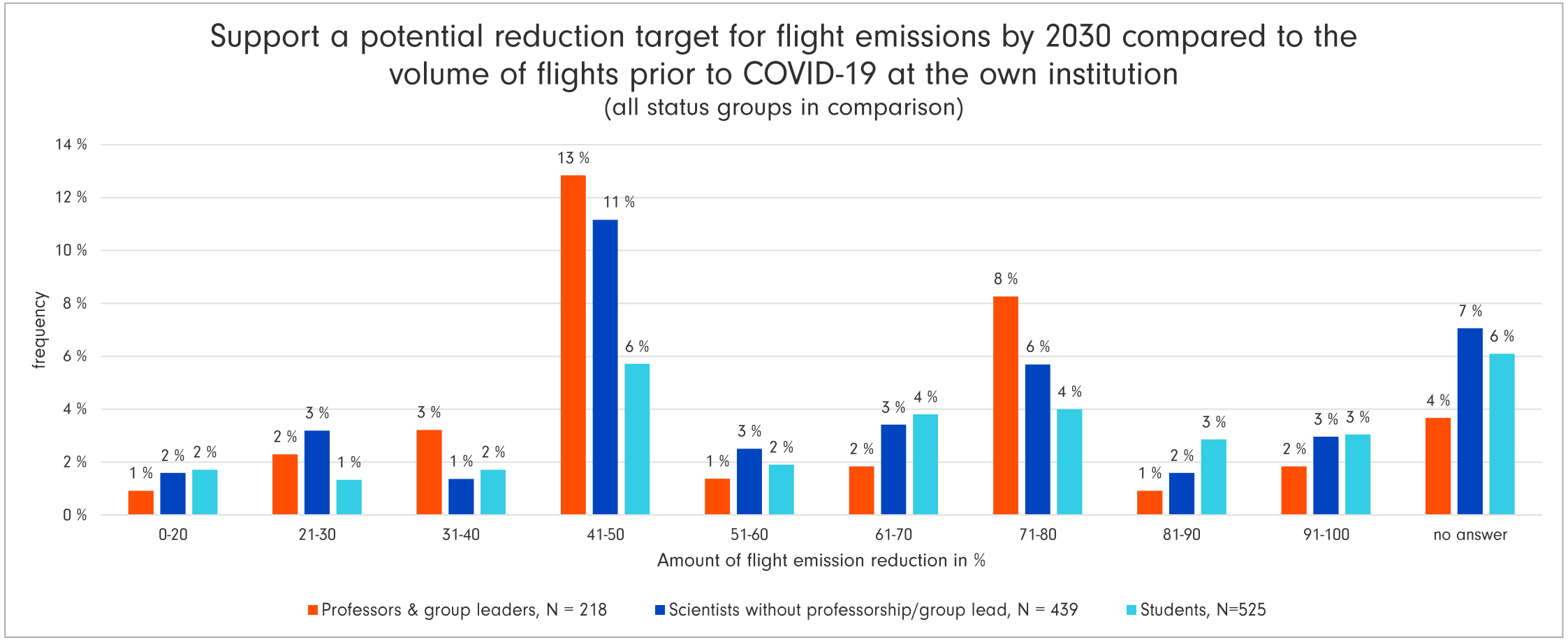
Graphic: Own illustration, FlyingLess Survey 2022: C. Merrem, ifeu.

7.3 FlyingLess survey – students (1/2)



Graphic: Own illustration, FlyingLess Survey 2022: C. Merrem, ifeu.

7.3 FlyingLess survey – students (2/2)



Graphic: Own illustration, FlyingLess Survey 2022: C. Merrem, ifeu.

7.4 Student air travel (1/16)

Student flights differ from staff flights in a number of ways:

- Reasons for travel: e.g. exchange, excursion, internship, summer school
- Travel decisions are made by:
  - From the university offering courses as part of the curriculum
  - from the individual students

A study on flight emissions at ETH Zurich (Medhaug, 2021) shows that:

- Student flights cause approx. 10% of the emissions from employee flights
- The emissions are unequally distributed between the groups: 1 Prof causes about as many emissions as 2 Guests/5 Senior Researchers/8 PhD/25 Admin/84 Students
- Approx. 90% of emissions are caused by long-haul flights, similar to employee flights

7.4 Student air travel (2/16)

› Student mobility has a large CO_2 footprint - Davies and Dunk (2016) studied 25 UK universities

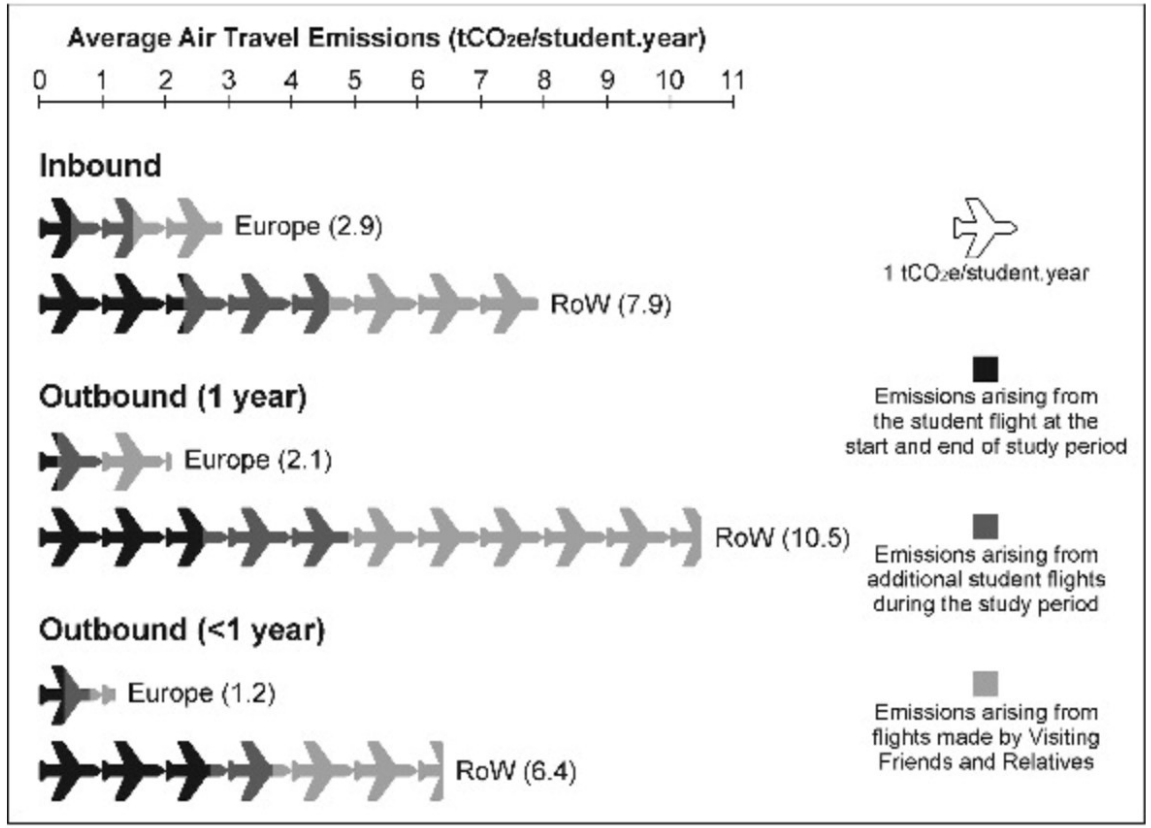


Image source: Jonathan C. Davies & Rachel M. Dunk (2015) Flying along the supply chain: accounting for emissions from student air travel in the higher education sector, Carbon Management, 6:5-6, 233-246, DOI: 10.1080/17583004.2016.1151503, reprinted by permission of the publisher (Taylor & Francis Ltd, http://www.tandfonline.com)

7.4 Student air travel (3/16)

International student mobility - background information

- The pros and cons of student mobility is a particularly controversial and also emotionally debated topic, with social benefits versus environmental costs.
- International student mobility is a global phenomenon that is influenced by economic, educational, and political factors (Shen et al., 2022)
- Shen et al. also provide a conceptual framework for knowledge and international academic mobility and global knowledge system

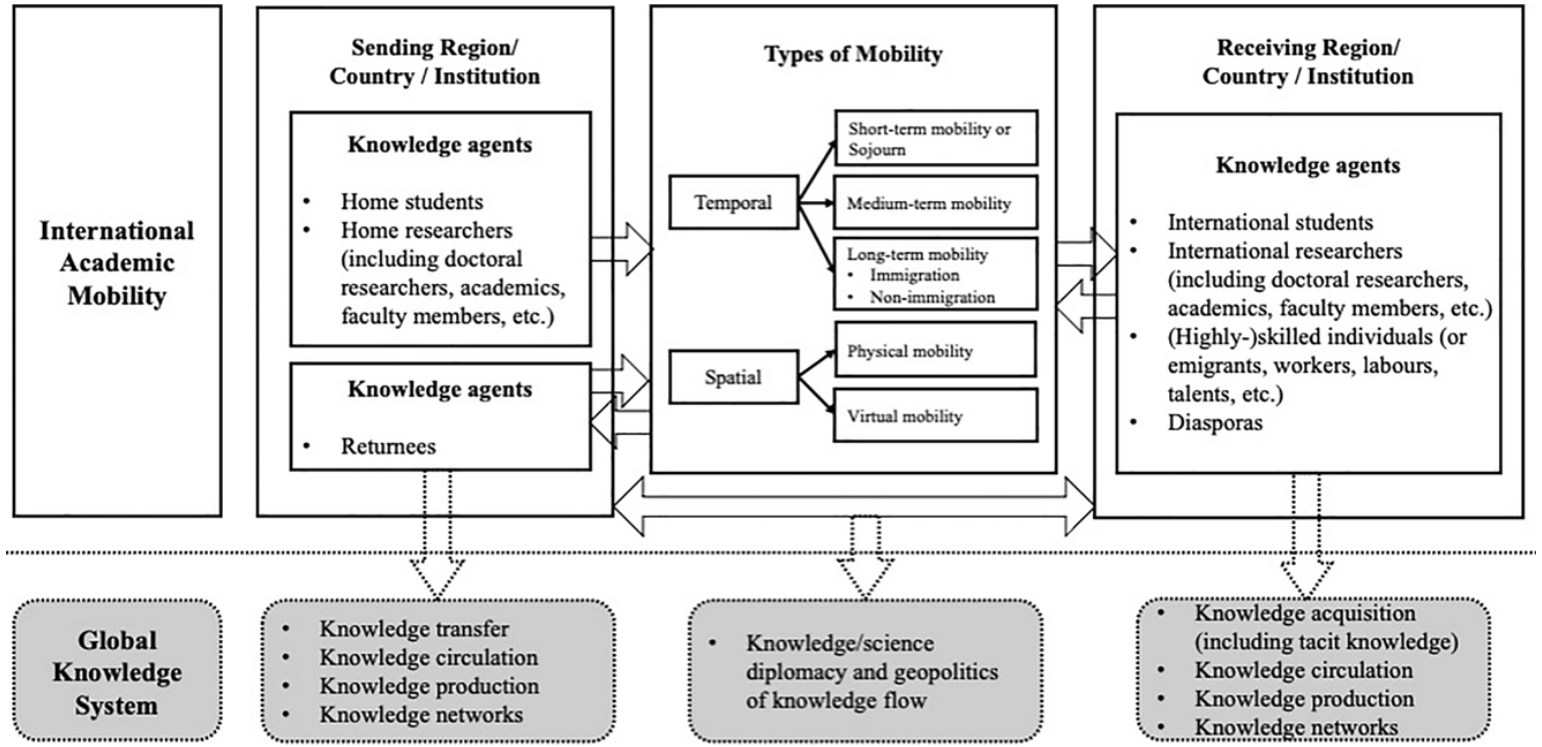


Image source: Shen et al. (2022): "Reconceptualising International Academic Mobility in the Global Knowledge System: Towards a New Research Agenda." Higher Education 84 (6): 1317–42. https://doi.org/10.1007/s10734-022-00931-8, reproduced with permission from SNCSC.

7.4 Student air travel (4/16)

International student mobility - background information

Shields (2019) summarizes the literature in favor of student mobility as follows:

- The number of students who go abroad for higher education has grown rapidly, from 1.4 million in 1999 to 4.8 million in 2016 (UNESCO Institute for Statistics, 2018)
- Mobility is a global phenomenon, with students from 209 countries studying abroad in at least 143 hosting countries (UNESCO Institute for Statistics, 2018)
- Newly industrialized countries with growing disposable income account for a large share of students who go abroad for higher education (e.g. China and India, they accounted for a combined total of 26.7% of outgoing international students in 2014)
- Several factors are responsible, including neoliberal funding regimes that require institutions to increase revenues from international student fees (Bessant et al., 2015), global labour markets that place a high premium on skills (Autor, 2014; Gürüz, 2011), and the formation of cosmopolitan identities that shape individuals' identities and aspirations (Tran, 2016; Rizvi, 2011)
- International student mobility is also closely tied to international labour market migration, with many students migrating to the host country and contributing to the labour force in important areas (Kahanec and Kralikova, 2011)
- Literature suggests several important benefits to international study, including intercultural proficiency (Clarke et al., 2009), employability (Crossman and Clarke, 2009; Norris and Gillespie, 2009), and engagement in global issues (Paige et al., 2009), with benefits to both hosting economies and institutions (Luo and Jamieson-Drake, 2013; Perna et al., 2014)

Shields, Robin. 2019. "The Sustainability of International Higher Education: Student Mobility and Global Climate Change." Journal of Cleaner Production 217 (April): 594-602. https://doi.org/10.1016/j.jclepro.2019.01.291

7.4 Student air travel (5/16)

International student mobility - background information

There are also problematic aspects in the literature (Shen et al., 2022):

- For master's students, the positive influences of mobility on the labour market are minimal, which also vary largely across their backgrounds (e.g. Lindberg, 2009)
- Internationalisation of higher education in countries with more outbound mobilities may be hindered by brain drain (e.g. Teferra & Altbach, 2004)
- Geopolitics of knowledge production, as well as the relationship between this dilemma and global inequality in higher education (e.g. Burford et al., 2021)
- The Peoples' Sustainability Treaty on Higher Education (2012) from the Rio.20 conference argues, "Before higher education can genuinely contribute to sustainable development, it must transform itself. The dominant education paradigm is centred on values and priorities that threaten sustainable development (Shields, 2019)

Shields, Robin. 2019. "The Sustainability of International Higher Education: Student Mobility and Global Climate Change." Journal of Cleaner Production 217 (April): 594-602. https://doi.org/10.1016/j.jclepro.2019.01.291

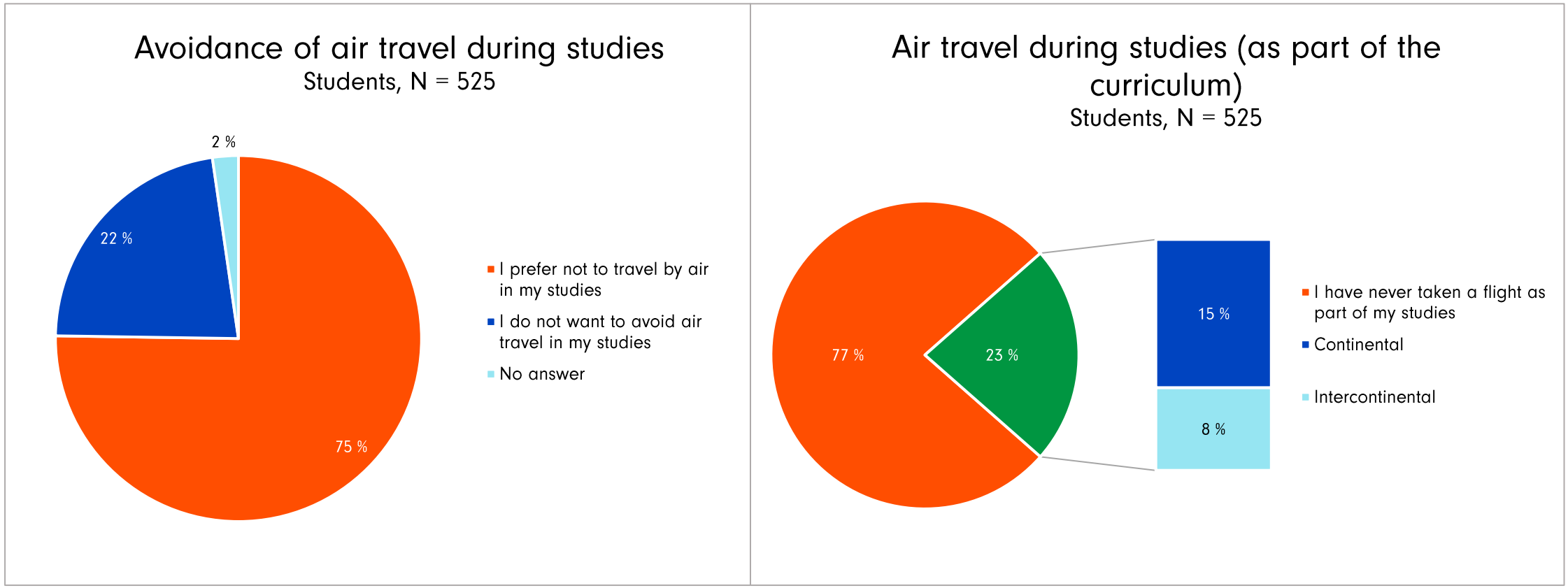
7.4 Student air travel (6/16)
FlyingLess survey

To provide information concerning travel reasons and factors for student flights in Germany, we performed in 2022 a survey at six universities as part of the FlyingLess project.

Shields, Robin. 2019. „The Sustainability of International Higher Education: Student Mobility and Global Climate Change“. Journal of Cleaner Production 217 (April): 594–602. https://doi.org/10.1016/j.jclepro.2019.01.291

7.4 Student air travel (7/16)

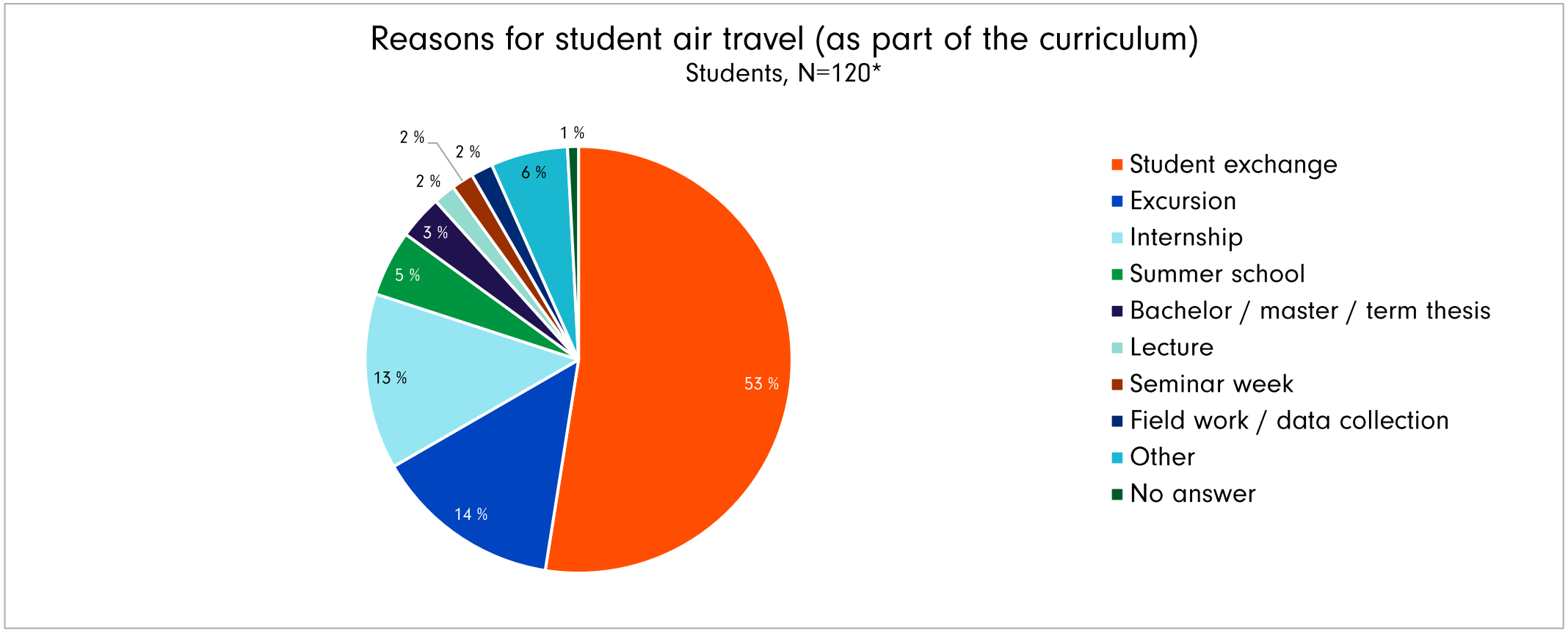
FlyingLess survey at six universities in Germany



Graphic: Own illustration, FlyingLess Survey 2022: C. Merrem, ifeu.

7.4 Student air travel (8/16)

FlyingLess survey at six universities in Germany

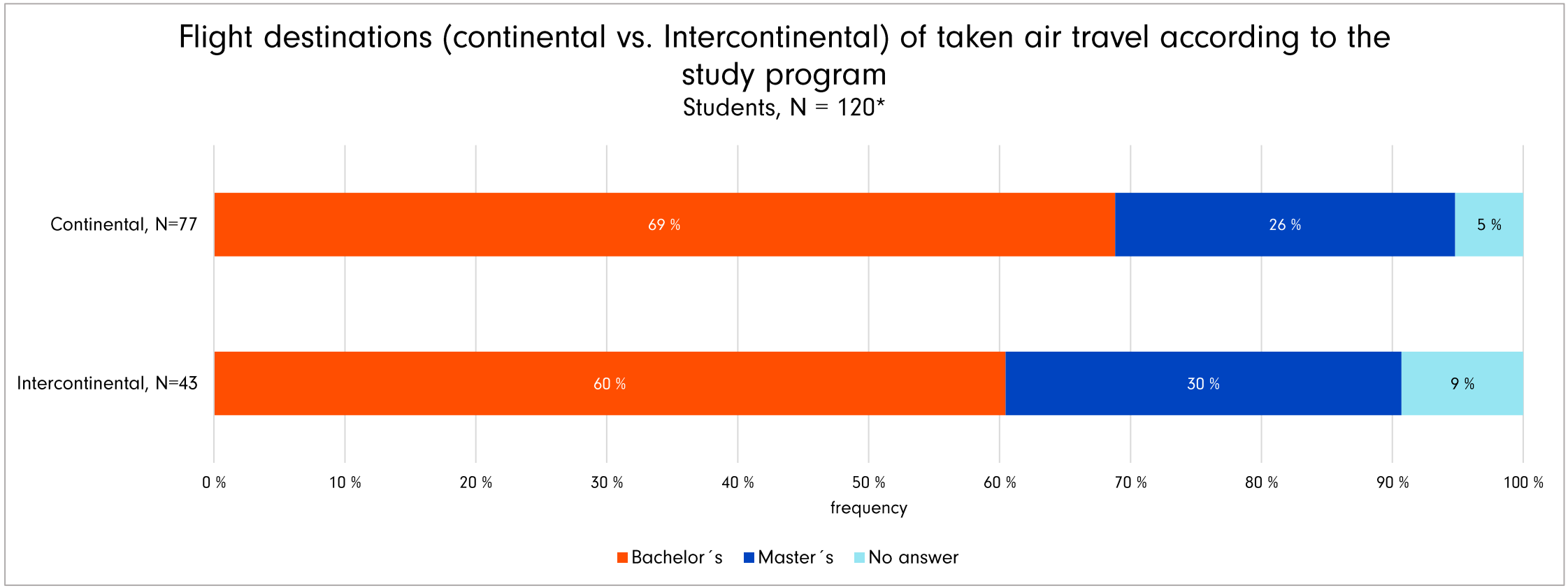


*Students who stated they took a flight during their studies were asked about their most recent flight.

Graphic: Own illustration, FlyingLess Survey 2022: C. Merrem, ifeu.

7.4 Student air travel (9/16)

FlyingLess survey at six universities in Germany

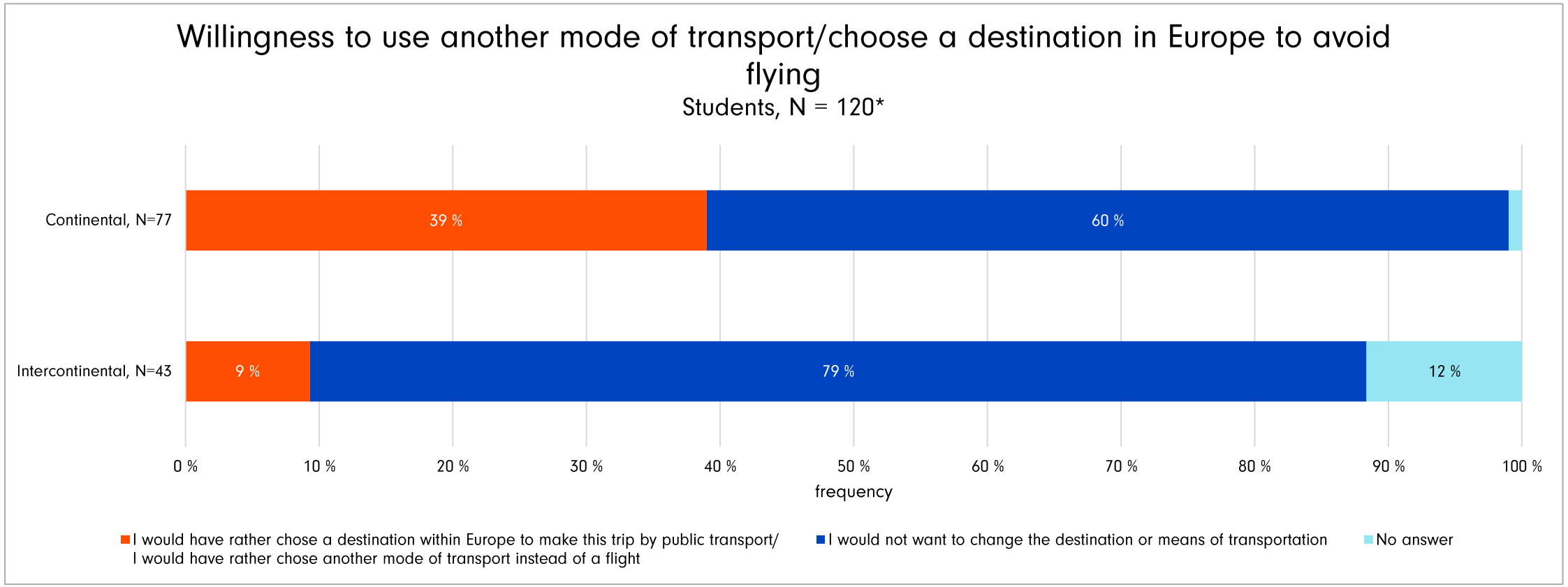


*Students who stated they took a flight during their studies were asked about their most recent flight.

Graphic: Own illustration, FlyingLess Survey 2022: C. Merrem, ifeu.

7.4 Student air travel (10/16)

FlyingLess survey at six universities in Germany

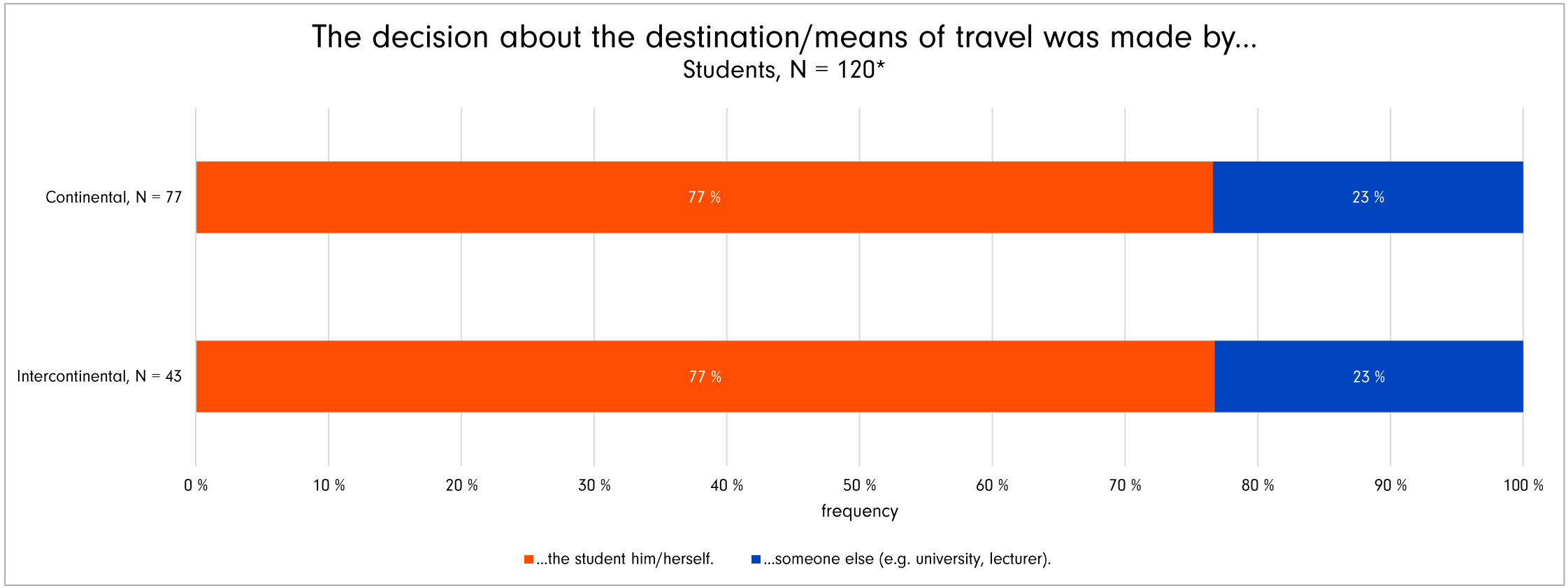


*Students who stated they took a flight during their studies were asked about their most recent flight.

Graphic: Own illustration, FlyingLess Survey 2022: C. Merrem, ifeu.

7.4 Student air travel (11/16)

FlyingLess survey at six universities in Germany

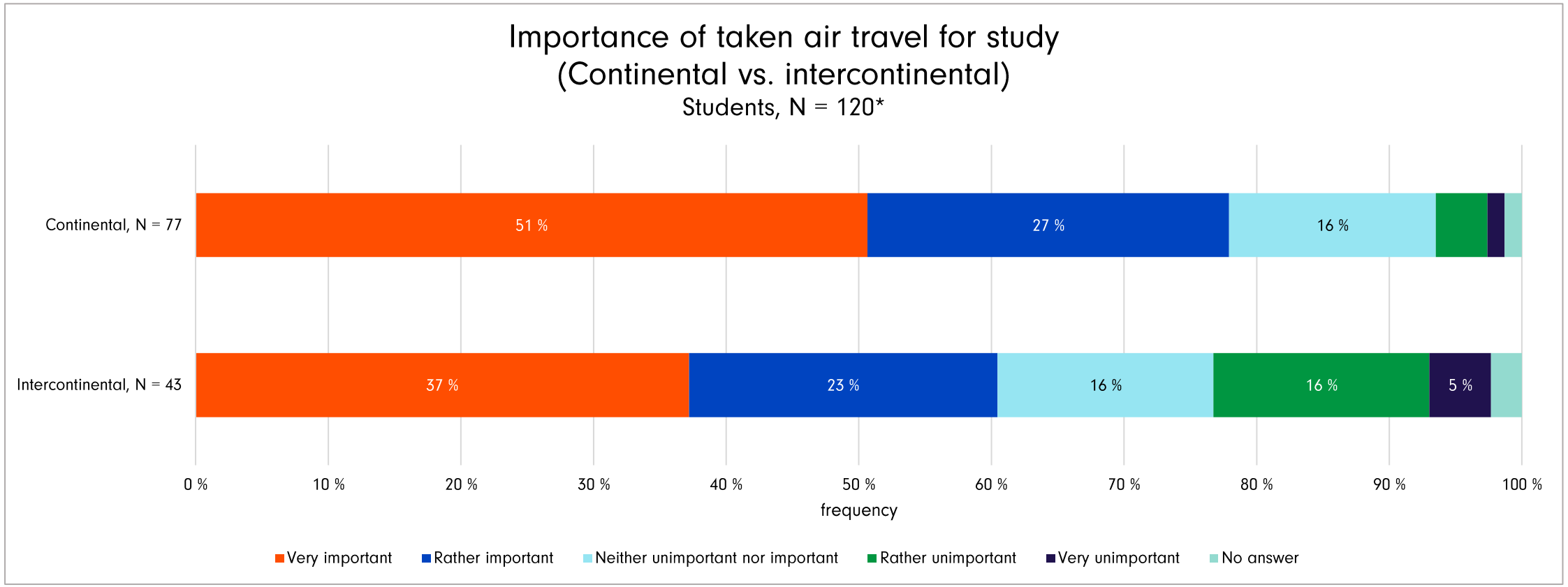


*Students who stated they took a flight during their studies were asked about their most recent flight.

Graphic: Own illustration, FlyingLess Survey 2022: C. Merrem, ifeu.

7.4 Student air travel (12/16)

FlyingLess survey at six universities in Germany

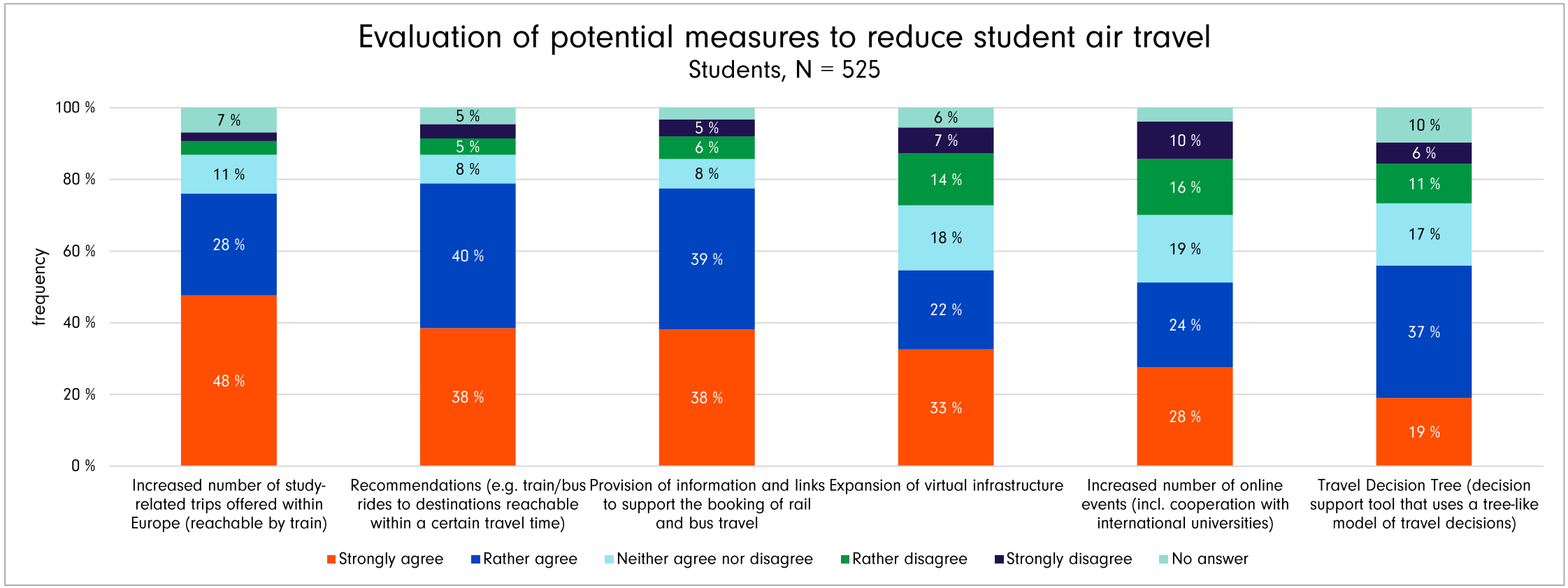


*Students who stated they took a flight during their studies were asked about their most recent flight.

Graphic: Own illustration, FlyingLess Survey 2022: C. Merrem, ifeu.

7.4 Student air travel (13/16)

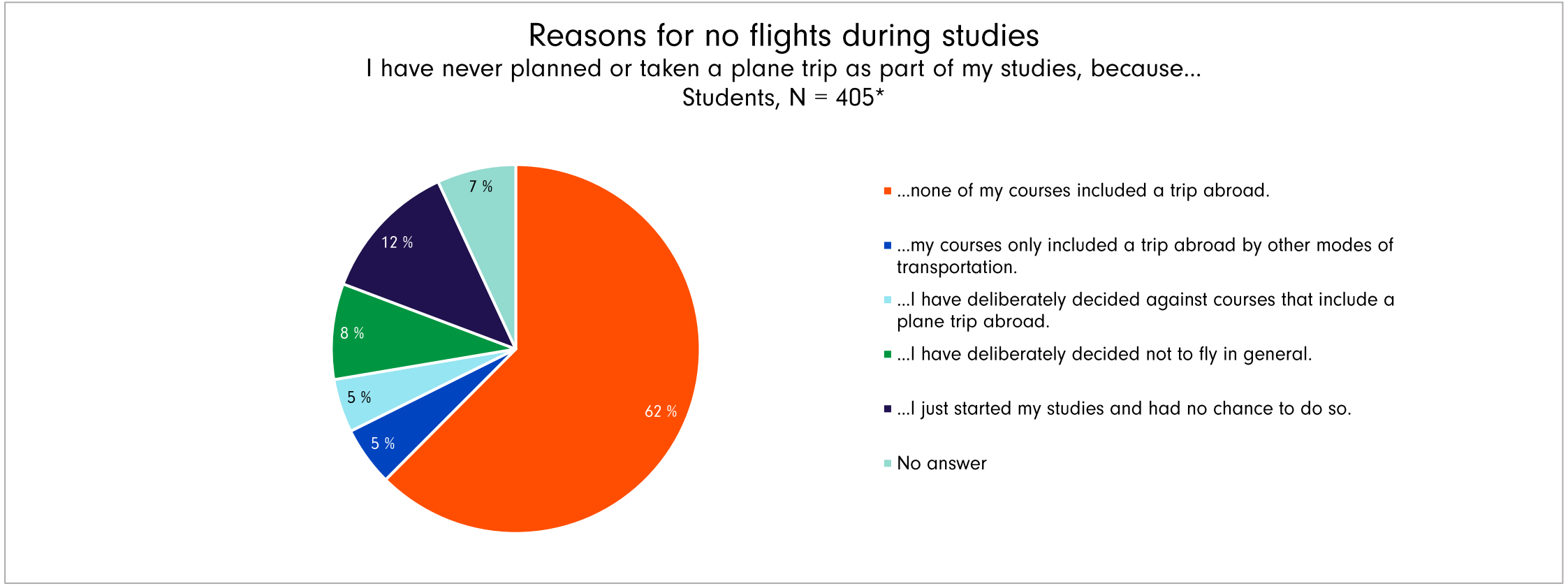
FlyingLess survey at six universities in Germany



Graphic: Own illustration, FlyingLess Survey 2022: C. Merrem, ifeu.

7.4 Student air travel (14/16)

FlyingLess survey at six universities in Germany

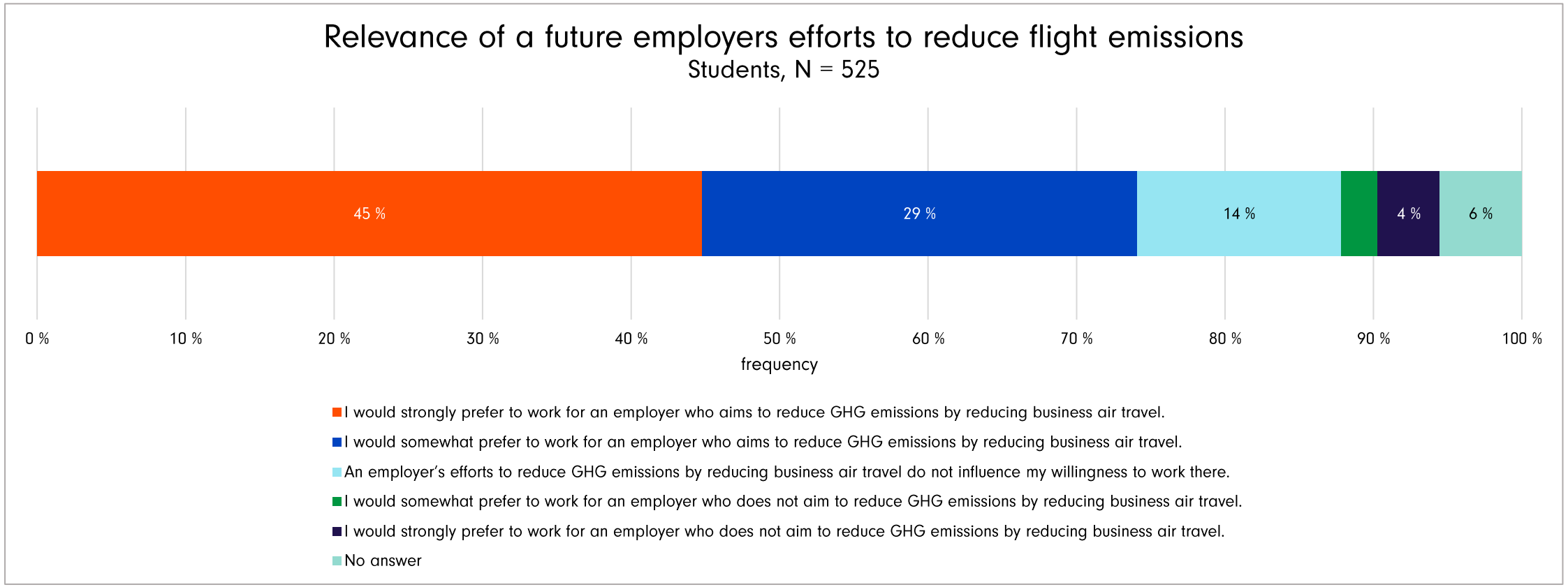


* 405 of the students surveyed stated that they had never flown as part of their studies or planned to do so. The relative frequency given refers to the sample size of 405 students.

Graphic: Own illustration, FlyingLess Survey 2022: C. Merrem, ifeu.

7.4 Student air travel (15/16)

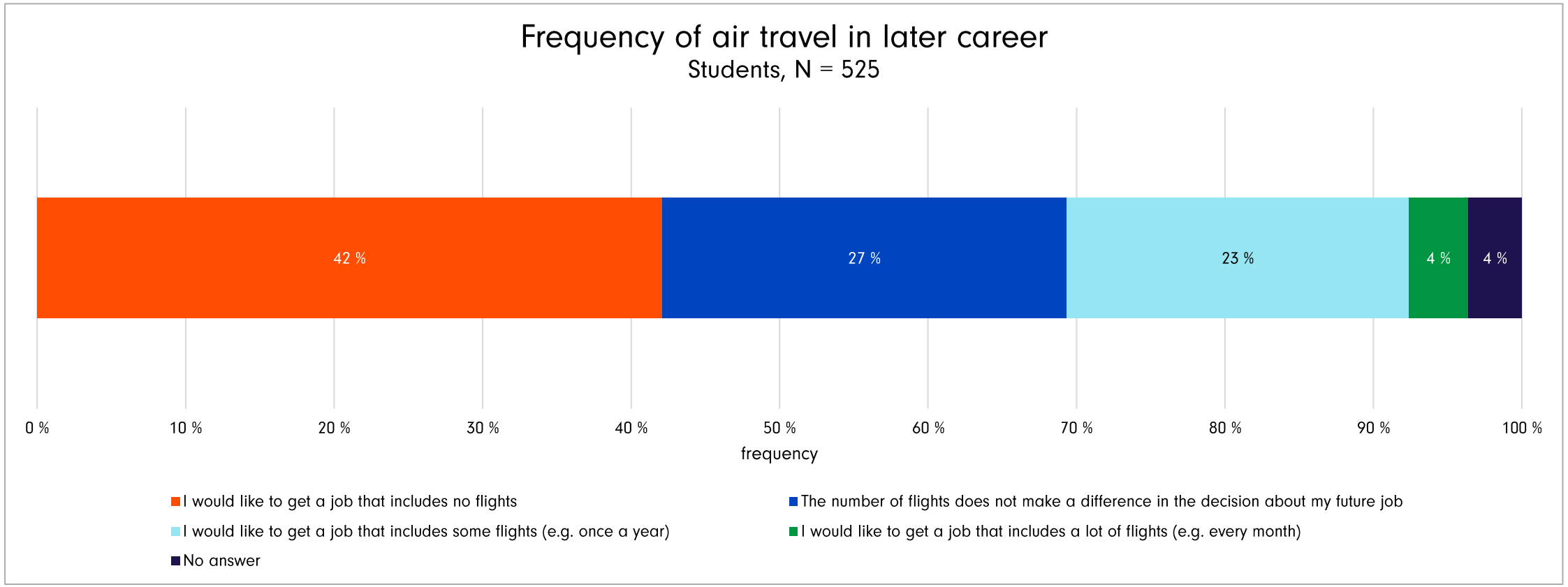
FlyingLess survey at six universities in Germany



Graphic: Own illustration, FlyingLess Survey 2022: C. Merrem, ifeu.

7.4 Student air travel (16/16)

FlyingLess survey at six universities in Germany



Graphic: Own illustration, FlyingLess Survey 2022: C. Merrem, ifeu.

flyingless

8 Emotions in Business Travel (1/3)

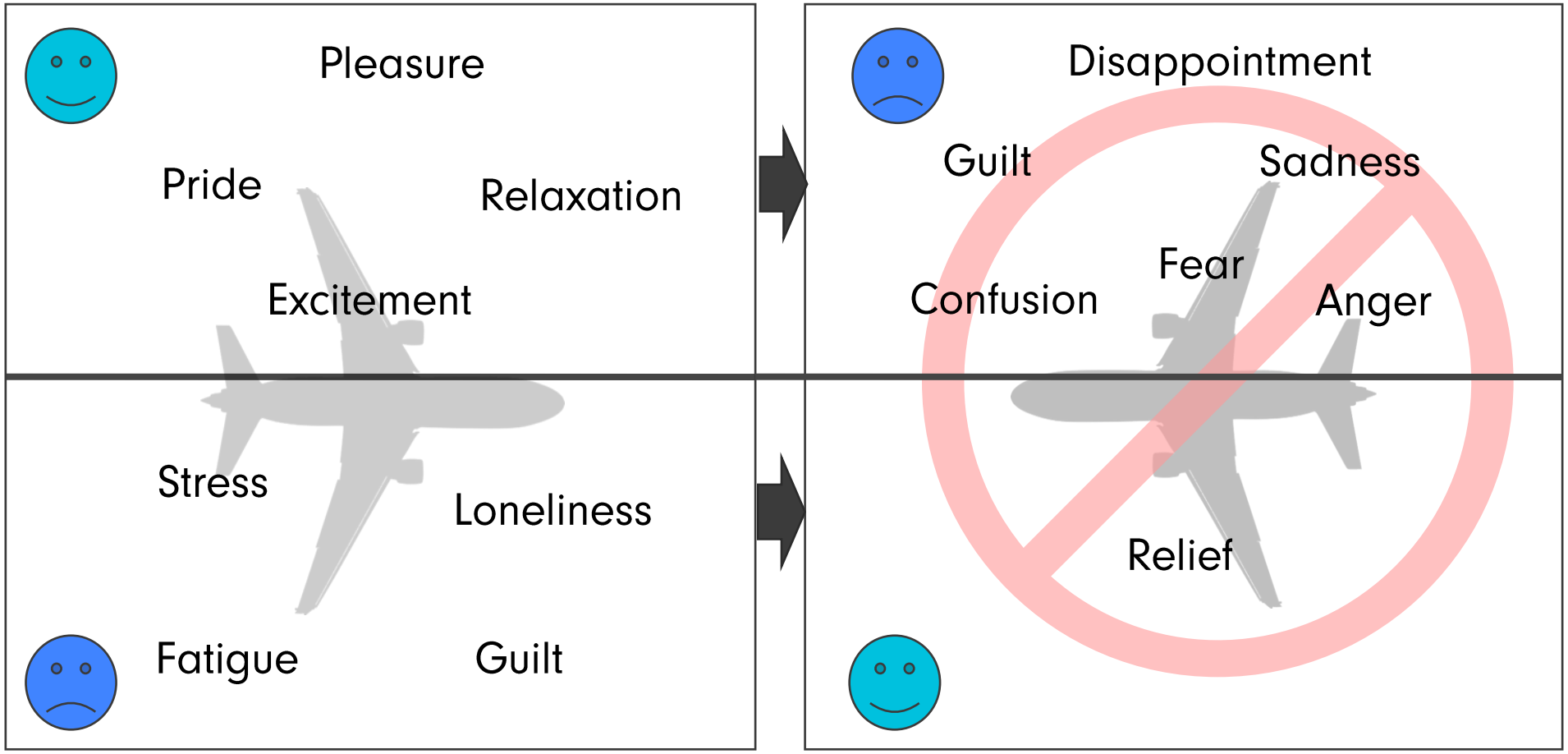


Image source: Agnes Kreil.

8 Emotions in Business Travel (2/3)
Reactions

- Deny, downplay information that is too uncomfortable ("But the printing paper is much worse!")
- Getting angry, question your agenda, feel betrayed, snap at you ("Should we all stop breathing then?")

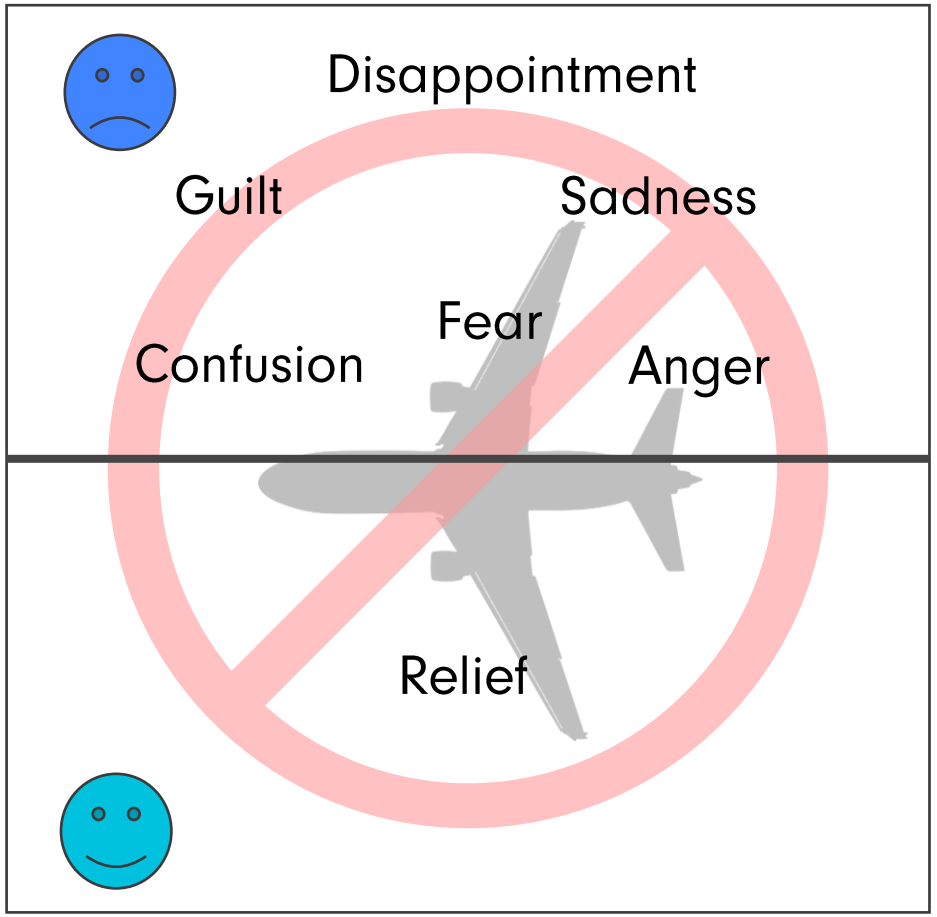


Image source: Agnes Kreil.

8 Emotions in Business Travel (3/3)
How can emotional barriers be overcome?

- Be sensitive
- Do not expect an immediate change
- Run your campaign from a common standpoint
- Run a campaign with ambivalence
- Affirm feelings, not assumptions

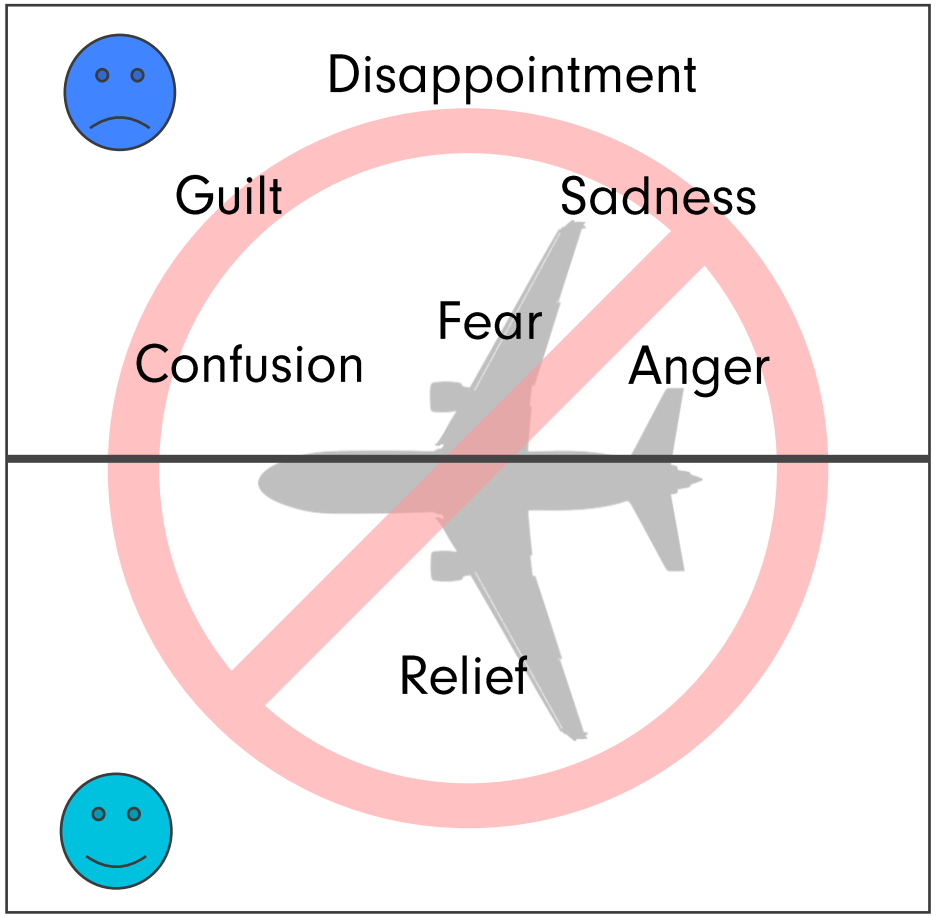


Image source: Agnes Kreil.

9 Technological solutions

- The following slides contain a selection to present different aspects and views on technological solutions and do not necessarily represent the opinion of FlyingLess.
- To reflect the range, both academic publications, blogs and information from website like Stay grounded are listed.
- The following article also provides a brief overview of technologies: Zero CO_2 emissions aviation, Peeters, P., Lyle, C. & Goodwin, H; 2021

9.1 Technological solutions (links and conclusion)
Synthetic fuels/Sustainable Aviation Fuels (SAFs)

Links

- Drop-in fuels from sunlight and air
- Nature Power-to-liquid via synthesis of methanol, DME or Fischer-Tropsch-fuels: a review - Energy & Environmental Science (RSC Publishing) DOI:10.1039/D0EE01187H
- https://www.rolandberger.com/en/Insights/Publications/Sustainable-aviation-fuels-Key-solution-to-achieving-net-zero.html
- https://stay-grounded.org/wp-content/uploads/2021/08/SG_factsheet_8-21_Biofuels_print_Lay02.pdf
- https://www.pik-potsdam.de/de/aktuelles/nachrichten/e-fuels-wahrscheinlich-noch-lange-knapp-pik-analyse-papier

Conclusion

- **Advantage:**
  Infrastructure is available, flight is **CO_2**-neutral
- **Disadvantage:**
  (still too) expensive, supply cannot (yet) meet demand, high (renewable!) energy demand, non-**CO_2** effects still present (even if less than conventional paraffin)

Source: Links and conclusion by Curdin Spirig, ZHAW

9.2 Technological solutions (links and conclusion)
Batteries

Links

- Technological, economic and environmental prospects of all-electric aircraft | Nature Energy
- Performance Metrics Required of Next-Generation Batteries to Electrify Commercial Aircraft | ACS Energy Letters
- https://theicct.org/aviation-global-expecting-electric-jul22
- https://stay-grounded.org/wp-content/uploads/2021/08/SG_factsheet_8-21_Electricity_print_FIN_korr.pdf

Conclusion

- **Advantage:**
  High efficiency, flight is climate neutral
- **Disadvantage:**
  Energy density (still too) low at most short-haul flights, high (renewable!) energy demand, lack of infrastructure

Source: Links and conclusion by Curdin Spirig, ZHAW

9.3 Technological solutions (links and conclusion)
Hydrogen

Links

- Hydrogen powered aircraft : The future of air transport - ScienceDirect
- Hydrogen-powered aviation and its reliance on green hydrogen infrastructure - Review and research gaps - ScienceDirect
- https://stay-grounded.org/wp-content/uploads/2021/08/SG_factsheet_8-21_Hydrogen_FIN_Korr.pdf
- https://www.airbus.com/en/newsroom/press-releases/2020-09-airbus-reveals-new-zero-emission-concept-aircraft; https://www.reuters.com/business/aerospace-defense/airbus-tells-eu-hydrogen-wont-be-widely-used-planes-before-2050-2021-06-10/

Conclusion

- **Advantage:**
  Flight is **CO_2** neutral
- **Disadvantage:**
  Energy density per kg is high (approx. 3 times higher than paraffin), but per volume 4 times smaller than paraffin and that with liquid H_2 (from -252.9°C), non-CO_2 effects still exist to a small extent, lack of infrastructure.

Source: Links and conclusion by Curdin Spirig, ZHAW

9.4 Technological solutions (links and conclusion)
Carbon Capture and Storage

Links

- Carbon capture and storage (CCS): the way forward - Energy & Environmental Science (RSC Publishing) DOI:10.1039/C7EE02342A
- The technological and economic prospects for CO2 utilization and removal | Nature
- https://www.greenpeace.org/international/story/54079/great-carbon-capture-scam/

Conclusion

- Despite the broad consensus that CCS is central to achieving climate goals and its technical maturity, it has not yet been deployed on a scale commensurate with the ambitions formulated ten years ago.
- The potential for CCS is in the gigatonnes range, but the barriers to implementation remain significant.

Source: Links and conclusion by Curdin Spirig, ZHAW

9.5 Technological solutions (links and conclusion)
Direct Air Capture and Storage (DAC+S)

Links

- Direct air capture: process technology, techno-economic and socio-political challenges - Energy & Environmental Science (RSC Publishing) DOI:10.1039/D1EE03523A
- A review of direct air capture (DAC): scaling up commercial technologies and innovating for the future - IOPscience
- Climate policy for a net-zero future: ten recommendations for Direct Air Capture - IOPscience

Conclusion

- In recent years, DAC+S has undergone considerable technical development, so that commercial companies are now also active on the market and there is the prospect of a significant expansion of CO_2 capture.
- However, the framework conditions still need to be significantly improved so that these technologies can be applied on a large scale worldwide

Source: Links and conclusion by Curdin Spirig, ZHAW

9.6 Technological solutions (links and conclusion)
Compensation

Links

https://www.researchsquare.com/article/rs-3149652/v1

https://www.spektrum.de/news/waldschutz-zertifikate-die-grosse-kompensationsluege/2173485?utm_source=pocket-newtab-de-de

CO2-Kompensation (admin.ch)

Freiwillige CO2-Kompensation durch Klimaschutzprojekte | Umweltbundesamt*

The inconvenient truth of carbon offsets | Nature

https://de.stay-grounded.org/emissions-offsetting-a-modern-sale-of-indulgences/

Conclusion

Better than no compensation, though:

- Effects are overrated
- Partly multiple compensation (certificates are sold several times)*
- Side effects lead to more emissions*
- „Greenwashing“
- If certificates are used, they should comply with the gold standard

Source: Links and conclusion by Curdin Spirig, ZHAW

9.7 Technological solutions
Virtual tools (1/5)

Links

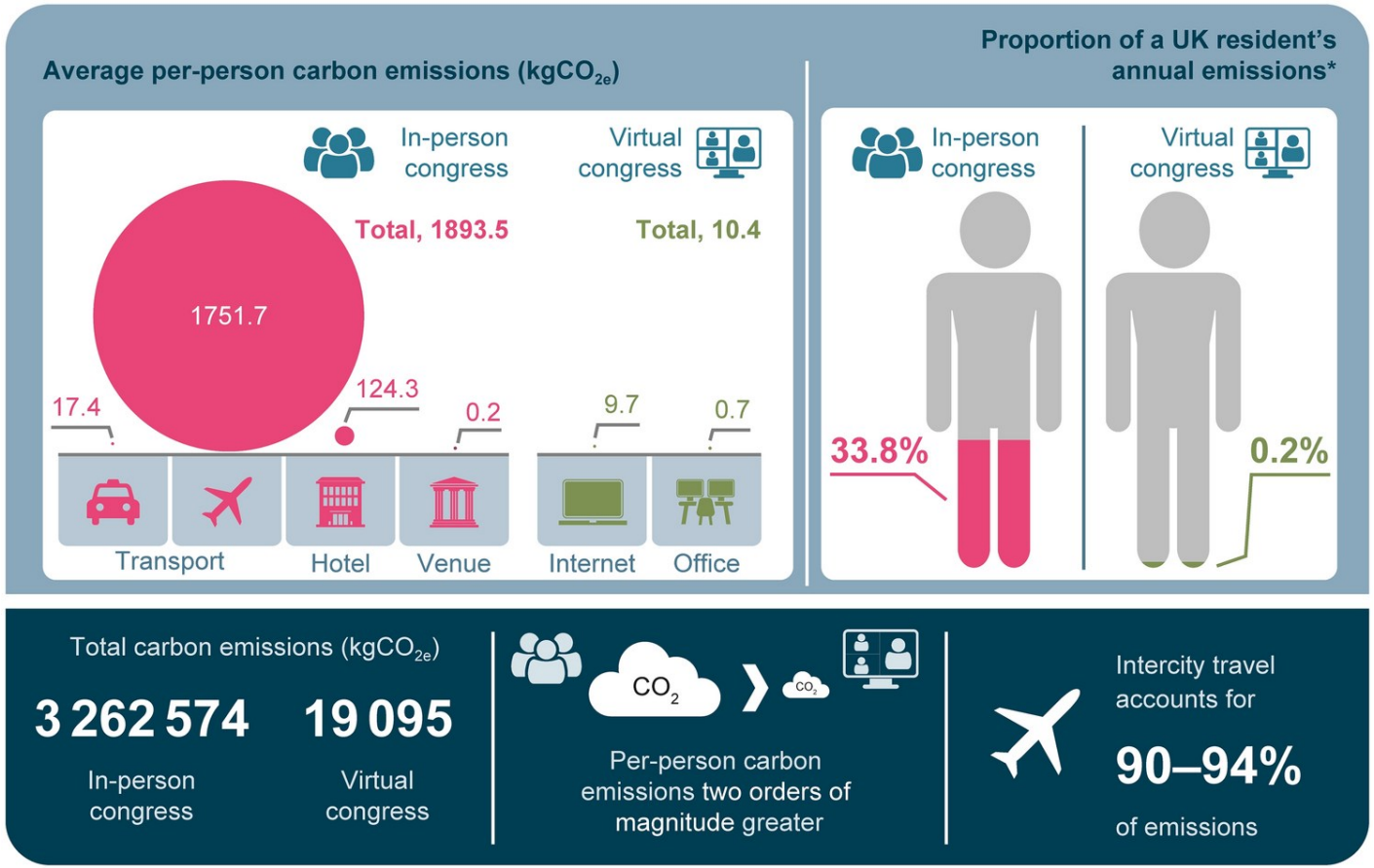
- https://thefutureofmeetings.wordpress.com/
- Online matchmaking Minglr: https://doi.org/10.1145/3411764.3445776
- For more inclusivity, diversity and equality Source: https://doi.org/10.1038/s41893-021-00823-2
- Virtual conferences can contribute to a 94% reduction in carbon footprint and a 90% reduction in energy use Source: https://doi.org/10.1038/s41467-021-27251-2

Conclusion

Virtual tools are essential for reducing emissions from long-haul flights. These can already be used, but need to be expanded and improved.

Source: Ariane Wenger, ETHZ

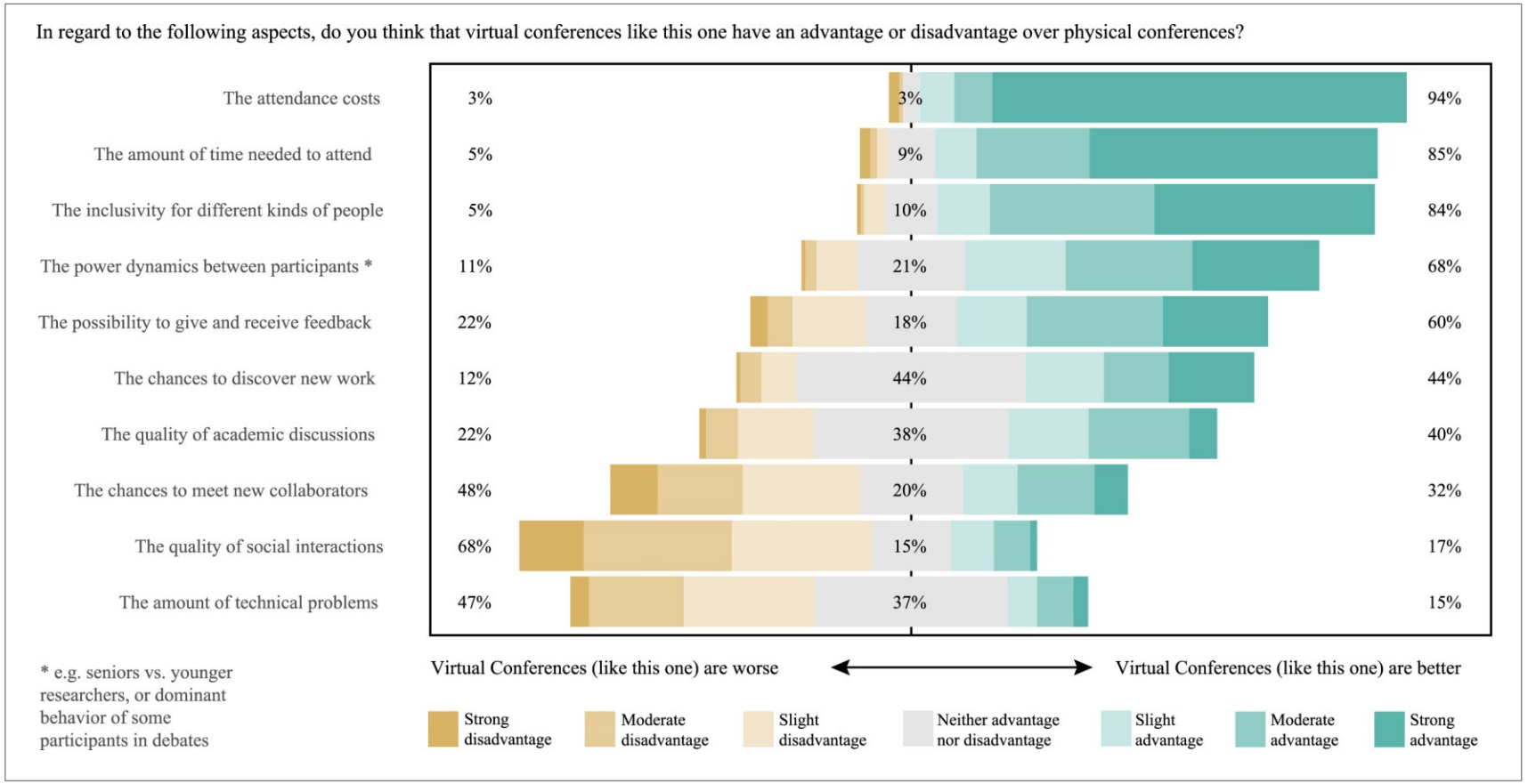
9.7 Technological solutions
Virtual tools (2/5)



Comparison of in person and virtual congresses (average of four congresses).

Source: https://doi.org/10.1007/s40290-022-00421-3

9.7 Technological solutions
Virtual tools (3/5)



Benefits and challenges of virtual conferences...

Source: https://doi.org/10.1016/j.jclepro.2021.126287

9.7 Technological solutions
Virtual tools (4/5)

	In-person conferences		Virtual conferences	
	M	SD	M	SD
Best attended conferences	8.13	1.71	6.46	2.15
Average attended conferences	6.88	1.39	5.42	1.85
Worst attended conferences	4.35	2.02	3.10	1.94

Variables were measured on a scale from 1 (extremely useless) to 10 (extremely useful).

Usefulness of best, worst and average in-person and virtual conferences participants had attended. Results from a survey among early career researchers in environmental psychology.

Source: https://doi.org/10.3389/fpsyg.2022.906108

9.7 Technological solutions
Virtual tools (5/5)

- What is the goal of the meeting? How can I achieve it? With which formats and tools?
- Where is it possible and useful to use virtual tools? Where do face-to-face meetings (still) need to be held?
- How can very good virtual tools be further developed and expanded to cover different purposes (meetings, conferences, informal interactions, field work, etc.)?
- How does one interact differently virtually (compared to presence), what adjustments are needed in virtual interaction?
- More experience needed with different hybrid formats. What is the best way to connect online and physically present?
- How do you encourage testing and experimenting with mixed / augmented / virtual reality?
- What is the significance of social media networking (Twitter, LinkedIn, etc.)?
- How do you develop and test new formats for scientific exchange?

Source: Ariane Wenger, ETHZ

10. Conclusion

- We need a **transformation** - this needs creativity and innovation
- Different **framework conditions** are needed
- Change triggers **emotional** reactions, takes some **getting used to** and needs **time**

We need to rethink our scientific system and exchange, conferences, teaching, evaluation criteria and the role of policy and funders.

A change in values and culture is needed.

About FlyingLess

The aim of the FlyingLess project is to support universities and research organisations in reducing air travel, which causes a significant part of their total greenhouse gas emissions.

FlyingLess develops approaches to reduce air travel in the academic sector, which are implemented at different levels (research, teaching and administration).

The project is being carried out in close cooperation with four pilot institutions - EMBL (European Molecular Biology Laboratory) and MPI Astronomy in Heidelberg as non-university research institutions and the Universities of Konstanz and Potsdam as universities.

Further information can be found on the website www.flyingless.de.

The project is being led by ifeu Heidelberg in close cooperation with the TdLab Geography at the Institute of Geography at Heidelberg University.

The project is funded over 3 years as part of the National Climate Initiative (NKI) of the Federal Ministry for Economic Affairs and Climate Protection.

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(FlyingLess Projektleitung 2021-2023)

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