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Reporting Summary

Nature Portfolio 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 Portfolio 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	First, according to the high-frequency passenger vehicle sales database and the National Bureau of Statistics, we select 2015 as the base year and divide the fuel types into diesel, gasoline, and NEVs. The diesel and gasoline vehicles are further divided into five classes according to the displacement (Mini: < 1 L; Common Class: 1.0-1.6 L; Middle Class: 1.6-2.5 L; Medium-high Class: 2.5-4 L; High Class: >4 L). NEVs are divided into battery electric vehicles (BEVs), plug-in hybrid vehicles (PHEVs) and hybrid vehicles (HEVs). Considering that the data for dual-fuel vehicles are very limited, these vehicles are eliminated. Second, the proportions of diesel, gasoline and NEVs (different types and fuels) from 2016 to 2019 are calculated based on the entire sample mean of each label in the database. Among them, the NEV data are calibrated according to the annual data published by the Ministry of Public Security and relevant institutions. Third, since the National Bureau of Statistics does not distinguish passenger and freight vehicle ownership at the level of prefecture-level cities, we selected the share of vehicle ownership among local citizens in the number of civil vehicles in the province as the proportion of passenger vehicles owned in prefecture-level cities.
Data analysis	e calculated the actual fuel consumption per 100 km of different types by matching the BearOil app ((www.xiaoxiongyouhao.com (accessed on 18 May 2021))) and Autohome website based on millions of data observations. Similarly, the monthly average mileage is the actual mileage of monthly frequency calculated by using the above method. The gasoline and diesel emission factors are IPCC values. In addition, the power emission factor selects different carbon dioxide emission factors based on six regional power grids in China.

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 Portfolio 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 description of any restrictions on data availability
- For clinical datasets or third party data, please ensure that the statement adheres to our policy

The high-frequency passenger vehicle sales database is restrictive, and the generated emission dataset could be accessed upon requests.

Human research participants

Policy information about studies involving human research participants and Sex and Gender in Research.

Reporting on sex and gender	No relationship with sex and gender in this research
Population characteristics	Not applicable
Recruitment	Not applicable
Ethics oversight	Not applicable

Note that full information on the approval of the study protocol must also be provided in the manuscript.

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

Behavioural & social sciences study design

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

Study description	The low-carbon transformation of China's road transport sector is key to achieving the country's dual carbon goals. Based on China's high-frequency passenger vehicle sales data and real-time vehicle monitoring big data, we examined the reductions associated with vehicle electrification, and the pathways toward carbon neutrality
Research sample	City-level sales of vehicles and NEVs
Sampling strategy	We estimated the emissions of vehicle electrification, and developed a low-carbon transition planning model of China road transport (CRT-LCTP) to explore the pathways toward carbon neutrality.
Data collection	First, according to the high-frequency passenger vehicle sales database and the National Bureau of Statistics, we select 2015 as the base year and divide the fuel types into diesel, gasoline, and NEVs. The diesel and gasoline vehicles are further divided into five classes according to the displacement (Mini: < 1 L; Common Class: 1.0-1.6 L; Middle Class: 1.6-2.5 L; Medium-high Class: 2.5-4 L; High Class: >4 L). NEVs are divided into battery electric vehicles (BEVs), plug-in hybrid vehicles (PHEVs) and hybrid vehicles (HEVs). Considering that the data for dual-fuel vehicles are very limited, these vehicles are eliminated. Second, the proportions of diesel, gasoline and NEVs (different types and fuels) from 2016 to 2019 are calculated based on the entire sample mean of each label in the database. Among them, the NEV data are calibrated according to the annual data published by the Ministry of Public Security and relevant institutions. Third, since the National Bureau of Statistics does not distinguish passenger and freight vehicle ownership at the level of prefecture-level cities, we selected the share of vehicle ownership among local citizens in the number of civil vehicles in the province as the proportion of passenger vehicles owned in prefecture-level cities.
Timing	2016-2019
Data exclusions	None
Non-participation	N.A.
Randomization	N.A.

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
☒	☐ Clinical data
☒	☐ Dual use research of concern

Methods

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