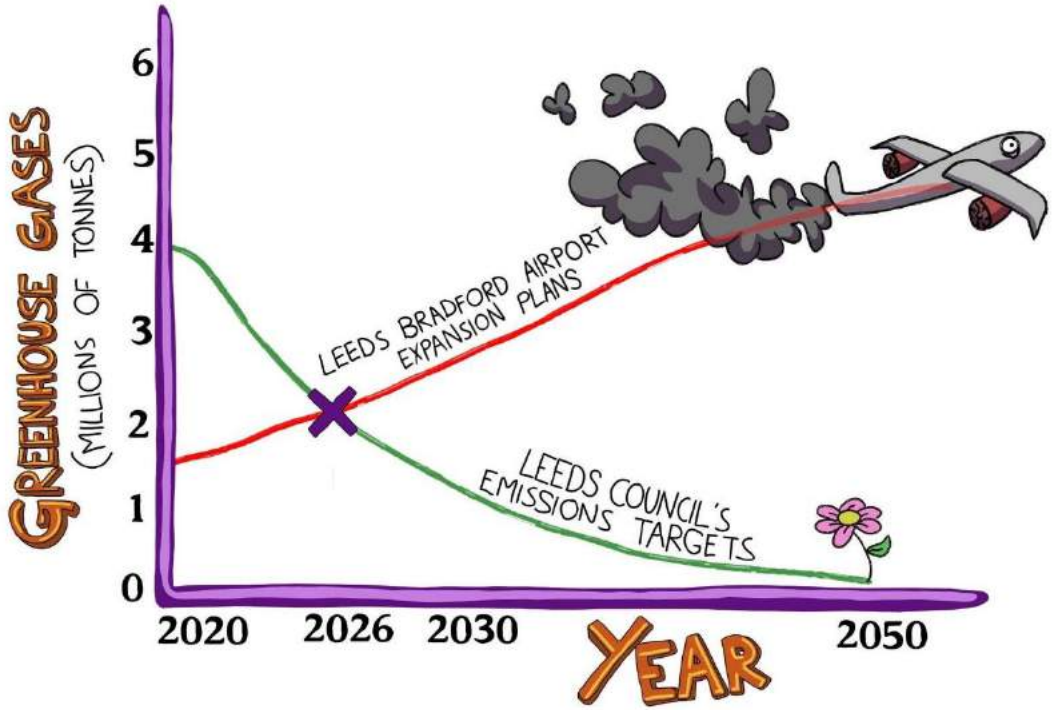
(Mis)assessing the climate impacts of airport expansion: The case of Leeds Bradford Airport



Jefim Vogel
Sustainability Research Institute
University of Leeds

The Leverhulme Trust

Leeds Café Scientifique - webinar 2020/11/23

UNIVERSITY OF LEEDS

Outline

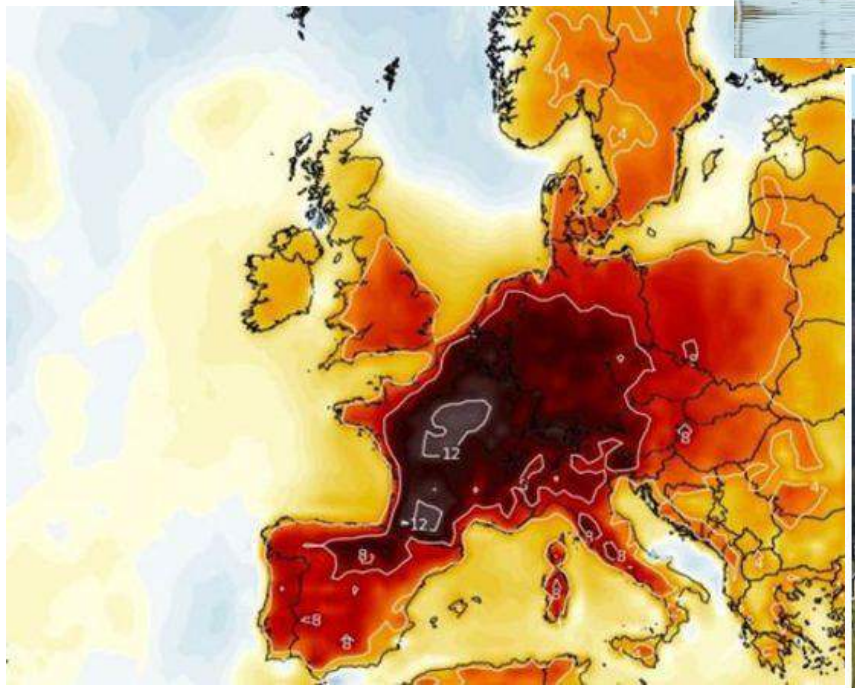
1. Introduction: The climate emergency & Leeds' climate targets
2. Aviation and its climate impacts: The global & national context
3. How to estimate the climate impacts of aviation and of airport expansion
4. The case of Leeds Bradford Airport (LBA) expansion
5. A critical review of LBA's climate impact assessment
6. Conclusion

The climate emergency: what's at stake?

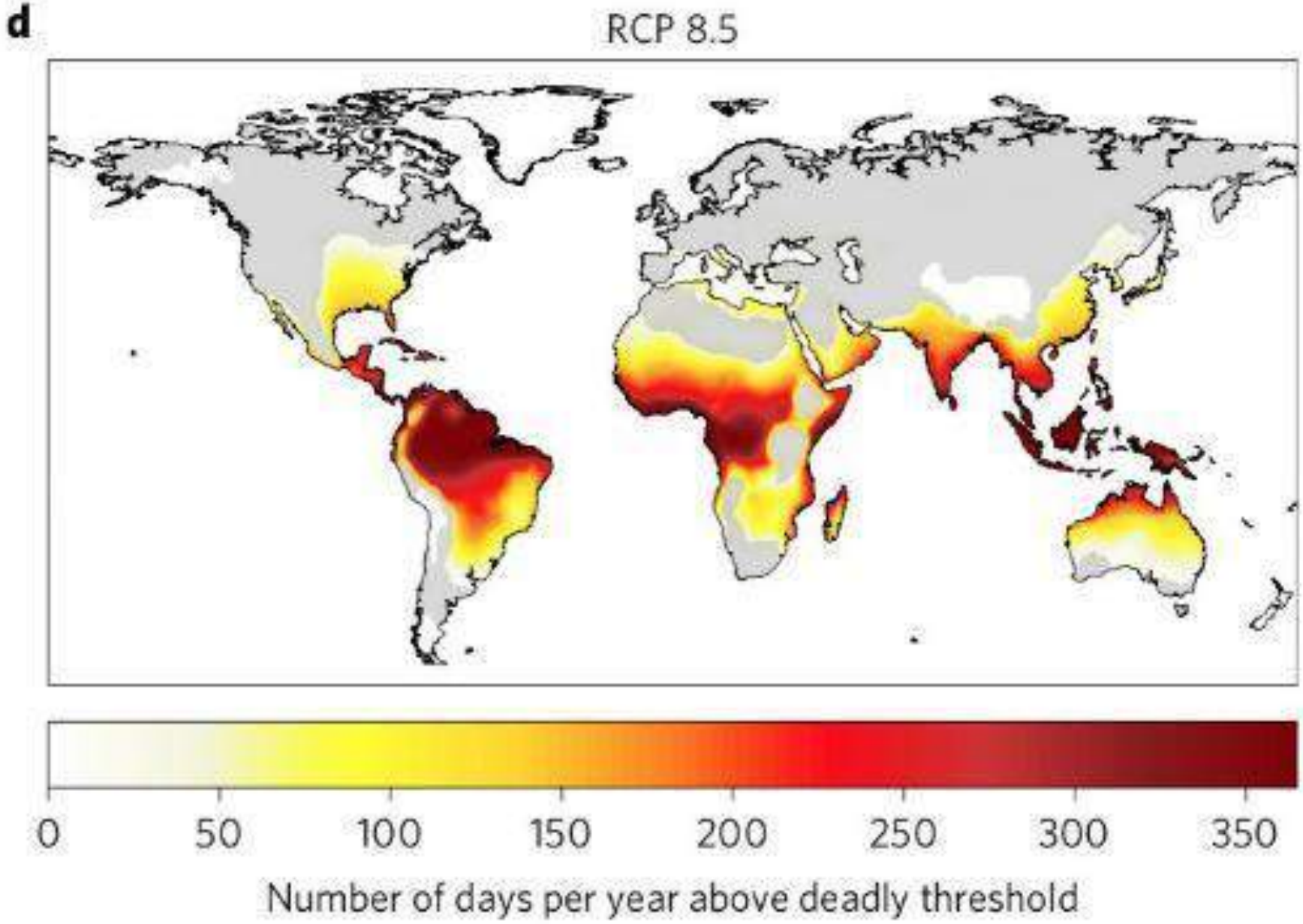
Climate impacts I: more of all things terrible

Escalating frequency and severity of

- heat waves
- drought
- wildfires
- flooding
- storm surges



Climate impacts II: regions becoming uninhabitable

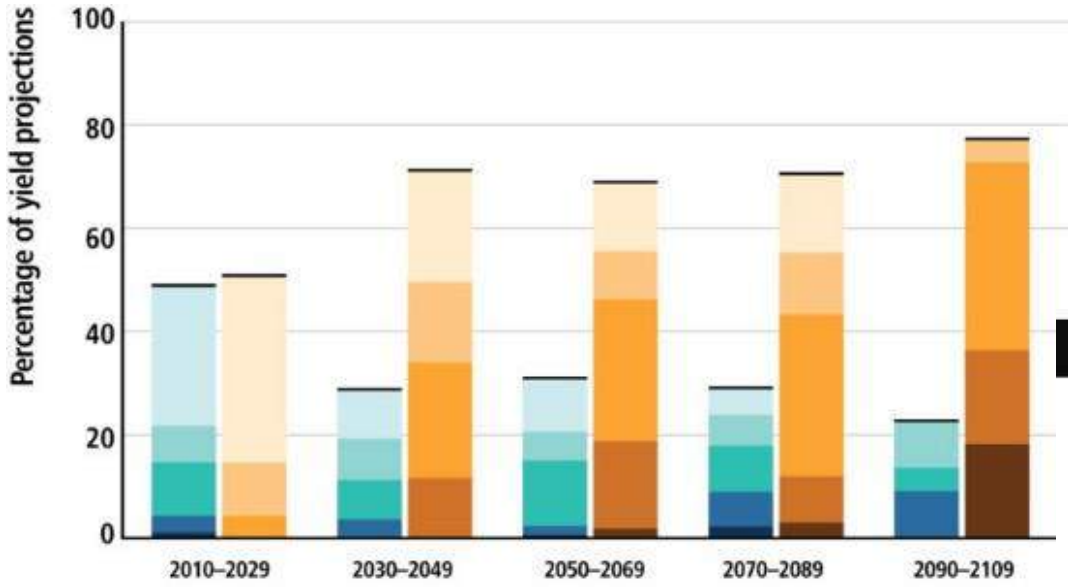


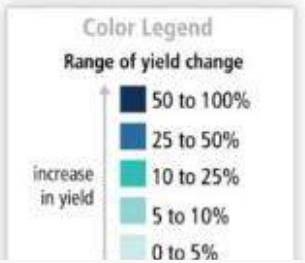
[Mora *et al.,* 2017]

Climate impacts II: regions becoming uninhabitable

[Ahsan, 2015]

Climate impacts III: food and water shortages





[IPCC AR5 WGII, 2014]

CNN World Africa Americas Asia Australia China Europe India Middle East United Kingdom

India's sixth biggest city is almost entirely out of water

By Jessie Yeung, Helen Regan and Swati Gupta, CNN

Updated 1841 GMT (0241 HKT) June 20, 2019

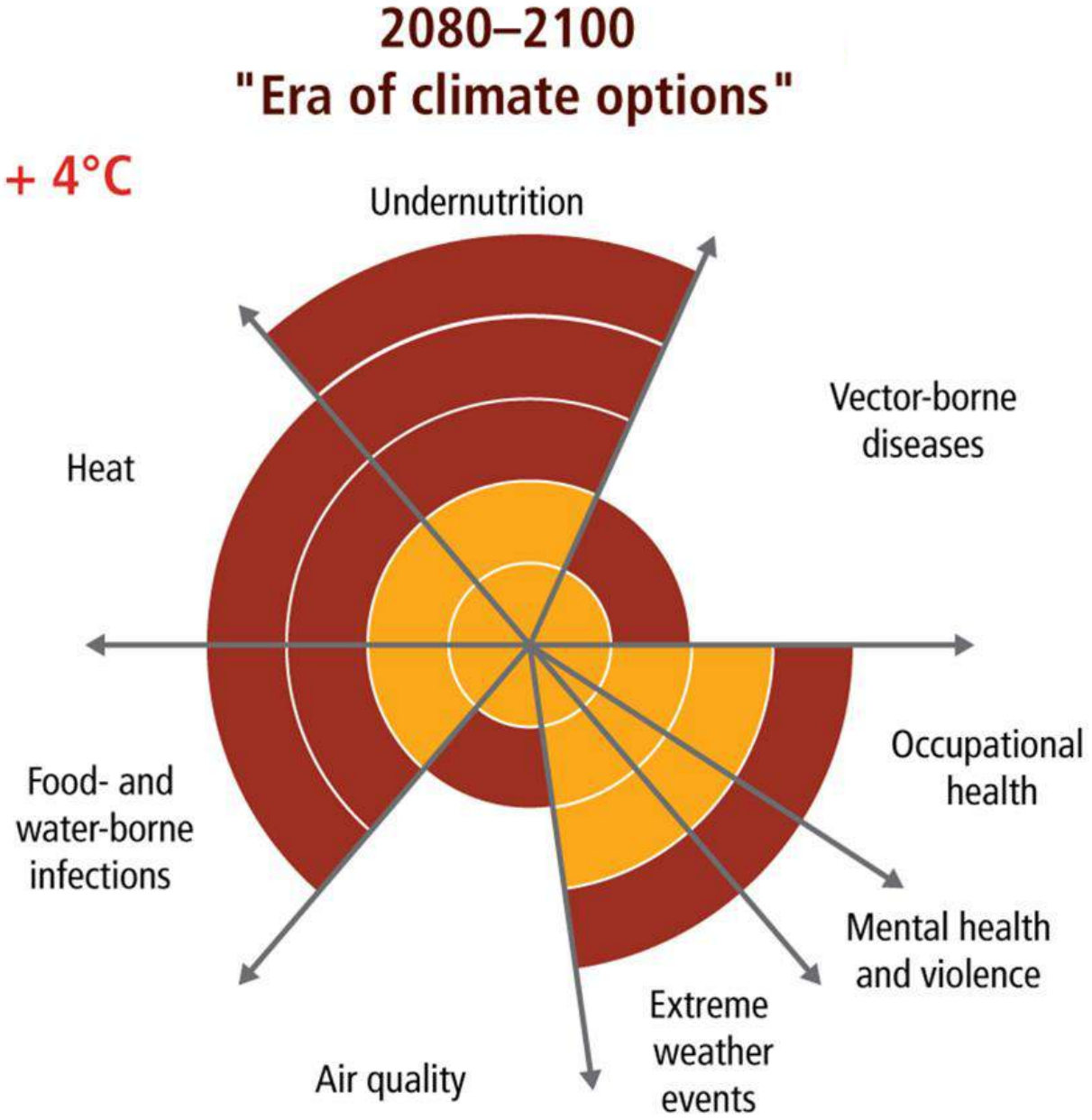
Climate impacts IV: climate refugees

By 2050

- 200 million environmental refugees
- 150 million climate refugees
  (estimates between **25 million and 1 billion)**

[EJF, 2009: No place like home report]

Climate impacts V: public health

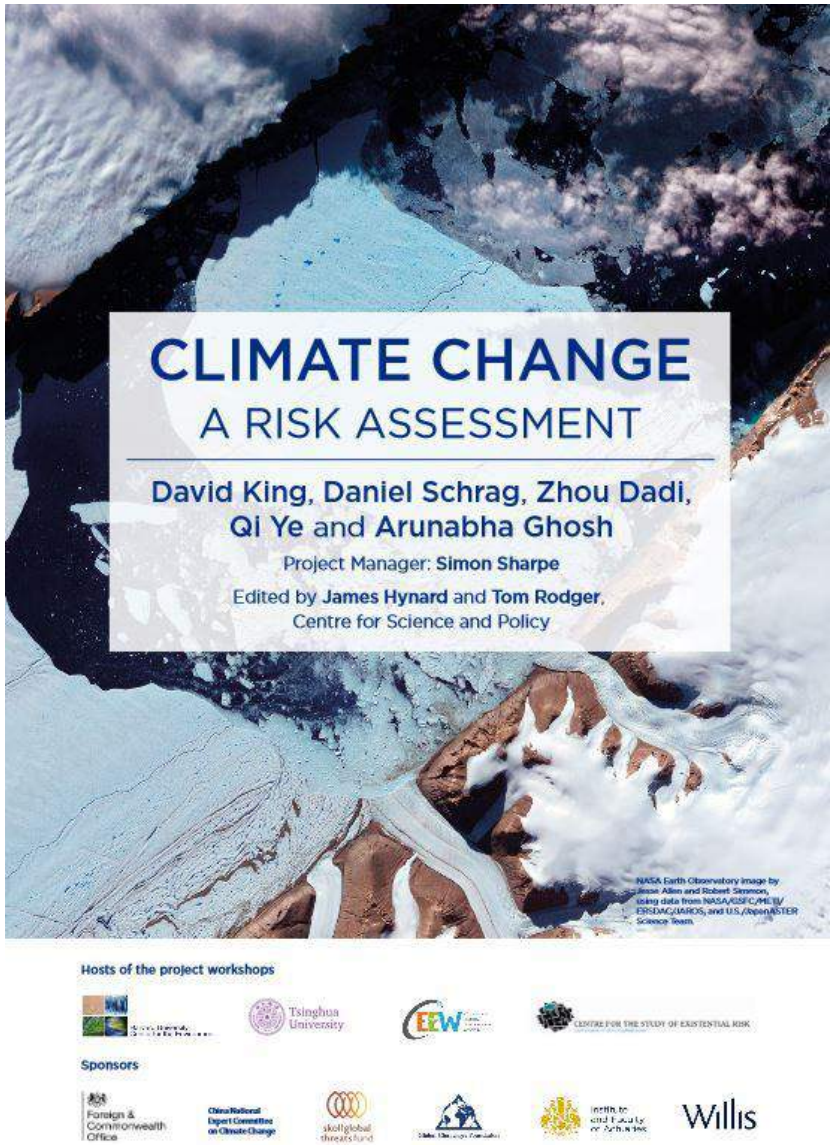


[IPCC AR5 WGII, 2014]

"Climate change is a medical emergency."

[Hugh Montgomery, Lancet Commission Co-Chair]

Climate impacts supercharge the potential for crises and violent conflict



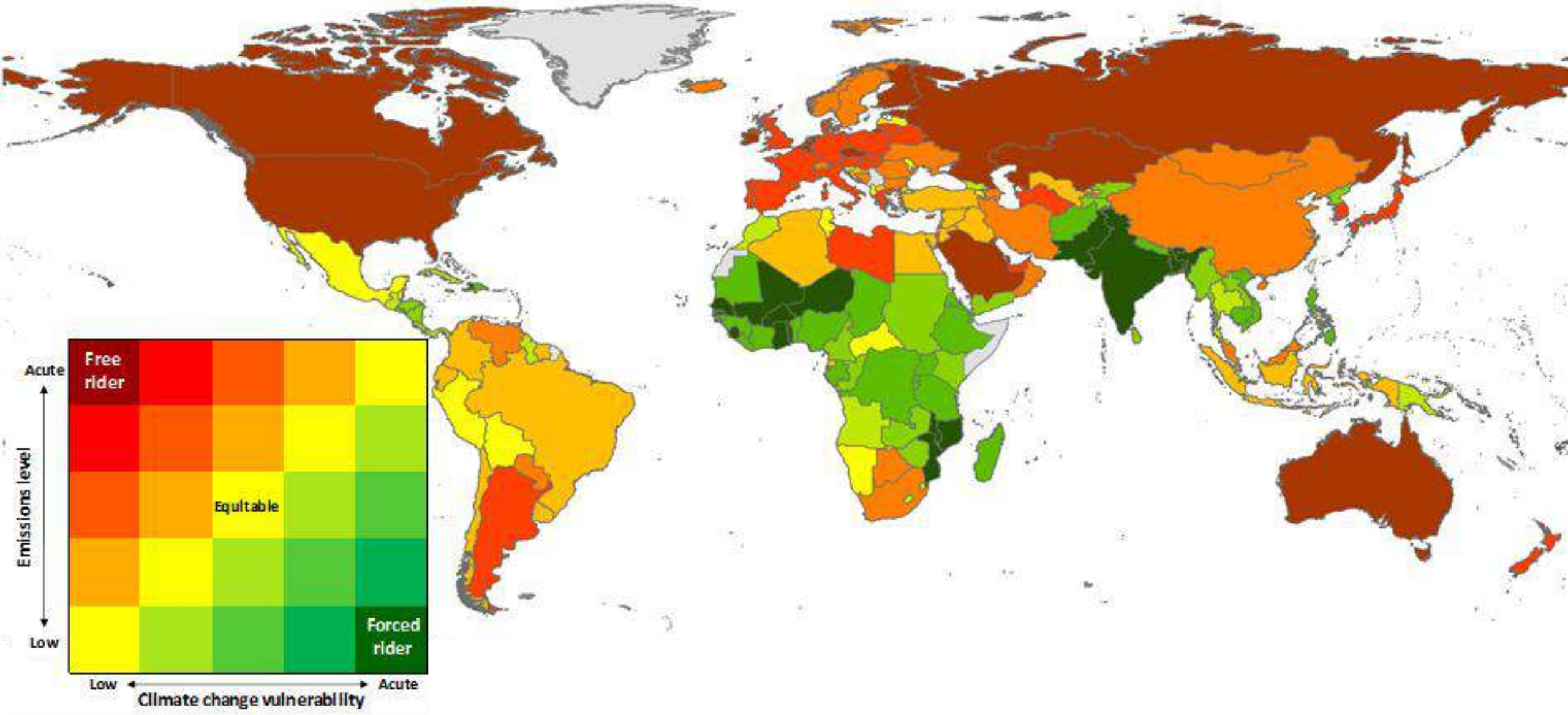
[CSAP, 2015]

Exacerbating the risk of

- food crises and famines, water crises
- conflict and war over food, water, land, resources, national identity, migration

"Security risks at high degrees of climate change seem likely to be of **a different order of magnitude**. […] even threatening those that are currently considered developed and stable." [CSAP, 2015]

(Double) climate injustice: CO2 emissions per-capita vs climate impact vulnerability



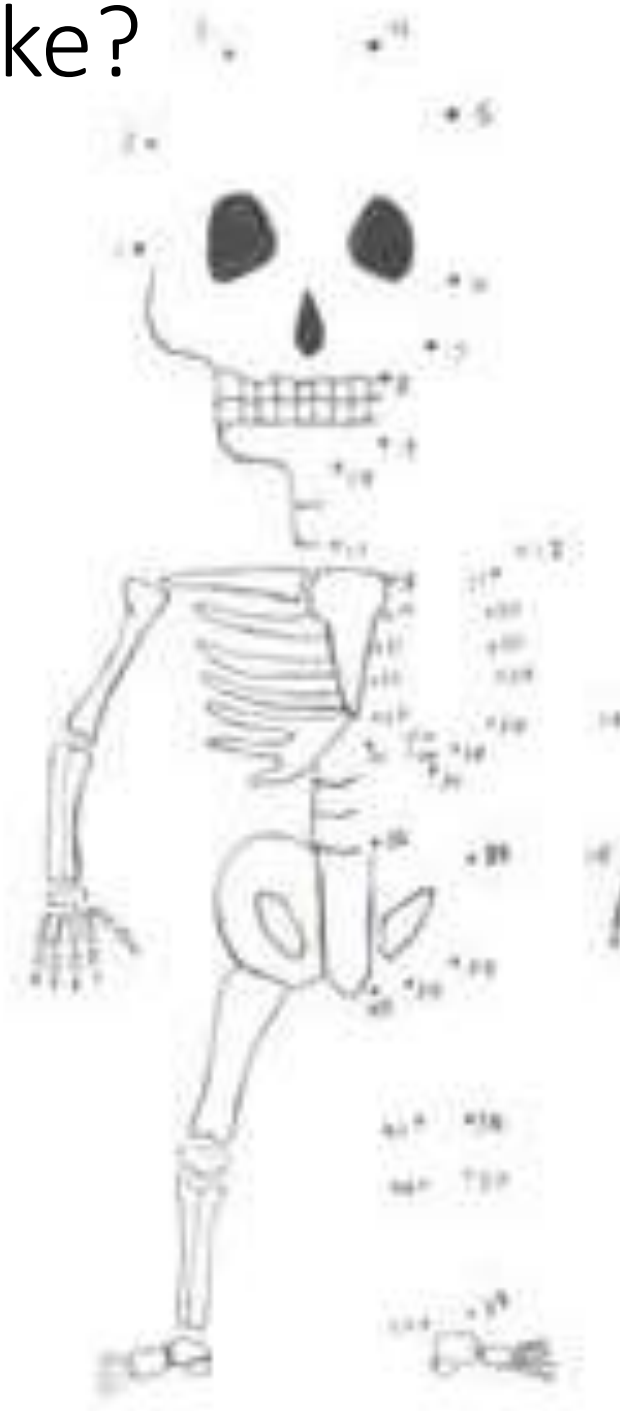
Althor et al., 2016: Nature Scientific Reports. (SI Fig. 3b for 2030)

Connecting the dots: what's at stake?

What's the difference between 2C and 4C warming?

- "**Human civilisation**."

Hans-Joachim Schellnhuber



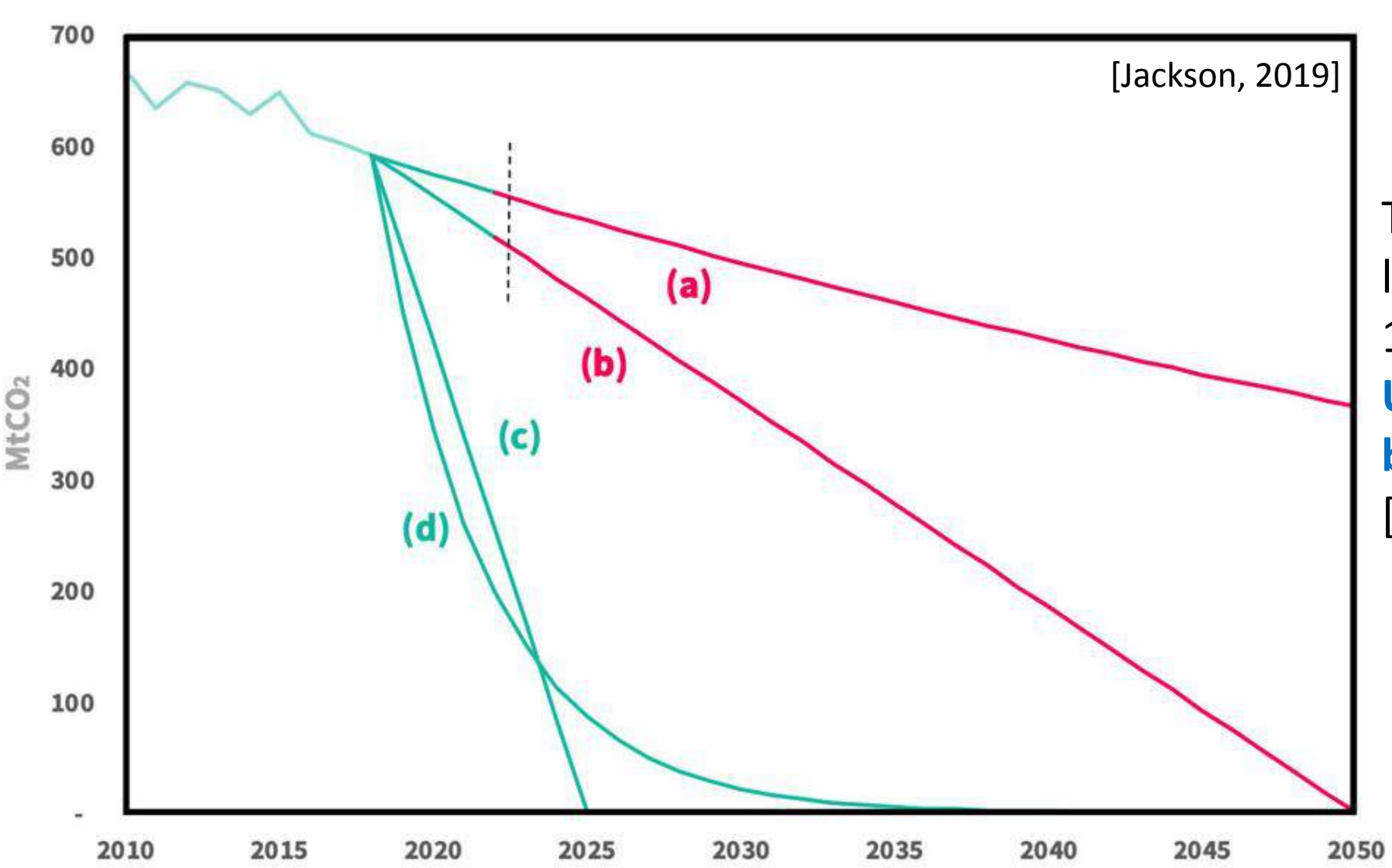
What does this imply?

1. Tackling the climate emergency should be seen an issue of overriding priority for every body of governance and power

2. A complete dis-continuation with business-as-usual!
   Current ways of living and ways of doing business cannot be seen as legitimate, and cannot be expected to be sustained.

3. Very little room for “yes, but… ”!
   Every “but” must be weighed up against human lives and livelihoods on a massive scale, and a very real threat to human civilization.

Required emissions reductions for a fair UK contribution to 1.5C

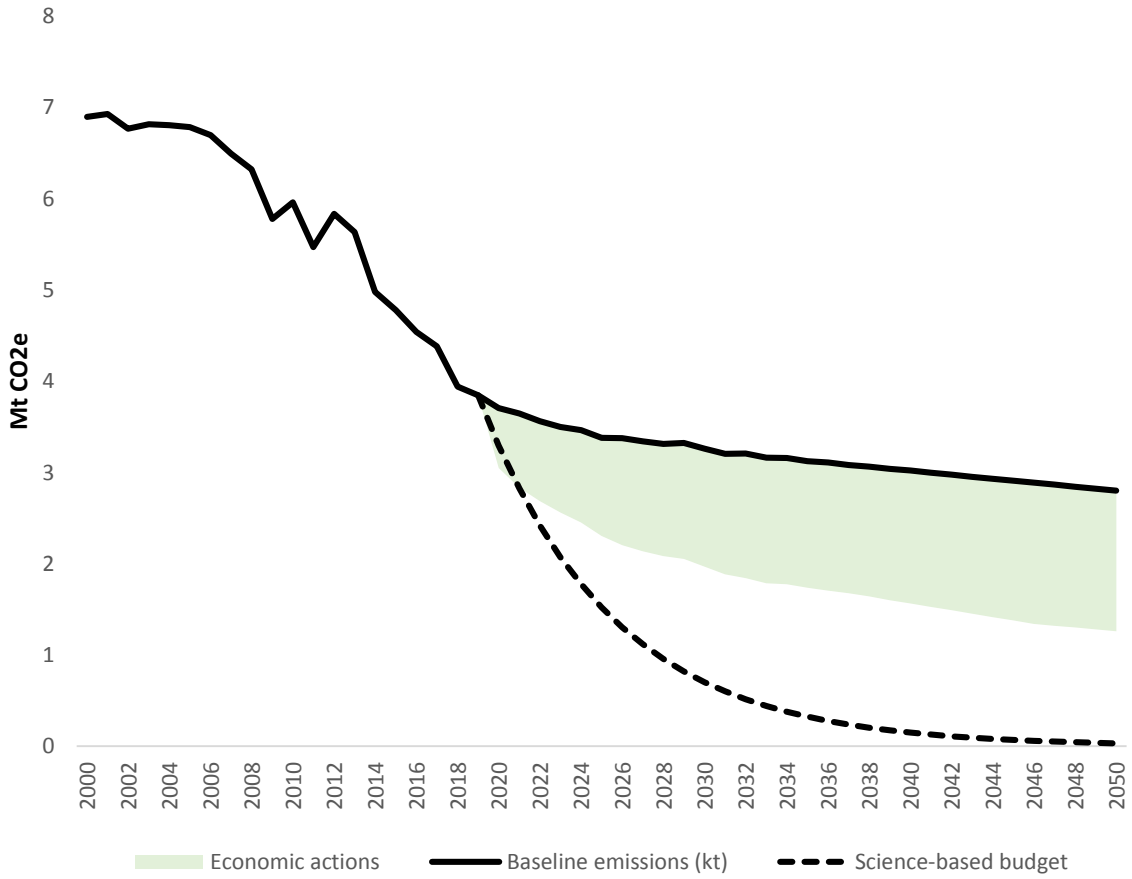


To do our fair share in limiting global heating to 1.5C, **we need to reduce UK emissions by 85—95% by 2030**.
[Jackson, 2019]

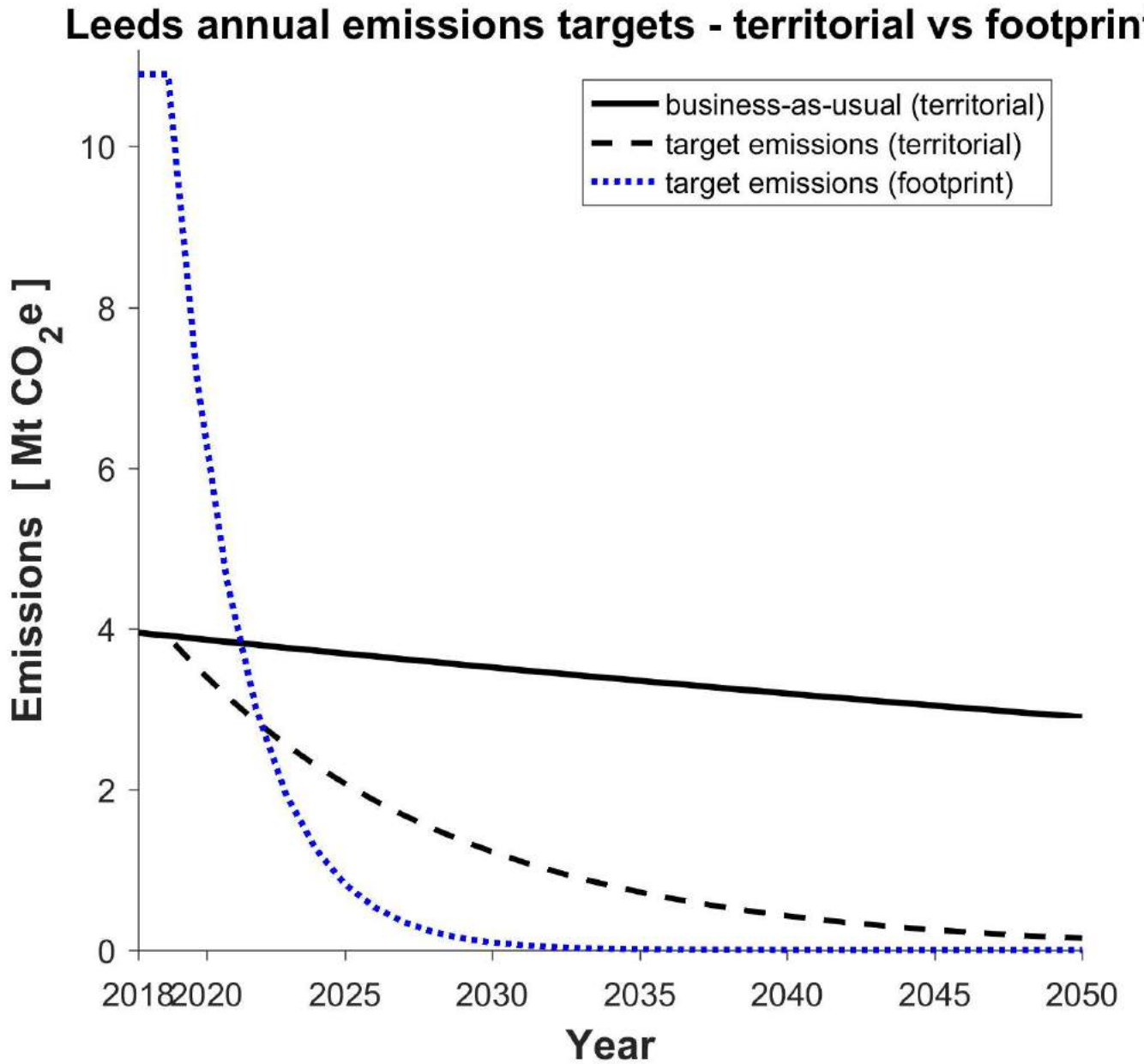
How are we doing in Leeds?

March 27th , 2019

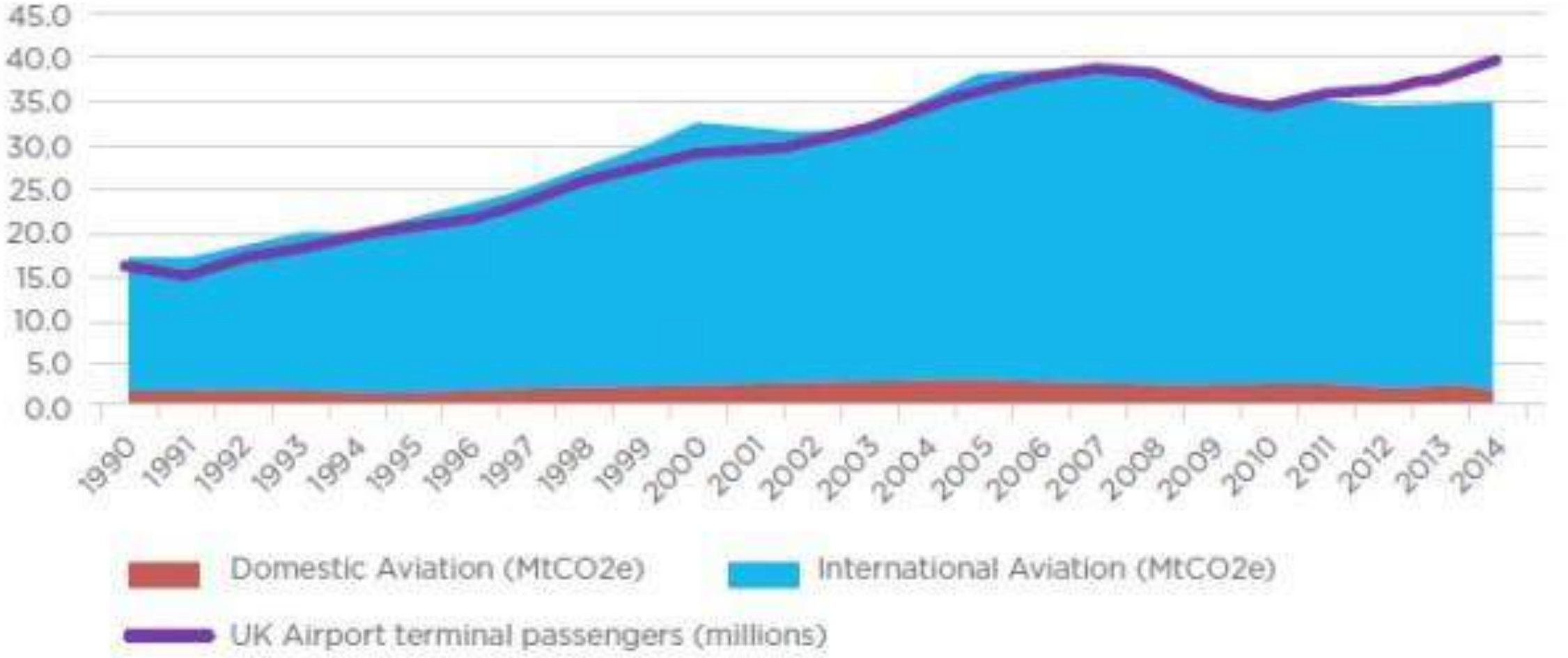
Leeds Carbon Roadmap (Climate Commission)



(Not) accounting for our imports



What about flight emissions?



Source: UK government

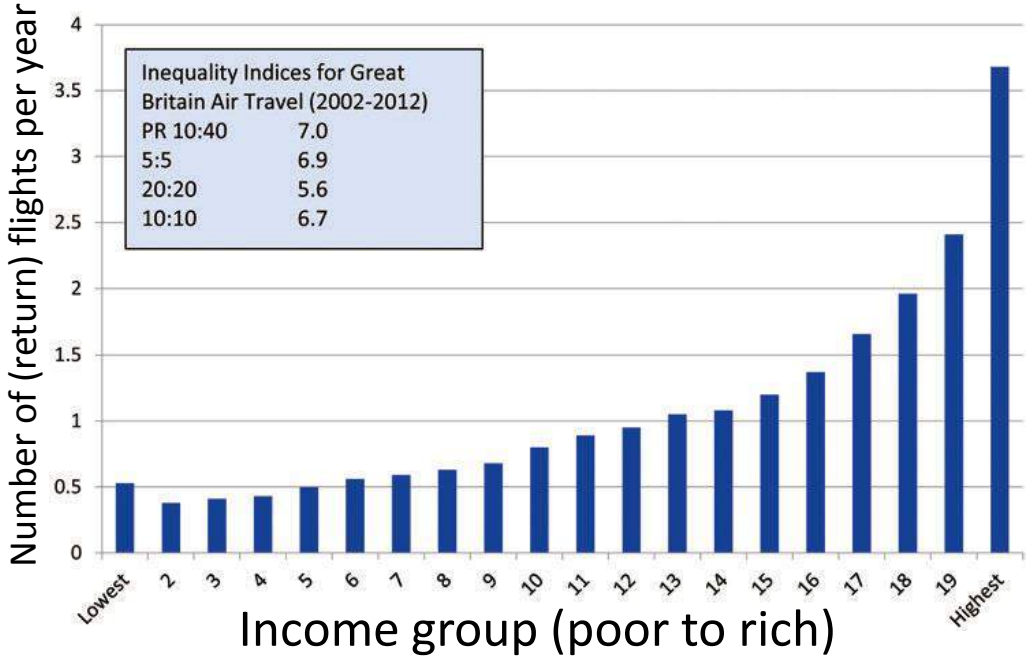
Who is flying?

1% of people cause half of global aviation emissions – study

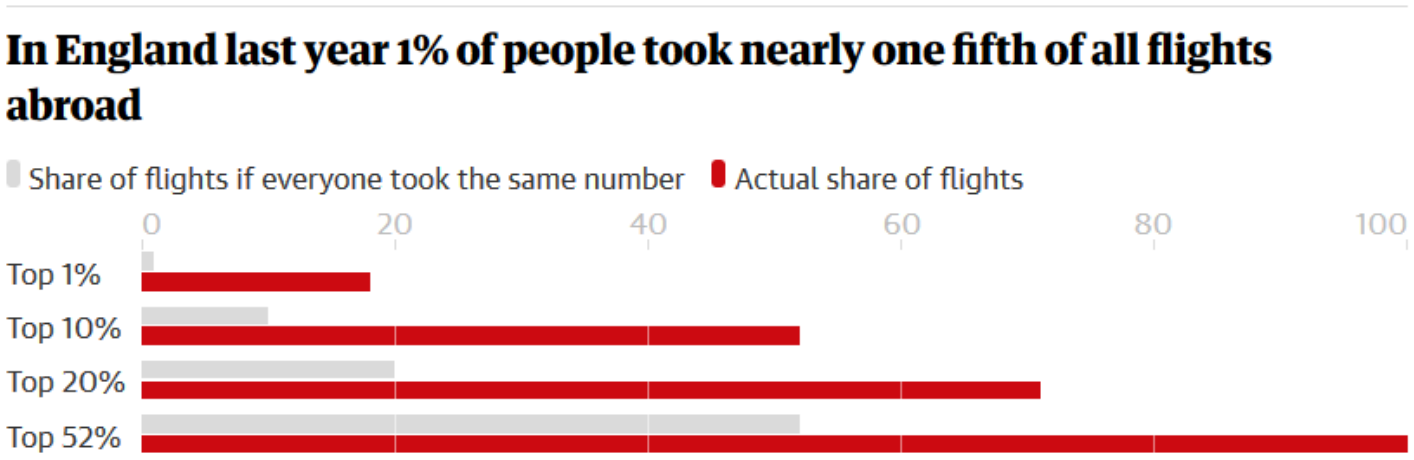
Exclusive: Researchers say Covid-19 hiatus is moment to tackle elite 'super emitters'

theguardian.com

Who is flying?



https://www.inequalityintransport.org.uk/exploring-transport-inequality/who-travels-air



https://www.theguardian.com/environment/2019/sep/25/1-of-english-residents-take-one-fifth-of-overseas-flights-survey-shows

In the UK:

- Over 70% of flights are taken by just 15% of the population (2013/2014)
- 18% of flights abroad are taken by 1% of the population (2018)
- More than 50% of the population doesn't fly at all (2013/2014)

https://fullfact.org/economy/do-15-people-take-70-flights/

What are the prospects of sustainable aviation?
Part I: Technological improvement vs. growth.

% change in flight emissions = % increase in flight passengers - % efficiency improvement

If % increase in flight passengers > % efficiency improvement → flight emissions INCREASE.

- In reality, efficiency improvements have been outpaced by increases in flight passengers!
  - think: running down on an upward-running escalator (a fast one…).

- Danger: rebound! Efficiency improvements *drive* further increases in flight passengers

Spoiler:

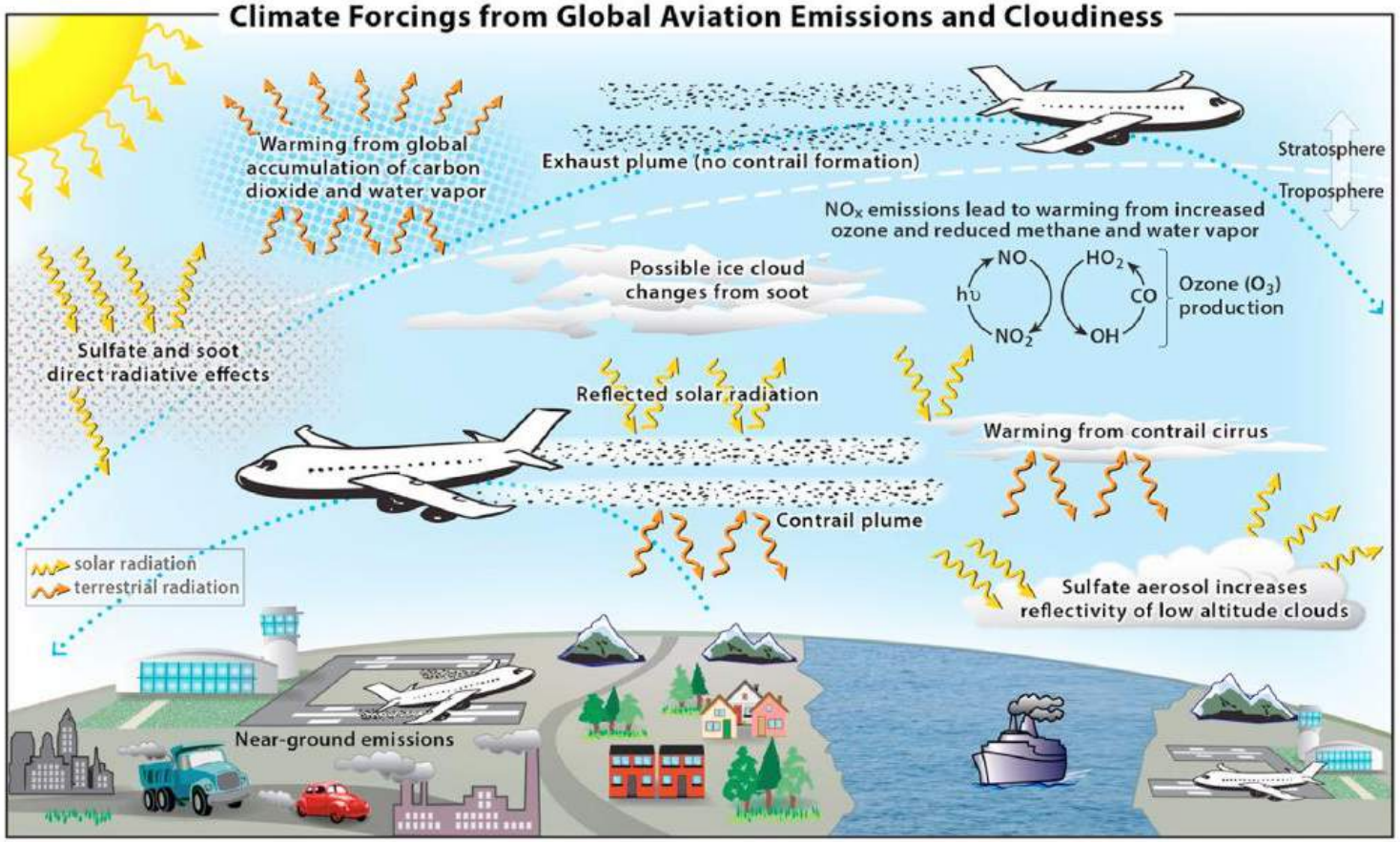
- Leeds Bradford Airport expansion foresees roughly 80% passenger increase by 2030.
- To keep emissions even just constant (when what we need is less), we would need to see 80% efficiency improvement by 2030.

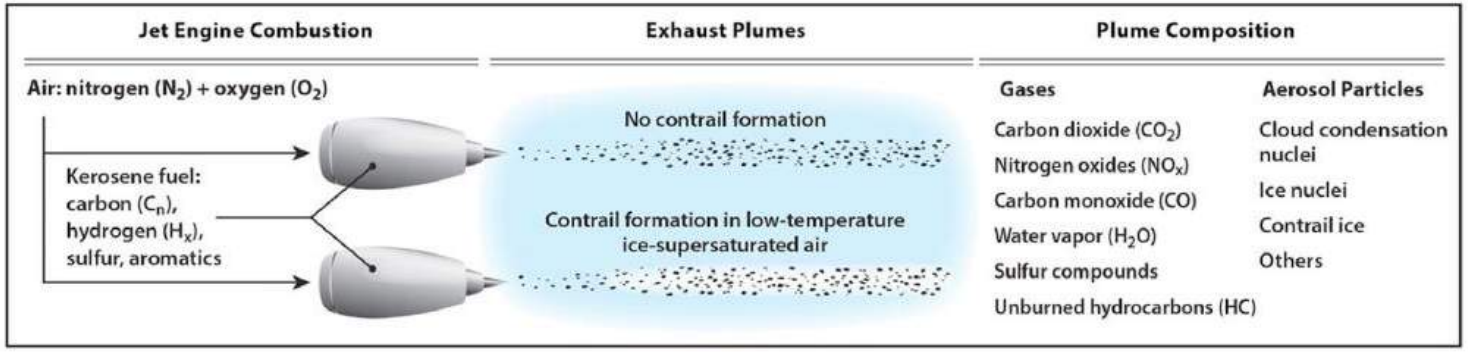
What are the prospects of sustainable aviation? Part II: Is zero-carbon aviation around the corner?

- Fuel efficiency improvements are slow and very limited
- development of alternatives (bio-fuelled or electric aircraft) is slow:
  - immature technology, not at all ready for deployment at scale
  - roll-out at scale is slow
  - Not relevant for the time period in which bulk of emissions reductions needs to happen (next 5 years)
- other environmental and justice issues (food security, biodiversity, critical materials)
- rates of technological improvements are outpaced by faster rates of increased passengers

→ technology can help to reduce emissions from aviation, but is NOT sufficient to reduce emissions fast enough if current passenger levels are maintained, let alone if passenger levels further increase

Accounting for climate impacts of aviation: non-CO2 effects





Contents lists available at ScienceDirect

Atmospheric Environment

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The contribution of global aviation to anthropogenic climate forcing for 2000 to 2018

D.S. Lee [a,*], D.W. Fahey [b], A. Skowron [a], M.R. Allen [c,n], U. Burkhardt [d], Q. Chen [e], S.J. Doherty [f], S. Freeman [a], P.M. Forster [g], J. Fuglestvedt [h], A. Gettelman [i], R.R. De León [a], L.L. Lim [a], M. T. Lund [h], R.J. Millar [c,o], B. Owen [a], J.E. Penner [j], G. Pitari [l], M.J. Prather [k], R. Sausen [d], L. J. Wilcox [m]

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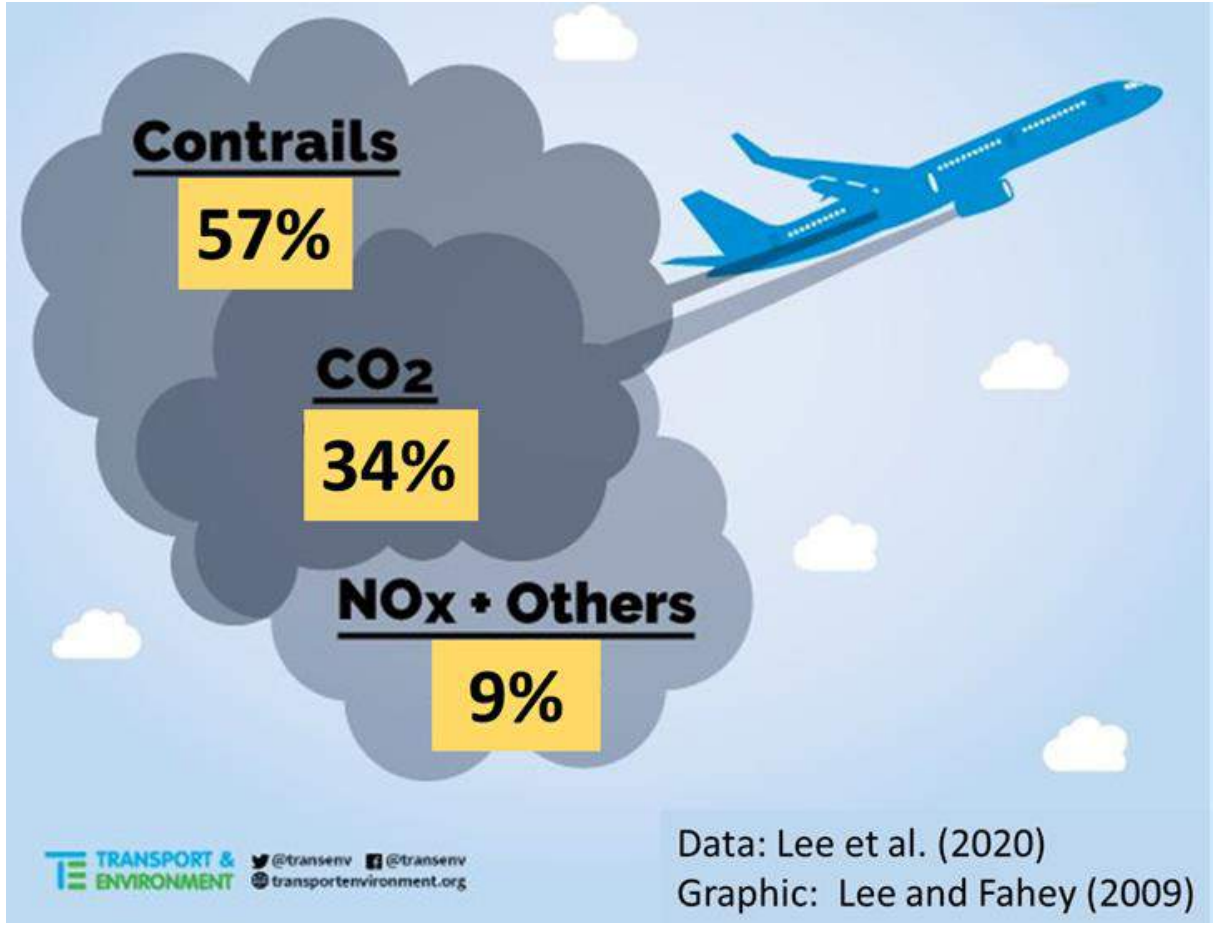
[i] National Center for Atmospheric Research, Boulder, CO, USA
[j] Department of Climate and Space Sciences and Engineering, University of Michigan, 2455 Hayward St., Ann Arbor, MI, 48109-2143, USA
[k] Department of Earth System Science, University of California, Irvine, 3329 Croul Hall, CA, 92697-3100, USA
[l] Department of Physical and Chemical Sciences, Università dell'Aquila, Via Vetoio, 67100, L'Aquila, Italy
[m] National Centre for Atmospheric Science, Department of Meteorology, University of Reading, Earley Gate, Reading, RG6 6BB, UK
[n] Department of Physics, University of Oxford, Oxford, UK
[o] Committee on Climate Change, 151 Buckingham Palace Road, London, SW1W 9SZ, UK

Lee et al. (2020)

Accounting for climate impacts of aviation: non-CO2 effects



- Aviation contributes to global heating not only due to its CO2 emissions but also due to so-called **non-CO2 effects** (contrails, nitrogen oxides etc.)
- **Total climate impacts of aviation are 3x larger than the climate impacts of aviation CO2 emissions alone!**
- Often, only the CO2 component of the climate impact of aviation is considered, i.e. often only 1/3 of the total climate impact of aviation is considered: 2/3 are ignored!
- The non-CO2 effect can be accounted for by multiplying CO2 emissions ($\widehat{F}$) by a factor 3:

$$F \approx 3 * \widehat{F}$$

F : total climate impacts of flights (CO2 + non-CO2)

$\widehat{F}$: flight CO2 emissions

Emissions accounting for ‘normal’ airport operation

Accounting for ‘normal’ airport operation:

For any particular airport, by convention, only emissions from departing flights (not those from arrival flights) are counted into the flight emissions for that airport

$$E = G + D$$

E : climate impacts related to airport operation (no expansion)

G : emissions from airport ground operation (no expansion)

D : climate impacts from departure flights (no expansion)

Emissions accounting for airport expansion

The emissions accounting convention for 'normal' operation is inadequate for the case of airport expansion: **all** additional flights (both departures and arrivals) should be considered as related to the expansion. If it wasn't for the expansion, these flights would not happen.

$$E_{expansion} = G_{expansion} + D + \Delta D_{expansion} + \Delta A_{expansion}$$

$$\Delta D_{expansion} = \Delta A_{expansion}$$

$$E_{expansion} = G_{expansion} + D + 2 * \Delta D_{expansion}$$

$E_{expansion}$: climate impacts related to airport operation (expansion scenario)

$G_{expansion}$: emissions from airport ground operation (expansion scenario)

D : climate impacts from departure flights (no expansion)

$\Delta D_{expansion}$: climate impacts from additional departure flights due to expansion

$\Delta A_{expansion}$: climate impacts from additional arrival flights due to expansion

$\Delta E_{expansion}$: additional climate impacts due to expansion

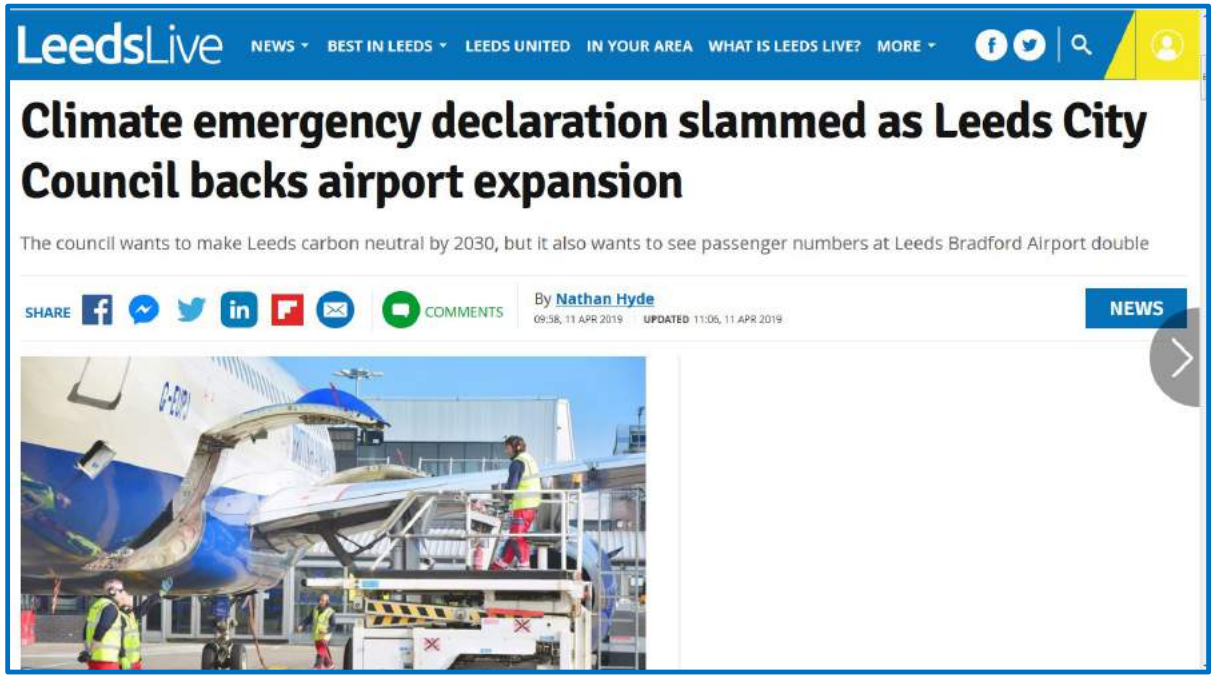
$\Delta G_{expansion}$: change in emissions from airport ground operation

$$\Delta E_{expansion} = \Delta G_{expansion} + 2 * \Delta D_{expansion}$$

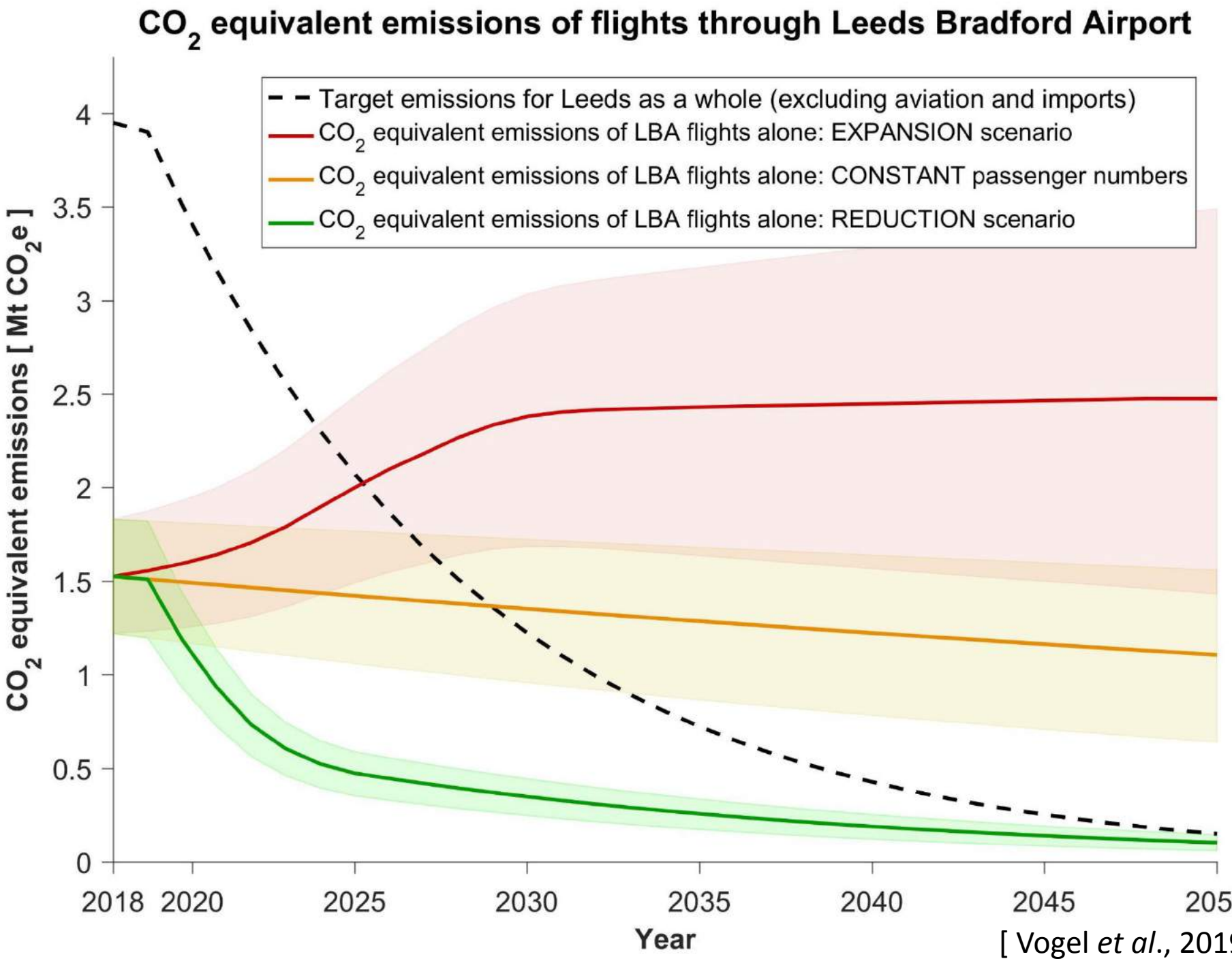
$$E = G + D$$

How are we doing in Leeds?

March 27th , 2019



April 11th , 2019

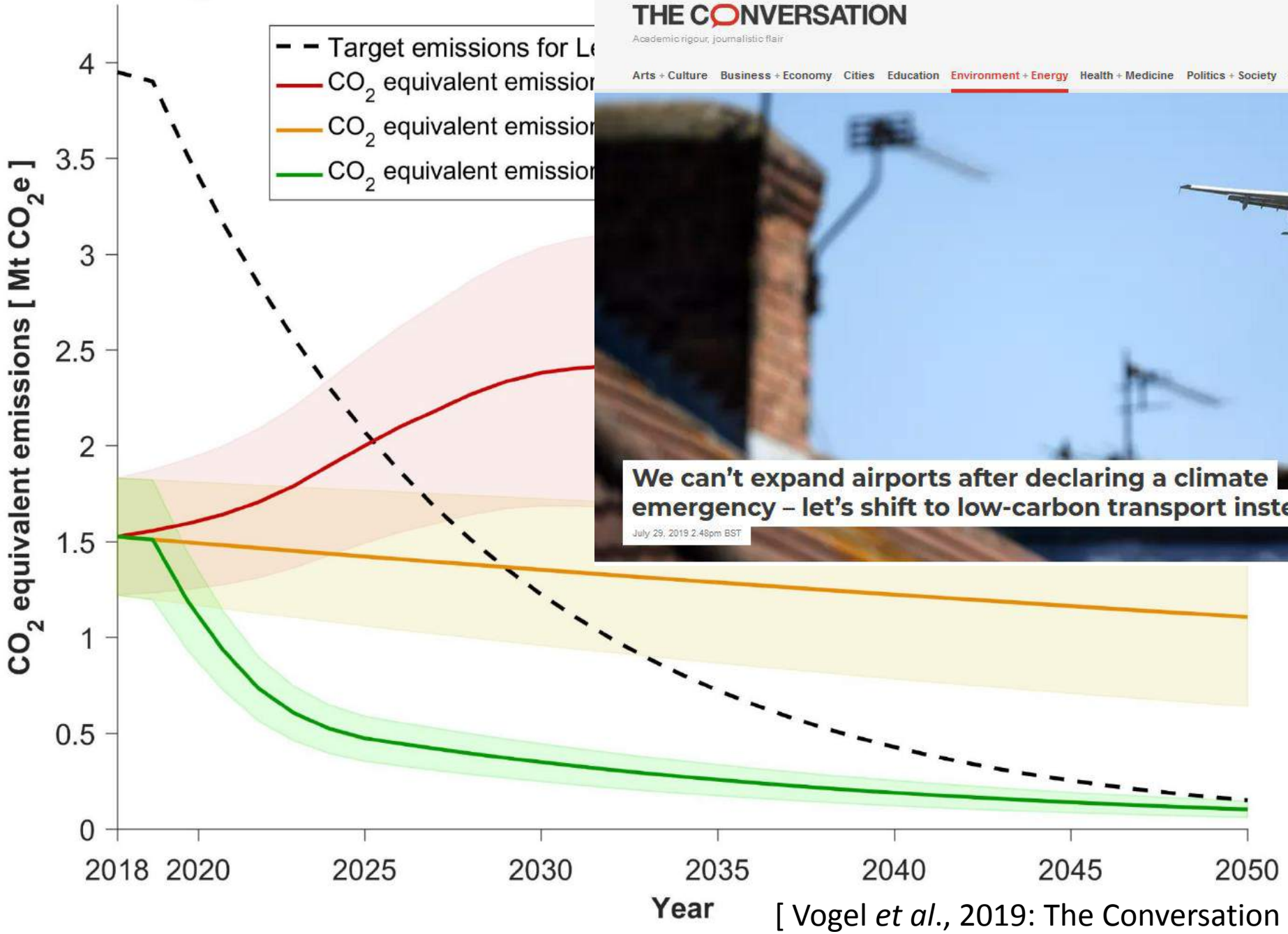


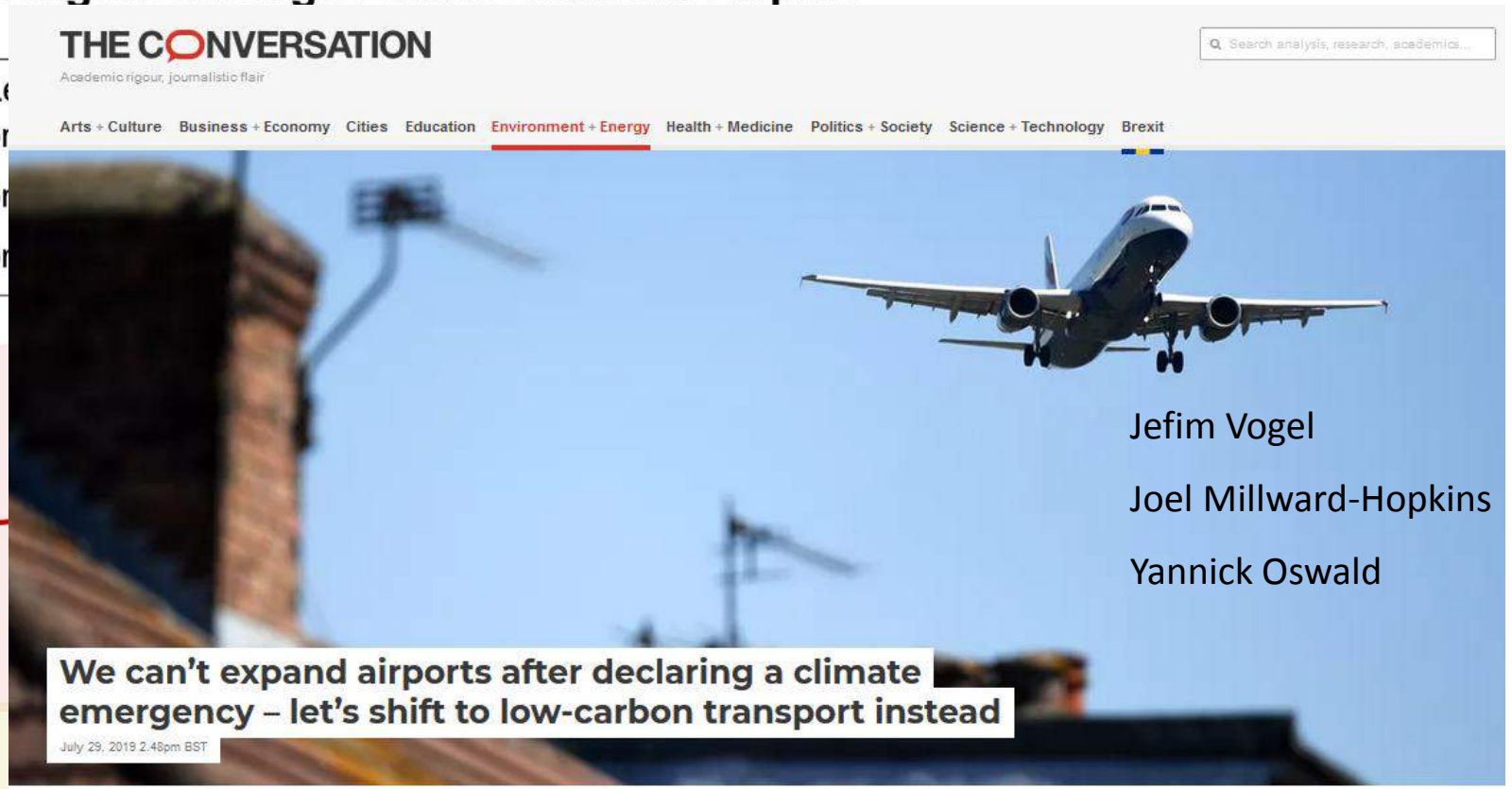
Here, we looked at total climate impact of all flights to/from LBA for different scenarios (which is what matters for climate).

In later assessment, we look more specifically at what share of flights are related to the expansion itself.

[Vogel *et al.*, 2019: The Conversation]

CO_2 equivalent emissions of flights through Leeds Bradford Airport





Jefim Vogel

Joel Millward-Hopkins

Yannick Oswald

[Vogel *et al.*, 2019: The Conversation]

LBA's climate impact assessment of expansion plans

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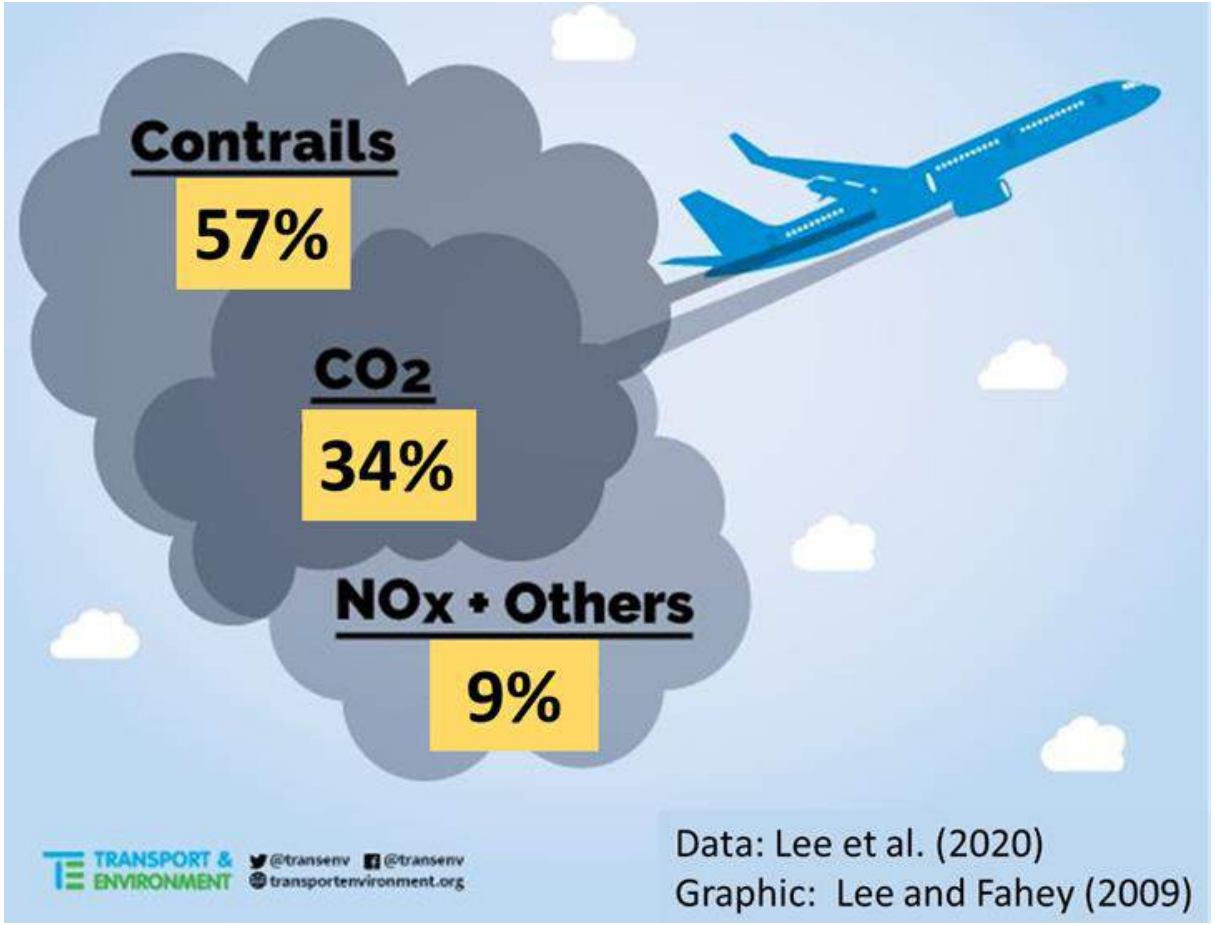
Leeds Bradford Airport: Scientists object to expansion plans

20 July

University of Leeds climate scientists have objected to plans to expand the terminal building

LBA's climate impact assessment of expansion plans: 5 major flaws

Flaw #1: Omission of non-CO2 warming effects of flights



Even though explicitly requested by Leeds City Council, LBA does not account for non-CO2 warming effects.

→ underestimates emissions per flight by a factor of 3!

LBA's climate impact assessment of expansion plans: 5 major flaws

Flaw #2: Omission of additional arrival flights

Accounting for airport expansion:

$$E_{expansion} = G_{expansion} + D + 2 * \Delta D_{expansion}$$

$$\Delta E_{expansion} = \Delta G_{expansion} + 2 * \Delta D_{expansion}$$

Even though explicitly requested by Leeds City Council,
LBA does not account for additional arrival flights due to the expansion.

How LBA accounts for airport expansion:

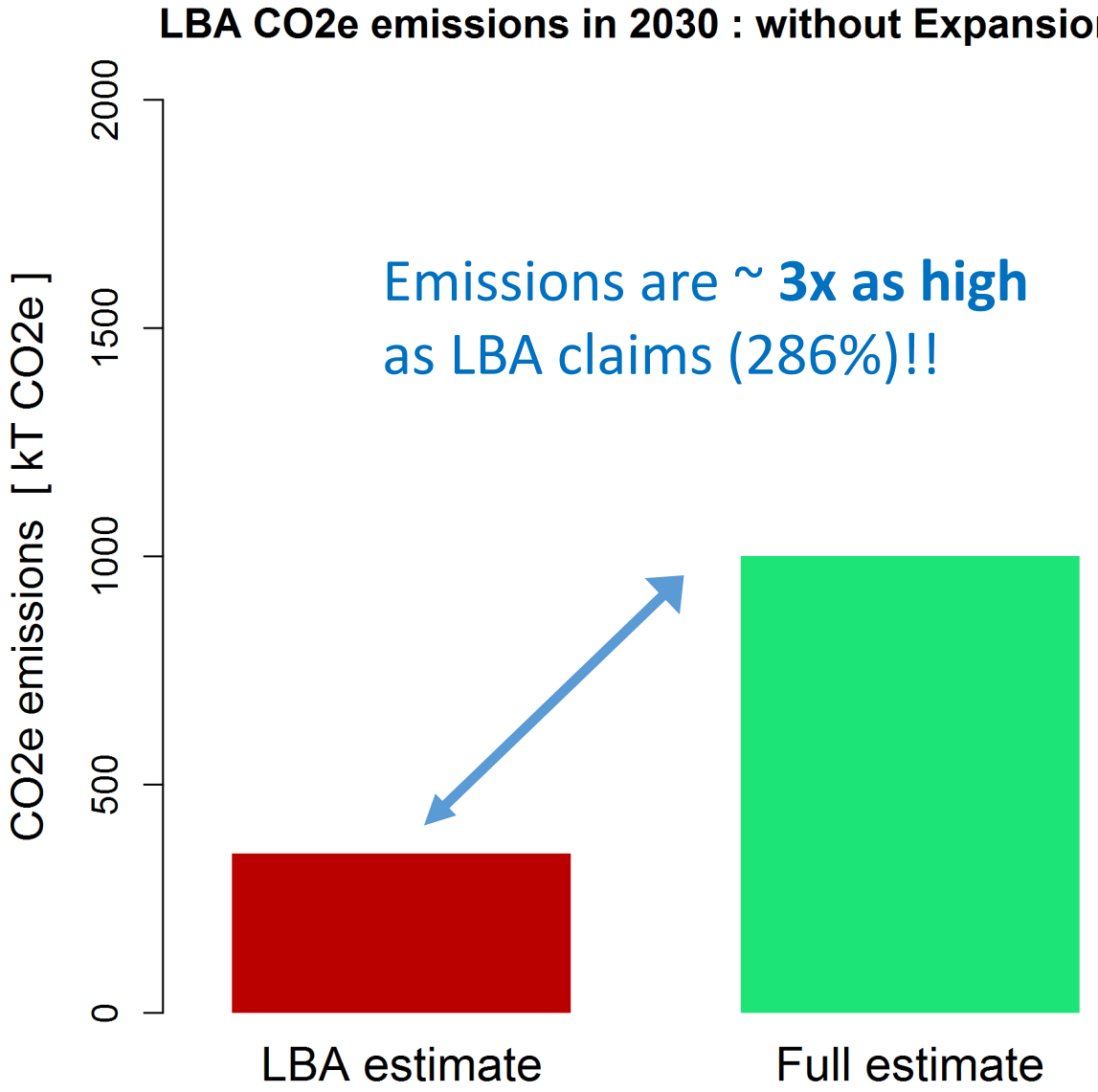
$$E_{expansion} = G_{expansion} + D + \Delta D_{expansion}$$

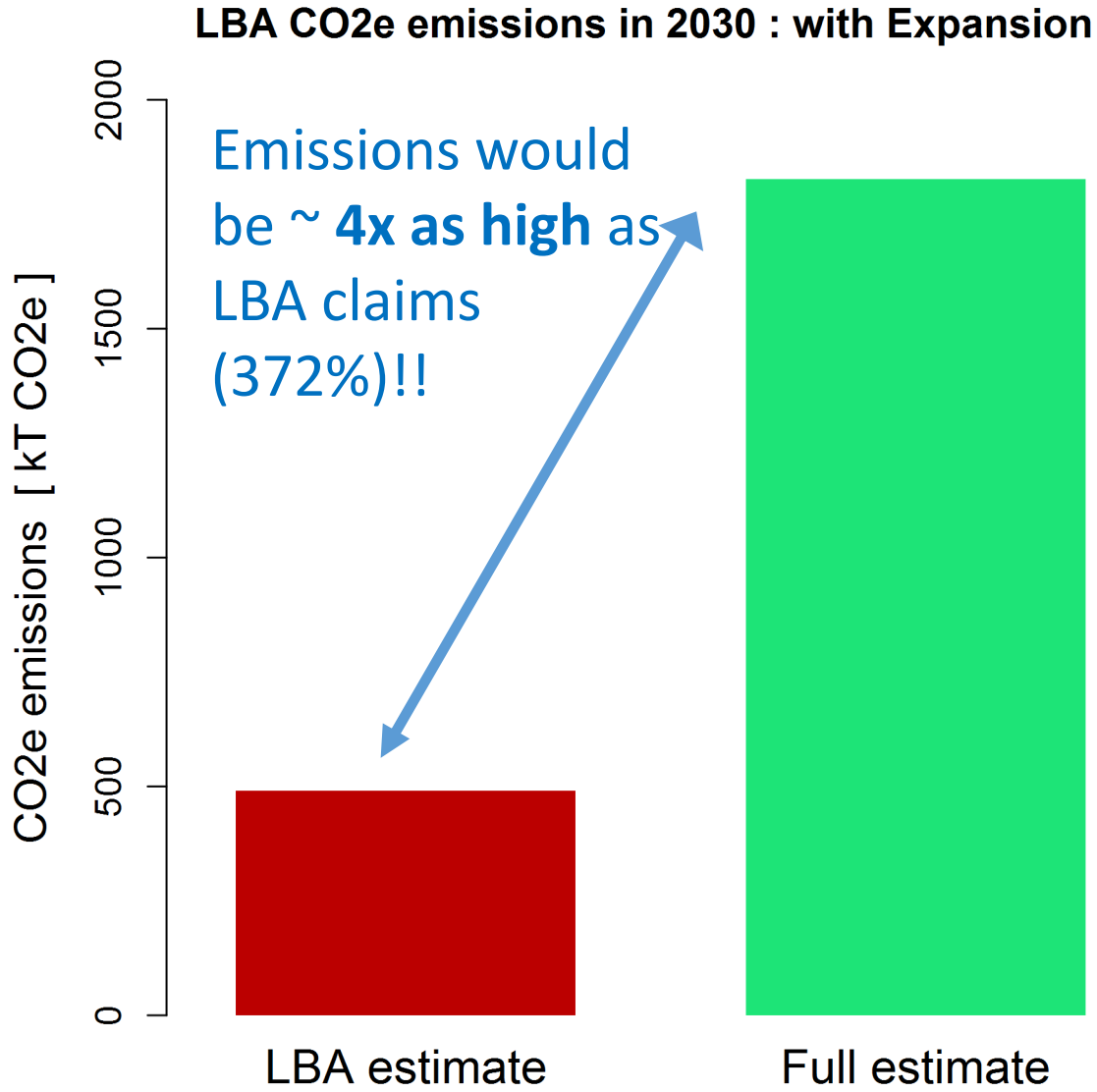
$$\Delta E_{expansion} = \Delta G_{expansion} + \Delta D_{expansion}$$

→LBA generally omits half of all additional flights (passengers)!
This means **underestimating the climate impacts of additional flights by a factor of 2**!
This factor of 2 compounds with the factor of 3 from the omission of non-CO2 effects

LBA's climate impact assessment of expansion plans: 5 major flaws

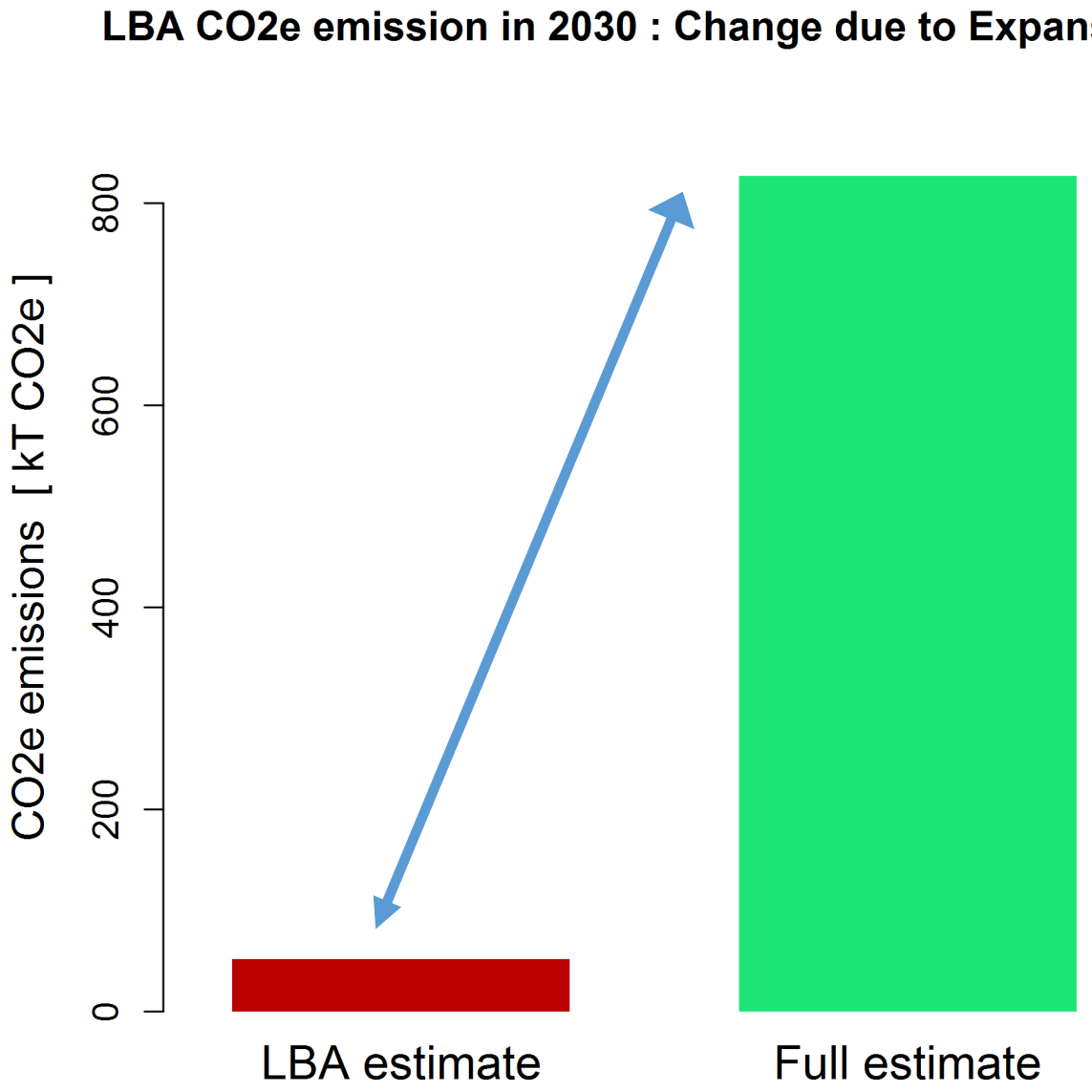
Flaws #1 & 2: Omission of non-CO2 effects & additional arrival flights





LBA's climate impact assessment of expansion plans: 5 major flaws

Flaws #1 & 2: Omission of non-CO2 effects & additional arrival flights



The additional emissions due to the expansion would be ~ **6x as high** as LBA claims (596%)!!

LBA's climate impact assessment of expansion plans: 5 major flaws

Flaw #3: Omission of international flights in key comparisons

Table 7-15: GHG Emissions Comparison to Leeds City Carbon Roadmap

Year	Leeds science-based carbon reduction vs 2005[12]	Leeds Projected (MT CO2e) to be consistent with science-based target	Without Development operational (exc. international Aviation) MT CO_2e	With Development operational (exc. international Aviation) MT CO_2e
2024	70%	2.04	0.049	0.050
2030	85%	1.02	0.048	0.054

- International flights constitute more than 90% of LBA flight emissions!

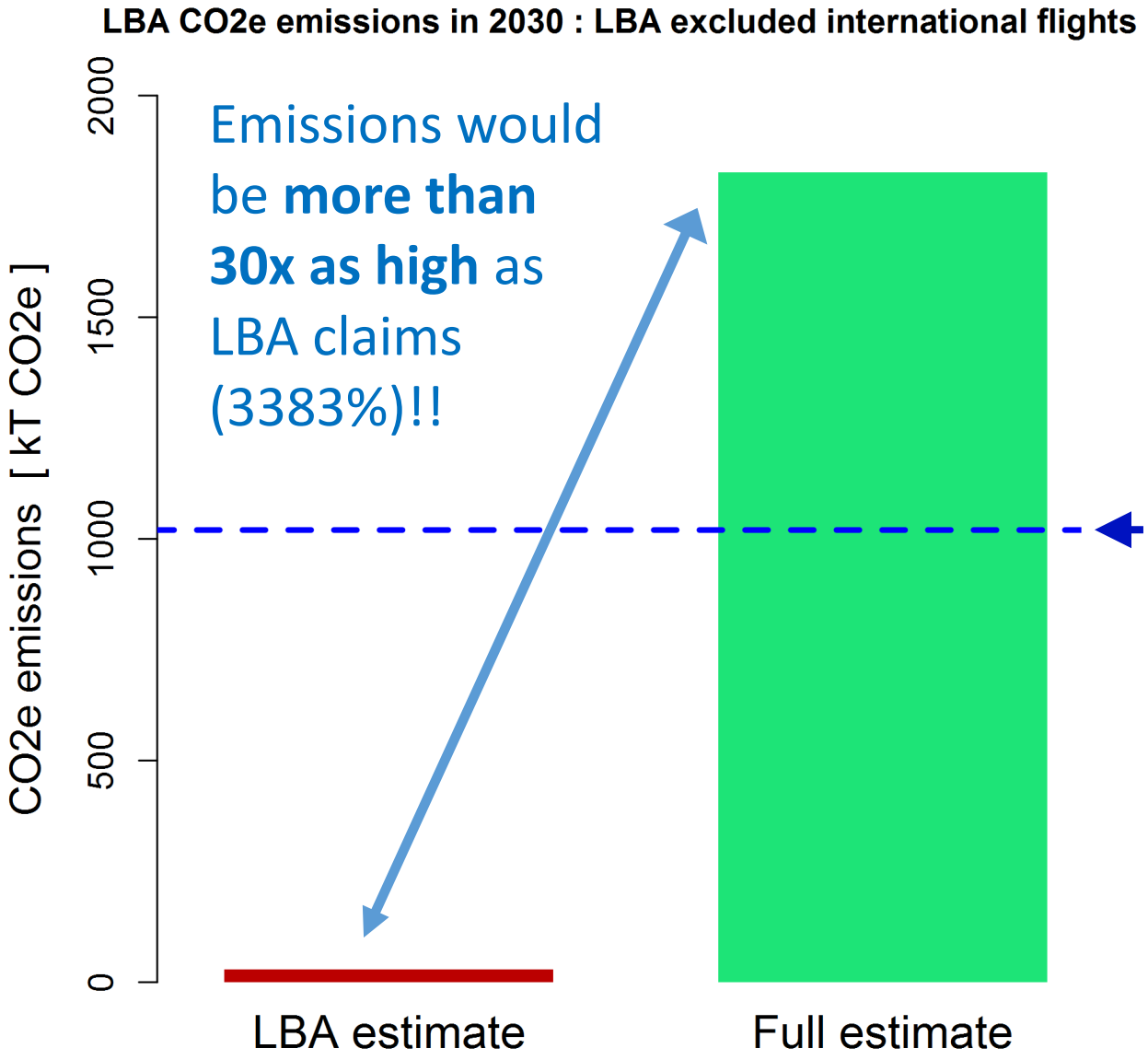
→ underestimates LBA emissions (in those comparisons) by roughly a factor of 10!

→ compounds with the omissions of non-CO2 effects and additional arrival flights.

[from LBA climate impact assessment, 2020]

LBA's climate impact assessment of expansion plans: 5 major flaws

Flaws #1 & 2 & 3: Omission of non-CO2 effects, international flights & arrival flights



Emissions would be **more than 30x as high** as LBA claims (3383%)!!

Maximum emissions allowance for the whole of Leeds in 2030

With the expansion, LBA emissions in 2030 would be almost **2x as high as the emissions allowance for the whole of Leeds.**

The airport alone would thus completely blow Leeds' climate targets.

LBA's climate impact assessment of expansion plans: 5 major flaws

Flaw #4: Cumulative emissions not assessed over a relevant period

Table 7-1: Issues raised by LCC and response

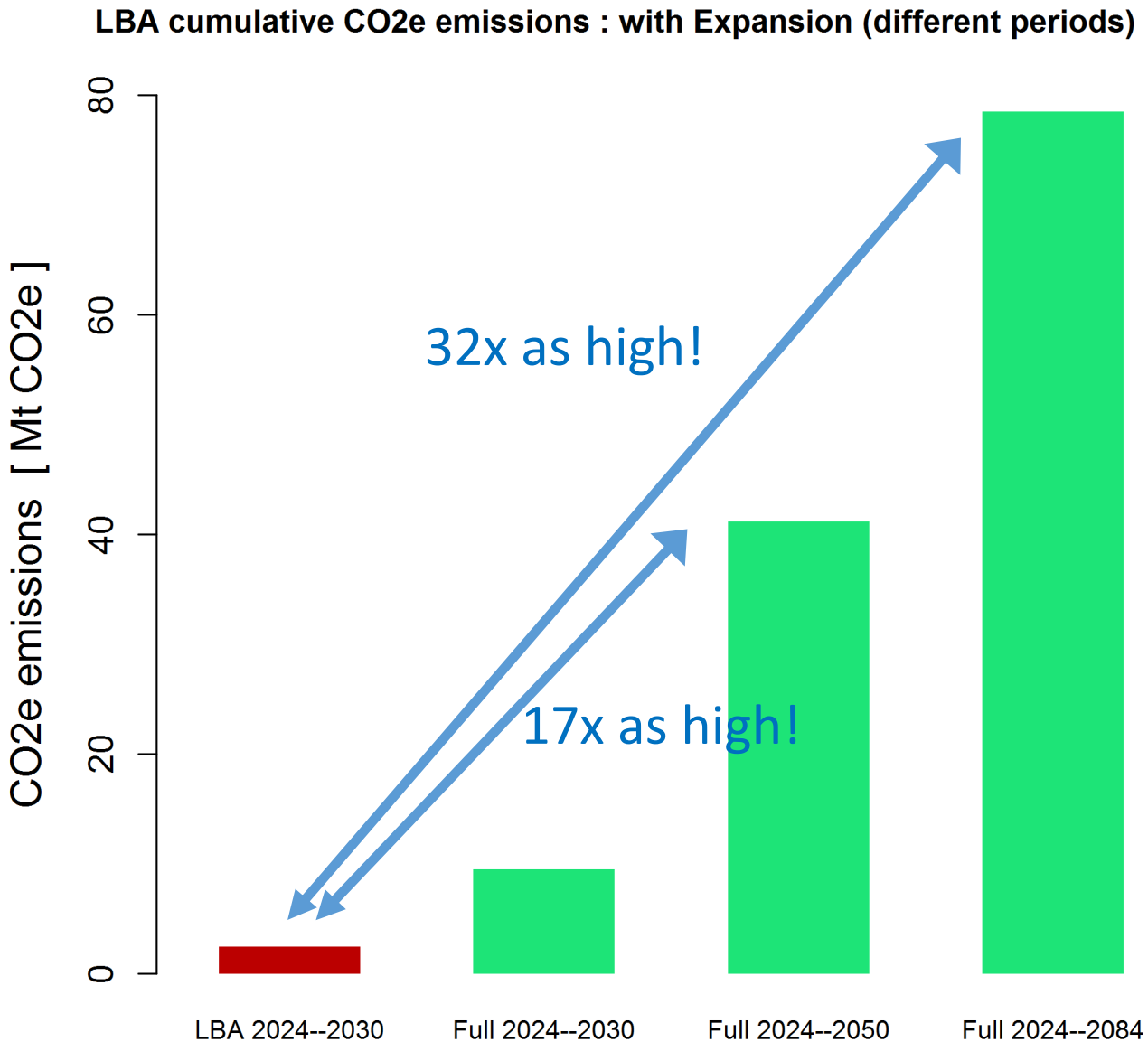
Issue raised by LCC
It is recommended that the Climate Chapter is broken down into two distinct sub-chapters covering 1) Greenhouse gas (GHG) emissions and 2) Climate resilience.
Undertake a comprehensive, thorough and conservative assessment of the total net increase in GHG emissions which will occur as a direct and indirect result of the Development over its whole life cycle e.g. 60 years.

[from LBA climate impact assessment, 2020]

- LBA was asked to assess the climate impact over 60 years.
- LBA only assessed them for 3 single years (2024, 2030, 2050) over a 27-year period.
- LBA assessed cumulative emissions only over a 7-year period (2024—2030) – not over the requested 60-year period, and not even over the 27-year period over which they provide snapshots.

LBA's climate impact assessment of expansion plans: 5 major flaws

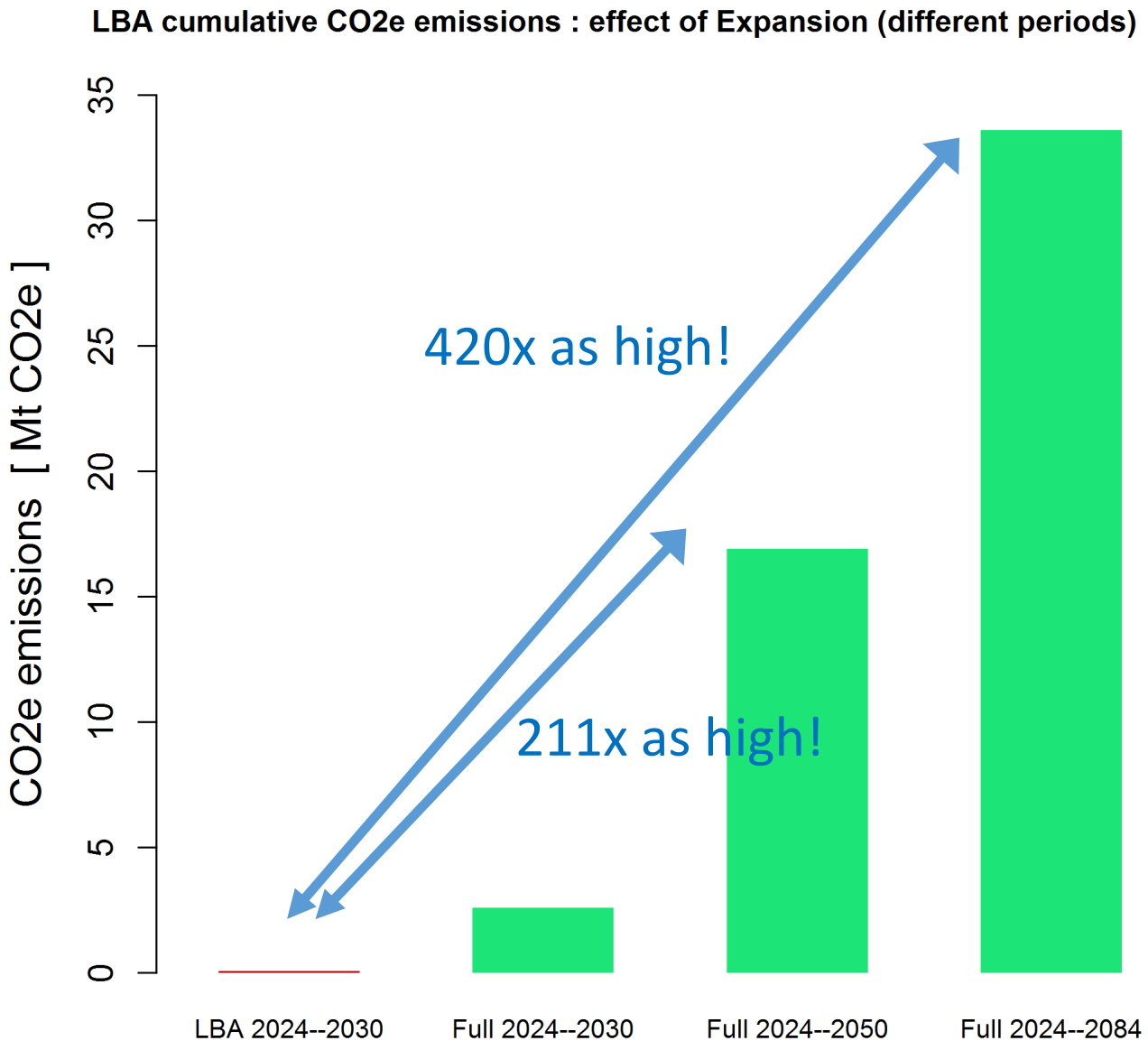
Flaw #4: Cumulative emissions not assessed over a relevant period



- Note this is partly comparing apples and oranges!
- The trouble is, LBA has only provided apples when it was supposed to provide oranges.

LBA's climate impact assessment of expansion plans: 5 major flaws

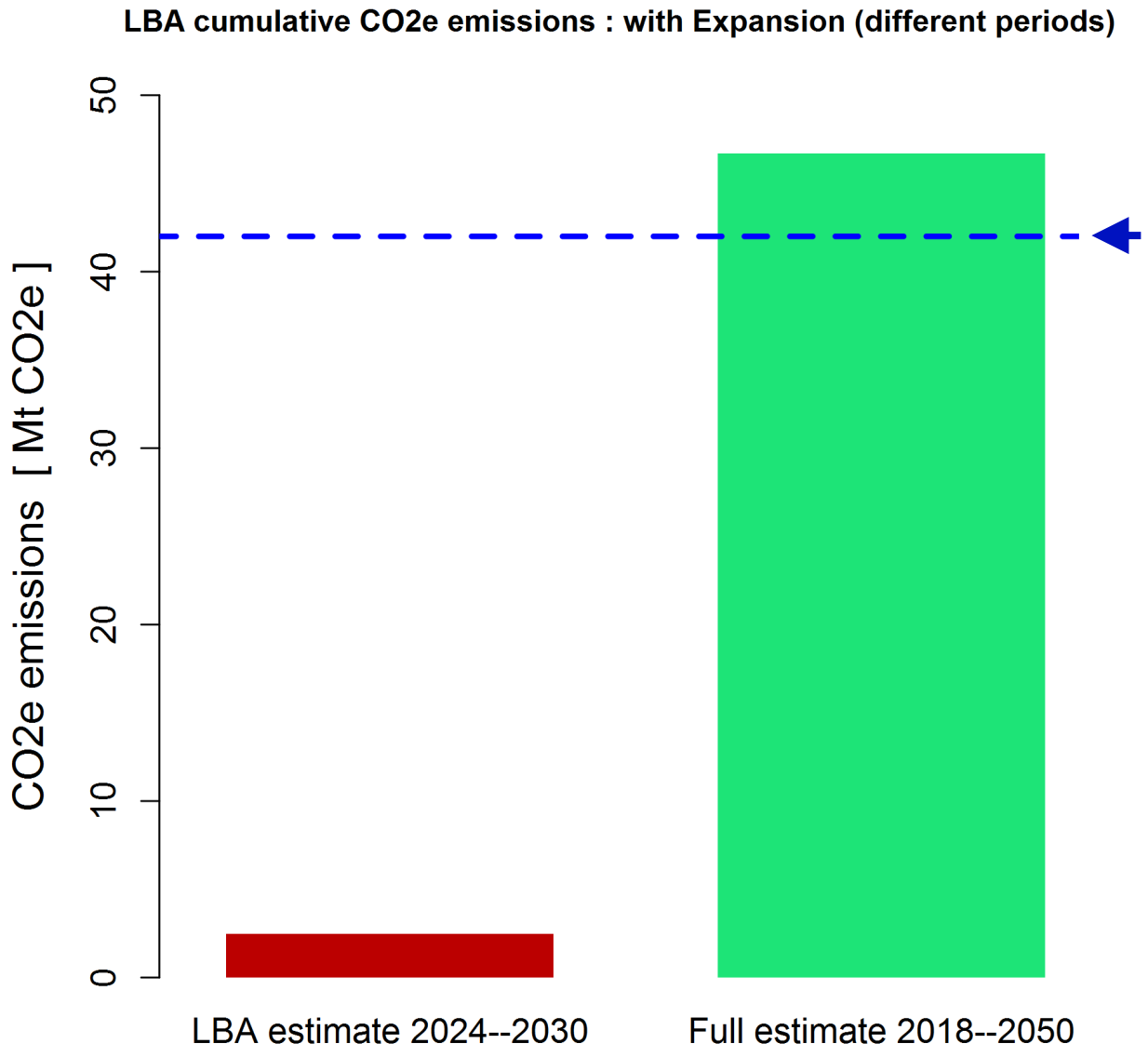
Flaw #4: Cumulative emissions not assessed over a relevant period



- Note this is partly comparing apples and oranges!
- The trouble is, LBA has only provided apples when it was supposed to provide oranges.

LBA's climate impact assessment of expansion plans: 5 major flaws

Flaw #4: Cumulative emissions not assessed over a relevant period

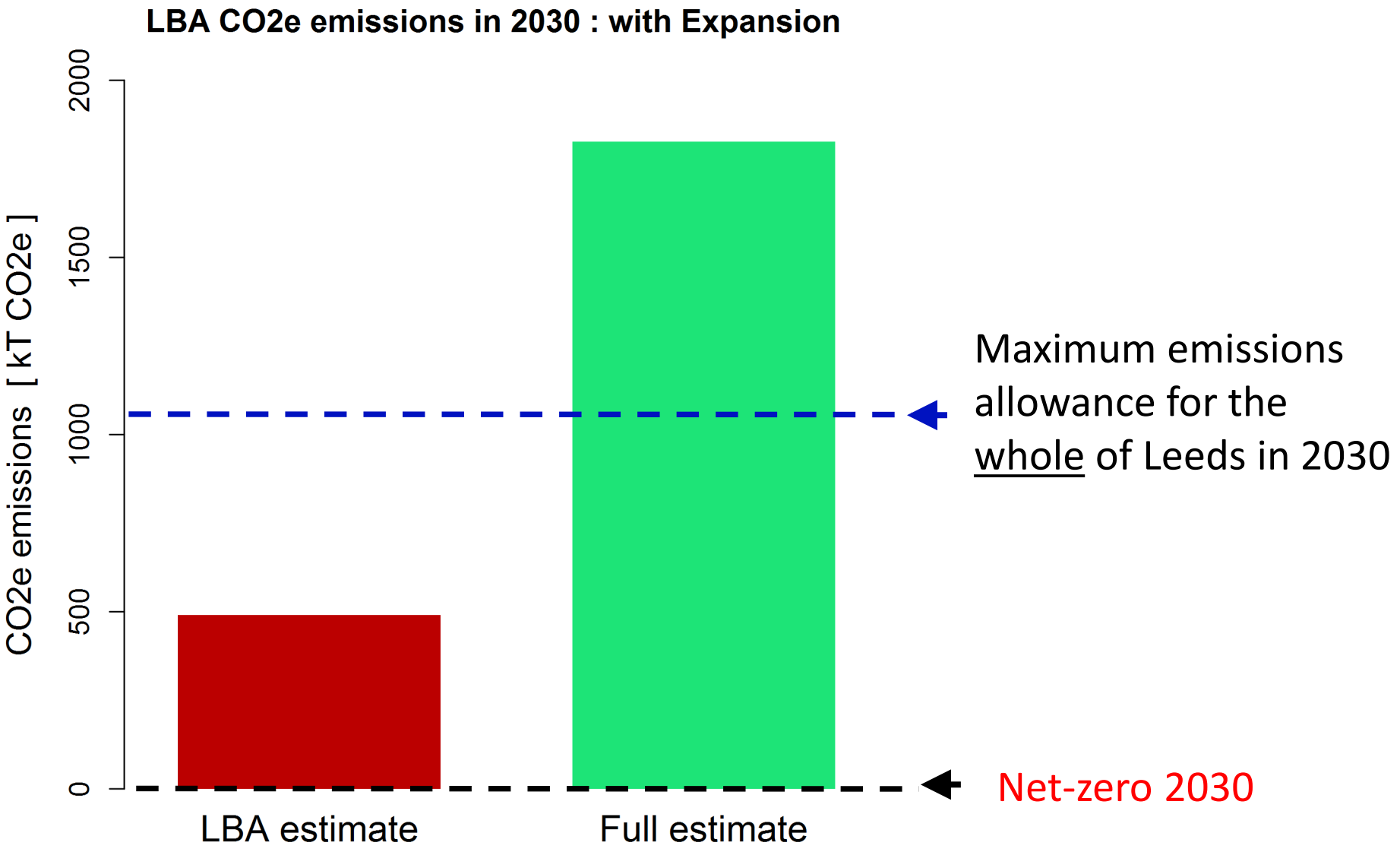


Maximum emissions allowance
for the <u>whole</u> of Leeds
for the period 2018—2050
("carbon budget")

- With the expansion, LBA emissions <u>alone</u> will exceed the whole city's carbon budget.
- **If LBA expansion goes ahead as planned, it would be impossible for Leeds to meet its climate targets** – we would inevitably fail to do our part in averting catastrophic climate disruption.

LBA's climate impact assessment of expansion plans: 5 major flaws

Flaw #5: No assessment of compatibility with Leeds' net-zero 2030 target



Verdict

LBA’s climate impact assessment:

LBA’s planning application:

How to approach an emergency?

1) We need to act right now: the house is on fire.
2) Clear focus: saving people and killing the flames are absolute priorities.
3) All hands on deck: **everyone do whatever they can to help**
   - no time to wait for help from London
   - no time to discuss why Manchester isn't helping

Thank you!

Questions?
Comments?
Ideas?

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