

Reporting Summary

Nature Research wishes to improve the reproducibility of the work that we publish. This form provides structure for consistency and transparency in reporting. For further information on Nature Research policies, see our [Editorial Policies](#) and the [Editorial Policy Checklist](#).

Statistics

For all statistical analyses, confirm that the following items are present in the figure legend, table legend, main text, or Methods section.

n/a Confirmed

- ☒ ☐ The exact sample size (n) for each experimental group/condition, given as a discrete number and unit of measurement
- ☒ ☐ A statement on whether measurements were taken from distinct samples or whether the same sample was measured repeatedly
- ☒ ☐ The statistical test(s) used AND whether they are one- or two-sided
Only common tests should be described solely by name; describe more complex techniques in the Methods section.
- ☒ ☐ A description of all covariates tested
- ☒ ☐ A description of any assumptions or corrections, such as tests of normality and adjustment for multiple comparisons
- ☒ ☐ A full description of the statistical parameters including central tendency (e.g. means) or other basic estimates (e.g. regression coefficient) AND variation (e.g. standard deviation) or associated estimates of uncertainty (e.g. confidence intervals)
- ☒ ☐ For null hypothesis testing, the test statistic (e.g. F , t , r) with confidence intervals, effect sizes, degrees of freedom and P value noted
Give P values as exact values whenever suitable.
- ☒ ☐ For Bayesian analysis, information on the choice of priors and Markov chain Monte Carlo settings
- ☒ ☐ For hierarchical and complex designs, identification of the appropriate level for tests and full reporting of outcomes
- ☒ ☐ Estimates of effect sizes (e.g. Cohen's d , Pearson's r), indicating how they were calculated

Our web collection on [statistics for biologists](#) contains articles on many of the points above.

Software and code

Policy information about [availability of computer code](#)

Data collection No software was used for data collection.

Data analysis Data analysis was performed in Excel using a variation of the Kaya identity, as described in the Methods. For Figure 4 and Supplementary Figure 7 we used R version 4.1.0 (2021-05-18) -- "Camp Pontanezen". The code is available in <https://github.com/CandeBergero/Code-Fig4-Net-zero-emissions-aviation>

For manuscripts utilizing custom algorithms or software that are central to the research but not yet described in published literature, software must be made available to editors and reviewers. We strongly encourage code deposition in a community repository (e.g. GitHub). See the Nature Research [guidelines for submitting code & software](#) for further information.

Data

Policy information about [availability of data](#)

All manuscripts must include a [data availability statement](#). This statement should provide the following information, where applicable:

- Accession codes, unique identifiers, or web links for publicly available datasets
- A list of figures that have associated raw data
- A description of any restrictions on data availability

Almost all data (except for aviation's energy consumption) was compiled from open sources, and the references are mentioned in Supplementary Table 1. Historical emissions are from IEA and CMP, while future emissions are calculated based on Equation 1. Historical demand is from ICAO, while freight demand is from the World Bank and IATA. Future aviation demand follows assumptions with data from IMF, ICAO, and IEA. Historical energy intensity values were calculated based on demand data and fuel consumption data from IEA. Future energy intensity estimates follow assumptions from Zheng et al., ICAO, and IEA. Historical carbon intensity is calculated with data from Bosch et al., and carbon equivalent intensity is calculated based on Lee et al. Future carbon intensities are calculated based on

penetration of different SAFs and electric/hydrogen powered planes. All sources are in the manuscript. The open-source data is available in <https://doi.org/10.5281/zenodo.7187059>

Field-specific reporting

Please select the one below that is the best fit for your research. If you are not sure, read the appropriate sections before making your selection.

☐ Life sciences ☐ Behavioural & social sciences ☒ Ecological, evolutionary & environmental sciences

For a reference copy of the document with all sections, see [nature.com/documents/nr-reporting-summary-flat.pdf](https://www.nature.com/documents/nr-reporting-summary-flat.pdf)

Ecological, evolutionary & environmental sciences study design

All studies must disclose on these points even when the disclosure is negative.

Study description	We use the parameters of the Kaya identity and create nine scenarios to 2050 to analyze potential emissions of the global aviation sector based on demand for aviation, the energy intensity of the industry and the carbon intensity of the energy used. We use open source data for historical periods, and project into the future based on assumptions described in the Methods.
Research sample	No sample used. We analyze global aviation emissions.
Sampling strategy	NA
Data collection	Data was collected from different sources, as described in Supplementary Table 1 of the manuscript. Greer Gosnell, Steven J. Davis and me, Candelaria Bergero, collected the data.
Timing and spatial scale	Data collection started in 2021 and concluded around May 2022. We analyze the period 1990-2021, and project for 2022-2050.
Data exclusions	NA
Reproducibility	Data analysis was done in Excel, and the calculations behind each scenario are reproducible. Figure 4 and Supplementary Figure 7 were developed in R, and the coded is provided.
Randomization	NA
Blinding	NA
Did the study involve field work?	☐ Yes ☒ No

Reporting for specific materials, systems and methods

We require information from authors about some types of materials, experimental systems and methods used in many studies. Here, indicate whether each material, system or method listed is relevant to your study. If you are not sure if a list item applies to your research, read the appropriate section before selecting a response.

Materials & experimental systems

n/a	Involved in the study
☒	☐ Antibodies
☒	☐ Eukaryotic cell lines
☒	☐ Palaeontology and archaeology
☒	☐ Animals and other organisms
☒	☐ Human research participants
☒	☐ Clinical data
☒	☐ Dual use research of concern

Methods

n/a	Involved in the study
☒	☐ ChIP-seq
☒	☐ Flow cytometry
☒	☐ MRI-based neuroimaging