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CO_2 footprint of EPFL business air travel: analysis and reduction opportunities

Joachim Ciers, Aleksandra Mandic, Leonardo Bellocchi, Dominic Zhao, Laszlo Daniel Toth, Giel Op't Veld

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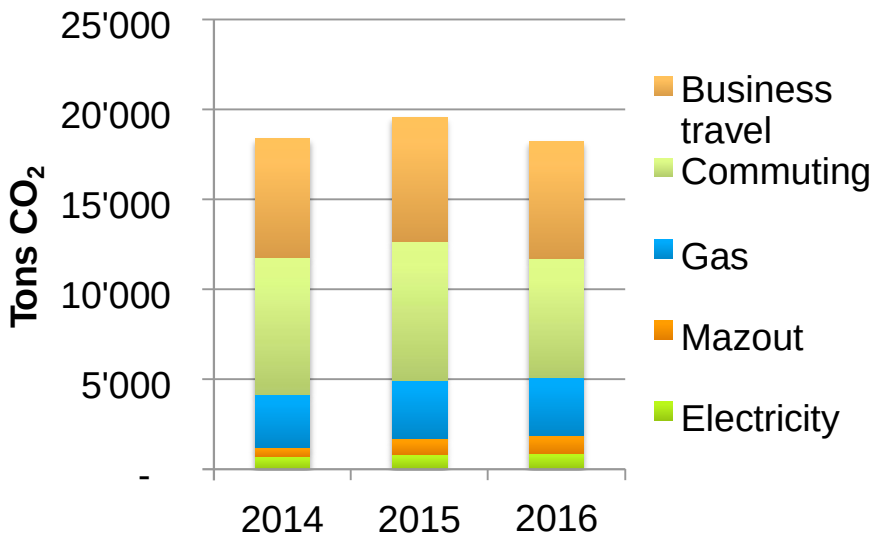
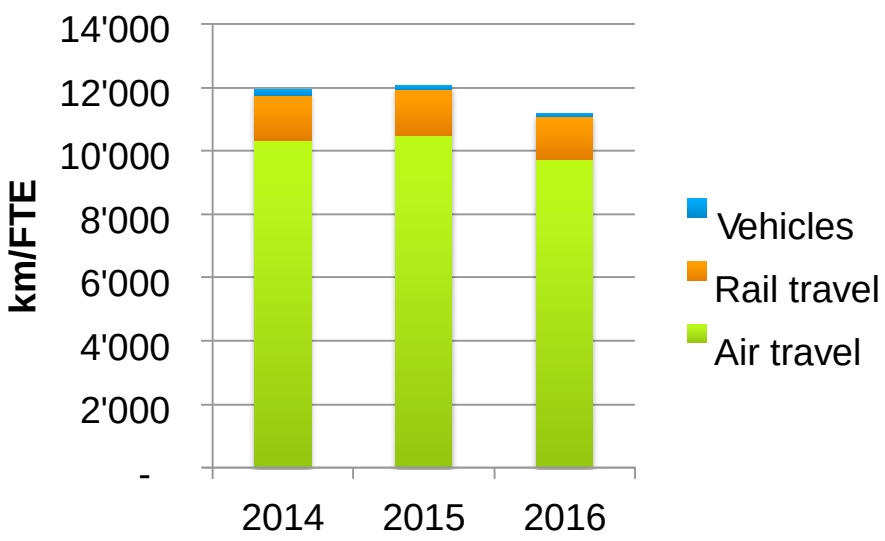
Air business travel produces 1/3 of EPFL's CO_2 emissions

Business travel is responsible for 36 % of EPFL's total CO_2 emissions



87 % of business travel is done by plane



CO_2 level needed to halt climate change

2 tons CO_2 / person/ year

Average EU citizen

9.1 tons CO_2 / person/ year

Return flight Geneva- New York (direct, economy)

2.3 tons CO_2 / person/ year

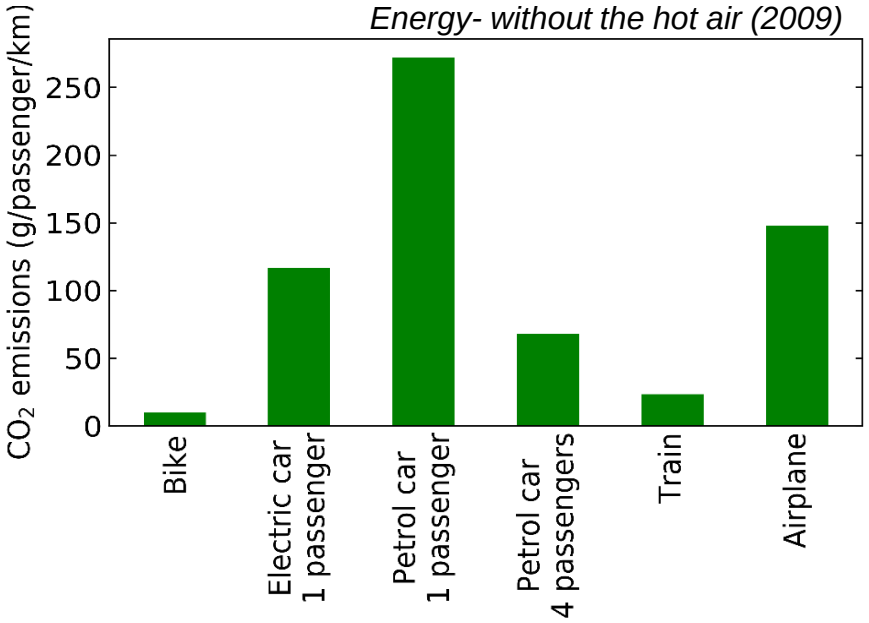
**FTE: full-time equivalent*

Impact of air travel on climate change: It's not only CO_2

CO_2 emissions

- Kerosene combustion: 3.15 kg CO_2/kg
- Kerosene production: 0.5064 kg CO_2/kg [1]
- Taxying, take-off and landing: 30-40 kg CO_2/passenger
- Airplane fabrication: ~5 g CO_2/passenger/ km

[2] *David MacKay, Sustainable Energy- without the hot air (2009)*



Other effects

- NO_x è Tropospheric O_3
- Condensation trails (contrails)
- Cirrus clouds

Contrails

Cirrus clouds

Total radiative effects are 2-4 times larger than only CO_2 radiative forcing [3] è Multiplication factor M

[1] http://www.ecoinvent.org/
[3] Kollmuss and Crimmins, Carbon Offsetting & Air Travel Part 2: Non-CO2 Emissions Calculations (2009)

Business Travel at EPFL: a necessity for research, with overlooked environmental costs

EPFL researchers experience almost no financial barriers to travel

Relatively low travel costs in Switzerland lead to nourishment of international collaborations, as well as other types of business travel (e.g. conferences, workshops, etc).

Green Innovation cannot keep up with the researchers' need to travel

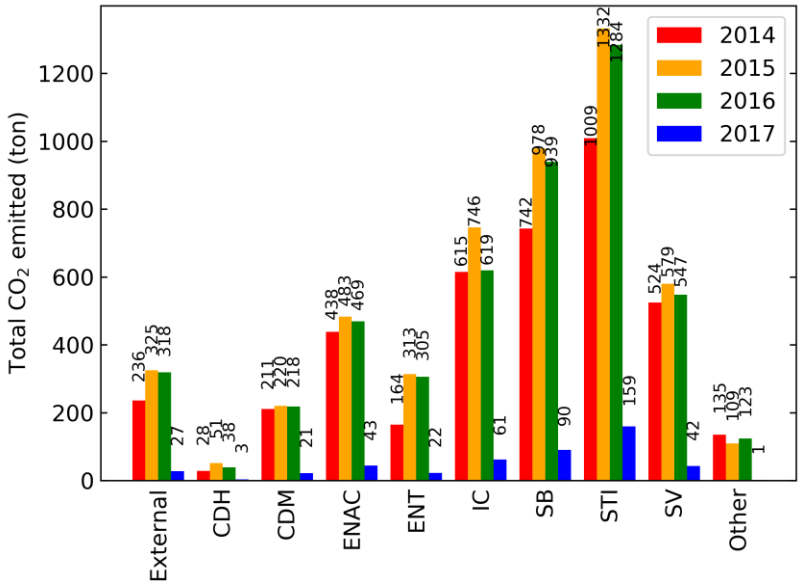
The Confederation: exemplary in energy: Decrease carbon footprint of the business air travel to less than 20% by 2020

Aims: addressing this environmental cost of business travel in the EPFL community

1. Studying travel habits and quantifying carbon footprint of EPFL research community
2. Estimation of potential carbon footprint reduction levels and proposal of the concrete steps towards carbon footprint mitigation

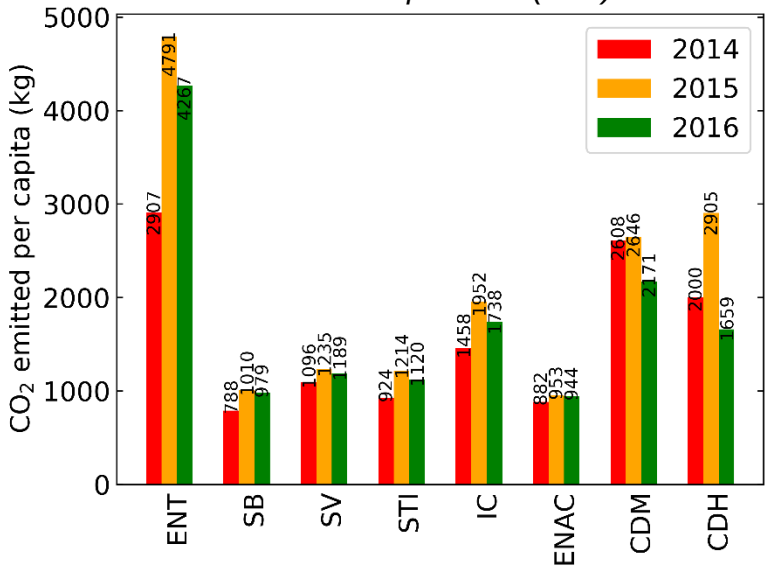
The larger faculties emit the most, but ENT has the largest footprint per capita

Our data: all EPFL air travel with Carlson Wagonlit Travel (CWT) between 2014-2017
è 80 % of total air travels (20 % booked by credit card)



- External people contribute significantly
- Larger faculties emit the most CO_2

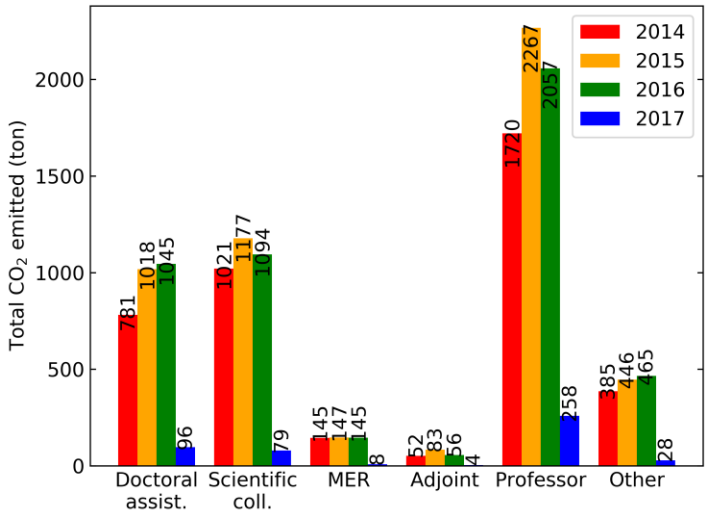
**Normalized per academic full-time equivalent (FTE)*



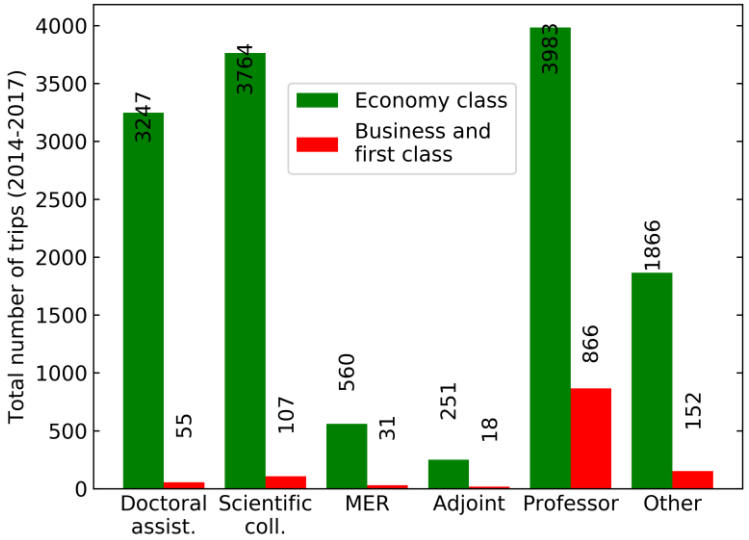
- ENT has the largest footprint per capita, but less than half the staff is academic

Professors have the biggest CO_2 impact

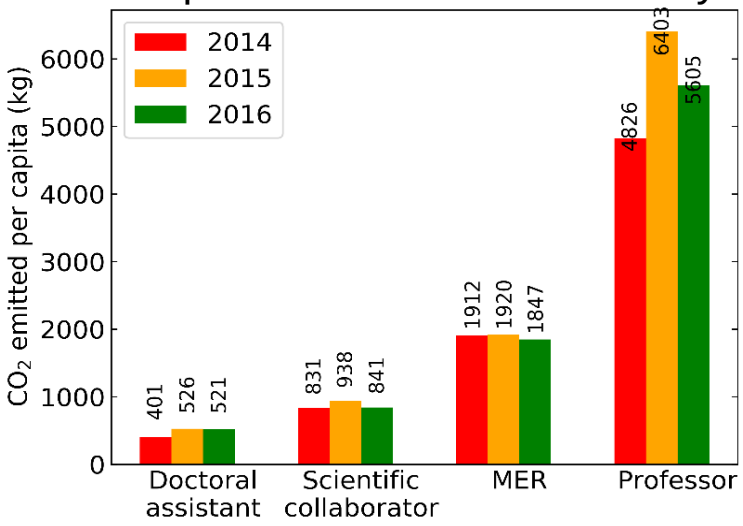
The professors have the biggest footprint



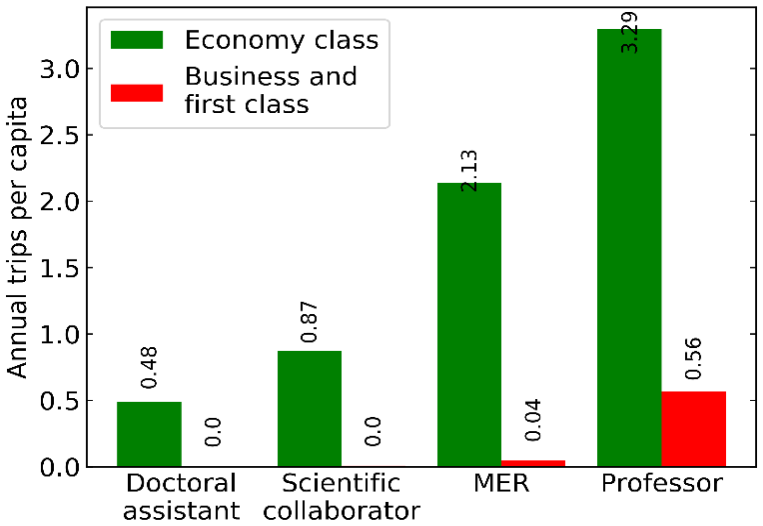
They are main users of business and first class



Footprint increases with seniority



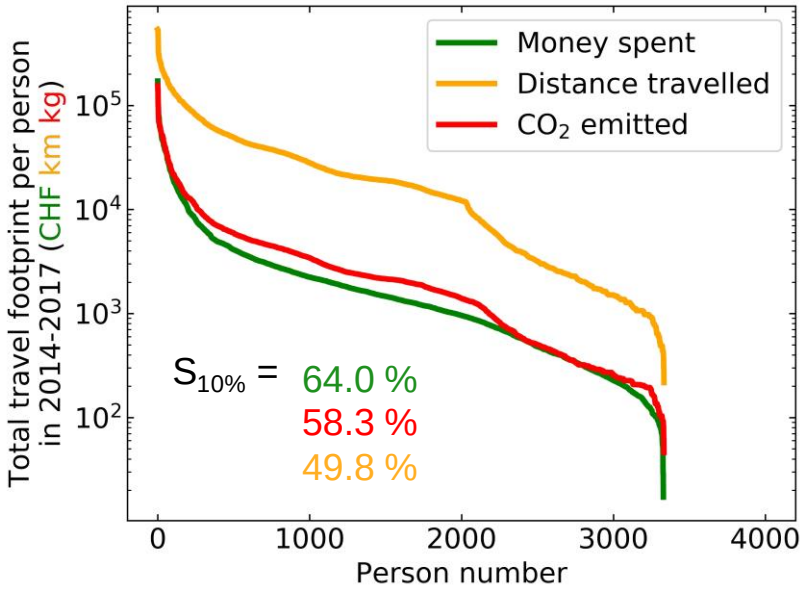
1 Professor = 10 PhDs = 5 Postdocs



The inequality in EPFL air travel is larger than for worldwide income

The 10 % biggest travelers emit 60% of all CO_2

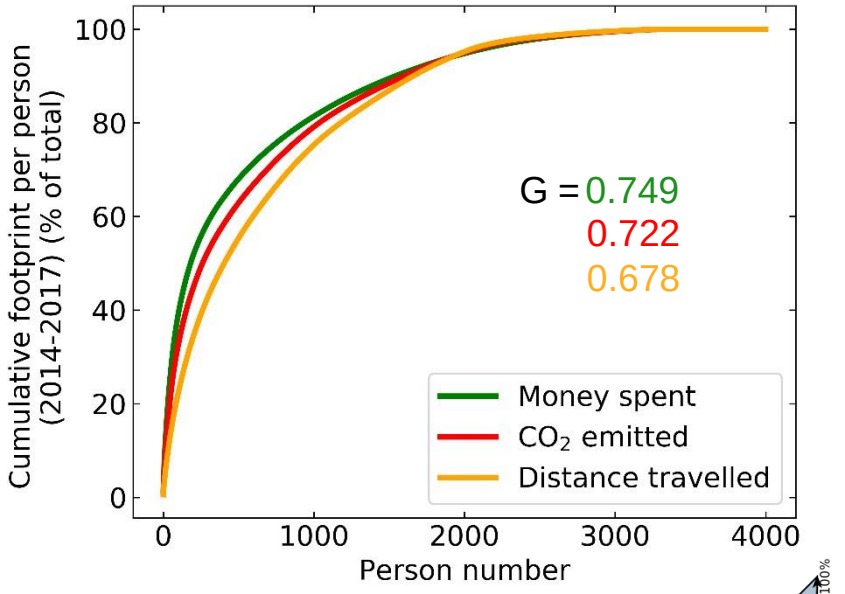
Biggest consumer → Smallest consumer



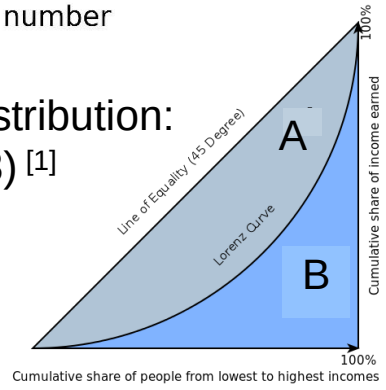
$S_{10\%}$ = Share of the 10% largest consumers

The Gini coefficient for CO_2 emission is 72% showing large inequality

Biggest consumer → Smallest consumer



Worldwide income distribution:
G = 0.65 (2013) [1]

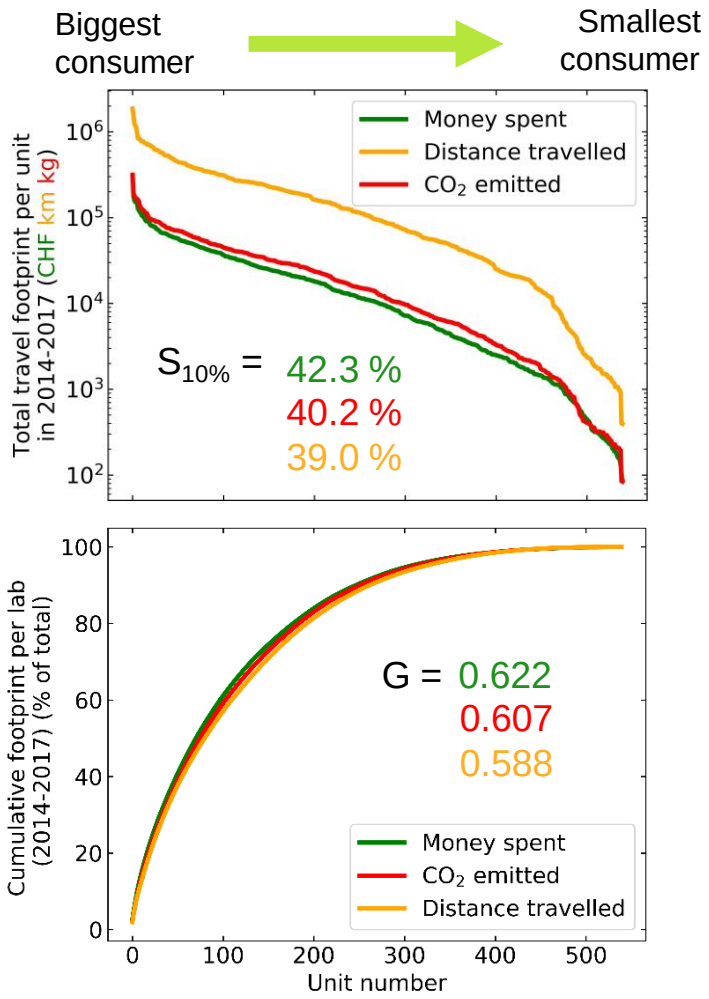


G = *A* / (*A* + *B*)

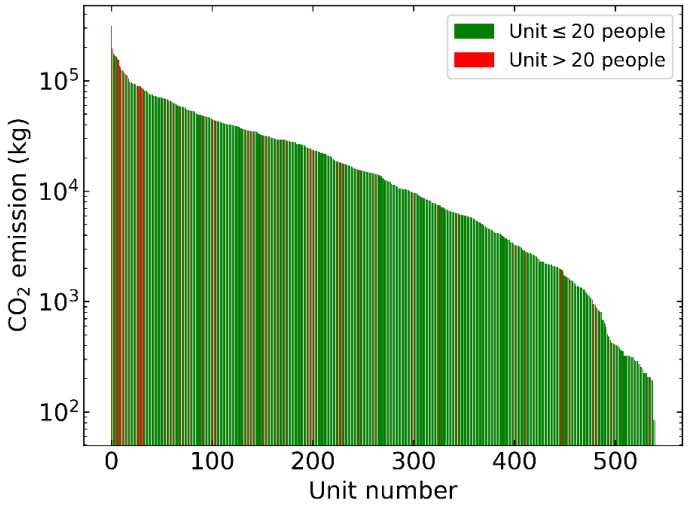
[1] World Bank, Poverty and Prosperity 2016 / Taking on Inequality

There is a large inequality between unit's travel habits

The 10 % most traveling units emit 40% of all CO_2



No clear relation between lab size and CO_2 emission



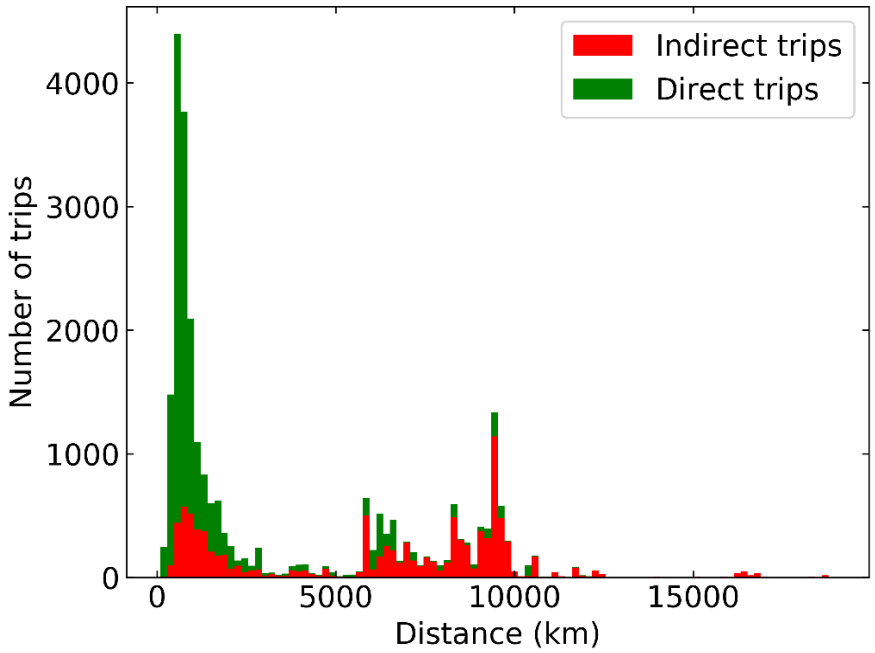
Big units:
886 kg CO_2 per unit average

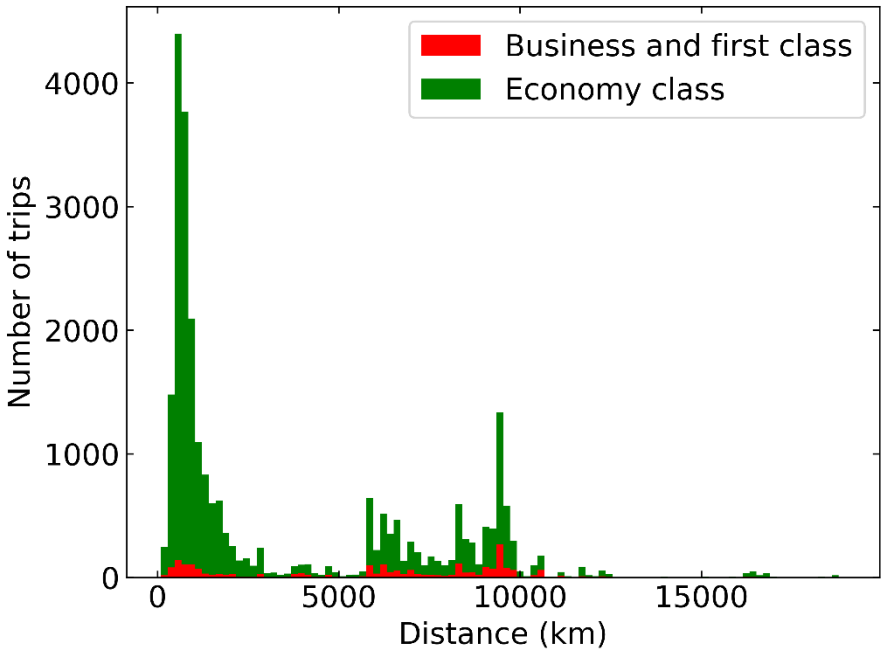
Small units:
1167 kg CO_2 per unit average

How much can we save?

Indirect trips
è **Replace by direct**

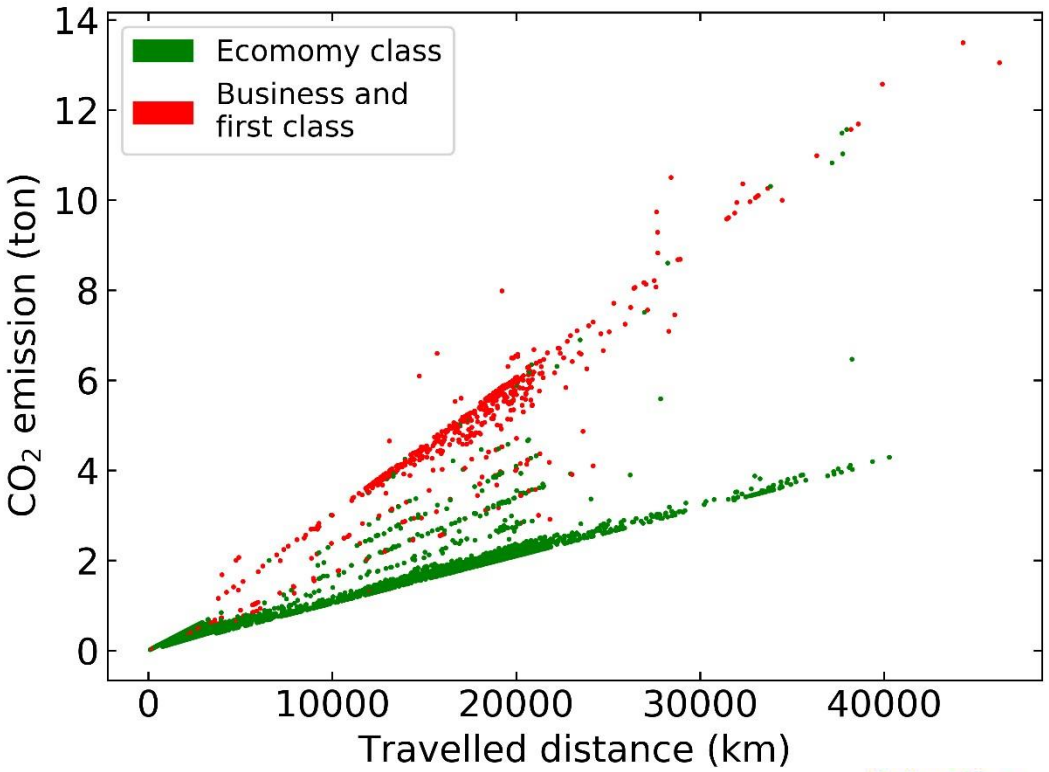
Business and first class trips
è **Replace by economy**





Short distance trips
è **Replace by train**

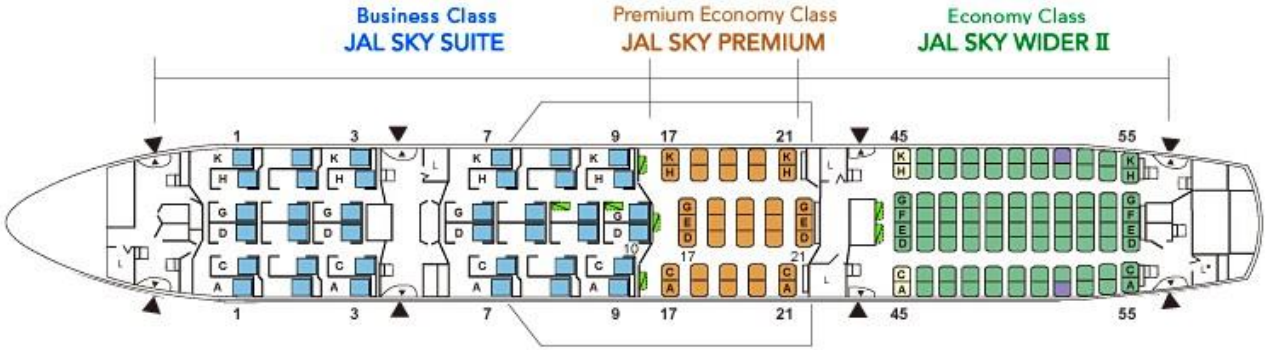
Business and first class flights emit 2 to 3 times more CO_2 per km than economy class.



Average emission:

- In economy class: 0.123 kg CO_2/km
- In business and first class: 0.278 kg CO_2/km

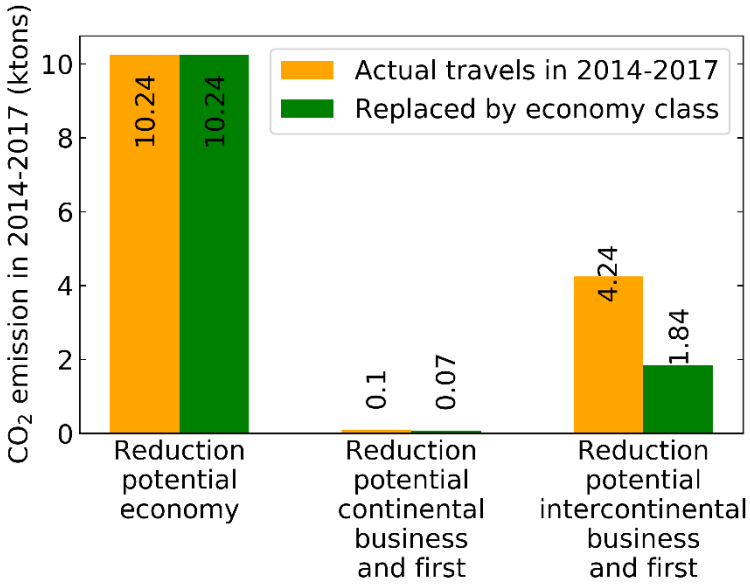
Higher classes take more floor space



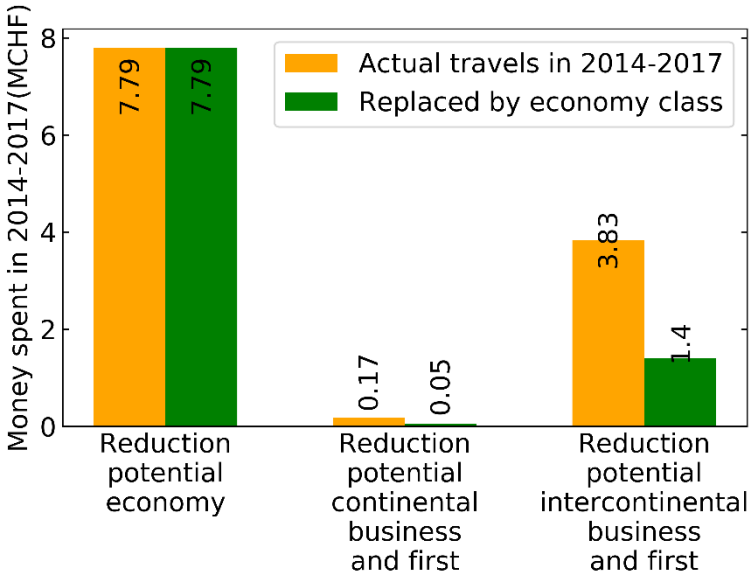
CO_2 emissions and costs can be reduced respectively by 17 % and 22 % if all business and first class flights are replaced with economy

Substituting all business and first class flights with economy

Reduction of 800 ton CO_2/year (17 %)



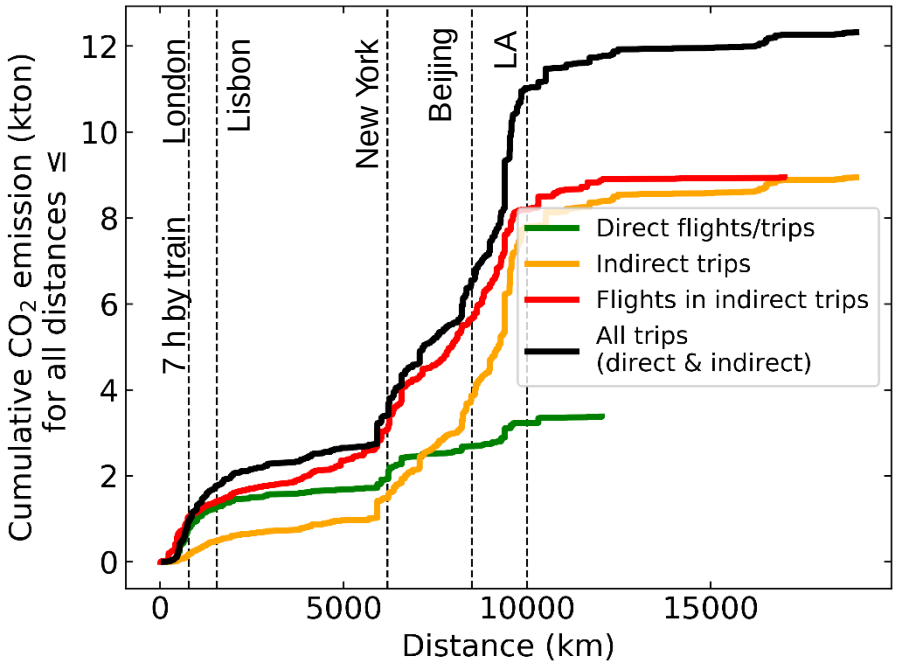
Reduction of CHF 850 000/year (22 %)



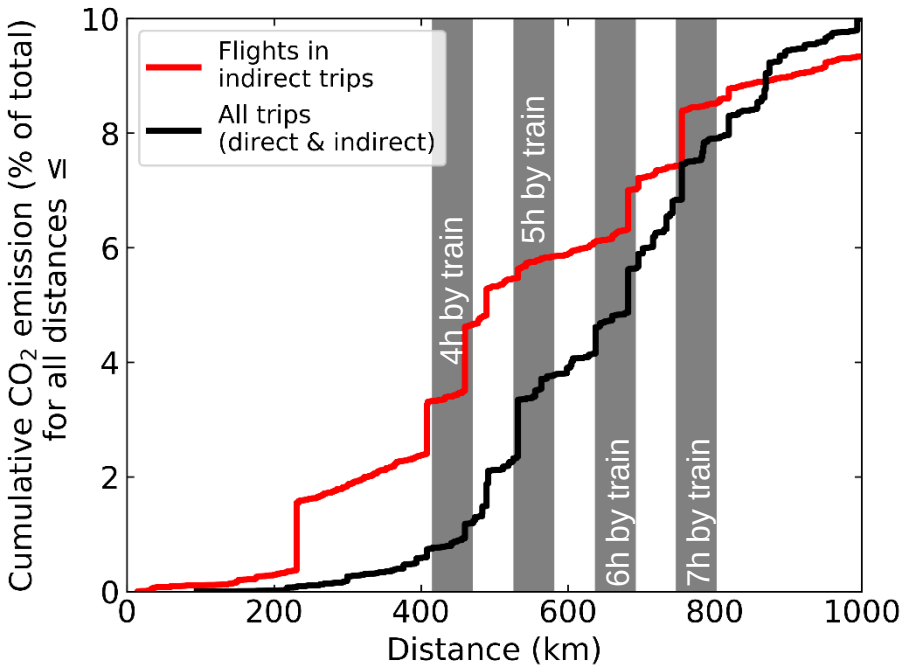
Business and first class flights' emissions within Europe are negligible

CO_2 emission could be reduced by approx. 15 % (upper bound) replacing all short-distance flights with train

15 % of CO_2 emissions on continental trips, 78 % on intercontinental



15 % of total emissions are coming from short trips and flights < 800 km



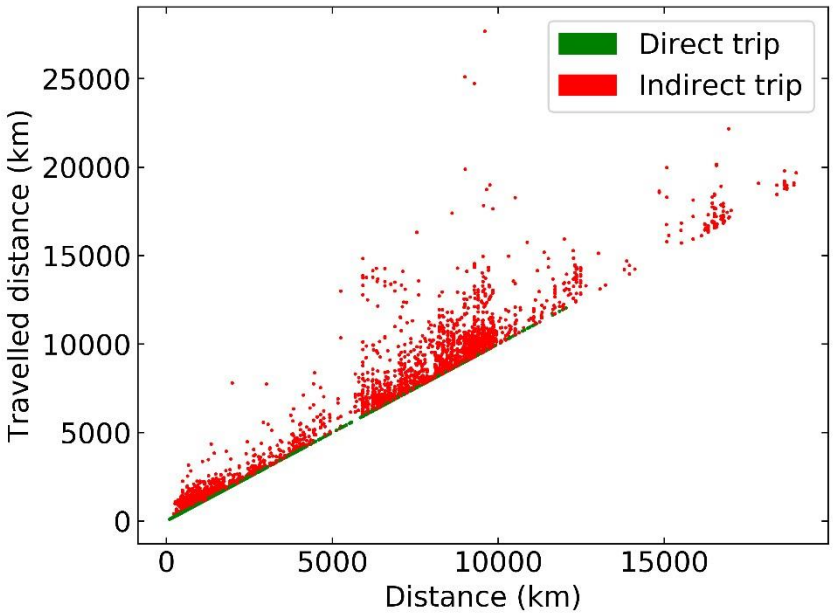
Replacing all flights up to approx. 600 km (5h train ride)
è -9 % CO_2

- GVA-ZRH:
  504 flights/year (1.2% of CO_2)
- GVA-CDG:
  333 flights/year (0.85% of CO_2)
- GVA-FRA:
  420 flights/year (1.1% of CO_2)

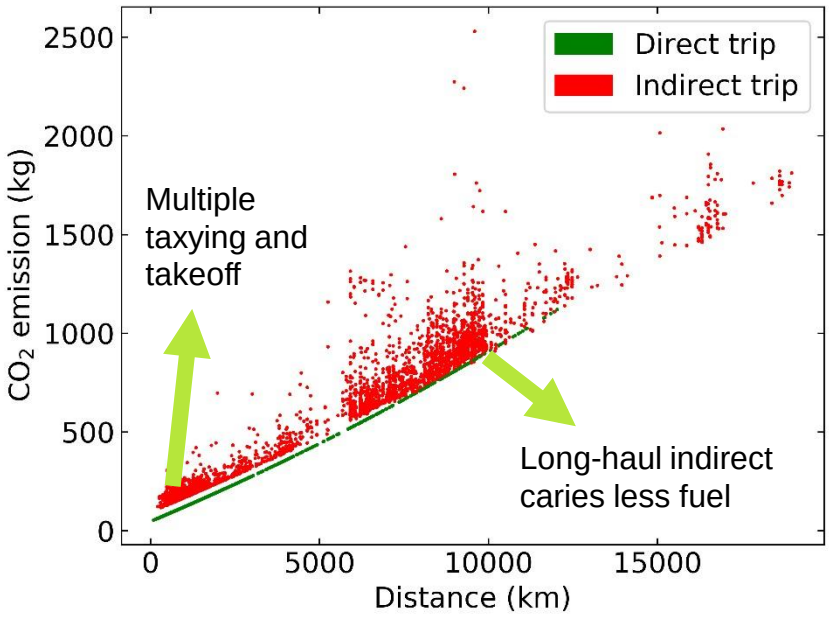
Indirect trip = multiple flights
Direct trip = one flight
Return journey = two trips

CO_2 emissions could be reduced by 8.6 % if we would replace all indirect trips by direct

Indirect trips cover many redundant kilometers



…and emit a lot of redundant CO_2



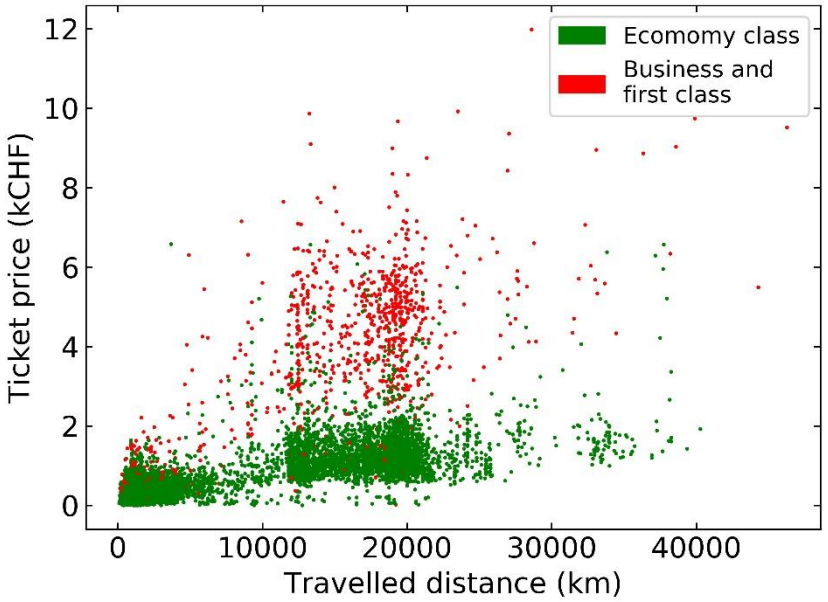
Travelled distance Distance (shortest between departure and destination)

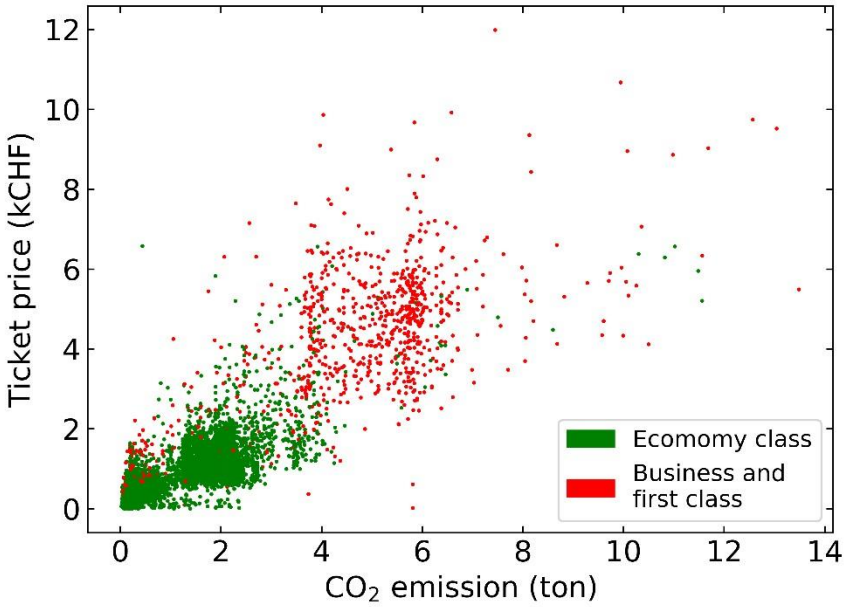
How much can we save? The answers!

	Full potential	Half of the potential
• Avoided flights	???	???
• Indirect è Direct	-8.6 %	-4.3 %
• Short trips è Train	-15 %	-7.5 %
• Business and first class è economy	-17 %	-8.5 %
Subtotal		-19 %
• The 10 % largest emitters reduce their travel by half	-29.1 %	-14.6 %
Total		-30.8 %

For a climate-neutral EPFL
è **Compensation of remaining emissions**

Ticket price correlates mainly with CO_2 emissions and service class, less with the distance travelled





- Ticket price correlates more with service class than with distance
- Average prices:
  - In economy class: CHF 0.094/km
  - In business and first class: CHF 0.257/km
- Ticket price is proportional to CO_2 emission

Reducing costs = reducing CO_2

1.22 kg of CO_2 for every CHF spent on air travel

The price of CO_2: Companies like Myclimate allow to compensate CO_2 emission

Projects in developing countries

Projects in Switzerland

CHF 30 per ton CO_2
è Air travel prices +7 %*

At least 50 % to projects in Switzerland:
CHF 100 per ton CO_2
è Air travel prices +24 %*

Production (including M): 820/M CHF/ton CO_2

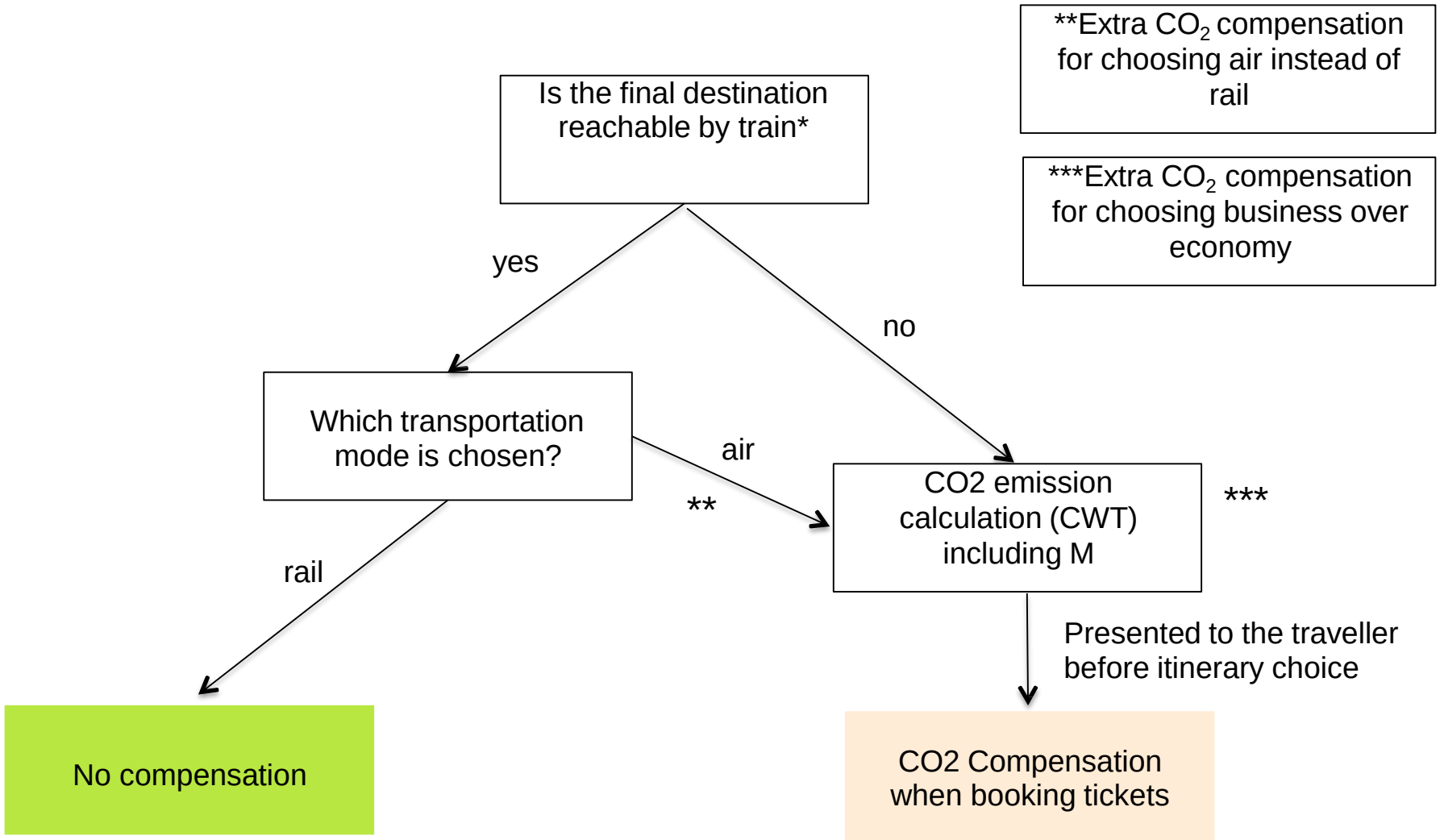
myclimate
shape our future

*Including multiplication factor of 2

What should we make EPFL travellers aware of?

	CO_2 reduction factor	Other advantages
• Can I stay at home? Video conference? is the event really interesting?	∞	No time wasted traveling No money on tickets
• Can I take the train?	10 (including M)	More comfortable More useful time (reading, working) Less cosmic radiation Arrive directly in city center
• Can I take a direct flight?	2 - 3 - 4 depending on routing	Faster No time lost waiting for connection Less chance of lost luggage
• Can I take economy class?	3	A lot cheaper

Carbon footprint compensation policy



- up to 5 hours by train

Summary:

- **Analysing EPFL business travel data, we have shown that there is large large inequality and that CO_2 footprint increases with seniority of EPFL research staff**
- **It is possible to reduce CO_2 footprint by 20-30%. Favouring economy class over business would cover largest portion of the reduction**
- **We have proposed a CO_2 footprint compensation policy and the travellers' mindset which should be promoted when choosing travel itinerary**