

Climate survey - France

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Proposed Outline for the Paper

Survey Methodology

Knowledge & Misperceptions

Who knows more?

Where information is lacking?

Who supports climate policies

Key heterogeneities

Respondents' profiles

Underlying mechanisms

Main mechanisms

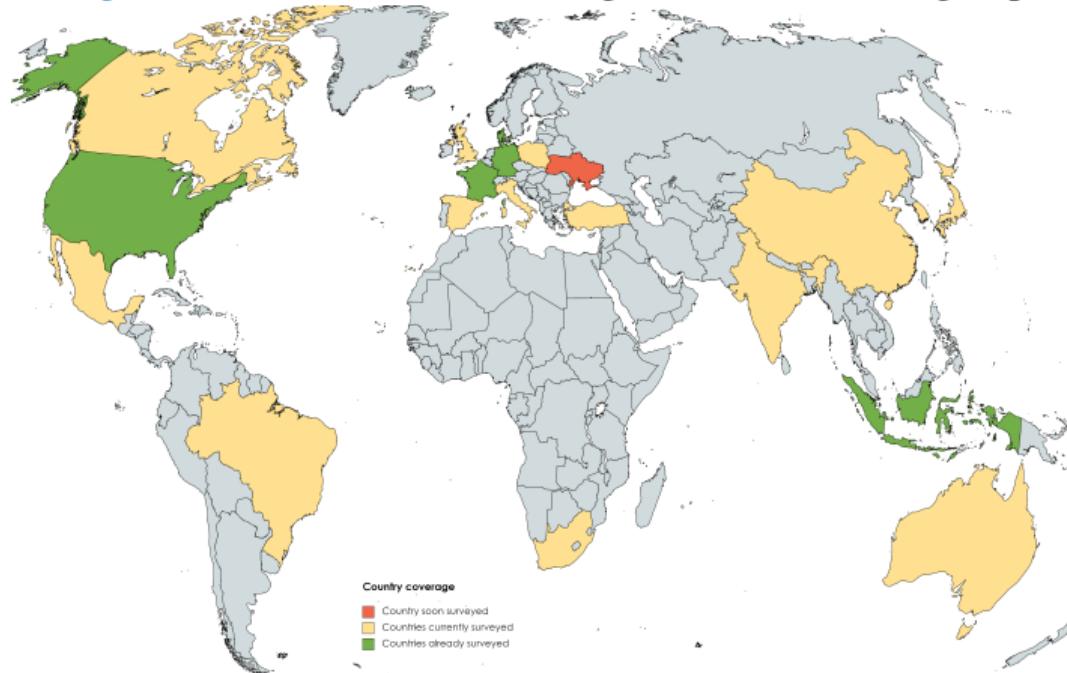
Information treatments

An international survey

Large-scale cross-country survey to analyse attitudes on climate change and climate policies.

Wide country coverage:

20 countries in all world regions, low-income as well as high-income,
covering 72% of global CO₂ emissions, including 18 out of the 21 largest polluters.



Questionnaire (for France)

Questionnaire

Background of respondent:

Socio-demographics, political views, energy use, consumption habits.

Questionnaire

Background of respondent:

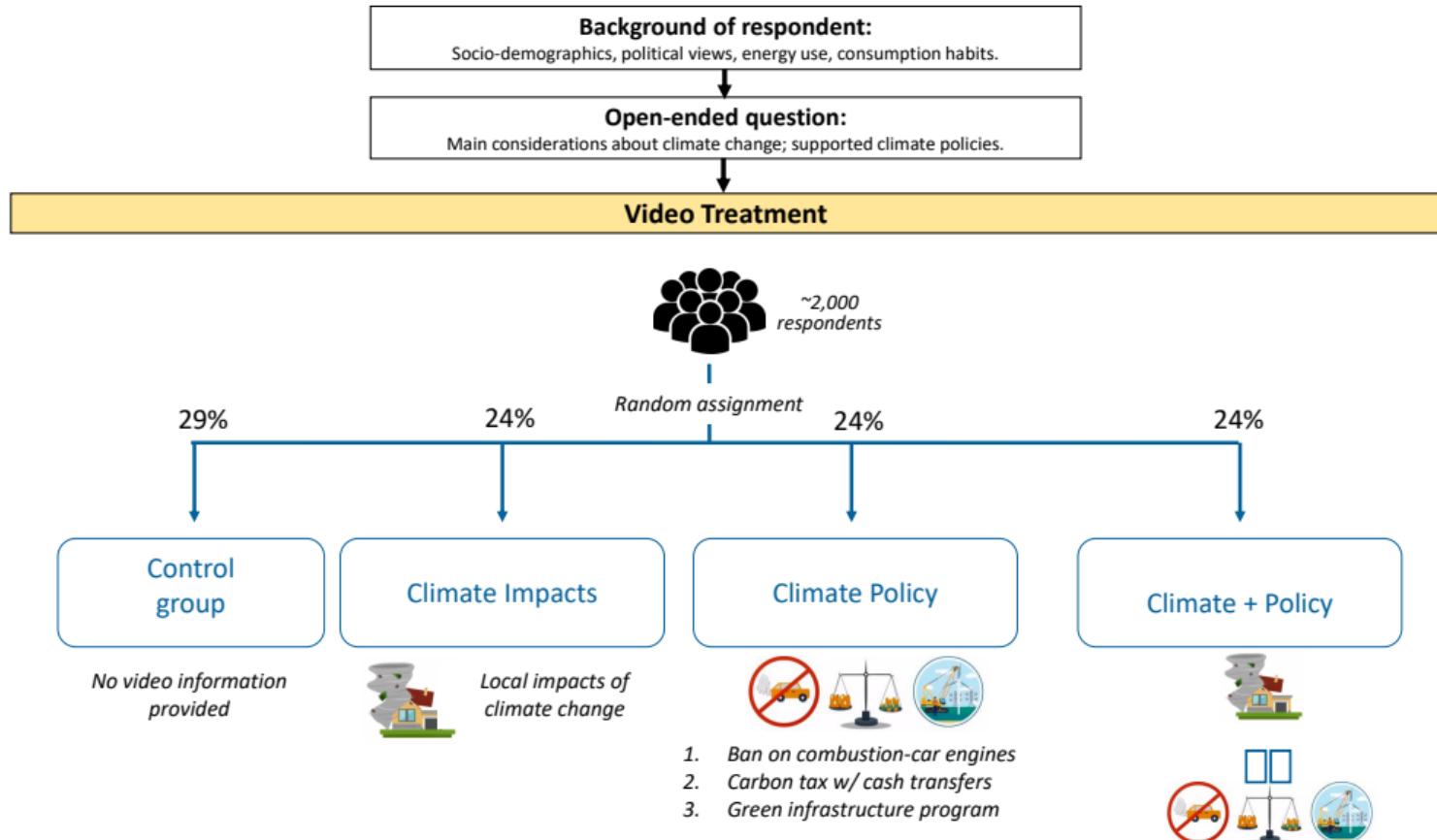
Socio-demographics, political views, energy use, consumption habits.



Open-ended question:

Main considerations about climate change; supported climate policies.

Questionnaire



Questionnaire

Local climate impact



With the mix of more hurricanes, rising sea levels, more heatwaves, and lower agricultural output

Ban on combustion-engine cars



so that only electric or hydrogen vehicles can be sold after 2030.

Green infrastructure program



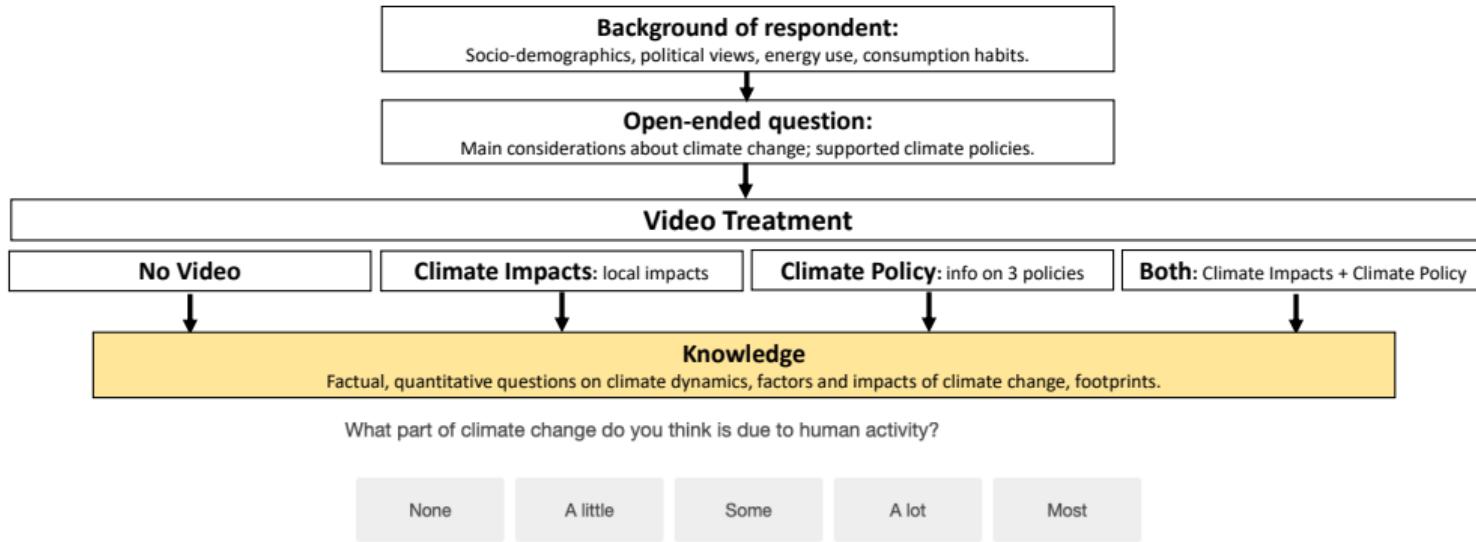
In the US, such a programme could create 4 million jobs in green sectors, such as public transportation, renewable power plants, buildings' insulation, or sustainable agriculture.

Carbon tax with cash transfers



To compensate people for the higher prices, the revenues of the carbon tax would be redistributed to all households, regardless of their income.

Questionnaire



What part of climate change do you think is due to human activity?

None

A little

Some

A lot

Most

Which source of electric energy emits the most greenhouse gases to provide power for a house?

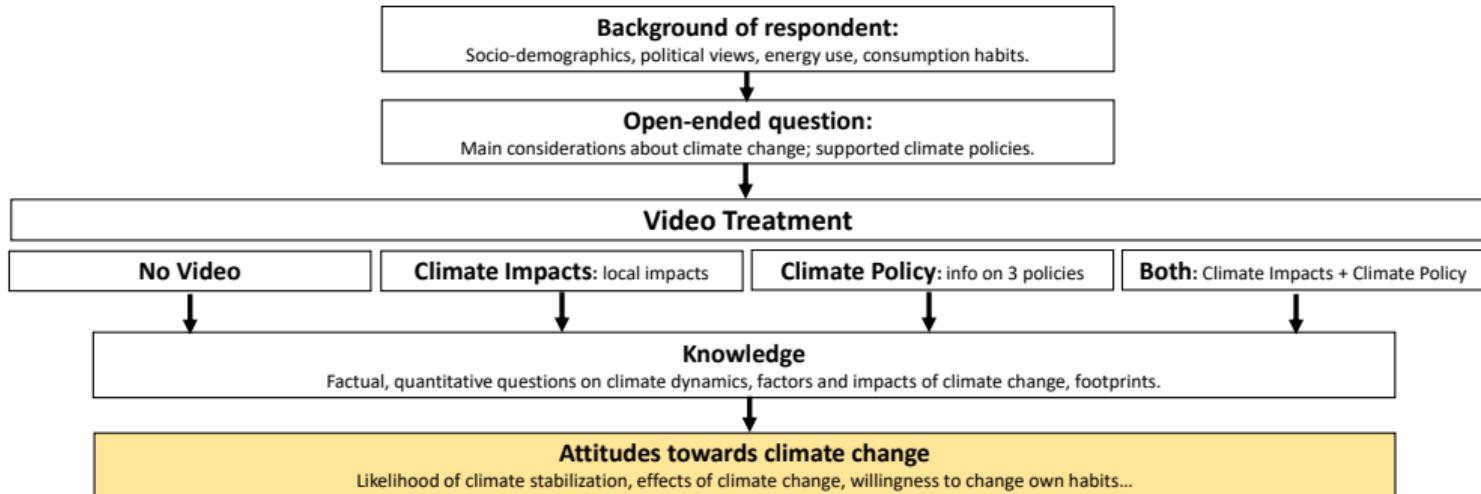
Please rank the items from 1 (most) to 3 (least) (by clicking and dragging the items).

Gas-fired power plant

Nuclear power plant

Coal-fired power station

Questionnaire



To what extent do you think that it is technically feasible to stop greenhouse gas emissions while maintaining satisfactory standards of living in the U.S.?

Not at all

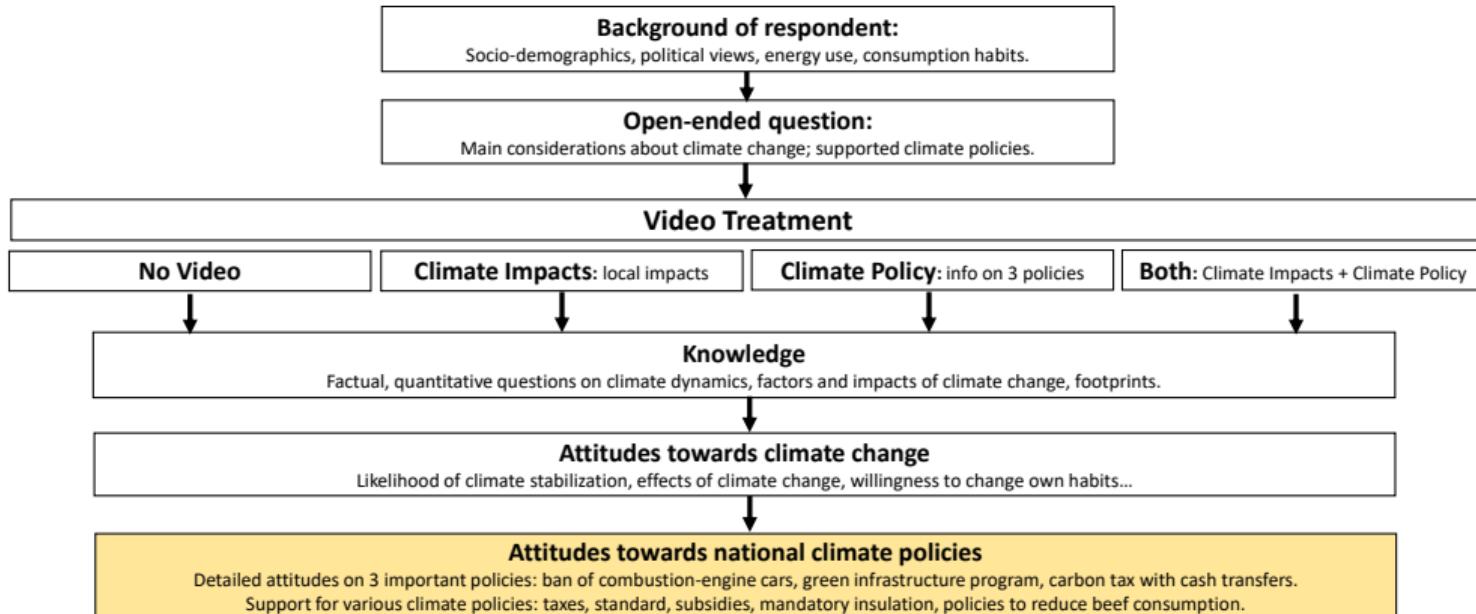
A little

Moderately

A lot

A great deal

Questionnaire



Do you support or oppose a ban on combustion-engine cars where alternatives such as public transports are made available to people?

Strongly
oppose

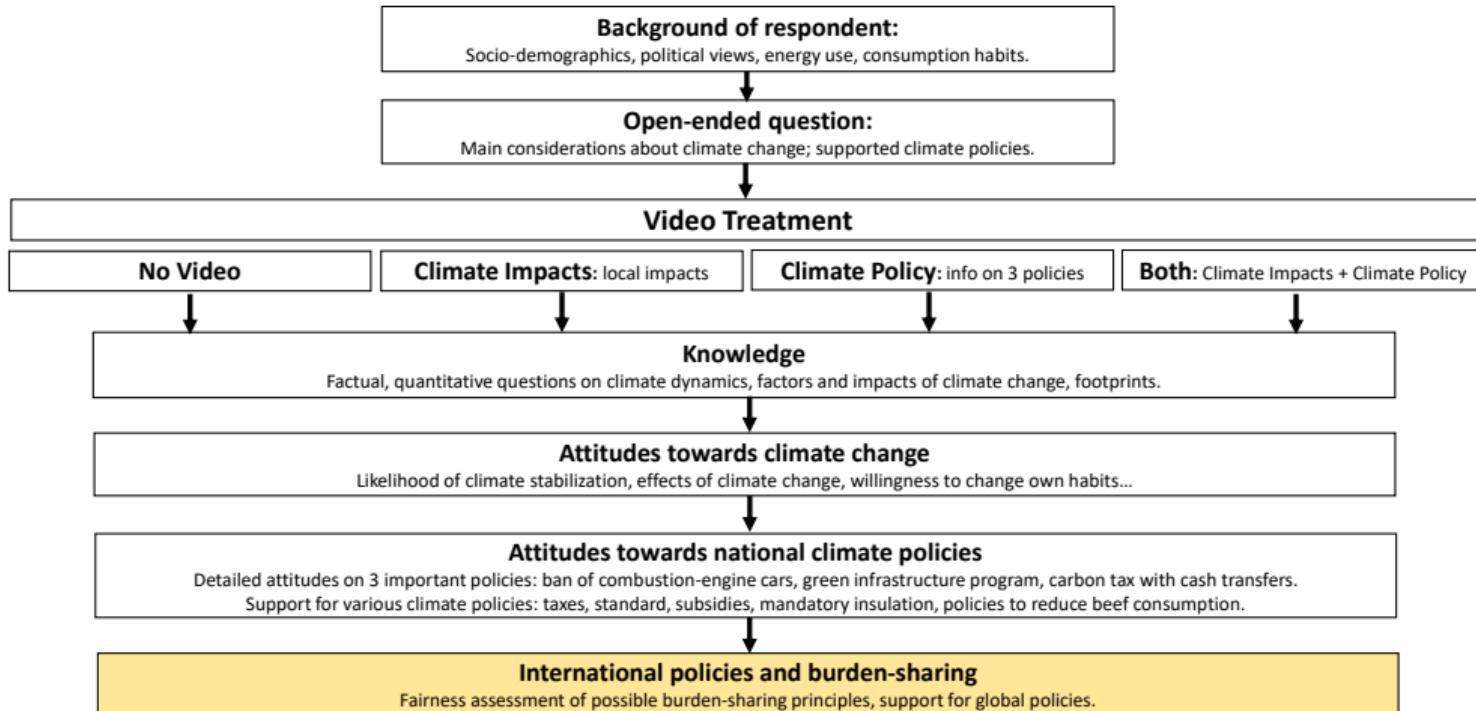
Somewhat
oppose

Neither
support nor
oppose

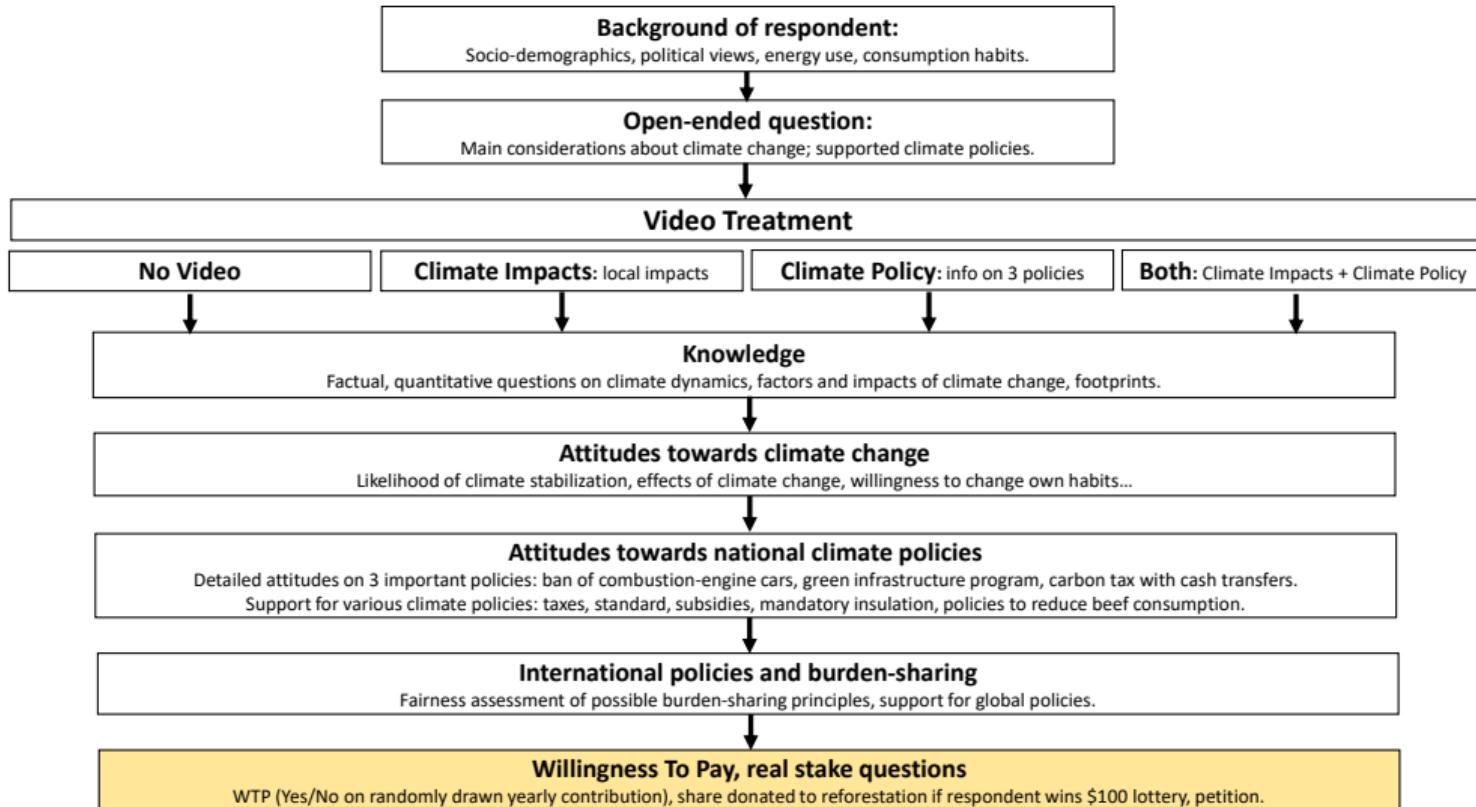
Somewhat
support

Strongly
support

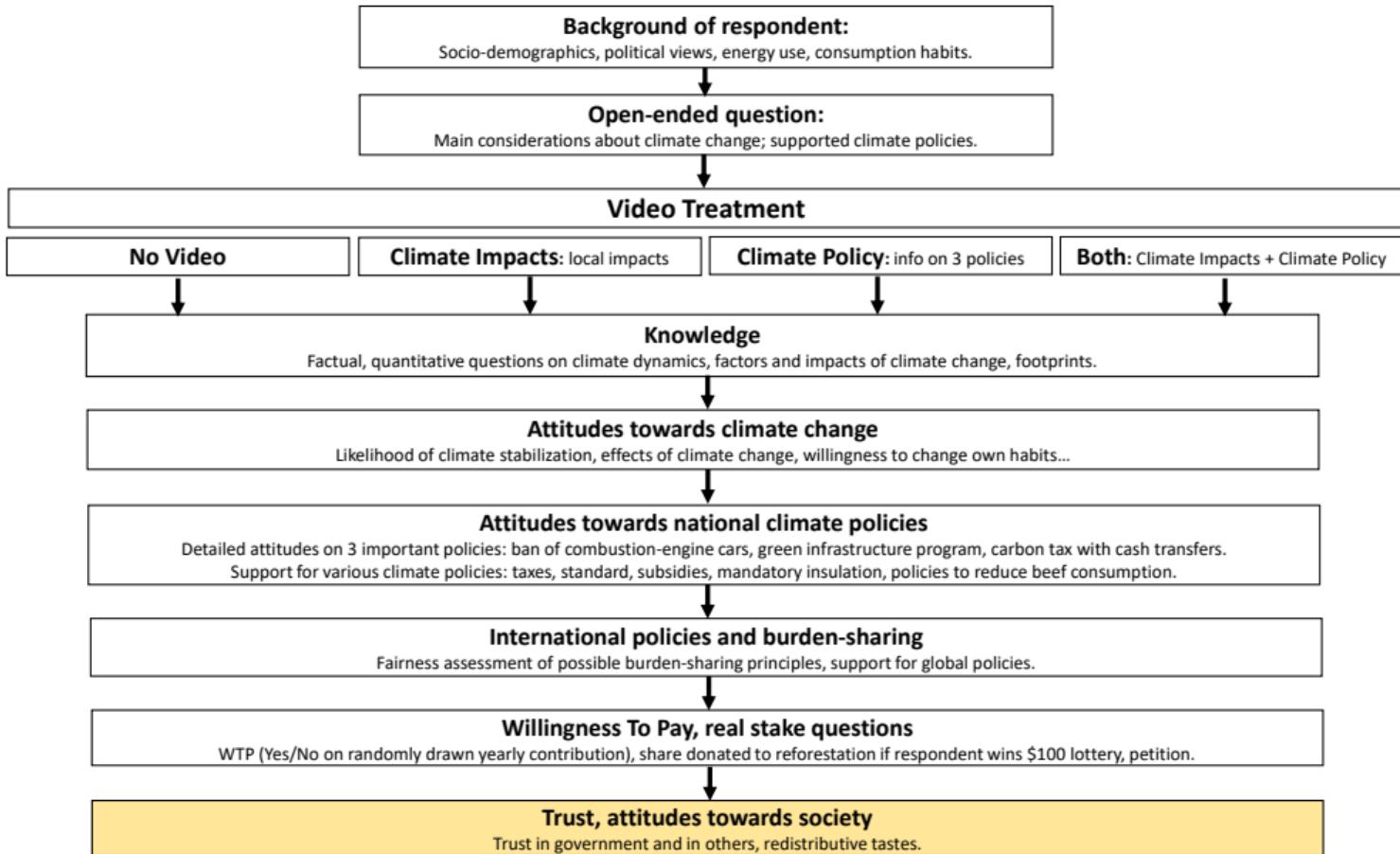
Questionnaire



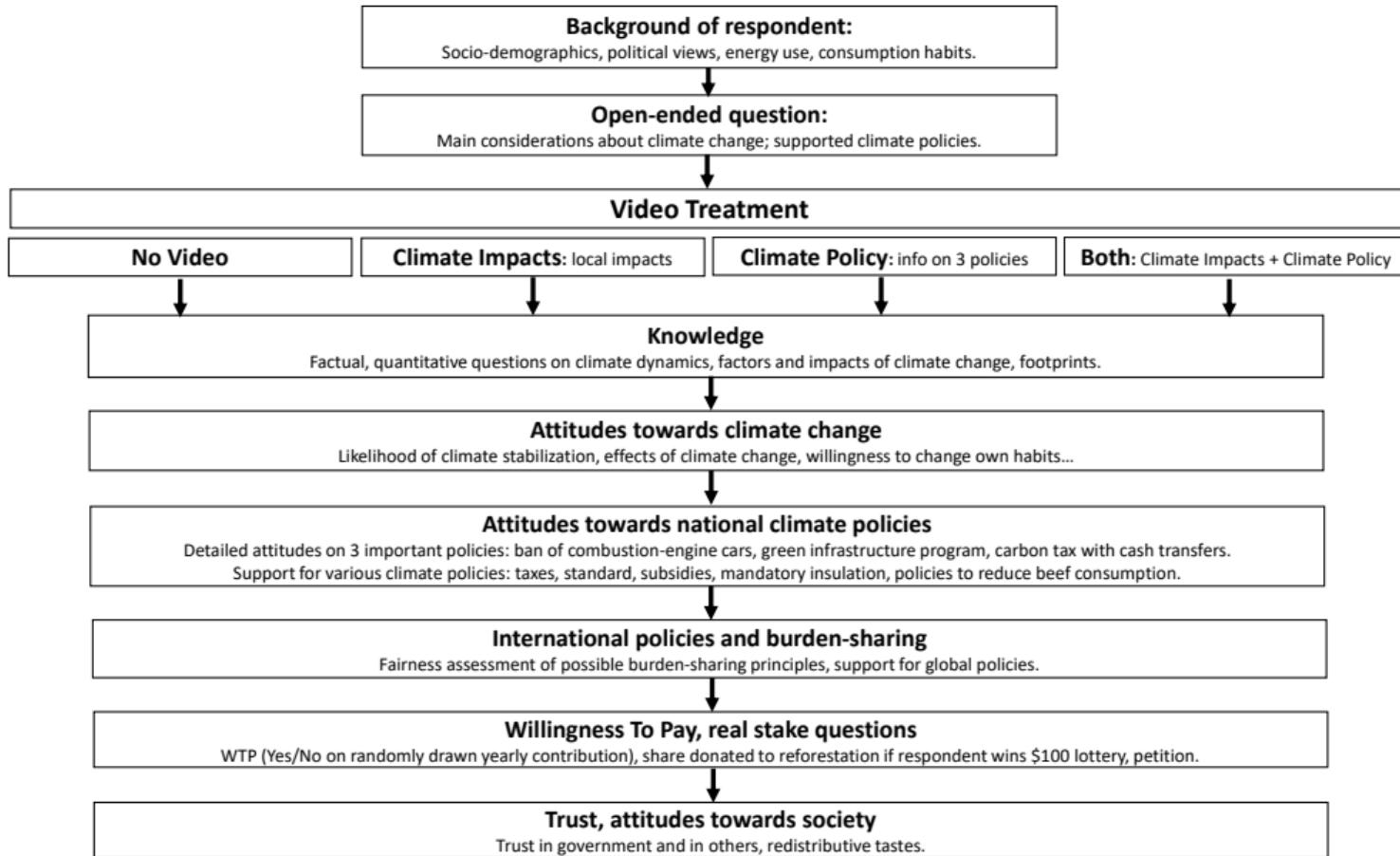
Questionnaire



Questionnaire



Questionnaire



Sample quality – France

Ensuring data quality

2,006 respondents selected through quotas that ensure representativeness along:
gender, age, income, region, diploma, urban/rural.

All results are re-weighted along quota variables (except rural/urban) to increase representativeness even further.

Screening question in the middle of the survey.

Appeal to people's social responsibility by insisting they should answer carefully and honestly, for the sake of science.

Warn that “incoherent and rushed responses” (< 11 min) are dismissed and disqualified for monetary compensation.

Record time spent on separate questions & overall survey (median: 27 min).

Ask for feedback post survey, whether felt survey was biased (78% find it unbiased).

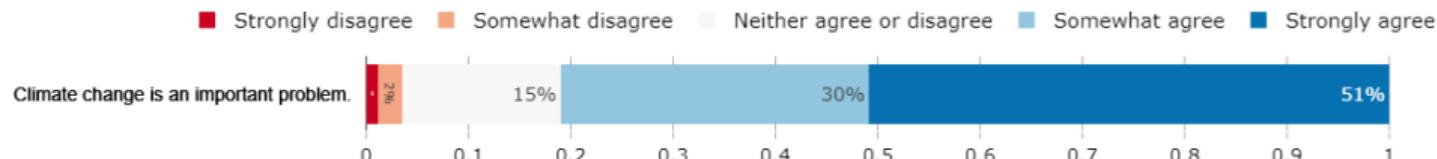
Representativeness of the Survey Sample

	Raw Sample	Weighted Sample	Population
Sample size	2,006	2,006	
Male	0.44	0.49	0.48
18-24 years old	0.10	0.12	0.12
25-34 years old	0.15	0.15	0.15
35-49 years old	0.25	0.24	0.24
50-54 years old	0.25	0.24	0.24
More than 65 years old	0.25	0.25	0.25
Income Q1	0.31	0.26	0.25
Income Q2	0.31	0.26	0.25
Income Q3	0.23	0.25	0.25
Income Q4	0.14	0.23	0.25
Île de France	0.19	0.19	0.19
Nord-Ouest	0.22	0.20	0.20
Nord-Est	0.24	0.22	0.22
Sud-Ouest	0.15	0.14	0.14
Sud-Est	0.20	0.25	0.25
Grand Pôle Urbain	0.59	0.59	0.60
Couronne Grand Pôle Urbain	0.20	0.20	0.18
Autre	0.21	0.21	0.22
Diplômé du supérieur	0.37	0.30	0.29
Bac	0.23	0.17	0.17
CAP ou BEP	0.29	0.25	0.25
Brevet ou Non diplômé	0.11	0.27	0.30

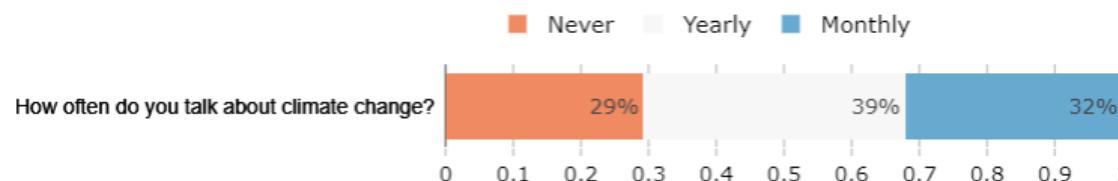
Knowledge

Climate change acknowledged as serious problem

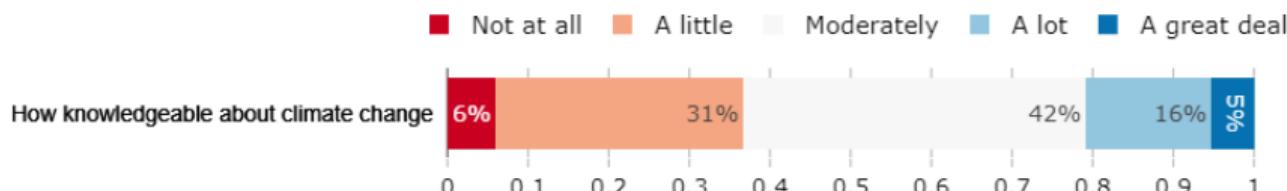
Do you agree or disagree with the following statement: "Climate change is an important problem."



How often do you think or talk with people about climate change?



How knowledgeable do you consider yourself about climate change?



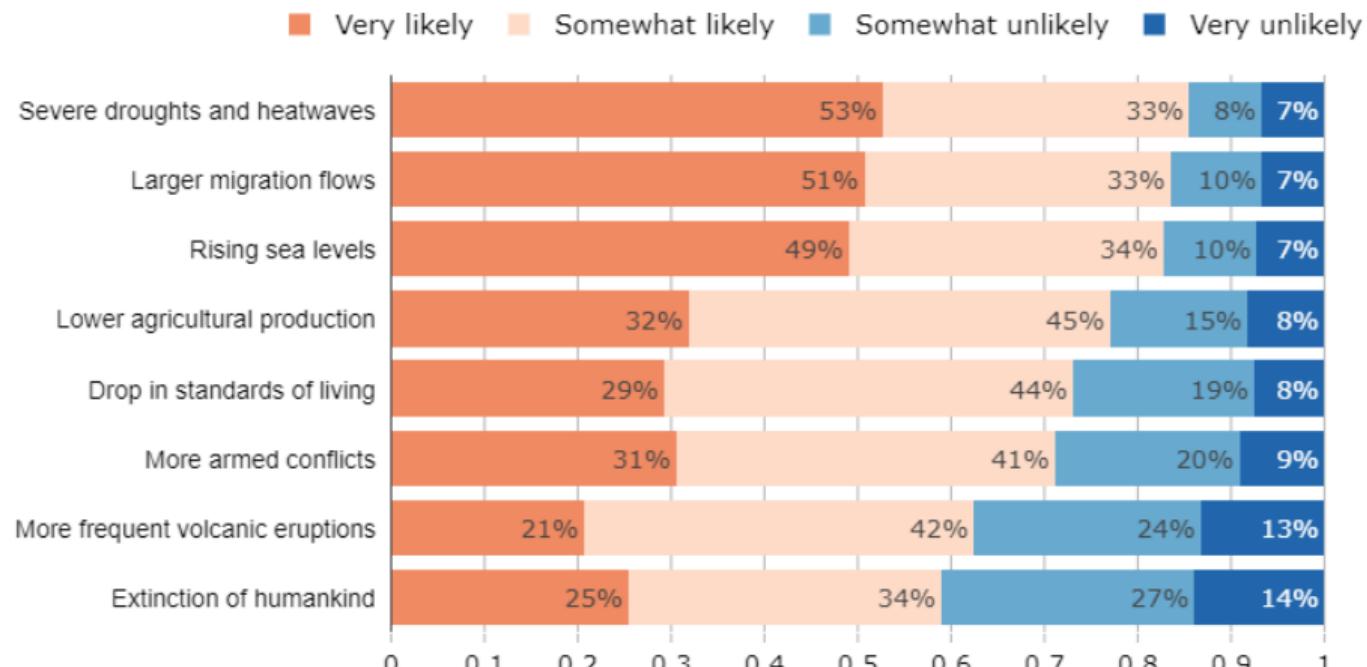
What are people relatively well aware of?

Impacts of climate change: Expect a lot of effects

If nothing is done to limit climate change, how likely do you think it is that climate change will lead to the following events?

Right answer: Very likely: Severe droughts and heatwaves; Rising sea levels

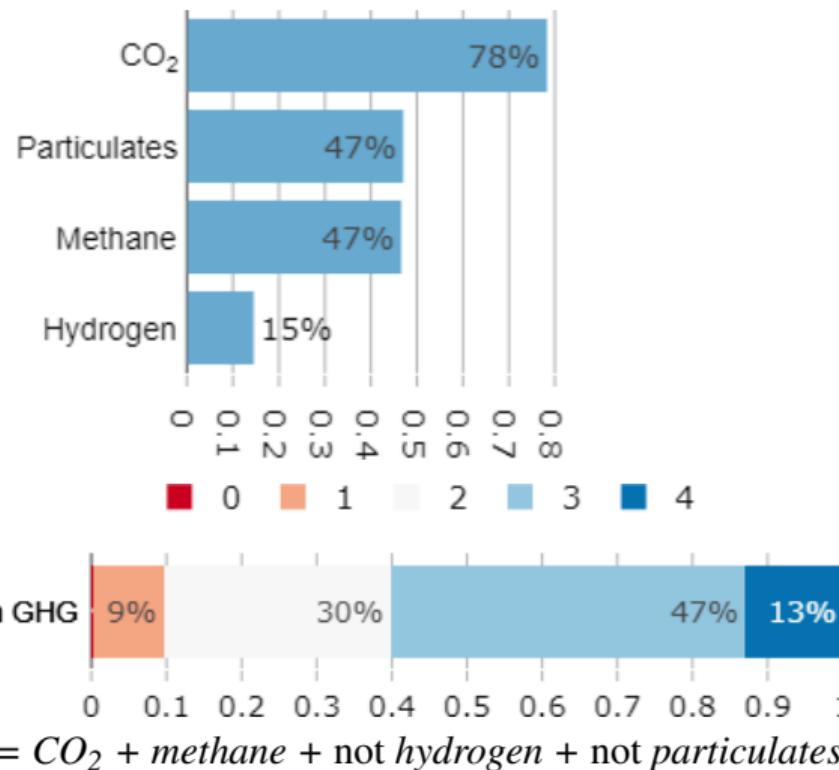
Very unlikely: More frequent volcanic eruptions (No scientific certainty on the other items)



Respondents relatively well aware about factors causing climate change

Which of the following elements contribute to climate change? (Multiple answers are possible)

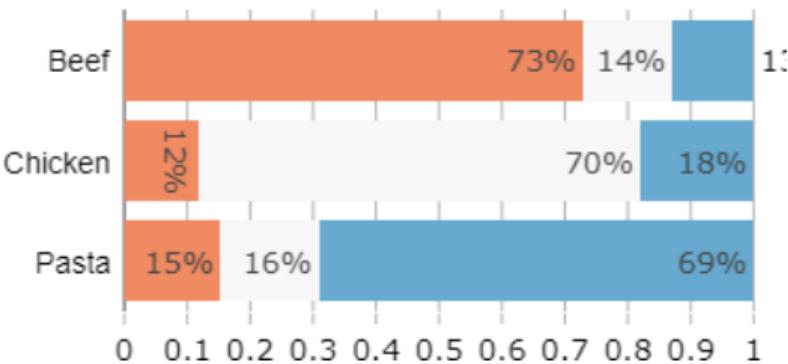
Right answer: *CO₂; Methane*



Which dish emits the most greenhouse gases? We consider that each dish weighs 200g. Please rank the items from 1 (most) to 3 (least).

Right answer: Beef (1), Chicken (2), Pasta (3)

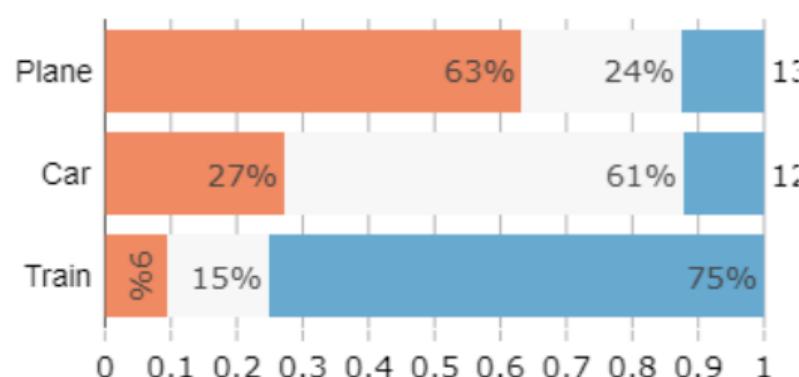
■ 1 Most ■ 2 ■ 3 Least



If a family of 4 travels 800 km from Bordeaux to Nice, with which mode of transportation do they emit the most greenhouse gases? Please rank the items from 1 (most) to 3 (least).

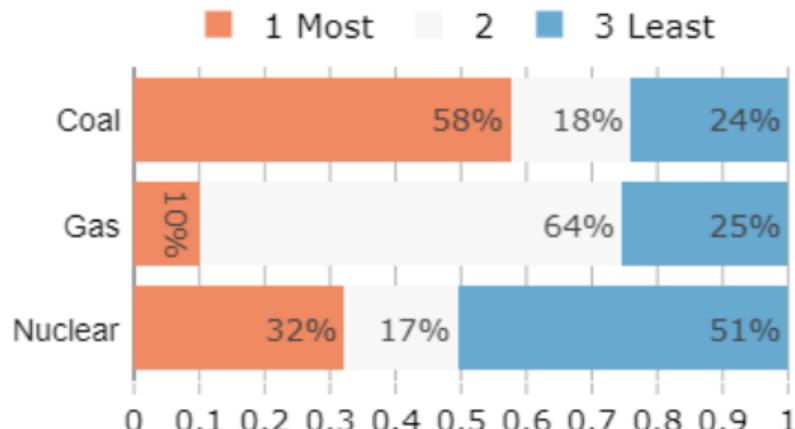
Right answer: Plane (1), Car (2), Train (3)

■ 1 Most ■ 2 ■ 3 Least



Which source of electric energy emits the most greenhouse gases to provide power for a house?

Right answer: Coal (1), Gas (2), Nuclear (3)

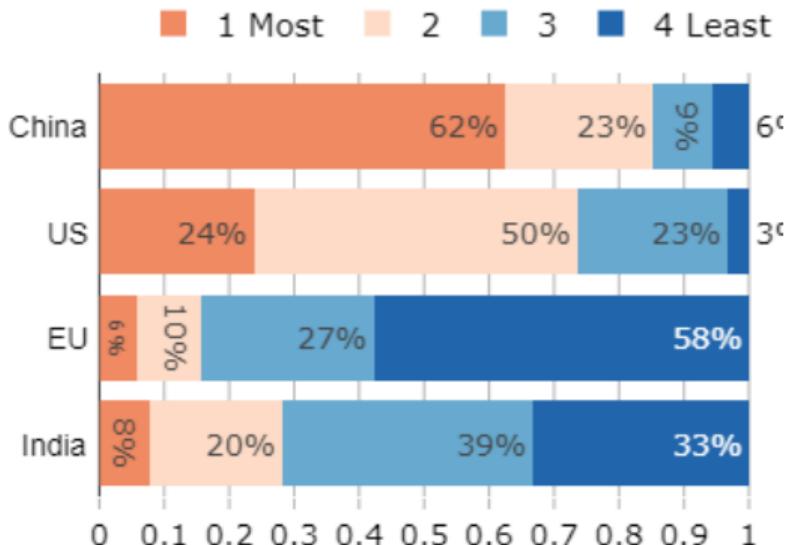


What do people misperceive?

Underestimation of EU emissions

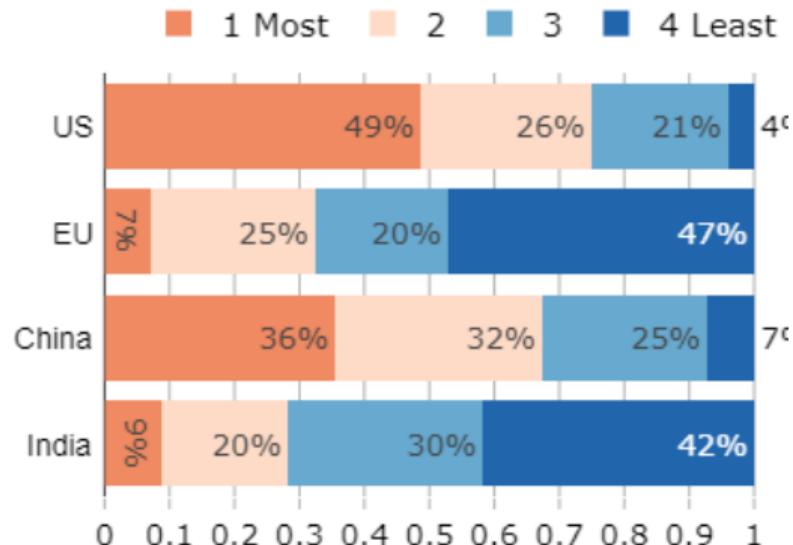
(a) Which region contributes most to global greenhouse gas emissions?

Right answer: China (1), US (2), EU (3), India (4)



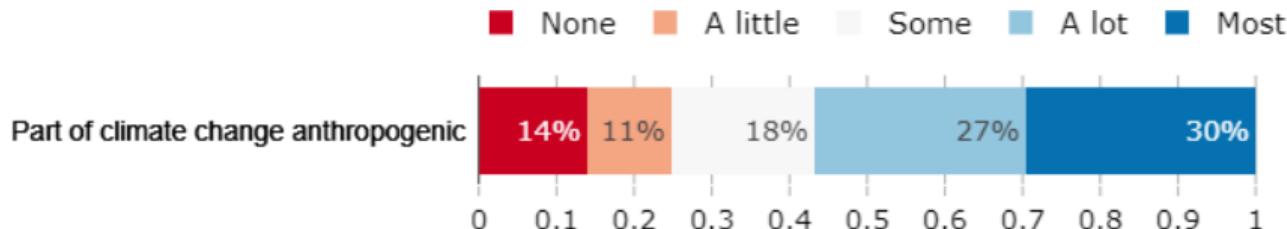
(b) In which region does the consumption of an average person contribute most to climate change?

Right answer: US (1), EU (2), China (3), India (4)

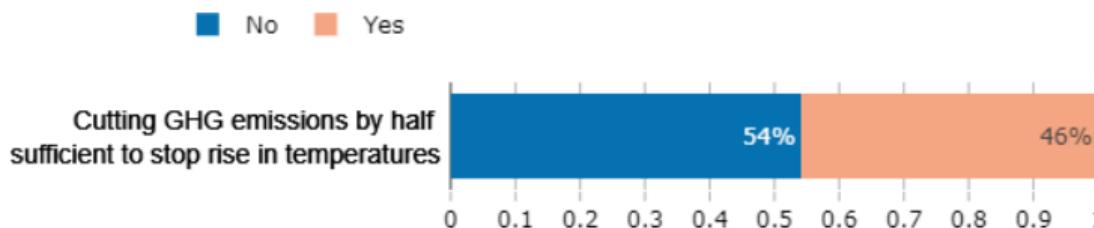


Mixed understanding of climate science

What part of climate change do you think is due to human activity? *Right answer: Most*



Do you think that cutting global greenhouse gas emissions by half would be sufficient to eventually stop temperatures from rising? *Right answer: No*



Who has better knowledge? – Definition

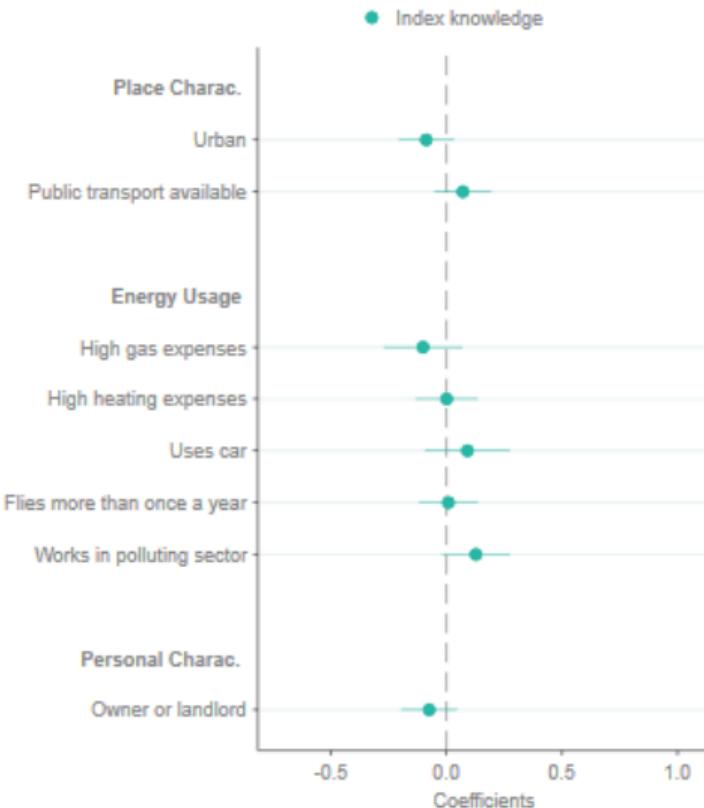
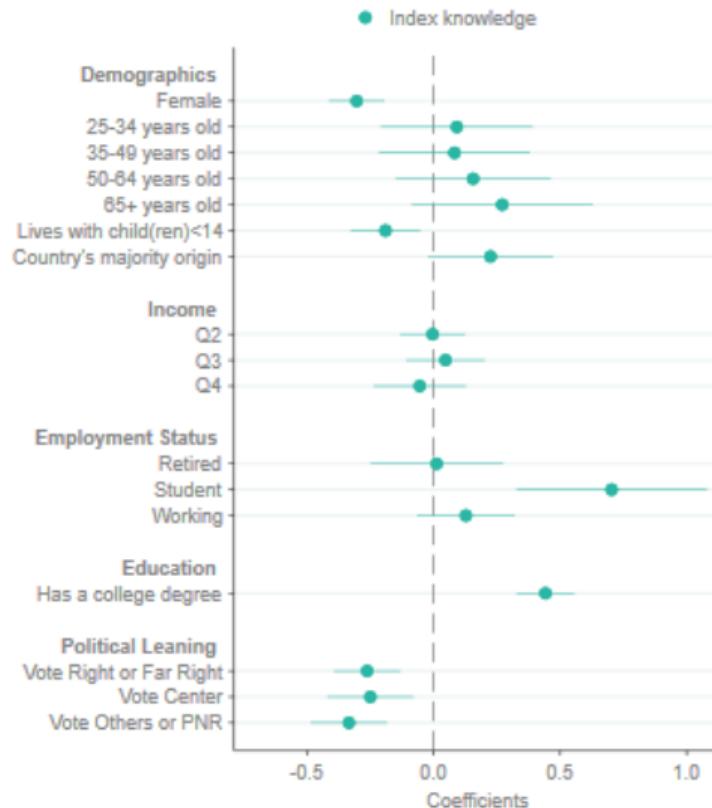
Index knowledge: average of following variables transformed in z-scores:

- *Score footprint transport*
- *Score footprint electricity*
- *Score footprint food*
- *Score footprint countries per capita*
- *Score footprint countries total*
- *Heating expenses*
- *Climate change real*
- *Dynamic of Climate change*
- *Climate change anthropogenic*
- *Score impacts of climate change*
- *Score greenhouse gases*

See Appendix for the definition of variables

Who has better knowledge?

Knowledge about Climate Change



Note: The figures show the results of standard OLS regression on socio-demographic covariates (LHS) and on energy characteristics (RHS). The RHS specification also controls for the socio-demographic variables.

Which respondents support climate action?

Most people support climate action and about half are willing to change their lifestyle.

Share of support (somewhat or strongly) for the main national policies.

	World	OECD	Australia	Canada	Denmark	France	Germany	Italy	Japan	Mexico	Poland	South Korea	Spain	Turkey	United Kingdom	United States	Non-OECD	Brazil	China	India	Indonesia	South Africa	Ukraine
CC exists, is anthropogenic	80	70	62	65	63	57	74	82	66	89	74	83	81	85	71	62	83	83	82	84	84	79	80
CC is an important problem	88	83	76	82	81	81	83	92	90	94	86	93	89	90	84	76	89	91	85	92	93	86	85
[Country] should fight CC	87	80	74	80	77	78	78	90	84	91	87	86	85	90	83	72	89	88	85	92	91	91	83
Willing to Limit flying	61	49	37	55	51	57	65	64	37	57	57	40	61	45	52	40	66	52	61	76	54	47	58
Willing to Limit driving	56	38	28	38	34	32	42	53	35	49	44	37	47	46	41	32	63	42	57	77	53	37	23
Willing to Have a fuel-efficient or electric vehicle	68	56	47	50	62	45	43	75	49	73	55	61	61	75	55	52	73	79	67	79	67	62	59
Willing to Limit beef consumption	54	39	31	37	34	38	45	62	24	41	51	36	42	34	44	38	60	41	53	73	50	36	46
Willing to Limit heating or cooling your home	56	36	29	28	31	39	36	52	26	58	40	36	44	31	31	30	63	45	52	79	60	41	7

France support climate policies less than the OECD average.

Share of support (somewhat or strongly) for the main national policies.

	World	OECD	Australia	Canada	Denmark	France	Germany	Italy	Japan	Mexico	Poland	South Korea	Spain	Turkey	United Kingdom	United States	Non-OECD	Brazil	China	India	Indonesia	South Africa	Ukraine
Carbon tax with cash transfers	65	37	35	39	32	28	27	46	33	53	38	53	42	52	36	32	76	50	79	81	69	55	42
Ban on combustion-engine cars	68	45	40	47	43	27	31	52	41	68	44	50	57	60	46	41	76	67	70	87	68	56	61
Ban on combustion-engine cars where alternatives made available	71	50	42	47	44	42	41	56	51	70	47	63	57	62	53	46	78	63	79	82	75	63	50
Green infrastructure program	78	59	52	55	55	58	42	78	50	85	60	69	72	78	58	51	85	80	86	86	83	76	78
Ban on intensive cattle	48	41	35	41	31	56	48	66	17	50	44	43	41	33	52	37	52	43	56	NA	46	32	36
Mandatory insulation of buildings	38	31	36	33	33	35	30	37	27	NA	38	29	21	41	34	28	44	NA	44	NA	NA	41	43
A tax on flying (raising price by 20%)	60	42	41	45	59	46	54	39	43	50	47	41	45	42	51	33	67	42	64	74	68	44	35
A ban of polluting vehicles in city centers	73	59	57	56	66	58	49	75	64	76	61	46	68	63	67	49	78	70	78	79	85	70	61

Most policies receive a relative majority support.

Share of support for the main national policies among non-Indifferent.

	World	OECD	Australia	Canada	Denmark	France	Germany	Italy	Japan	Mexico	Poland	South Korea	Spain	Turkey	United Kingdom	United States	Non-OECD	Brazil	China	India	Indonesia	South Africa	Ukraine
Carbon tax with cash transfers	82	55	50	57	50	44	38	70	56	65	55	70	56	72	61	50	91	70	95	90	91	74	70
Ban on combustion-engine cars	81	59	55	60	53	38	39	73	60	77	56	65	65	84	62	56	89	83	87	91	88	72	69
Ban on combustion-engine cars where alternatives made available	83	66	56	63	56	58	53	78	75	78	61	80	66	81	69	61	89	77	93	88	88	77	58
Green infrastructure program	91	78	69	77	78	77	58	93	80	95	83	91	87	93	80	69	95	92	99	92	98	90	92
Ban on intensive cattle	66	55	48	57	42	70	65	83	32	59	59	62	50	42	69	50	73	54	81	NA	61	41	44
Mandatory insulation of buildings	41	35	39	39	37	39	34	41	32	NA	41	35	23	44	38	32	47	NA	47	NA	NA	45	44
A tax on flying (raising price by 20%)	75	54	50	59	68	56	65	55	62	61	61	56	54	52	65	44	82	49	84	86	84	53	49
A ban of polluting vehicles in city centers	87	73	76	74	79	71	66	88	85	85	77	57	77	75	84	64	92	83	95	90	96	86	69

Global policies are strongly supported.

Share of support (somewhat or strongly) for the main global policies.

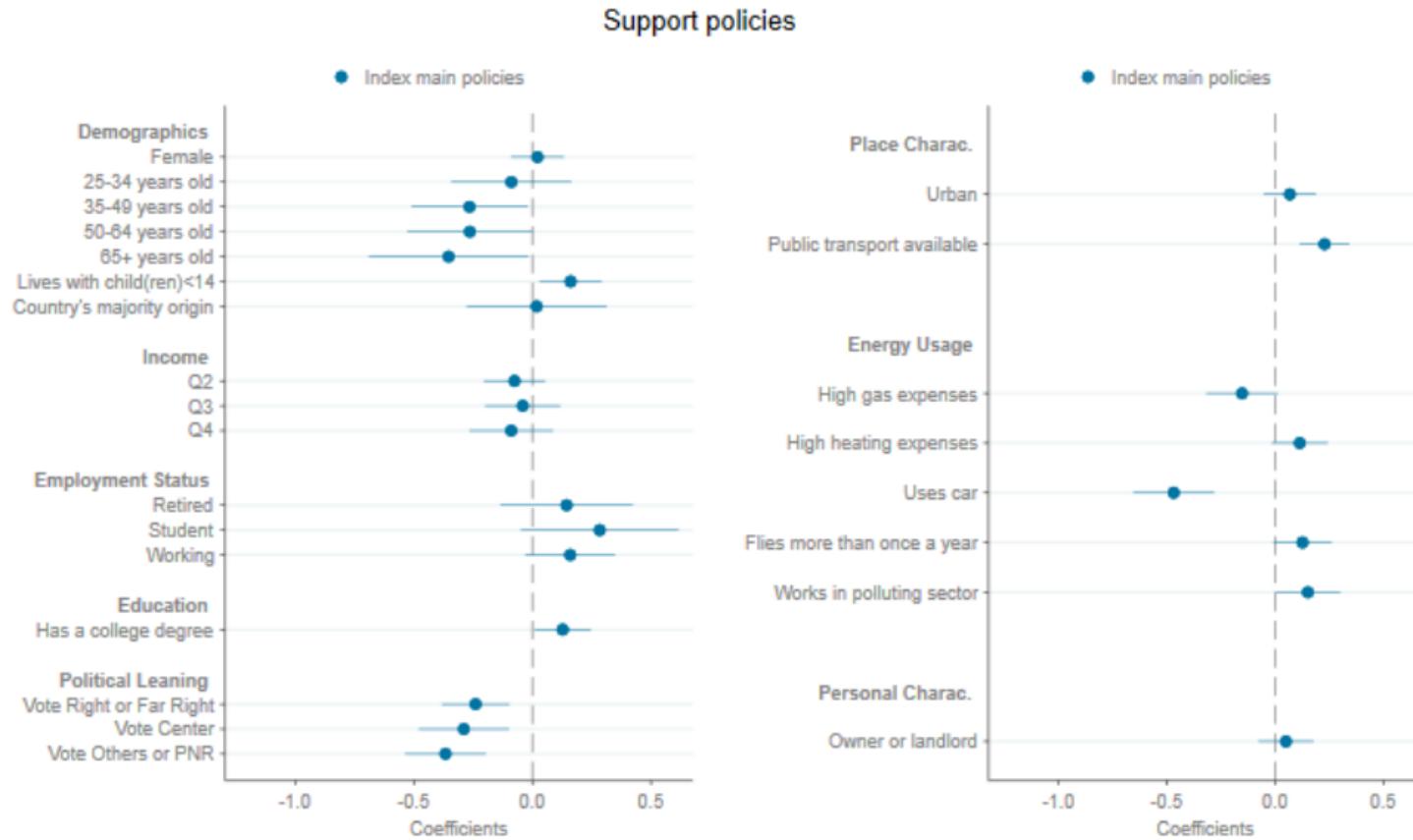
	World	OECD	Australia	Canada	Denmark*	France*	Germany	Italy	Japan	Mexico	Poland	South Korea	Spain	Turkey	United Kingdom	United States*	Non-OECD	Brazil	China	India	Indonesia	South Africa	Ukraine
Global carbon budget (+2°C) divided in tradable country shares	77	64	58	63	NA	NA	53	68	47	79	62	63	71	76	68	NA	81	71	78	85	79	73	70
Emission share should be in proportion to population*	76	65	65	56	53	73	56	67	50	73	64	60	67	75	63	69	81	67	81	84	77	74	69
Global tax on GHG financing a global basic income	63	38	32	31	40	34	35	34	30	70	31	32	41	44	30	34	73	59	68	81	71	41	55
Global democratic assembly on climate change	75	58	53	53	50	55	55	66	61	80	67	55	67	77	54	47	82	68	83	85	78	72	76
Global tax on millionaires funding LDC	78	63	60	65	57	66	65	72	61	78	61	57	74	77	65	54	83	76	84	85	84	71	91

How support varies – Definitions

Index main policies

Average of support variables for main policies (ban on combustion-engine cars, a green infrastructure program, and a carbon tax with cash transfers) transformed in z-scores

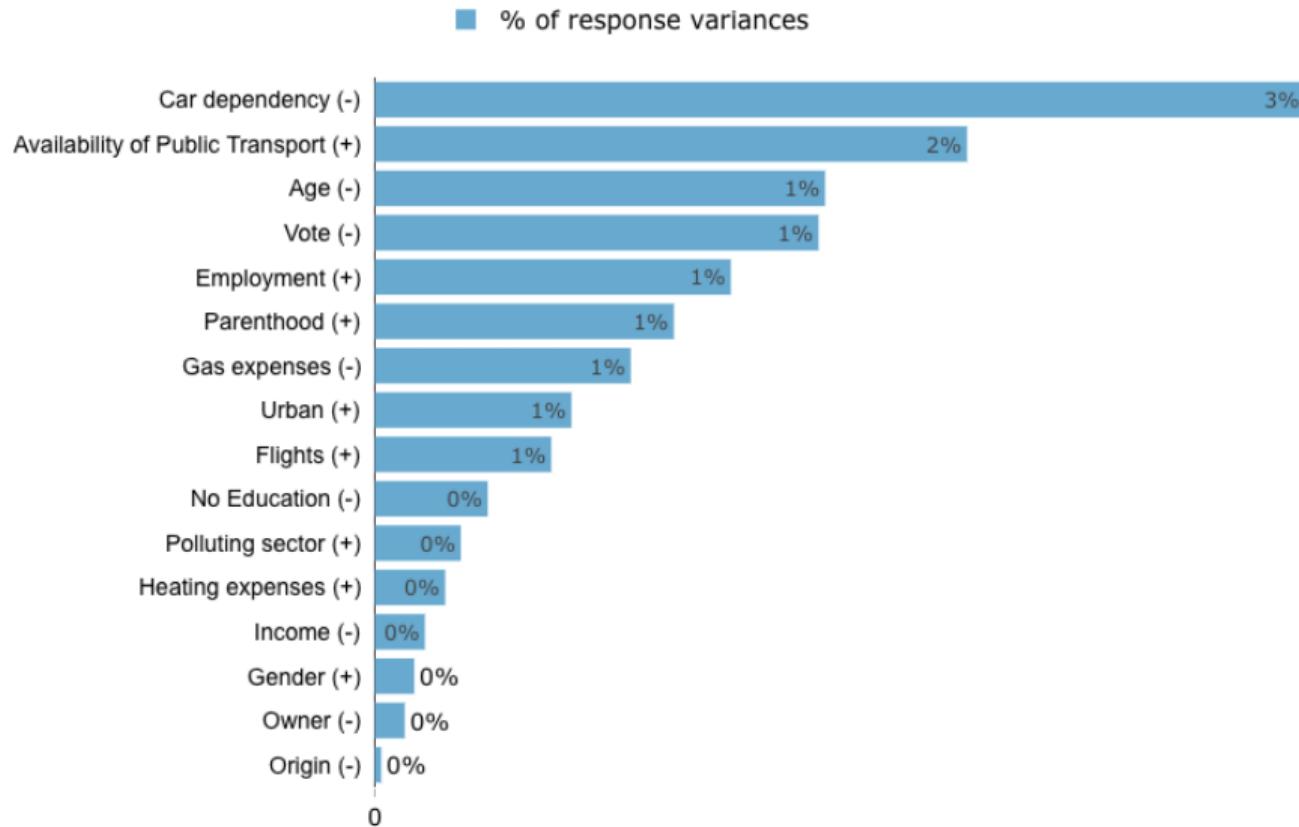
Less support among car users, right-wing, or older people.



Note: The figures show the results of standard OLS regression on socio-demographic covariates (LHS) and on energy characteristics (RHS). The RHS specification also controls for the socio-demographic variables.

Variance Decomposition of Policy Support – Individual Characteristics

$R^2 = 12.21\%$



What are the different *types* of people? Latent Dirichlet Allocation

Uncertain about the economic and distributive consequences of climate policies (*23.3% of the sample*)

- ▶ Uncertain about the effects of the main policies on the economy and employment
- ▶ Think their own households would neither win nor lose from a green investment program and a ban on combustion engine
- ▶ Think a carbon tax with dividend is neither fair nor unfair and that it won't affect high-income earners

Worried about the effects of climate change; think that France should fight CC. (*17.1% of the sample*)

- ▶ Climate change is real and will have negative impacts (droughts, rising sea levels, drop in standards of living, migration, wars, lower agricultural production)
- ▶ Pessimistic about the chances to halt climate change and the future of society as a whole
- ▶ Low trust in the government and others.
- ▶ Support climate policies to a limited extent

What are the different *types* of people? 'ed

Oppose climate policies and think they will have negative distributive consequences (*26.1% of the sample*)

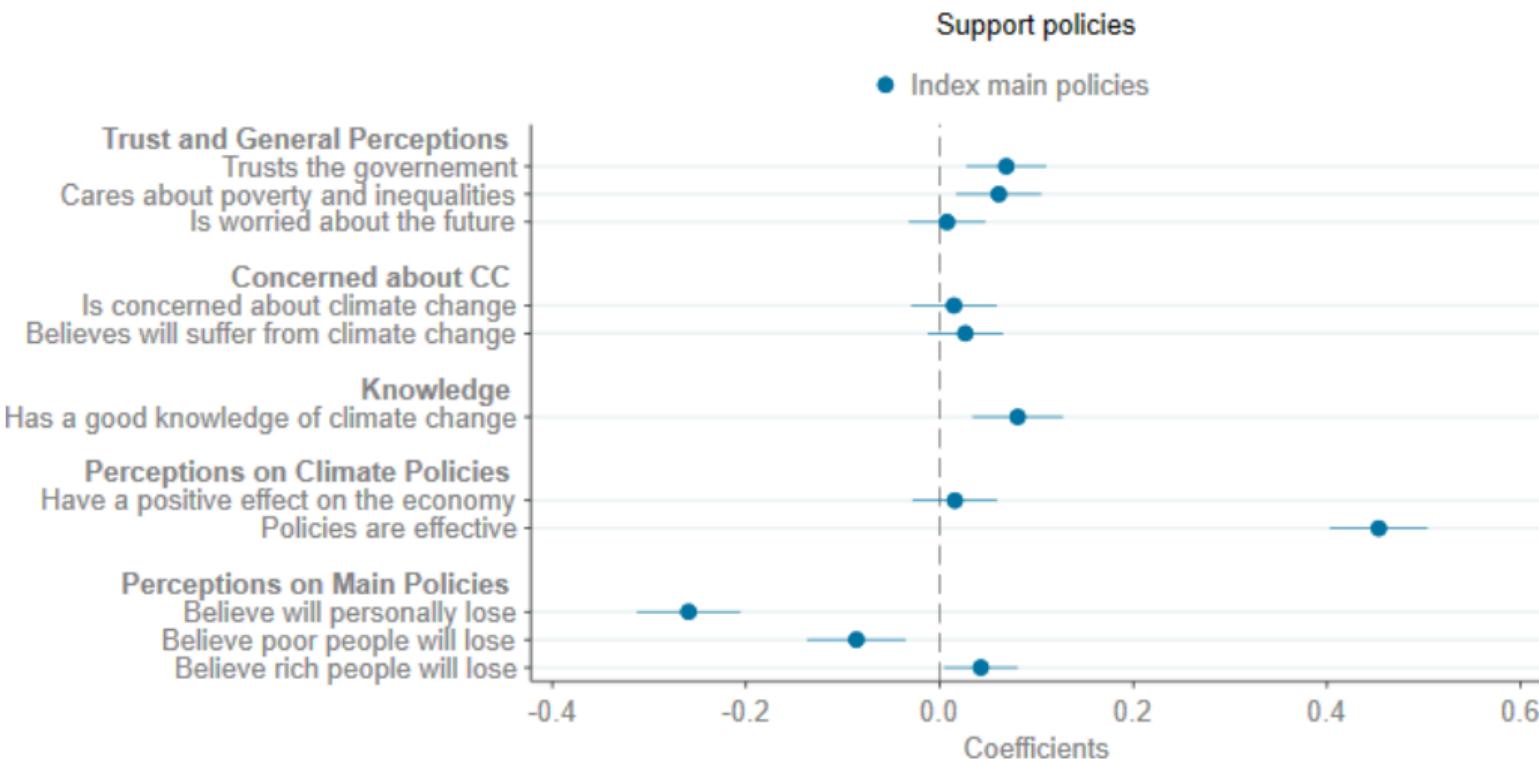
- ▶ Oppose tax policies (high tax on cattle products, national tax on fossil fuels) and ban on combustion engine cars
- ▶ A green investment program would harm: low-income earners and the middle class
- ▶ A carbon tax with dividends would harm: their own household, the middle class, and people living in rural areas
- ▶ A ban on combustion engine cars would harm: the middle class and people living in rural areas

Strong support for climate policies and believe in their effectiveness. Willing to make some changes (*33.5% of the sample*)

- ▶ Lot of support for climate policies (including a carbon tax with dividends)
- ▶ Efficiency: a carbon tax with dividends (\downarrow drive); ban on combustion engine cars (\downarrow CO₂ emissions from cars); green infrastructure program (\uparrow green electricity production)
- ▶ Believe climate change will have strong consequences, but optimistic about the future
- ▶ Higher trust in the government and other than other profiles. Believe France should do more if other countries do less

What ideas can explain support for climate policies?

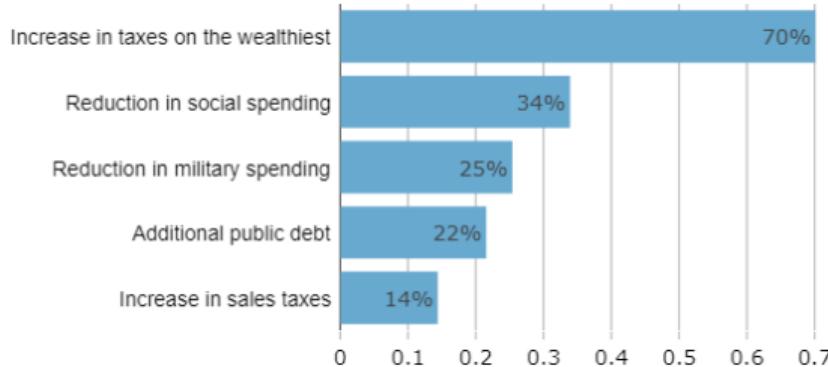
Beliefs in effectiveness and self-interest are key for policy support.



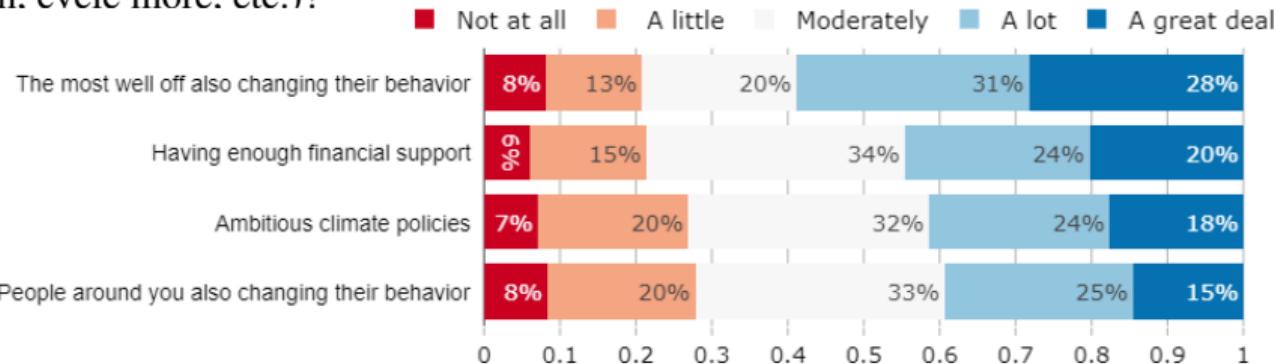
Note: The figure shows the results of standard OLS regression. Other socio-demographic and energy characteristics also included (not shown): female, gender, children <14, majority origin, employment status, education, income, voting, urban, availability of public transport, heating and gasoline expenses, car dependency, flies at least once a year, works in polluting sector, is homeowner.

The distributional dimension is critical.

What sources of funding do you find appropriate for public investments in green infrastructure? (Multiple answers are possible)

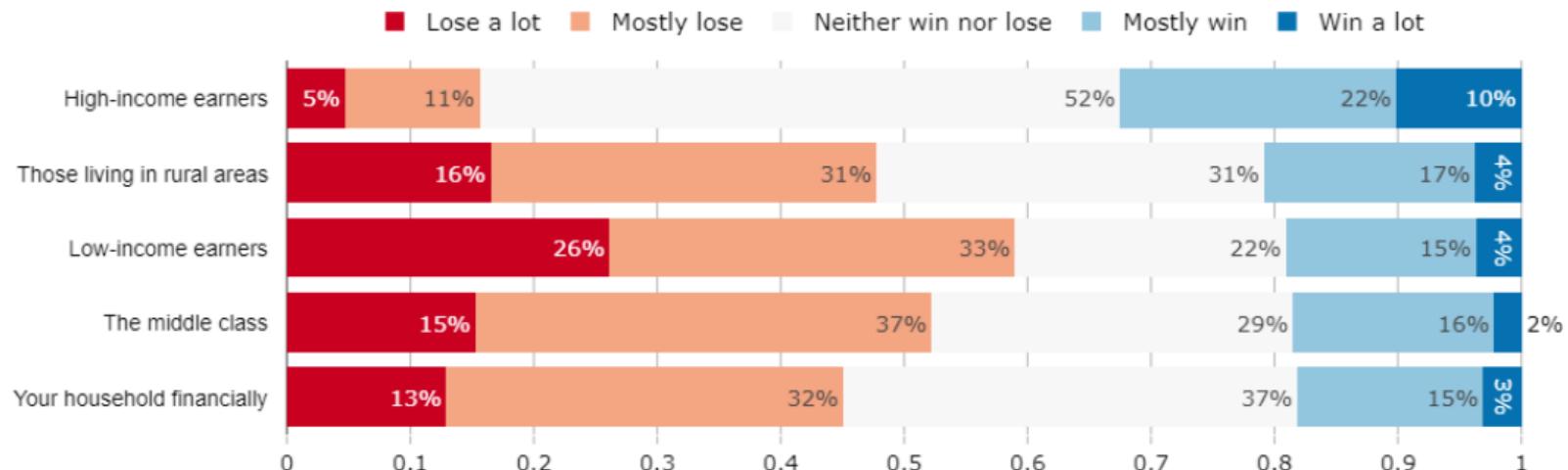


How important are the factors below in order for you to adopt a sustainable lifestyle (i.e. limit driving, flying, and consumption, cycle more, etc.)?



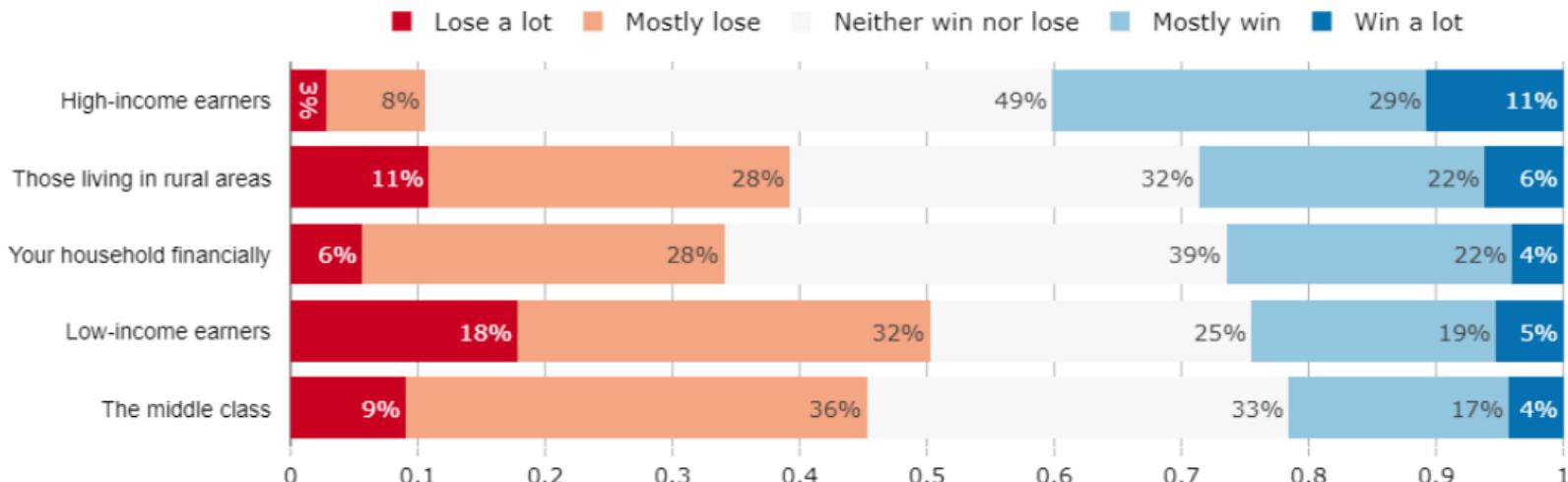
Carbon tax with cash transfers viewed as regressive

In your view, would the following groups win or lose under a carbon tax with cash transfers?



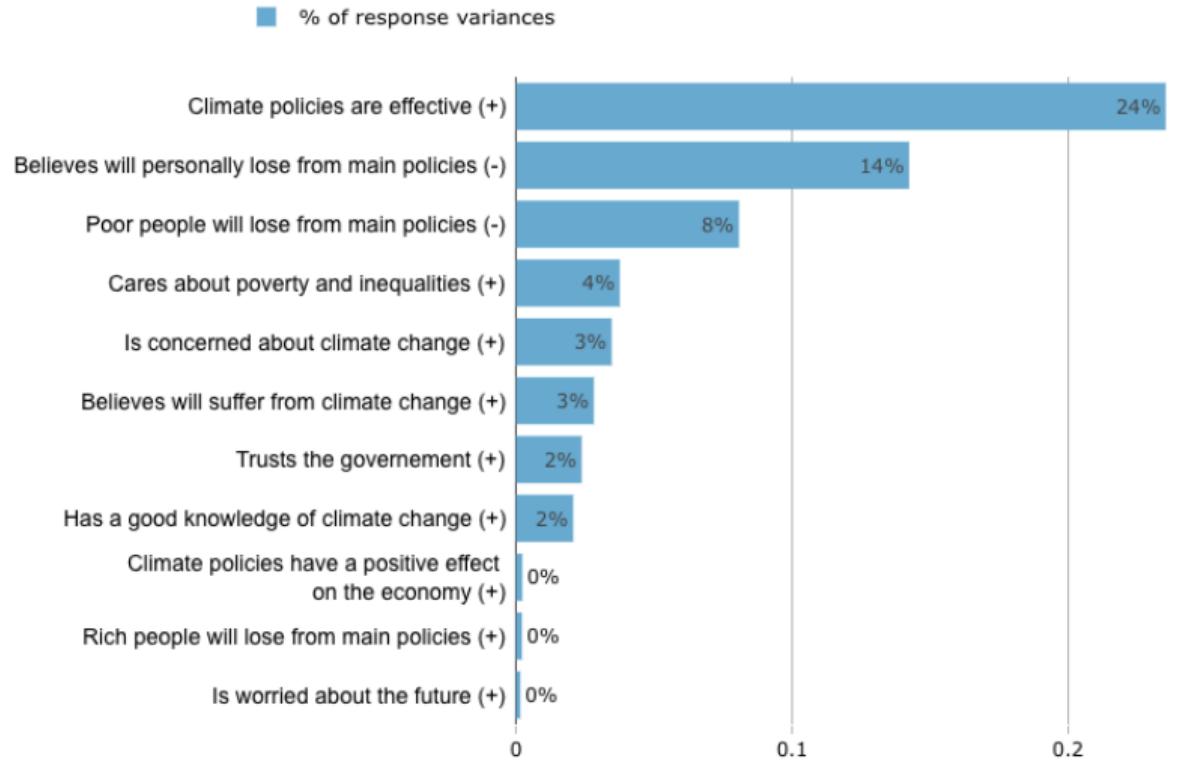
Green infrastructure program viewed as regressive

In your view, would the following groups win or lose with a green infrastructure program?



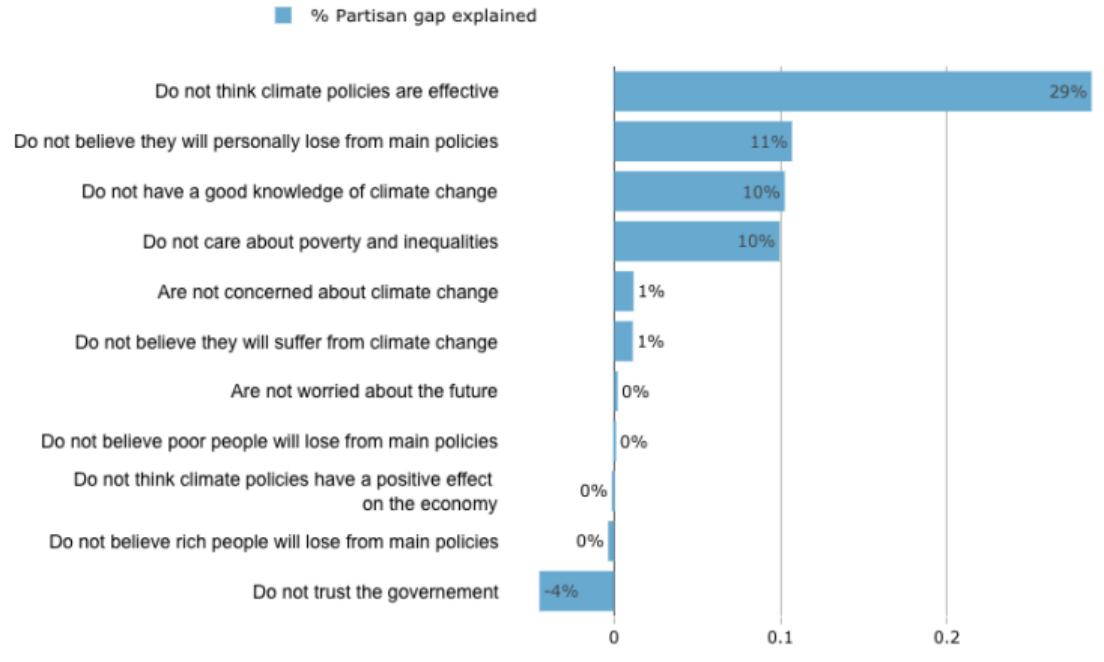
Variance Decomposition of Policy Support – Mechanisms

$R^2 = 60.94\%$



Explaining the partisan gap – Gelbach decomposition

Non-left voters support less climate policies, because they...

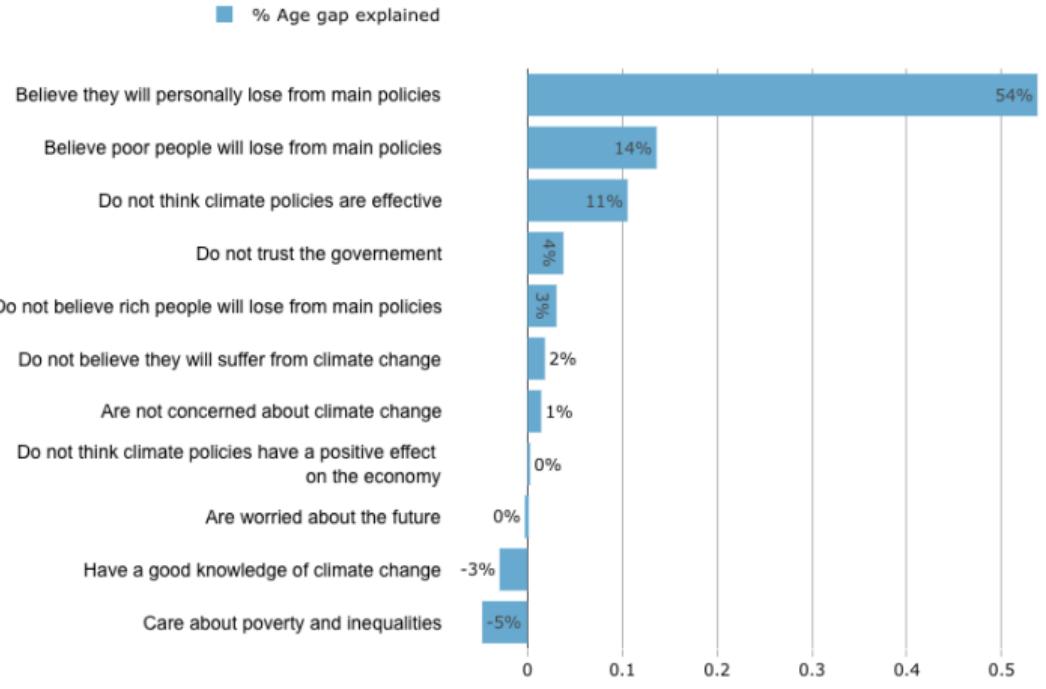


Notes: Each bar indicates the share of the partisan gap explained by each of the factors for the *index main policies*.

The unexplained share is 44%. Coefficient of left voters indicator variable in partial model is .229, and .104 in full model.

Explaining the age gap – Gelbach decomposition

People above 35 support less climate policies, because they...

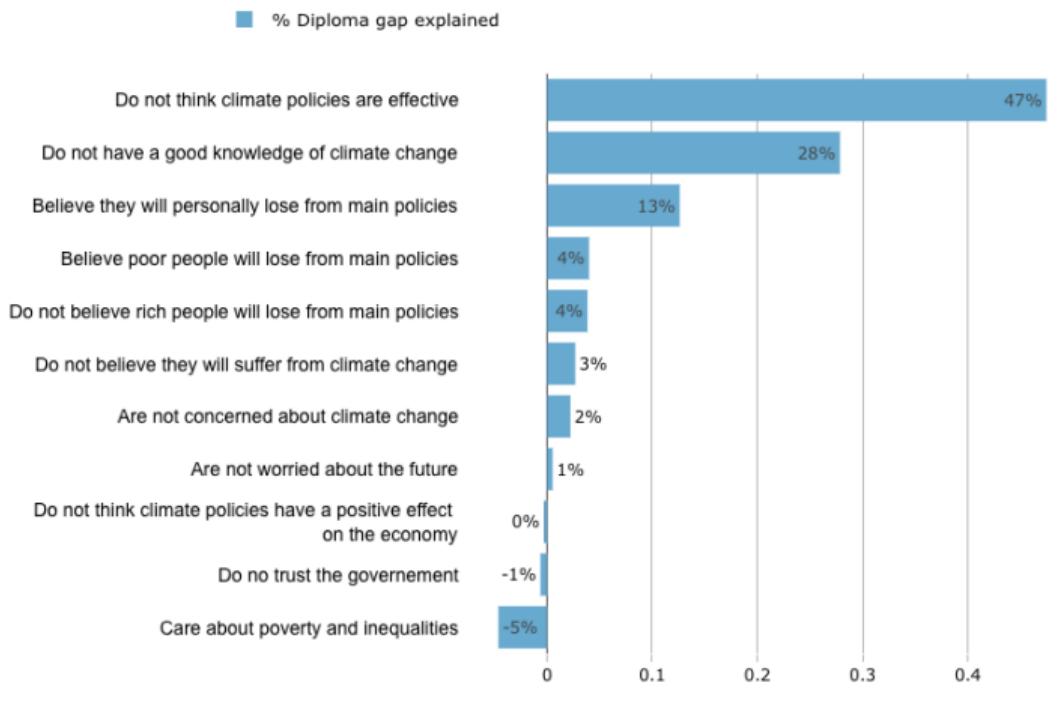


Notes: Each bar indicates the share of the age gap explained by each of the factors for the *index main policies*.

The unexplained share is 17%. Coefficient of young indicator variable in partial model is .176, and .031 in full model.

Explaining the education gap – Gelbach decomposition

People without a college degree support less climate policies, because they...

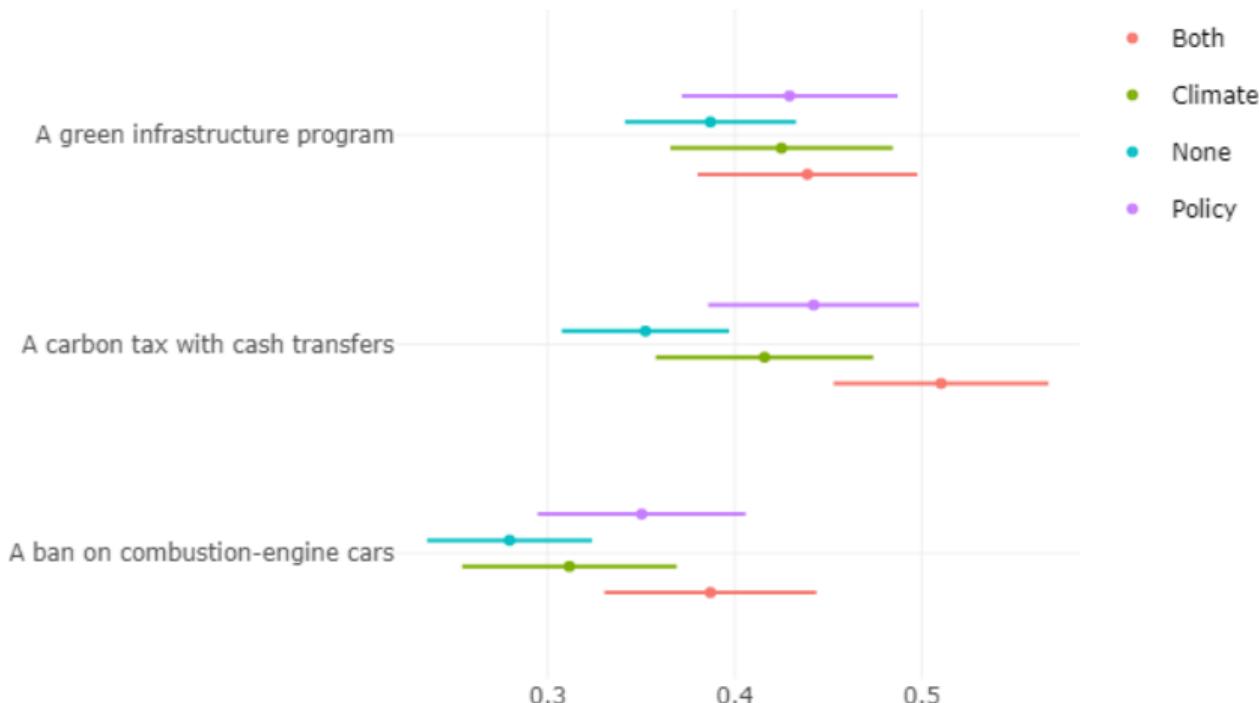


Notes: Each bar indicates the share of the diploma gap explained by each of the factors for the *index main policies*.

The unexplained share is 0%. Coefficient of college indicator variable in partial model is .128, and .004 in full model.

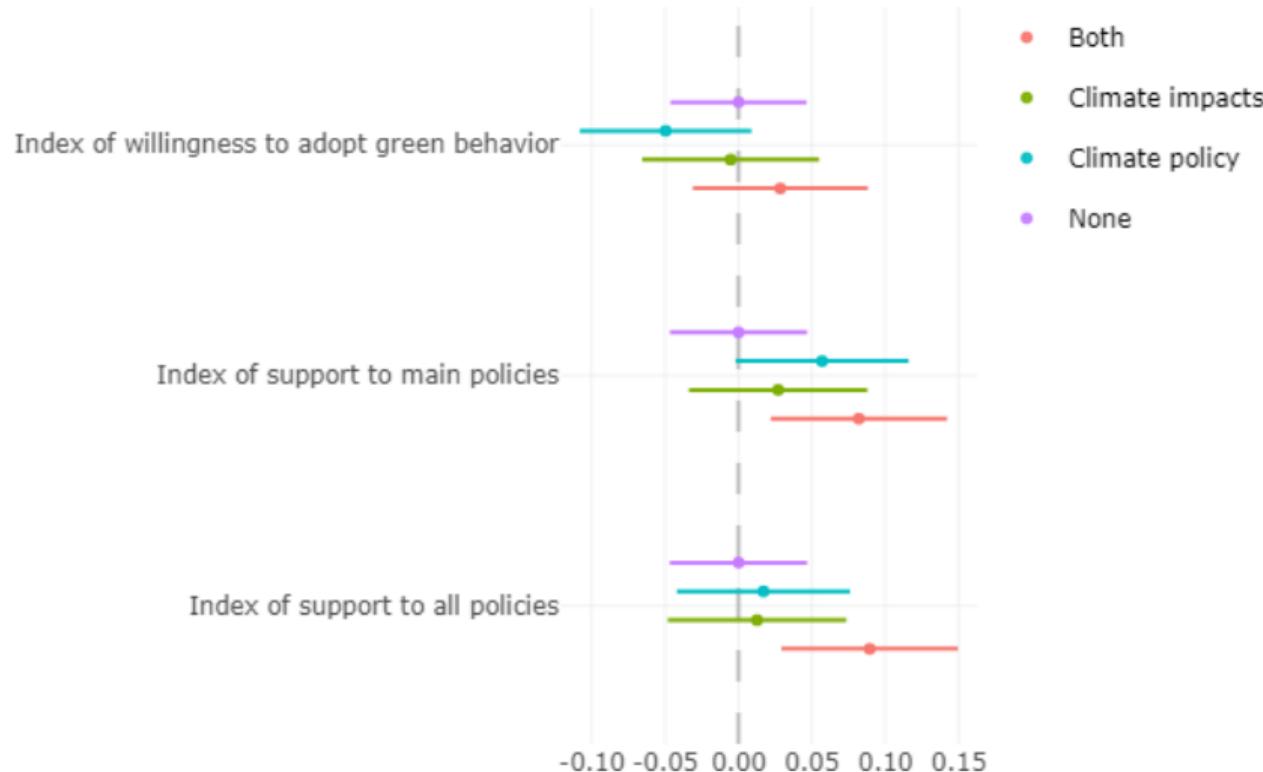
Can information change attitudes?

Treatment effects (of watching informational videos) in regressions of support for the main policies on the set (A) of socio-demographics.



Can information change attitudes?

Treatment effects (of watching informational videos) in regressions of indices of support and willingness to change on the set (A) of socio-demographics.



Conclusion

Key take-home messages for policy-making

Widespread concern for climate change and large support for global climate policies.

Majority support for a green infrastructure program

Mixed support for a carbon tax with cash transfers and a ban of combustion-engine cars.

Attitudes are largely idiosyncratic.

Availability of decarbonized alternatives like public transport is key.

The distributional fairness of the policy package is critical for the acceptance of many people.

⇒ Make sure the policy package is progressive, and that people understand that.

Information can improve understanding of a carbon tax with cash transfers, and thereby increase support.

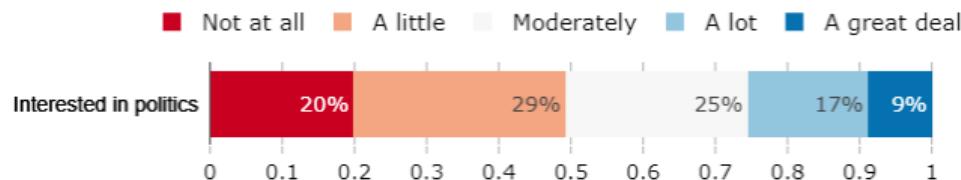
Appendix

Descriptive statistics on the control group

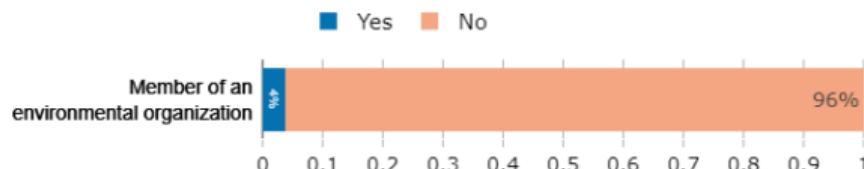
Households characteristics

Little interest for politics

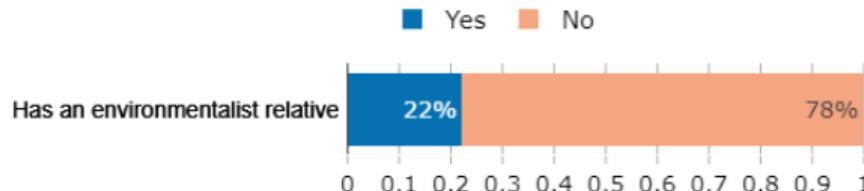
To what extent are you interested in politics?



Are you member of an environmental organization?

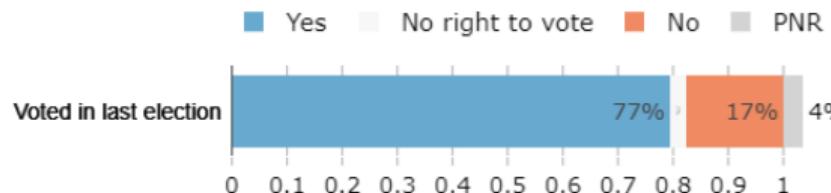


Do you have any relatives who are environmentalists?

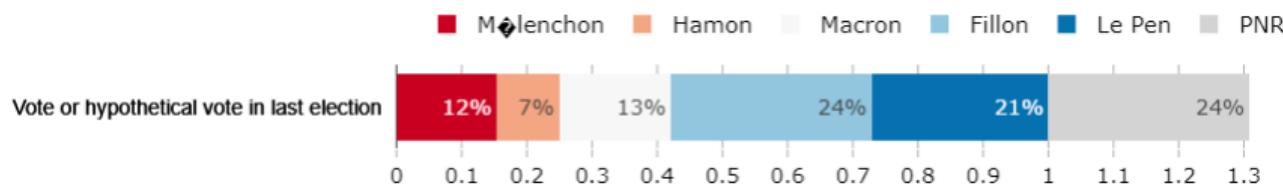


Broadly representative political leaning

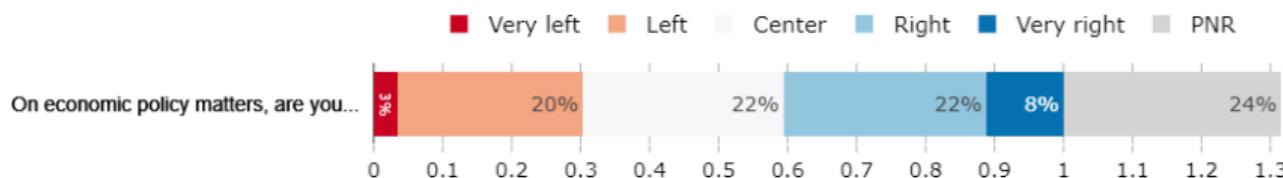
Did you vote in the 2017 French presidential election?



Which candidate did you vote / would you have voted for in the last presidential election?

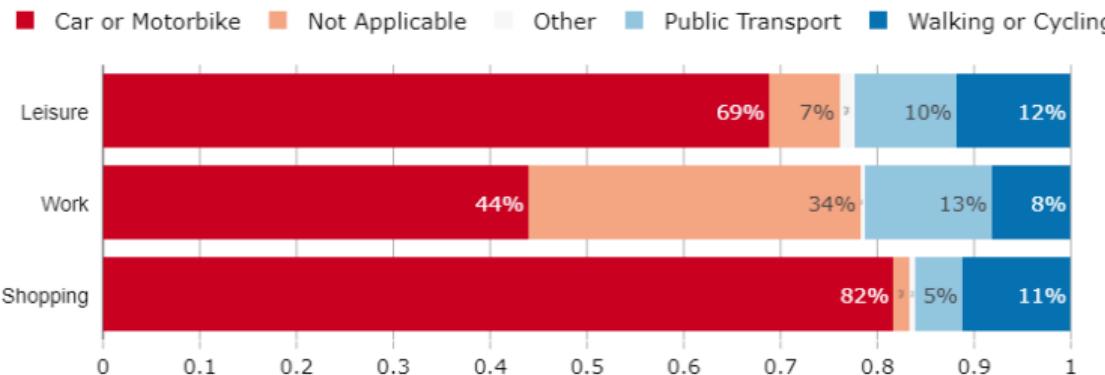


On economic policy matters, where do you see yourself on the left/right spectrum?

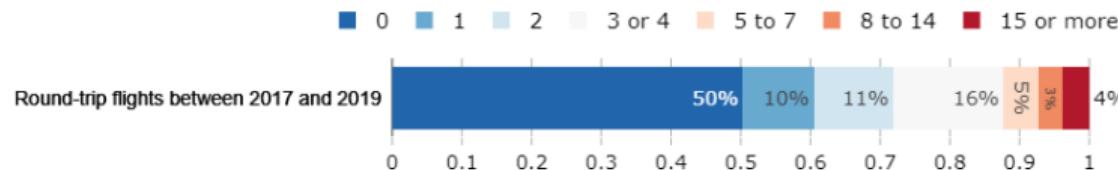


Drivers more than fliers

Which mode of transport did you mainly use for each of the following trips in 2019?



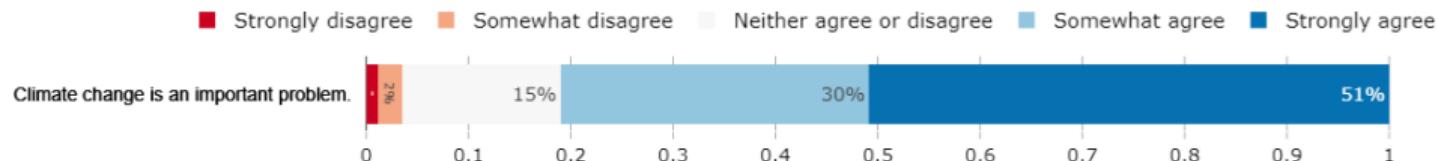
How many round-trip flights did you take between 2017 and 2019?



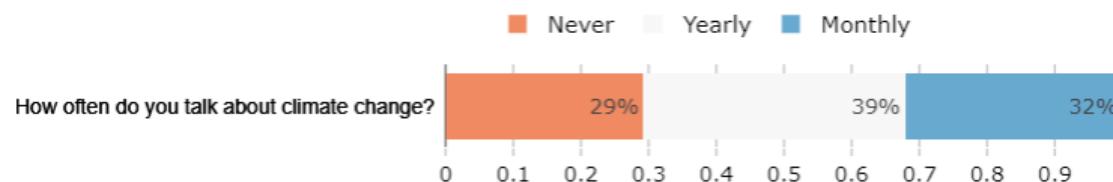
Climate Knowledge

Climate change acknowledged as a serious problem

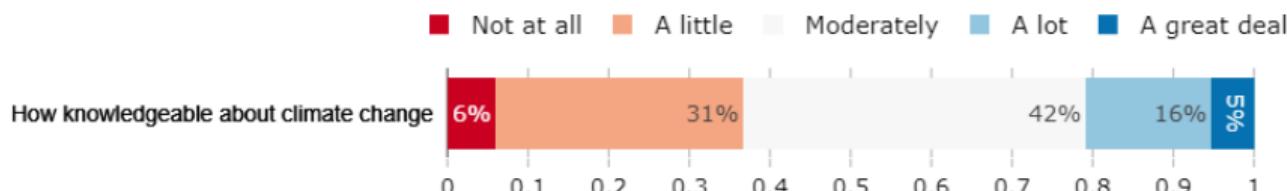
Do you agree or disagree with the following statement: "Climate change is an important problem."



How often do you think or talk with people about climate change?

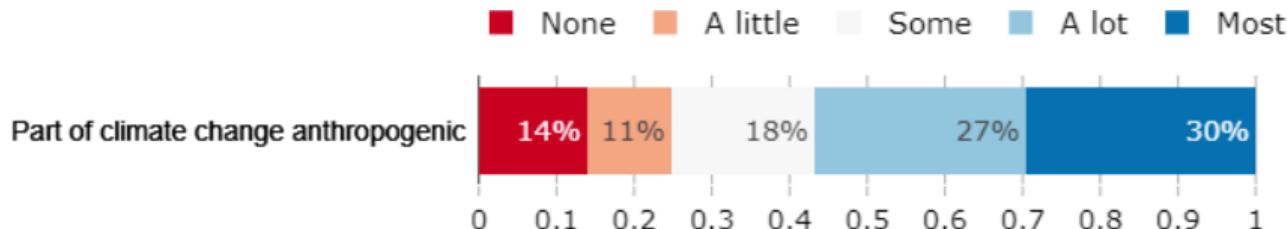


How knowledgeable do you consider yourself about climate change?

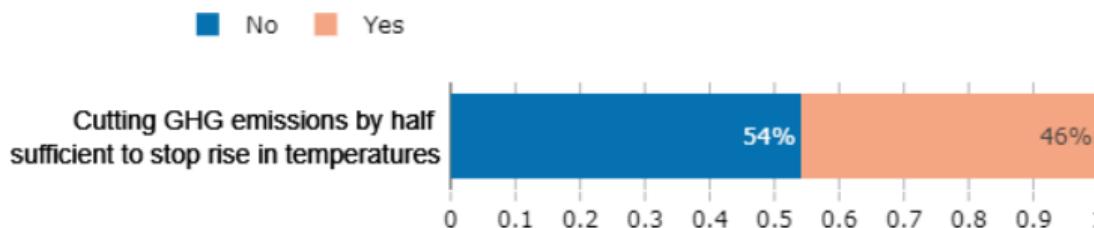


Limited understanding of climate science

What part of climate change do you think is due to human activity? *Right answer: Most*



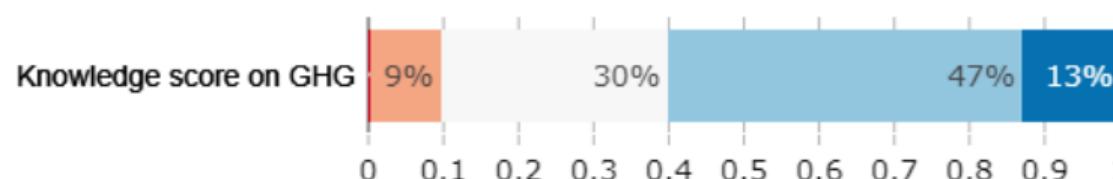
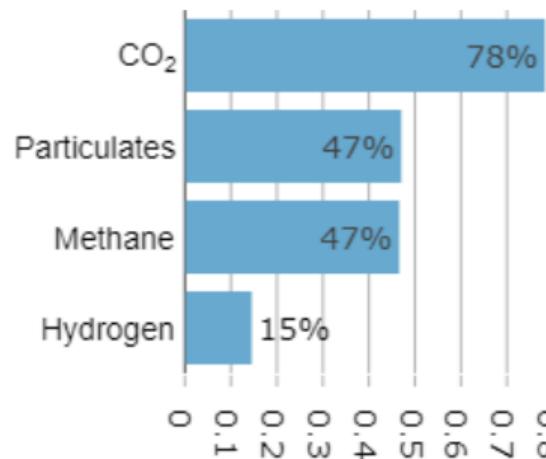
Do you think that cutting global greenhouse gas emissions by half would be sufficient to eventually stop temperatures from rising? *Right answer: No*



Some mistakes on the factors of climate change

Which of the following elements contribute to climate change? (Multiple answers are possible)

Right answer: *CO₂; Methane*

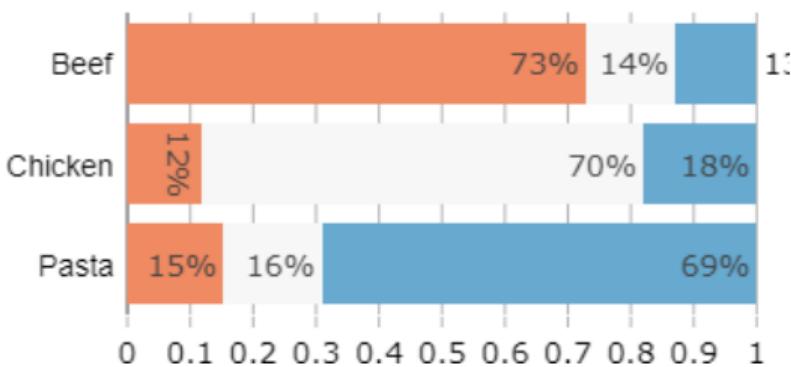


Score on GHG = CO₂ + methane + not hydrogen + not particulates

Which dish emits the most greenhouse gases? We consider that each dish weighs 200g. Please rank the items from 1 (most) to 3 (least).

Right answer: Beef (1), Chicken (2), Pasta (3)

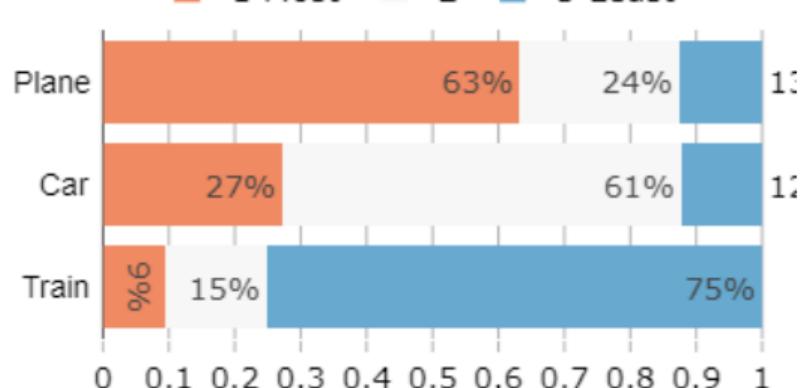
■ 1 Most ■ 2 ■ 3 Least



If a family of 4 travels 800 km from Bordeaux to Nice, with which mode of transportation do they emit the most greenhouse gases? Please rank the items from 1 (most) to 3 (least).

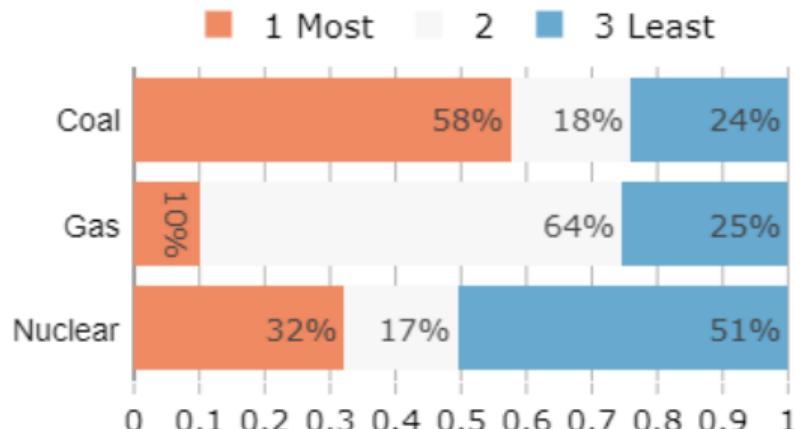
Right answer: Plane (1), Car (2), Train (3)

■ 1 Most ■ 2 ■ 3 Least



Which source of electric energy emits the most greenhouse gases to provide power for a house?

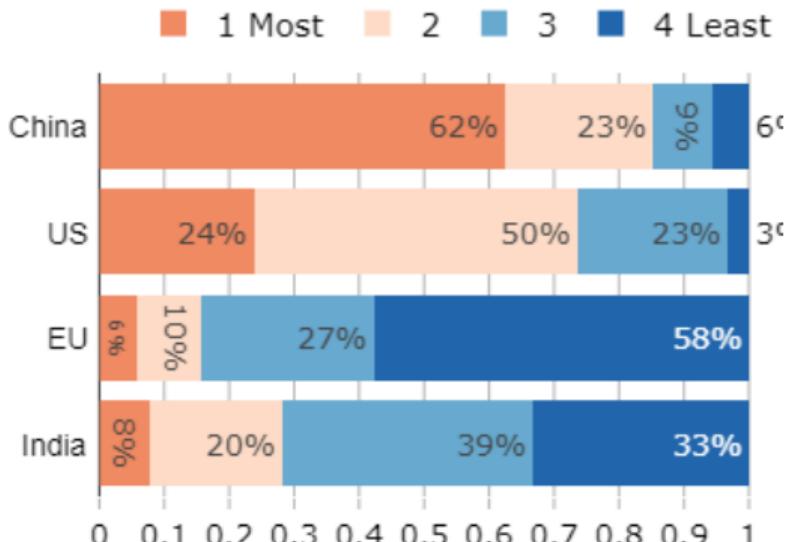
Right answer: Coal (1), Gas (2), Nuclear (3)



Underestimation of EU emissions

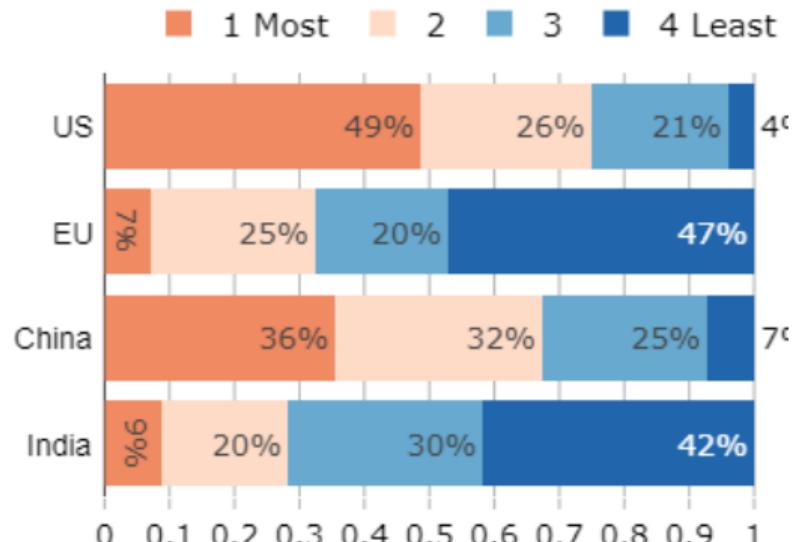
(a) Which region contributes most to global greenhouse gas emissions?

Right answer: China (1), US (2), EU (3), India (4)



(b) In which region does the consumption of an average person contribute most to climate change?

Right answer: US (1), EU (2), China (3), India (4)

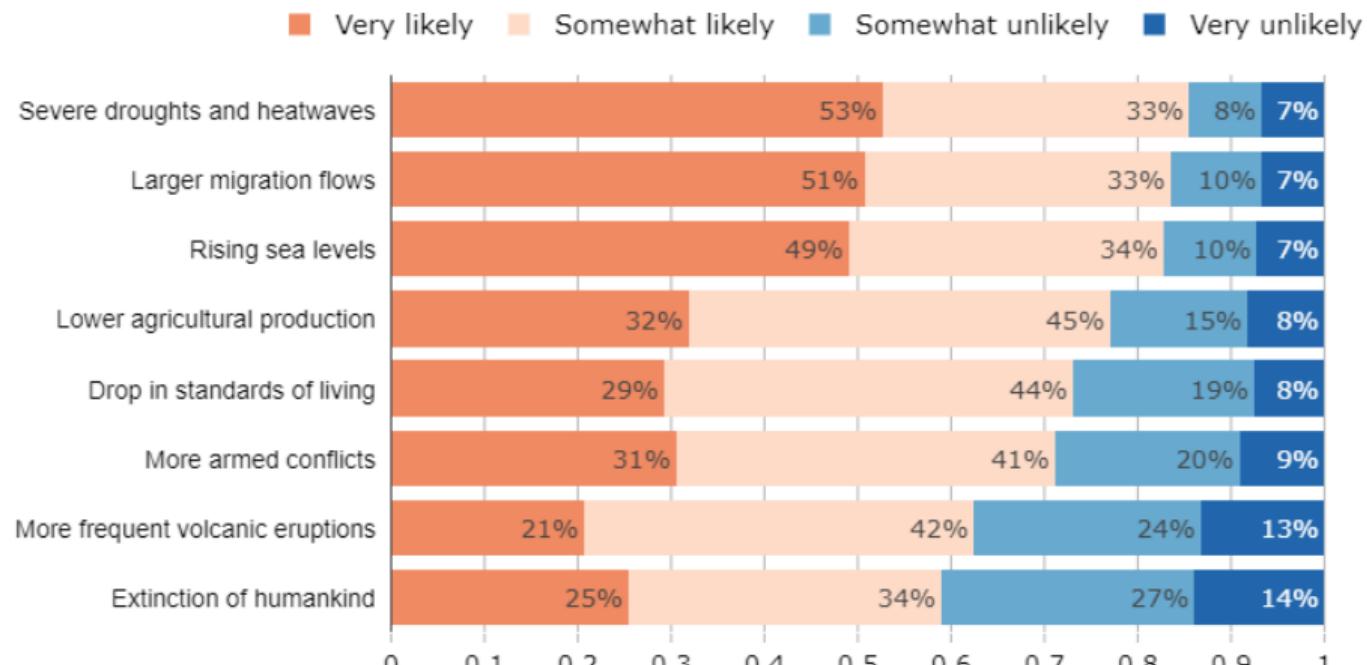


Impacts of climate change: Credit a lot of effects

If nothing is done to limit climate change, how likely do you think it is that climate change will lead to the following events?

Right answer: Very likely: Severe droughts and heatwaves; Rising sea levels

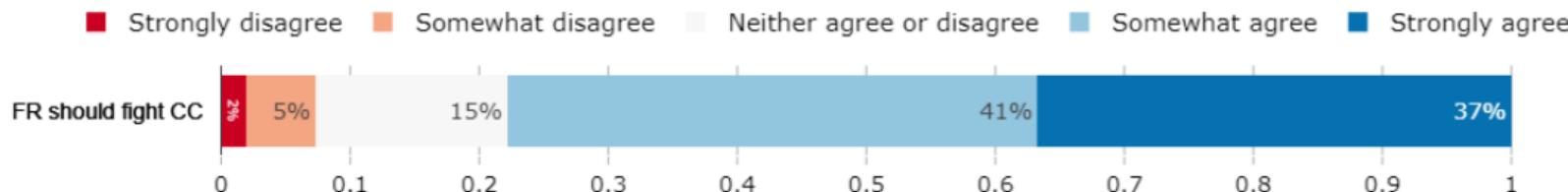
Very unlikely: More frequent volcanic eruptions (No scientific certainty on the other items)



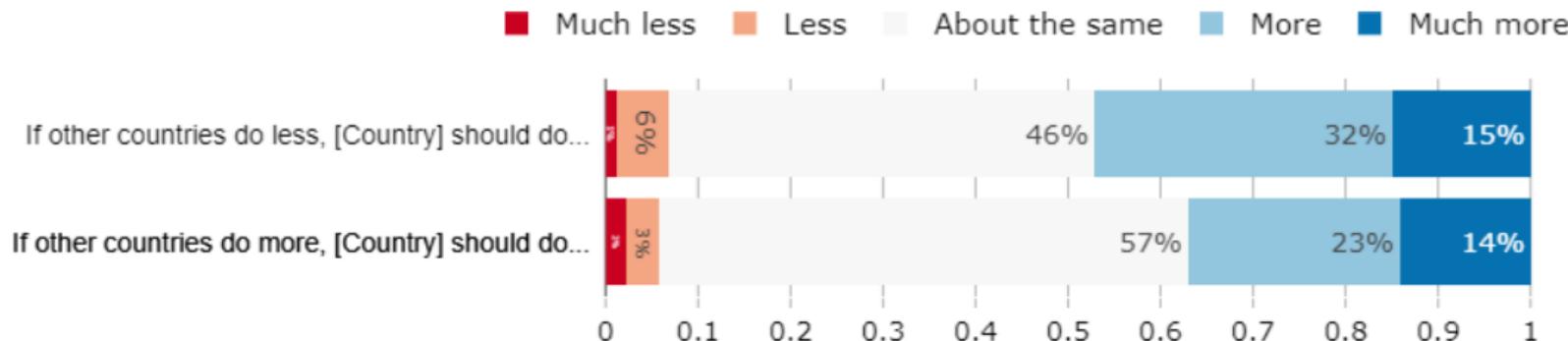
Climate Attitudes

In principle, high support for climate action

Do you agree or disagree with the following statement: "France should take measures to fight climate change."

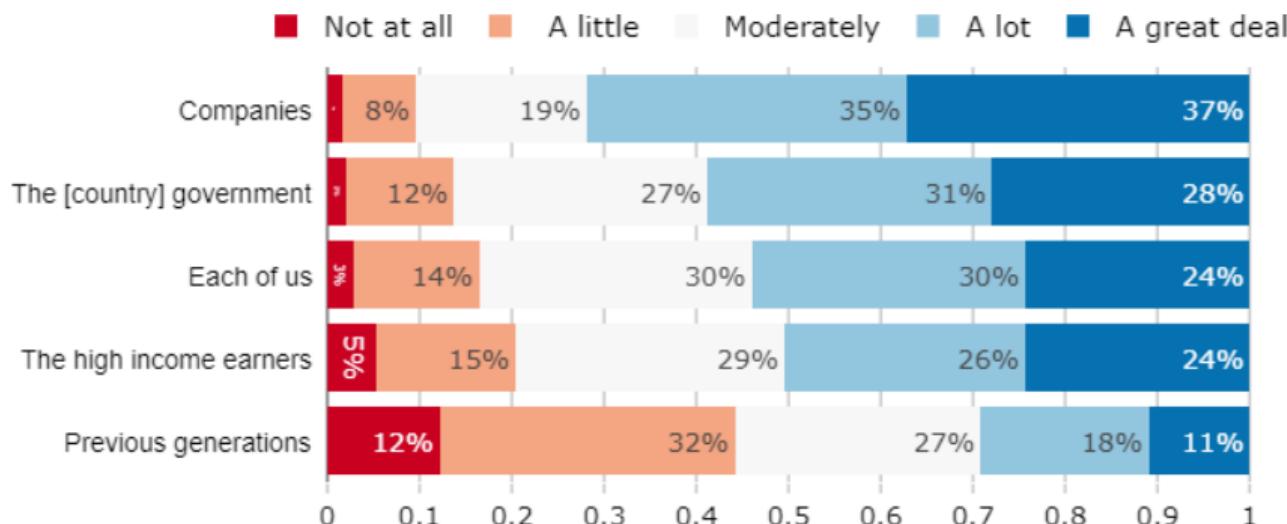


How should French climate policies depend on what other countries do?



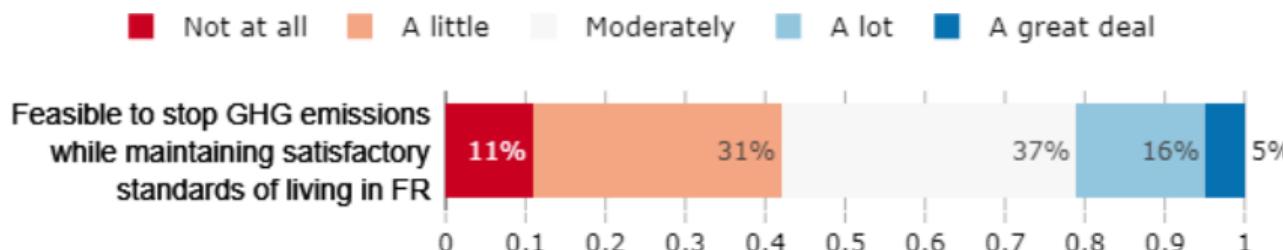
Companies held responsible

To what extent are the following groups responsible for climate change in France?

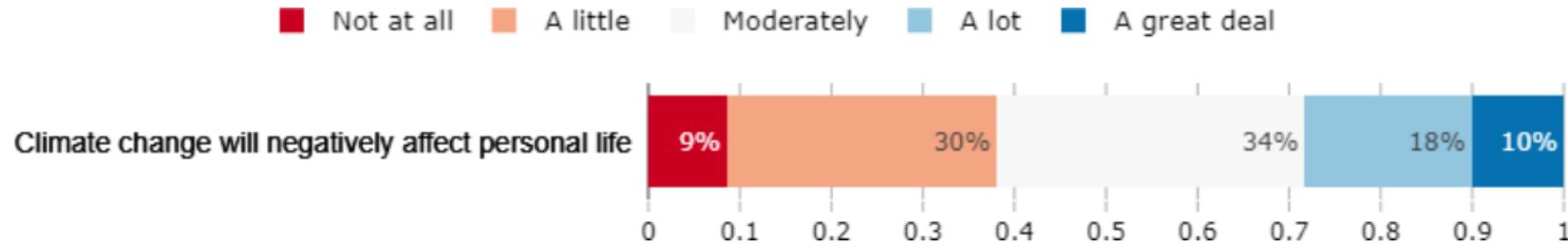


Balance between optimistic and pessimistic

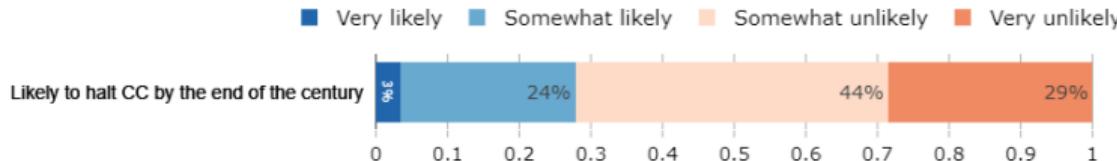
To what extent do you think that it is technically feasible to stop greenhouse gas emissions while maintaining satisfactory standards of living in France?



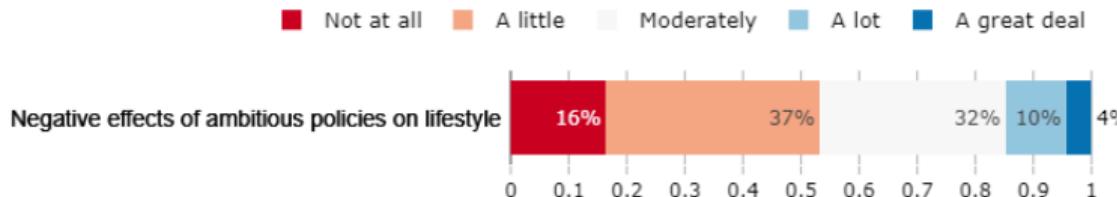
To what extent do you think climate change already affects or will negatively affect your personal life?



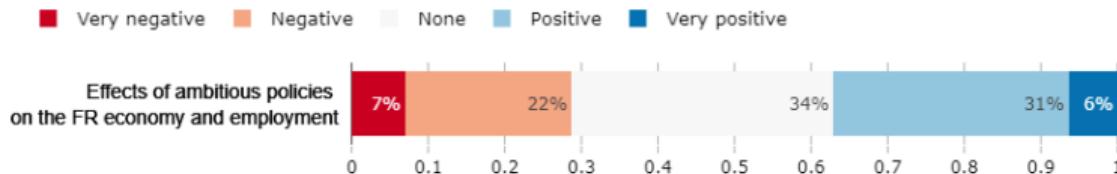
How likely is it that human kind halt climate change by the end of the century?



If we decide to halt climate change through ambitious policies, to what extent do you think it would negatively affect your lifestyle?

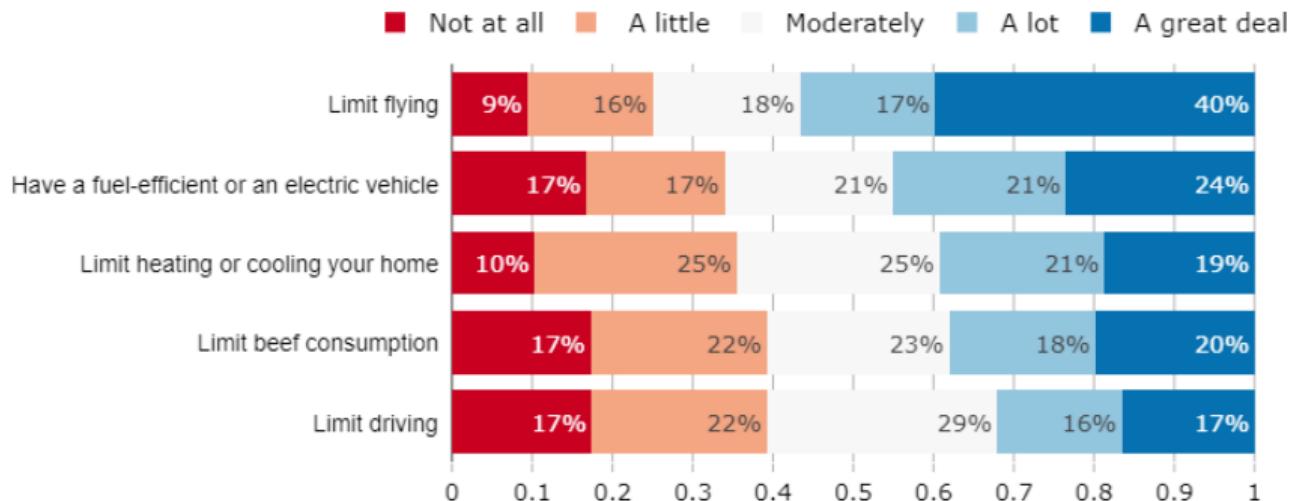


If we decide to halt climate change through ambitious policies, what would be the effects on the French economy and employment?



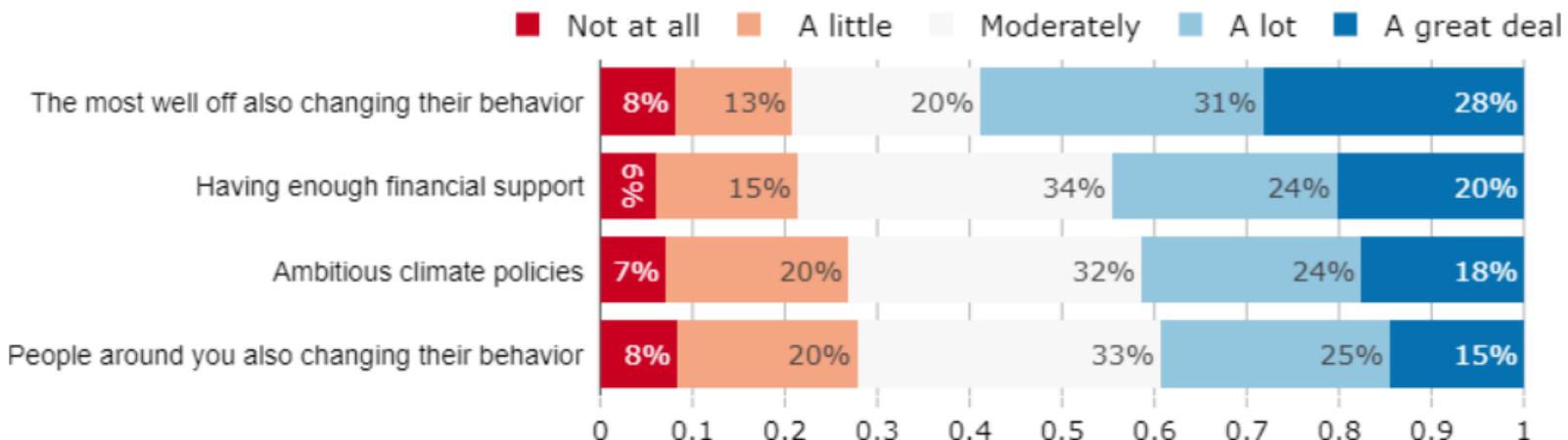
Willing to adopt the less restrictive behaviors

Here are possible habits that experts say would help reduce greenhouse gas emissions. To what extent would you be willing to adopt the following behaviors?



Main factor needed to change lifestyle: fairness

How important are the factors below in order for you to adopt a sustainable lifestyle (i.e. limit driving, flying, and consumption, cycle more, etc.)?



French people more pessimistic than Danish and Americans

Average answer on different questions recoded as [-2;+2].

	Australia	Canada	Denmark	France	Germany	Italy	Japan	Mexico	Poland	South Korea	Spain	Turkey	United Kingdom	United States	Brazil	China	India	Indonesia	South Africa	Uk
Feels affected by climate change	-0.2	0.1	-0.5	-0.1	0.1	0.4	0.3	0.8	0.4	0.9	0.4	1	0	0	0.7	0.6	1.2	0.8	0.7	0.4
Net zero by 2100 feasible	0.2	0	0	-0.3	0	0.2	-0.3	0.4	0.1	0.2	0.3	0.1	0	0.1	0.2	0.8	1	0.6	0.2	0.1
Likely that climate change ends by 2100	-0.1	-0.3	-0.4	-0.7	-0.6	-0.3	-0.5	0	-0.2	-0.1	-0.2	0.4	-0.3	-0.3	0	0.9	1.2	0.9	0.1	-0.2
World in 100 years will be richer	-0.3	-0.4	0	-0.5	-0.5	-0.6	-0.5	-0.4	-0.2	-0.4	-0.6	-0.6	-0.3	-0.2	-0.4	0.8	0.9	0.6	-0.4	-0.2

Comparison across the 3 Policies:

Policies precisely described

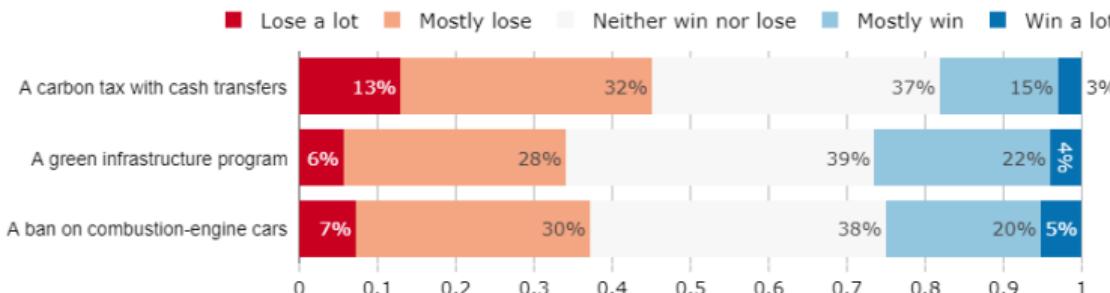
Ban on Combustion Engine Cars: To fight climate change, car producers can be required by law to produce cars that emit less CO₂ per km of the cars they sell. The emission limit is lowered every year so that only electric or hydrogen vehicles can be sold after 2030. This policy is called a *ban on combustion-engine cars*.

Green Infrastructure Program: A green infrastructure program is a large public investment program, which would be financed by additional public debt, to accomplish the transition needed to cut greenhouse gases emissions. Investments would concern renewable power plants, public transportation, thermal renovation of building, and sustainable agriculture.

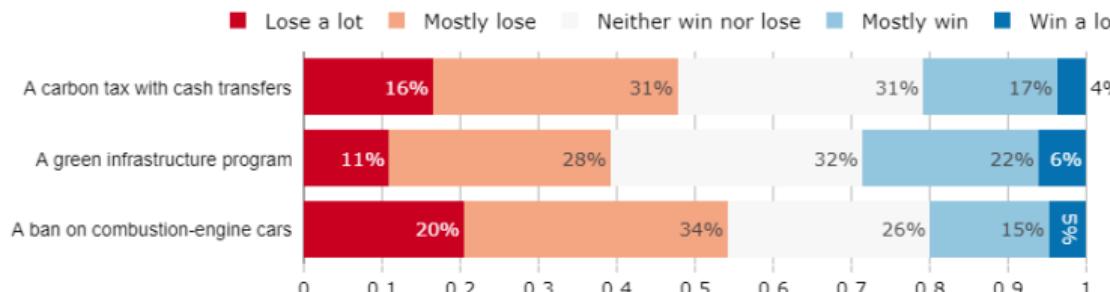
Carbon Tax with Cash Transfers: To fight climate change, the French government can make greenhouse gas emissions costly, to make people and firms change their equipment and reduce their emissions. The government could do this through a policy called a carbon tax with cash transfers. Under such a policy, the government would tax all products that emit greenhouse gas. For example, the price of gasoline would increase by 10 cents per liter. To compensate households for the price increases, the revenues from the carbon tax would be redistributed to all households, regardless of their income. Each adult would thus receive 160€ per year.

Many think they would lose out

Comparison of responses to each policy question: Do you think that financially your household would win or lose from the policy?

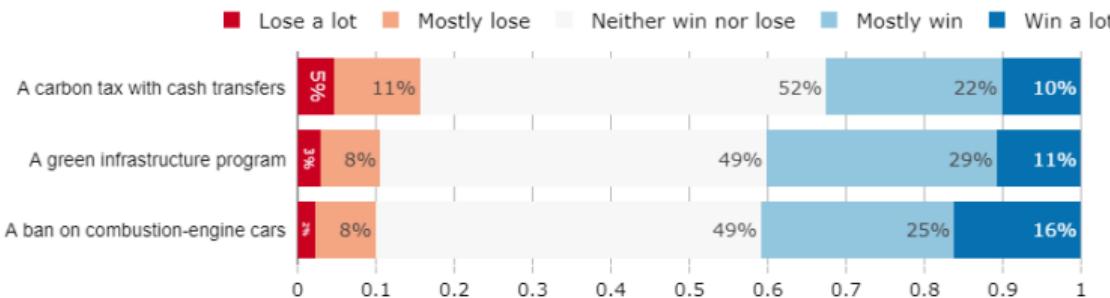


Comparison of responses to each policy question: In your view, would those living in rural areas win or lose from the following policy?

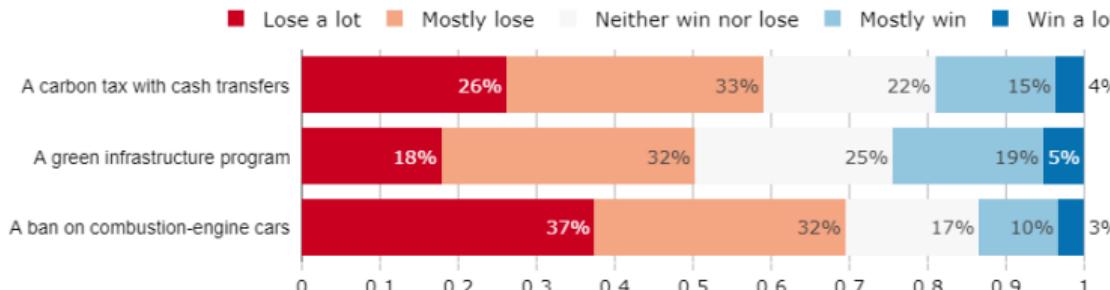


Most view rich winning and poor losing

Comparison of responses to each policy question: In your view, would high-income earners win or lose from the following policy?

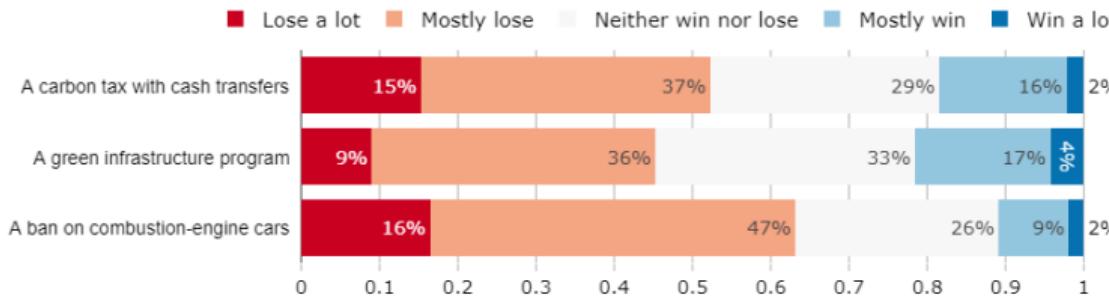


Comparison of responses to each policy question: In your view, would low-income earners win or lose from the following policy?

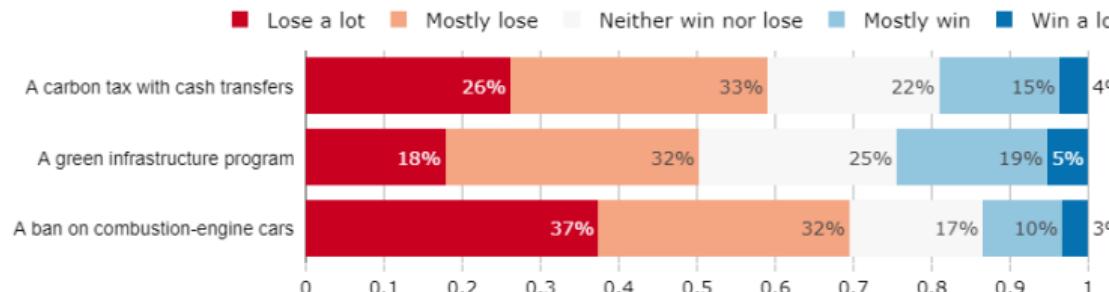


See the middle class gains close to the poor's

Comparison of responses to each policy question: In your view, would the middle-class win or lose from the following policy?

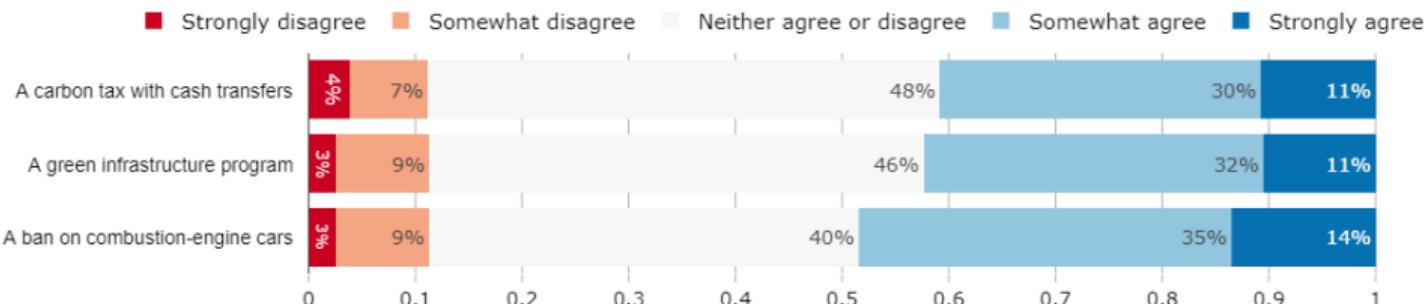


Comparison of responses to each policy question: In your view, would low-income earners win or lose from the following policy?

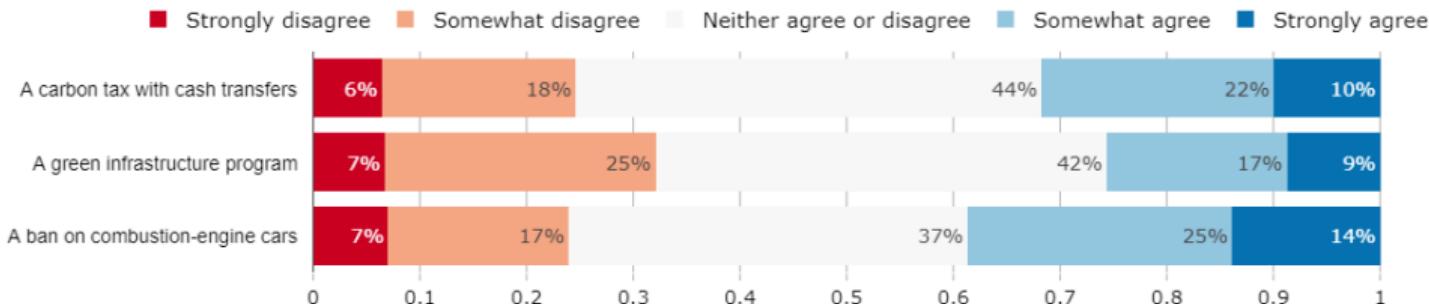


Only investments gather more positive than negative views

*Comparison of responses to each policy question: Do you agree or disagree with the following statement? The policy would have a **large** effect on the French economy and employment.*

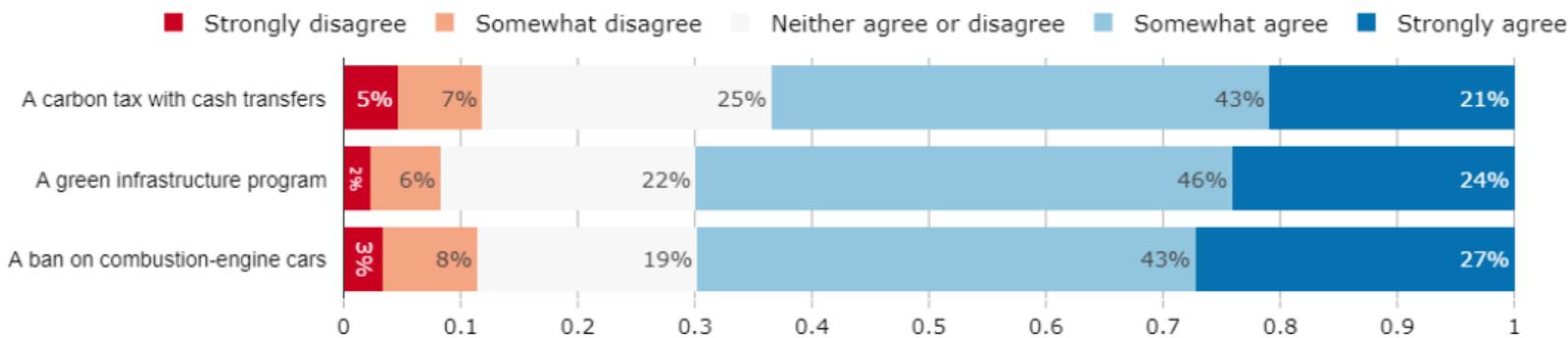
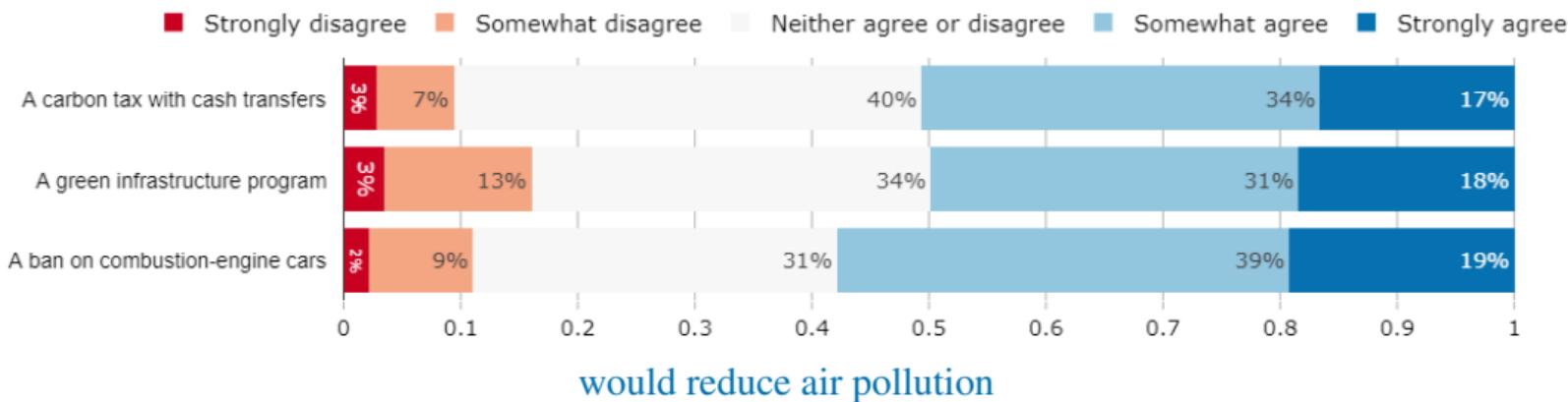


*Comparison of responses to each policy question: Do you agree or disagree with the following statement? The policy would have a **negative** effect on the French economy and employment.*



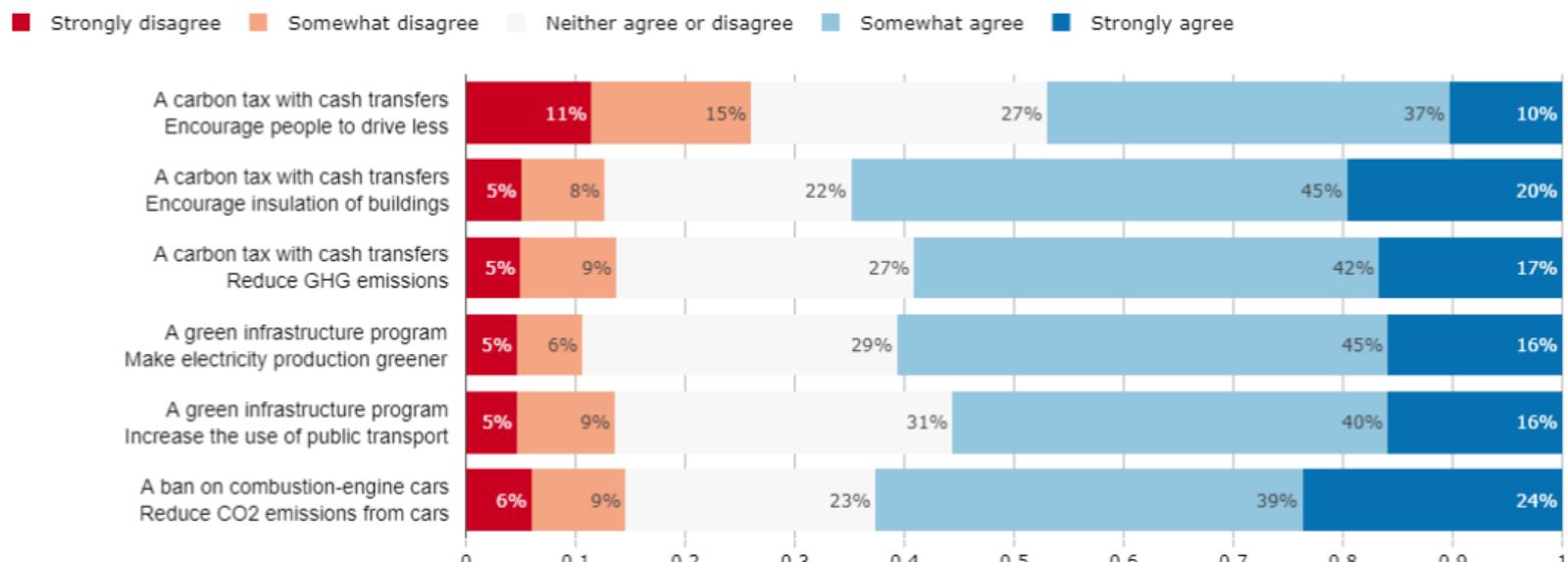
Policies seen as costly but effective

Comparison of responses to each policy question: Do you agree or disagree with the following statement? The policy would be costly to fight climate change



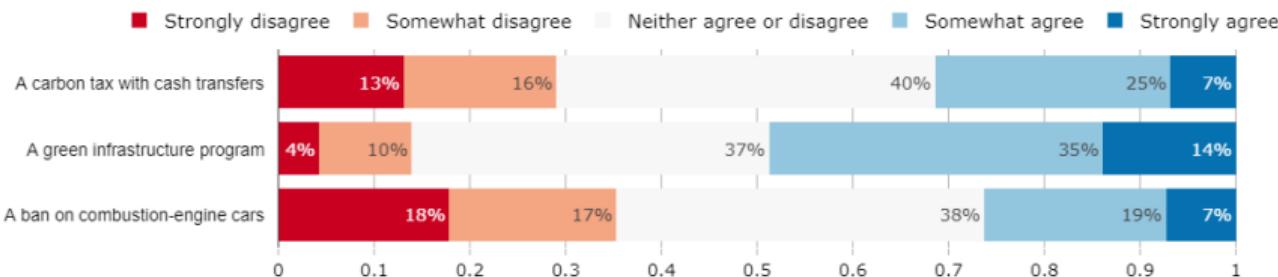
Incentives are acknowledged

Comparison of responses to each policy question: Do you agree or disagree with the following statement? The policy would ...

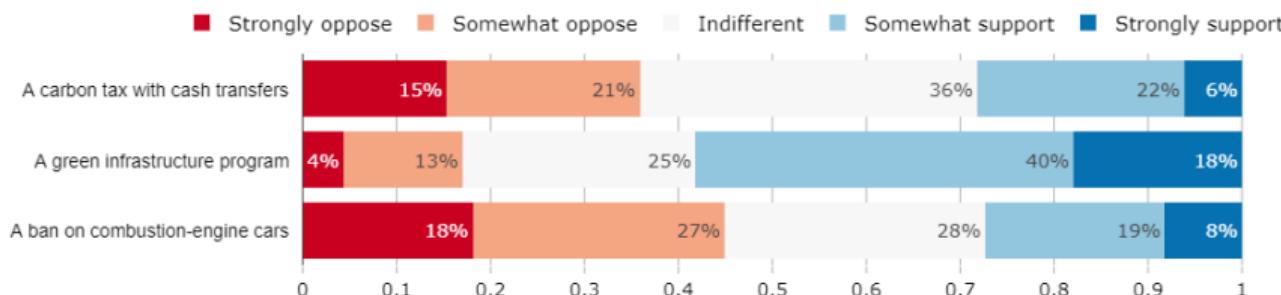


Fairness as main motive for support

Comparison of responses to each policy question: Do you agree or disagree with the following statement: "The policy is fair."

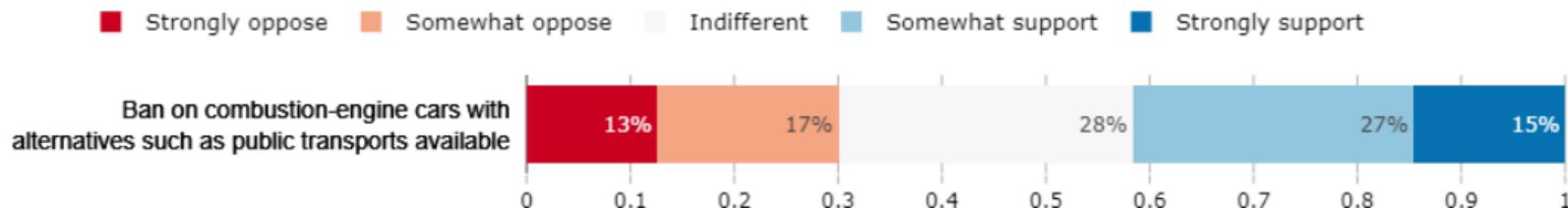


Comparison of responses to each policy question: Do you support or oppose the following policy?

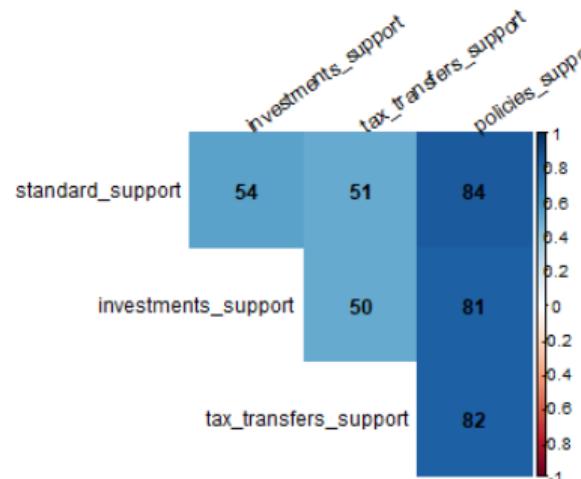


Ban on thermal cars supported if completed by investments

Do you support or oppose a ban on combustion-engine cars where alternatives such as public transports are made available to people?

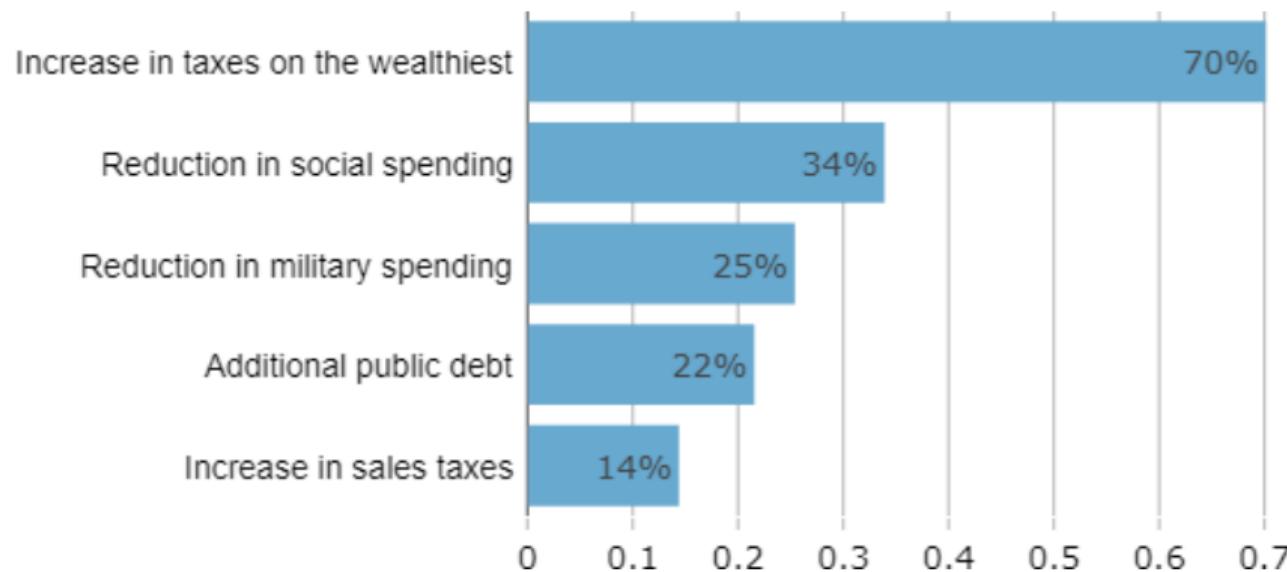


Sizable correlation between support of the 3 policies (coded as [-2;+2]).



Redistributive taxes foster support

Until now, we have considered that a green infrastructure program would be financed by public debt, but other sources of funding are possible. What sources of funding do you find appropriate for a green infrastructure program? (Multiple answers are possible)



French just a little less supportive than Danish, Americans

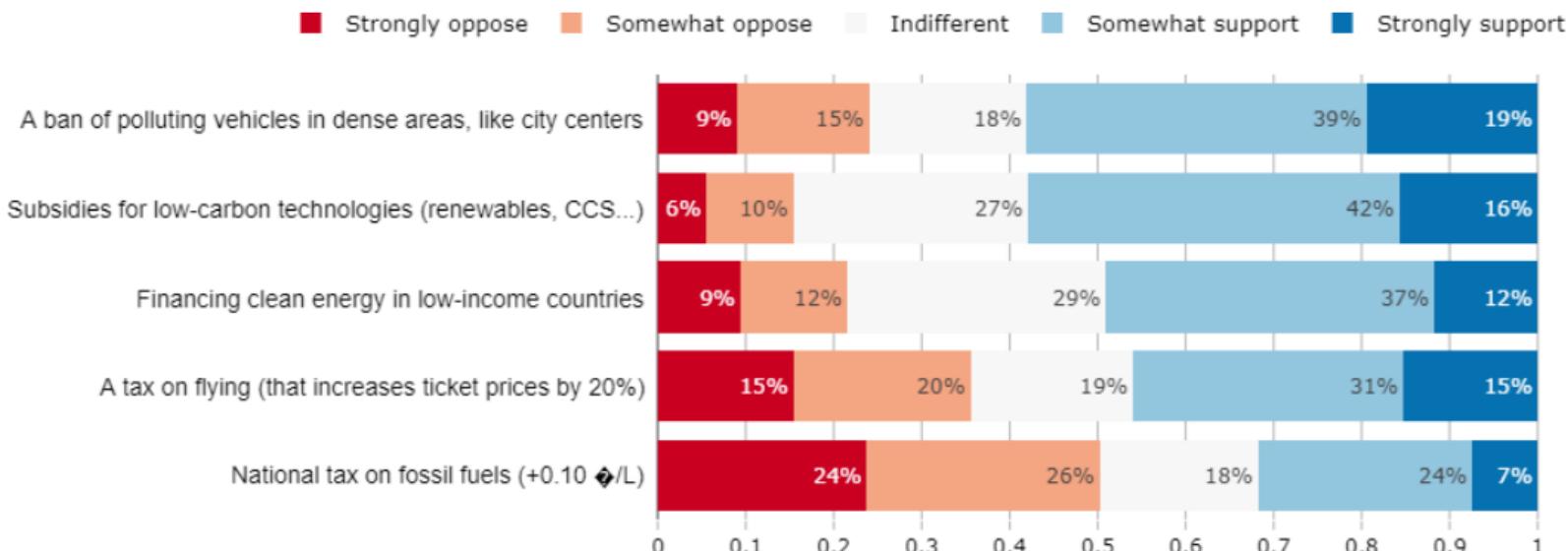
Average answer on different questions recoded as [-2;+2].

	Australia	Canada	Denmark	France	Germany	Italy	Japan	Mexico	Poland	South Korea	Spain	Turkey	United Kingdom	United States	Brazil	China	India	Indonesia	South Africa	Uk
A carbon tax with cash transfers	-0.1	0.1	0	-0.2	-0.3	0.3	0	0.3	0	0.4	0.1	0.5	0.1	0	0.4	0.9	1.2	1	0.5	0
A green infrastructure program	0.4	0.5	0.5	0.5	0.1	1	0.5	1.2	0.6	0.8	0.9	1.1	0.6	0.4	1.1	1.1	1.3	1.3	1	0.6
A ban on combustion-engine cars	0	0.2	0	-0.3	-0.3	0.4	0.2	0.7	0.1	0.3	0.4	0.7	0.2	0	0.8	0.8	1.2	1	0.5	0.1
Ban on combustion cars where public transport made available	0.1	0.3	0.1	0.1	0	0.5	0.4	0.7	0.2	0.6	0.4	0.6	0.4	0.2	0.7	1	1.1	1.1	0.7	0.2

Other Climate Policies

Other policies largely supported

Do you support or oppose the following climate policies?



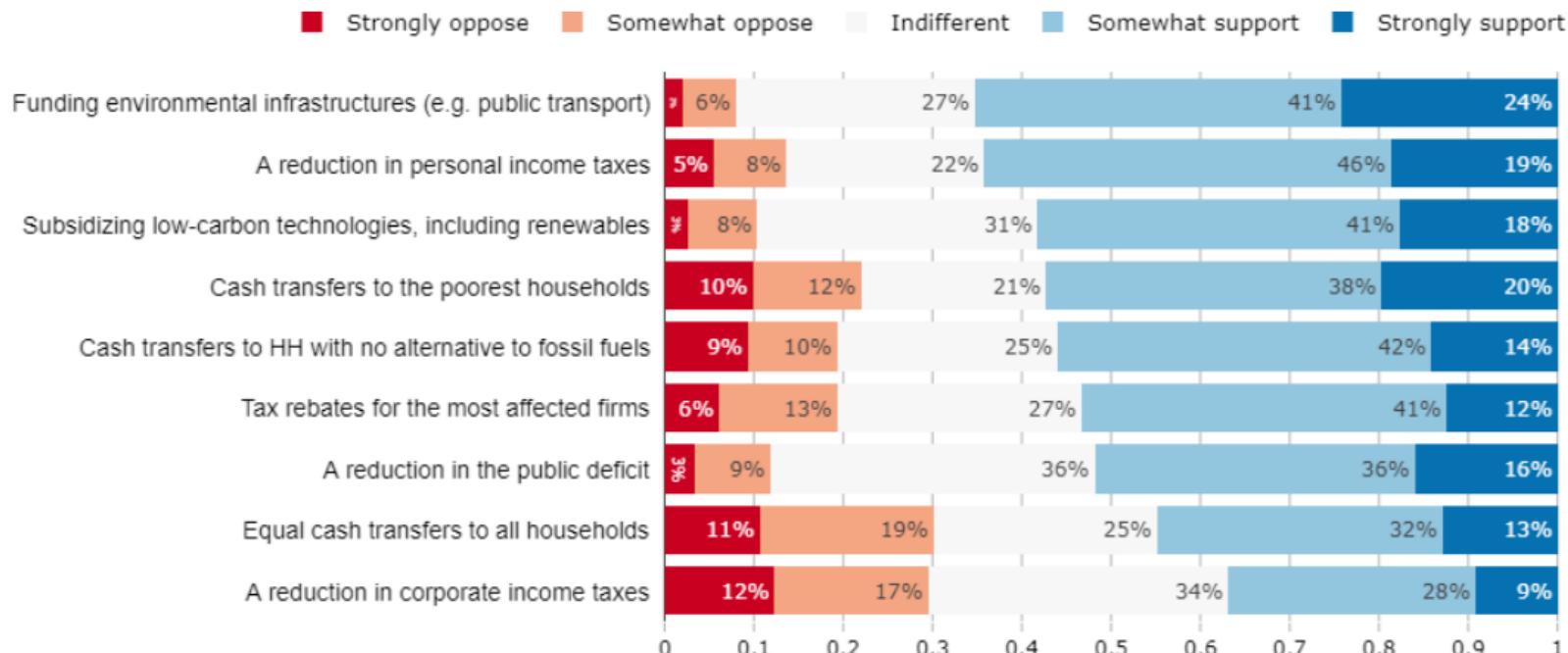
Danish > French > Americans in terms of support for other policies

Average answer on different questions recoded as [-2;+2].

	Australia	Canada	Denmark	France	Germany	Italy	Japan	Mexico	Poland	South Korea	Spain	Turkey	United Kingdom	United States	Brazil	China	India	Indonesia	South Africa	Ukr
Tax on flying (+20%)	-0.1	0.1	0.4	0.1	0.4	0.1	0.2	0.1	0.2	0.1	0.1	0	0.3	-0.2	-0.1	0.7	1	0.9	0	0.2
Tax on fossil fuels (\$45/tCO2)	-0.1	-0.1	0	-0.3	-0.3	-0.1	-0.1	-0.1	-0.3	0.2	-0.1	0.4	0.1	-0.3	-0.1	0.7	1	0.6	0	-0.3
Ban polluting cars in city centers	0.5	0.5	0.7	0.4	0.3	0.9	0.7	0.9	0.7	0.2	0.7	0.5	0.8	0.3	0.8	1	1.2	1.3	0.9	0.7
Subsidies to low-carbon technos	0.6	0.7	0.8	0.5	0.8	1	0.8	0.9	1	0.8	0.9	1	0.8	0.5	1.2	1	1.1	1.2	1.1	1
Funding clean energy in LDC	0.3	0.4	0.4	0.3	0.3	0.9	0.4	0.9	0.5	0.4	0.7	1	0.4	0.2	0.8	0.9	1	1.2	1	0.5

Carbon tax support higher when benefits are made salient

Governments can use the revenues from carbon taxes in different ways. Would you support or oppose introducing a carbon tax that would raise gasoline prices by 10 centimes par litre, if the government used this revenue to finance...



French more supportive of carbon tax than DK, US when benefits are salient

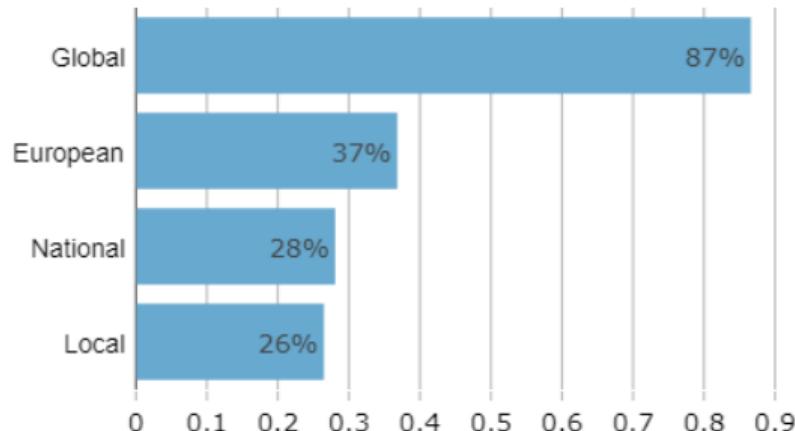
Percentage of somewhat/strongly support for carbon tax depending on revenue use.

	Australia	Canada	Denmark	France	Germany	Italy	Japan	Mexico	Poland	South Korea	Spain	Turkey	United Kingdom	United States	Brazil	China	India	Indonesia	South Africa	Ukraine
Tax with cash transfers	35	39	32	28	27	46	33	51	38	53	43	52	36	32	50	79	81	69	55	38
Cash for constrained HH	50	37	37	56	46	62	43	61	39	54	59	68	53	44	59	73	74	73	60	39
Cash for the poorest	53	42	43	57	47	67	50	64	48	53	59	79	57	44	70	81	77	86	63	48
Equal cash for all	39	37	27	45	31	41	41	57	39	39	45	61	35	36	46	72	75	74	57	39
Reduction in income tax	52	43	39	64	52	71	61	67	70	62	65	72	49	46	68	71	78	74	71	70
Reduction in corporate tax	29	30	25	37	24	53	34	52	49	49	46	63	25	29	54	66	71	66	53	49
Tax rebate for affected firms	44	37	37	53	33	64	47	52	62	58	53	61	41	38	61	74	74	70	66	62
Funding green infrastructure	59	45	60	65	61	75	56	77	71	78	68	74	64	57	79	78	79	81	80	71
Subsidies to low-carbon technos	58	47	53	58	66	76	67	75	73	77	70	70	63	54	72	81	80	80	75	73
Reduction in the deficit	41	37	34	52	41	64	49	60	59	52	62	57	46	47	61	76	77	70	64	39

International Burden-Sharing

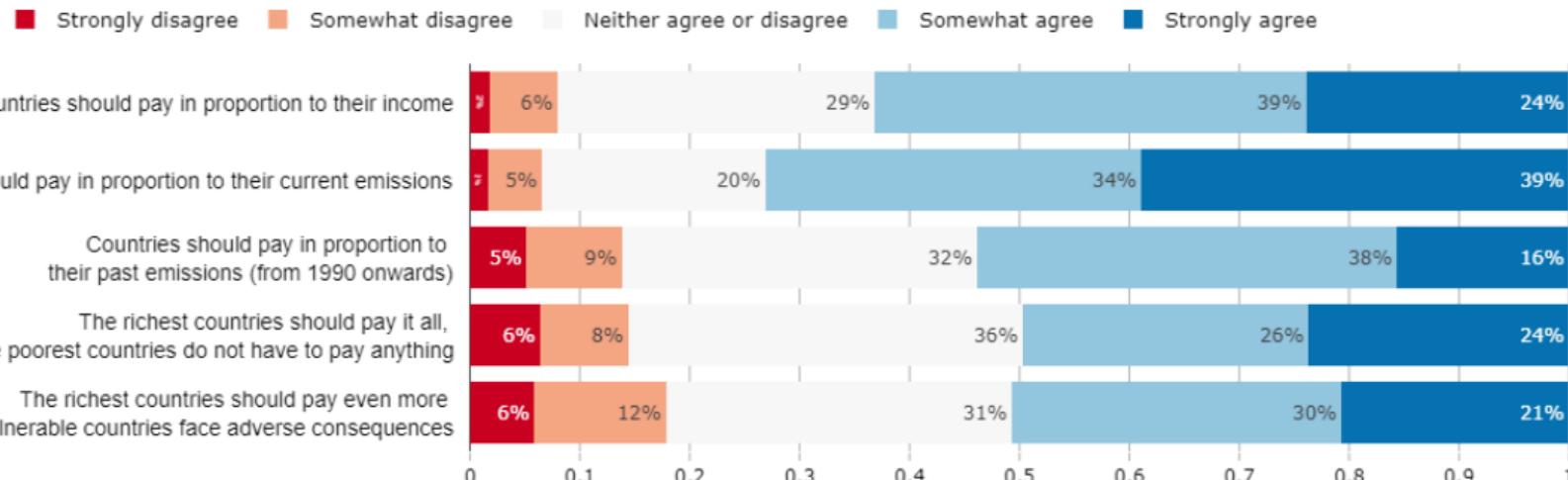
Quasi-unanimous agreement on need for global policies

At which level(s) do you think public policies to tackle climate change need to be put in place? (Multiple answers are possible)



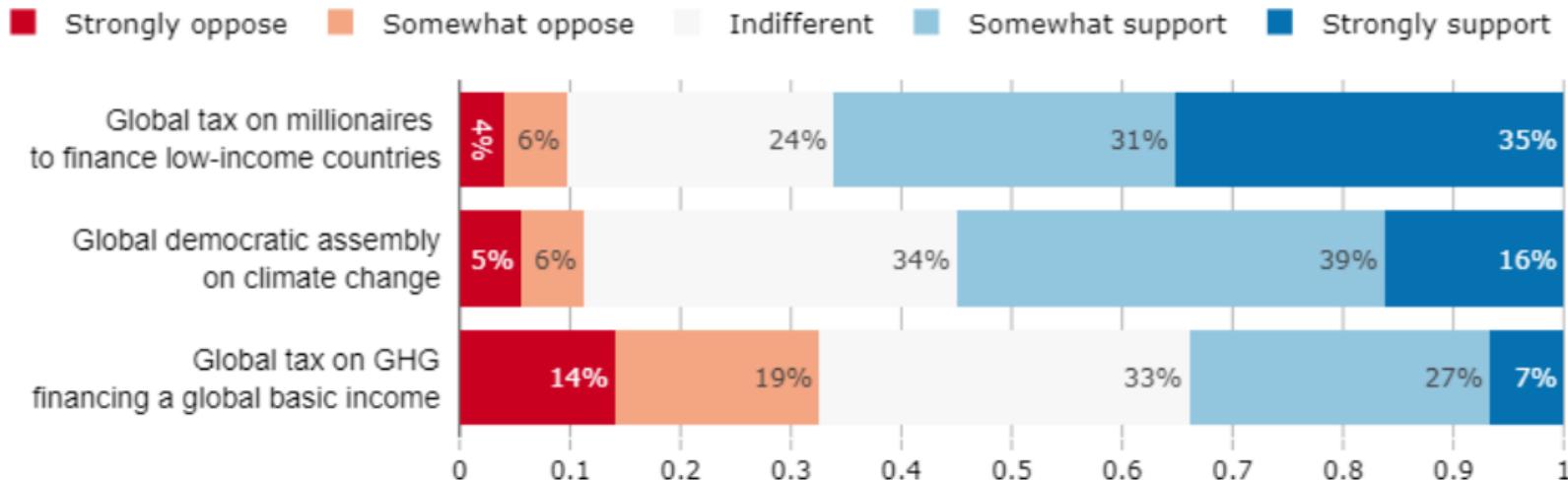
Large support for international transfers

To achieve a given reduction of greenhouse gas emissions globally, costly investments are needed. Ideally, how should countries bear the costs of fighting climate change?



Large support for a fairer global order

Do you support or oppose the following policies?



French people more humanist than Danish and Americans

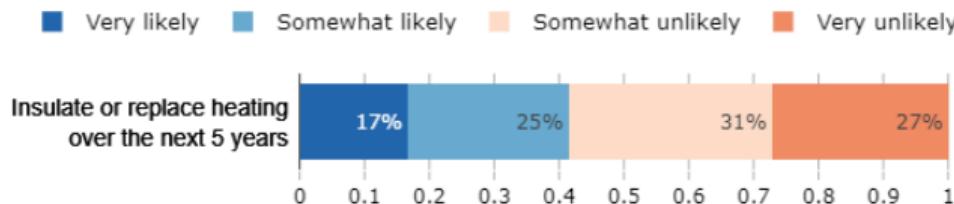
Average answer on different questions recoded as [-2;+2].

	Denmark	France	United States
Level of climate policies needed: global	0.8	0.9	0.7
All countries should pay in proportion to income	0.6	0.8	0.4
All countries should pay in proportion to current emissions	0.6	1	0.8
All countries should pay in proportion to post-1990 emissions	0.1	0.5	0.3
Richest should countries pay it all so poor ones don't pay	-0.4	0.5	-0.3
Richest countries should pay even more to help vulnerable ones	0.2	0.5	0.1
Global democratic assembly on climate change	0.4	0.5	0.3
Global tax on GHG financing a global basic income	0	-0.1	-0.1

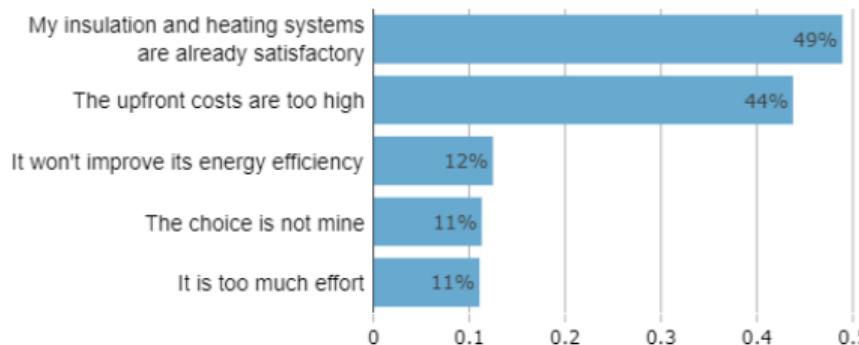
Housing/Preferences for Bans vs. Incentives

Many people ready to insulate if it is paid for

How likely is it that you will improve the insulation or replace the heating system of your accommodation over the next 5 years?



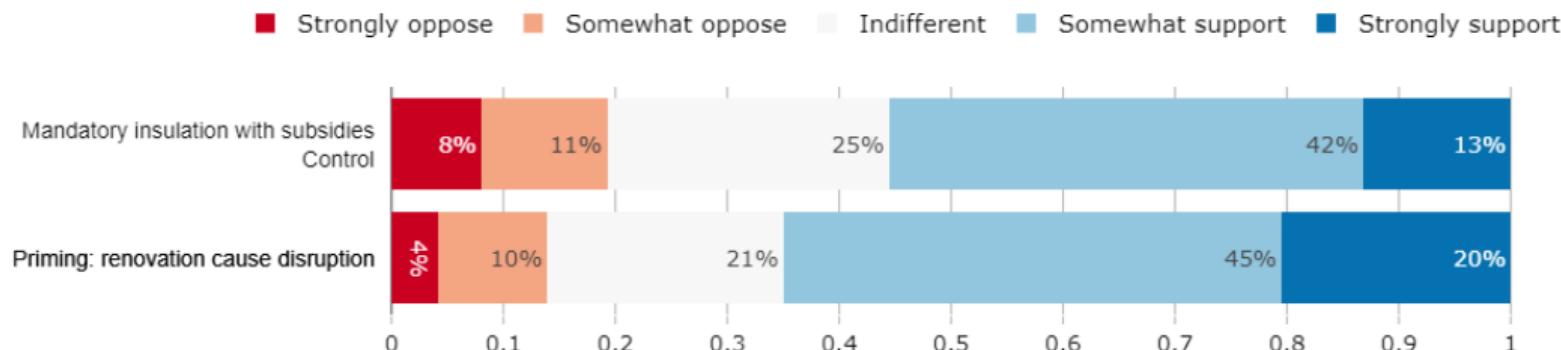
What are the main hurdles preventing you from improving the insulation or replace the heating system of your accommodation? (Multiple answers are possible)



Large support for mandatory insulation with 50% subsidy

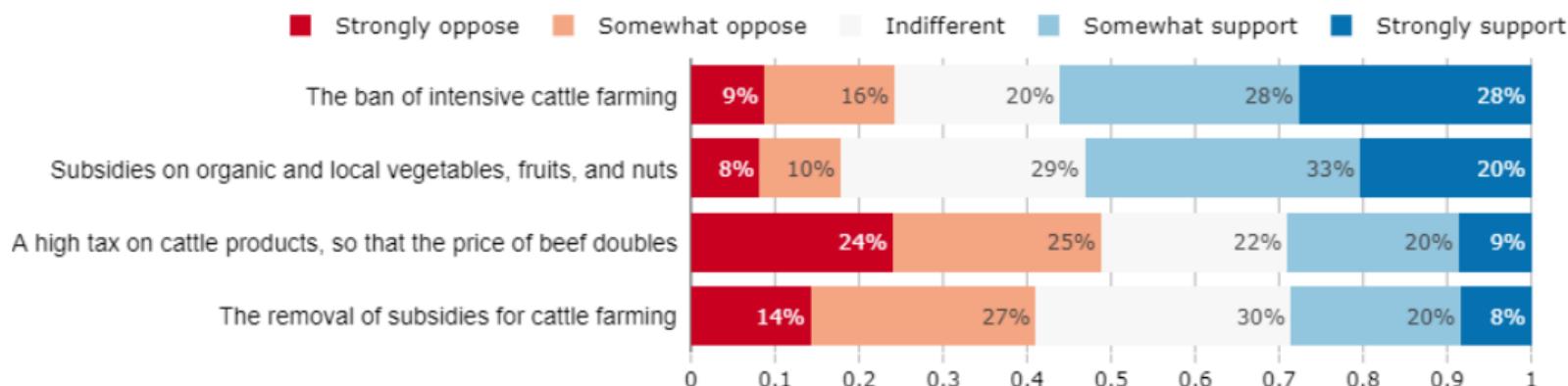
Imagine that the French government makes it mandatory for all residential buildings to have insulation that meets a certain energy efficiency standard before 2040. The government would subsidize half of the insulation costs to help households with the transition.

Displayed in disruption variant: [Insulating your home can take long, may cause disruptions to your daily life during the renovation works, and may even require you to leave your home until the renovation is completed.] Do you support or oppose such policy?



Majority support for ban of intensive farming

Imagine that, in order to fight climate change, the French government decides to limit the consumption of cattle products like beef and dairy. Do you support or oppose the following options?



Beef restrictions rejected in Denmark, US

Percentage of positive answers on different questions recoded as [-2;+2].

	Australia	Canada	Denmark	France	Germany	Italy	Japan	Mexico	Poland	South Korea	Spain	Turkey	United Kingdom	United States	Brazil	China	India	Indonesia	South Africa	Ukrain
Eats beef at least once a week	67	56	66	45	75	41	36	58	15	19	42	61	36	59	74	39	44	35	52	15
Knows that beef has high GHG footprint	81	78	86	73	85	83	72	59	79	84	75	59	86	76	70	59	43	53	73	79
Willing to limit beef consumption	31	37	34	38	45	62	24	40	51	36	42	32	44	38	41	53	73	50	36	51
Support for tax on cattle products that would double beef price	25	25	33	29	38	36	20	37	30	26	29	22	33	33	34	54	?	50	34	30
Support for subsidies on organic and local vegetables, fruits, and nuts	42	48	61	53	56	72	43	67	72	66	65	81	50	44	60	80	?	79	63	72
Support for removal of subsidies for cattle farming	30	35	33	29	39	43	16	54	35	29	40	24	38	41	45	53	?	54	31	35
Support for ban of intensive cattle farming	34	41	31	56	48	66	17	50	44	43	41	32	52	37	43	56	?	46	32	44

French less willing to pay for climate action than Danes and Americans

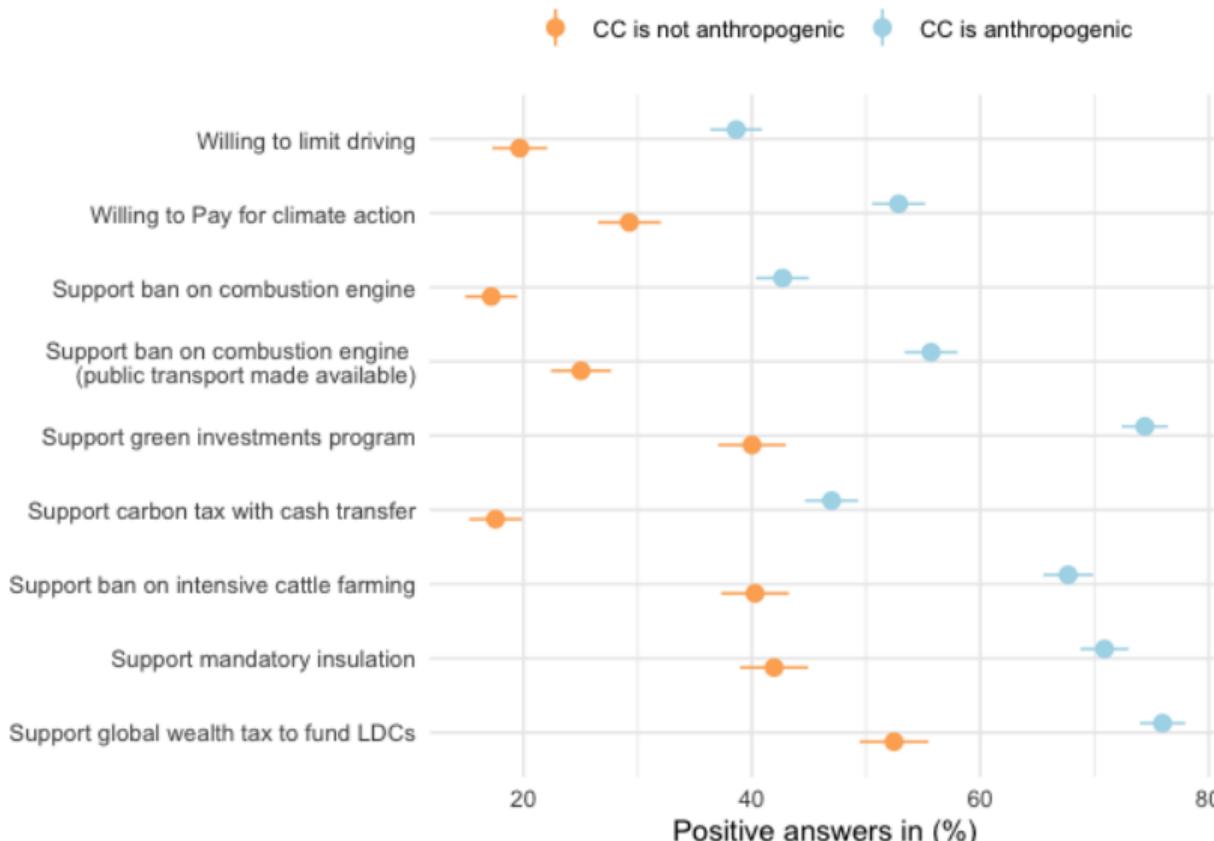
Percentage of Yes answers to the WTP question:

(...) Are you willing to pay [random amount] annually through an additional individual contribution to limit global warming to safe levels (less than 2 °C)?

	Australia	Canada	Denmark	France	Germany	Italy	Japan	Mexico	Poland	South Korea	Spain	Turkey	United Kingdom	United States	Brazil	China	India	Indonesia	South Africa	Ukraine
WTP (~ PPP\$/year): 10	53	71	82	76	73	81	63	73	60	32	79	72	61	59	68	94	97	82	73	60
WTP (~ PPP\$/year): 30	54	60	71	56	56	71	49	52	57	78	69	73	60	65	66	98	93	78	67	57
WTP (~ PPP\$/year): 50	49	47	62	63	57	65	52	53	55	58	45	55	55	56	50	94	91	71	70	55
WTP (~ PPP\$/year): 100	56	51	72	35	47	63	40	45	37	59	41	54	58	64	41	92	95	66	61	37
WTP (~ PPP\$/year): 300	30	57	56	29	32	29	19	47	19	31	25	49	36	48	34	64	92	65	65	19
WTP (~ PPP\$/year): 500	35	29	49	36	34	33	5	36	18	14	21	41	33	44	40	86	90	68	36	18
WTP (~ PPP\$/year): 1000	43	35	34	31	26	29	7	32	12	3	16	34	22	42	21	71	85	55	47	12

Heterogeneity Analysis

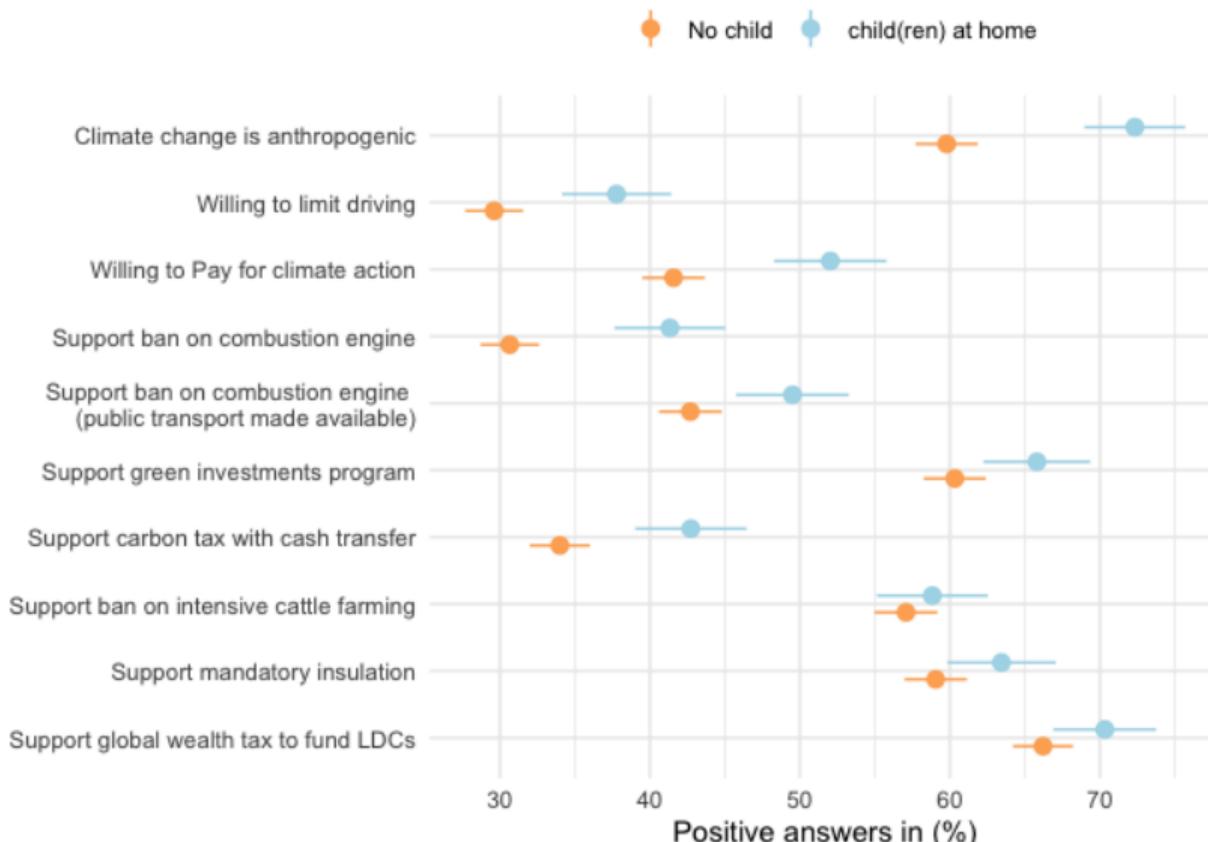
% of positive responses by beliefs about climate change



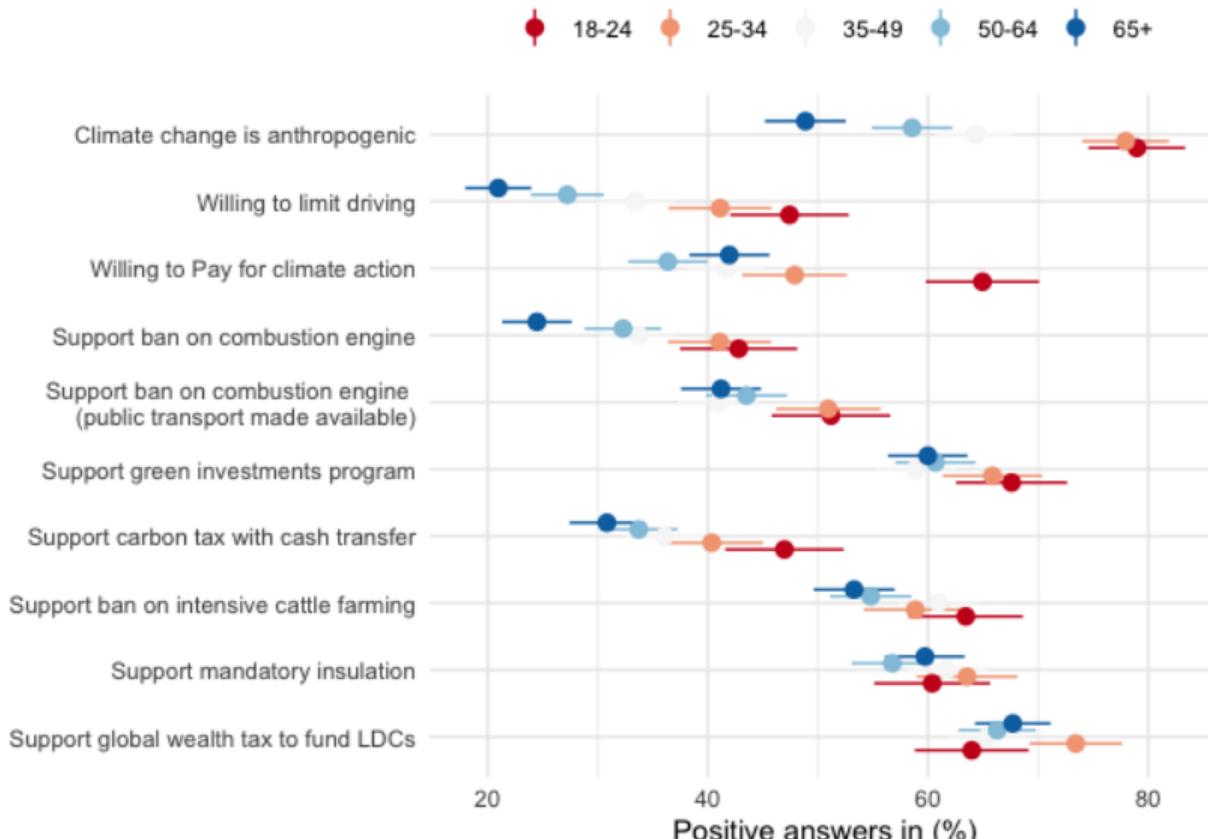
% of positive responses by trust in government



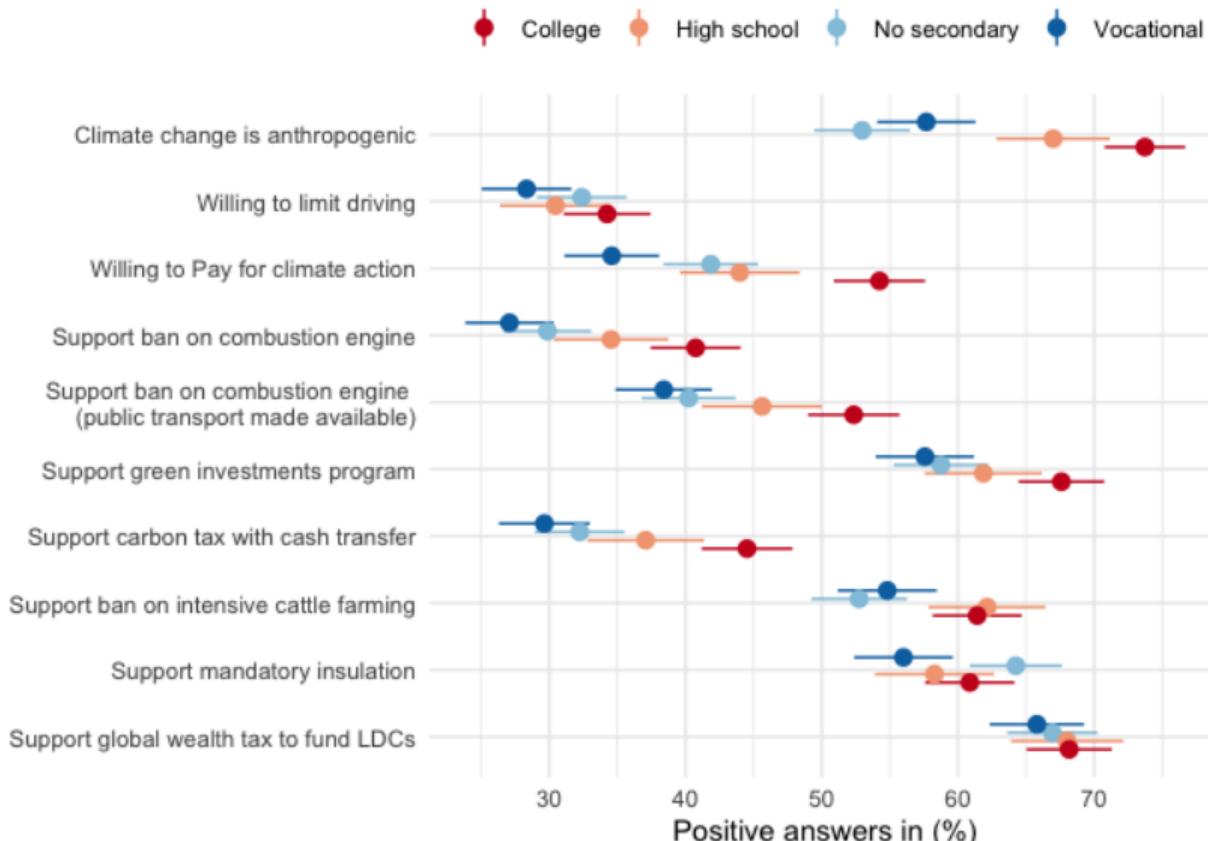
% of positive responses by living with child(ren) below 14



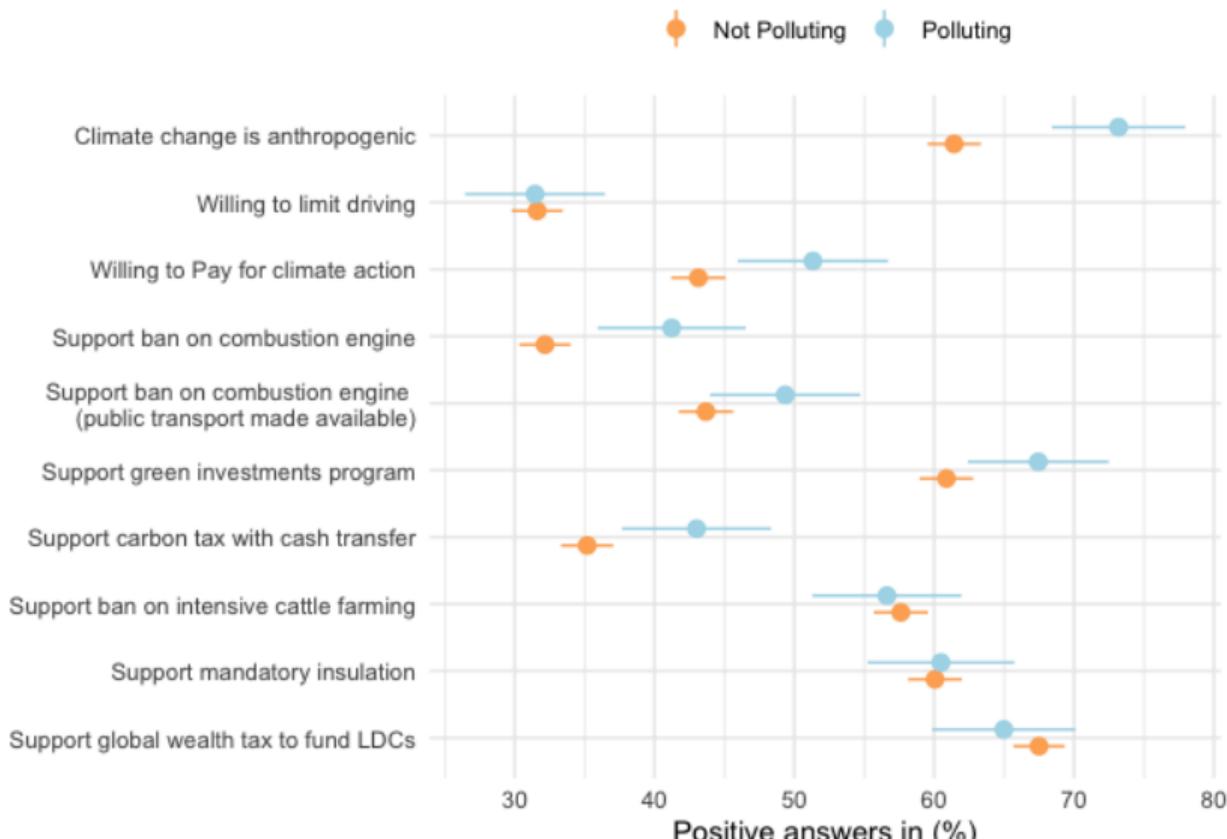
% of positive responses by age



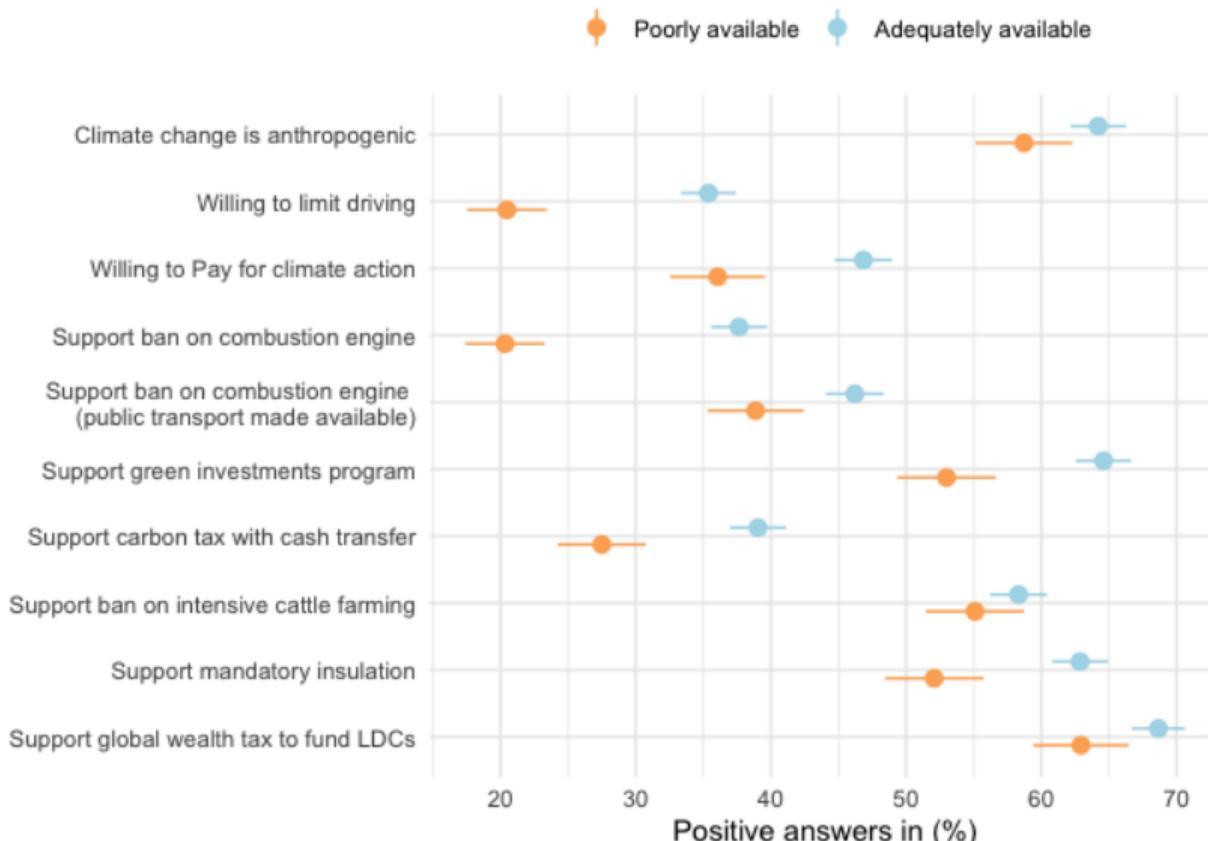
% of positive responses by diploma



% of positive responses by working sector



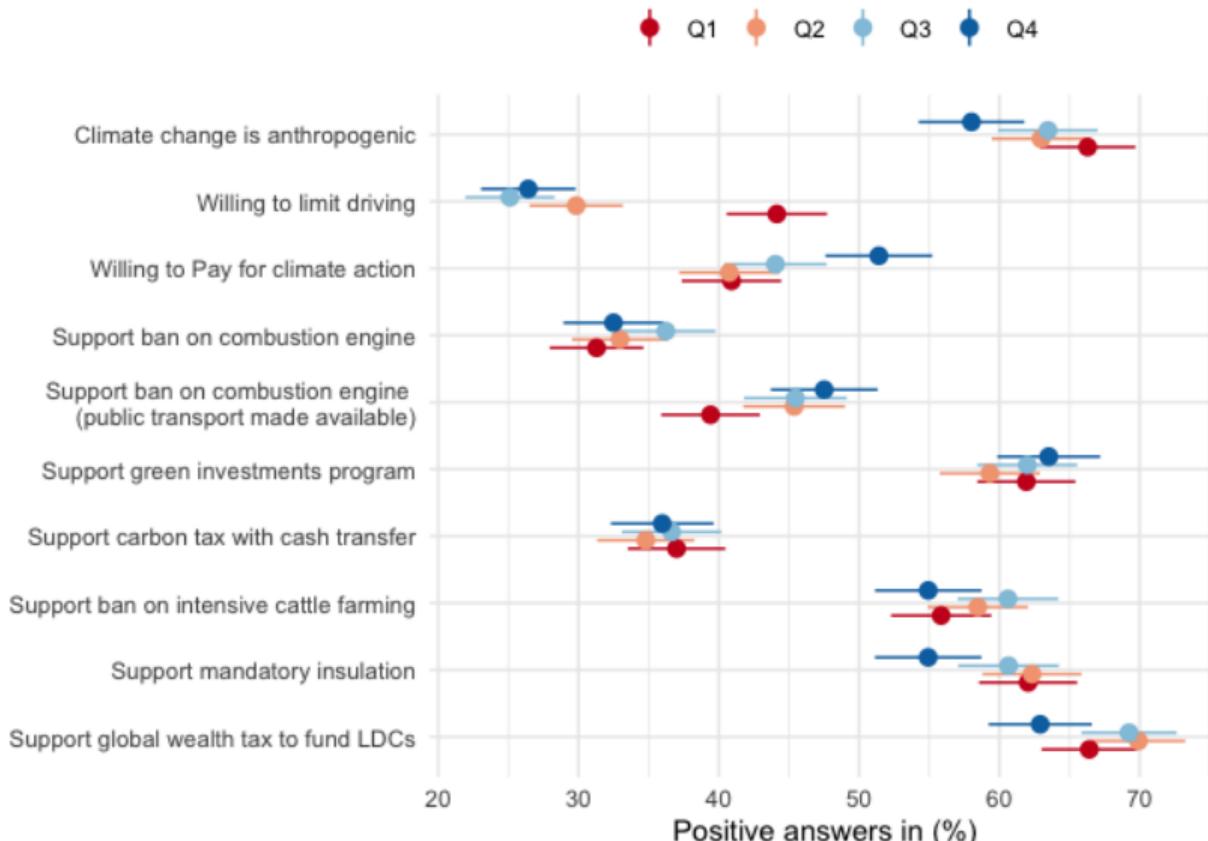
% of positive responses by availability of public transport



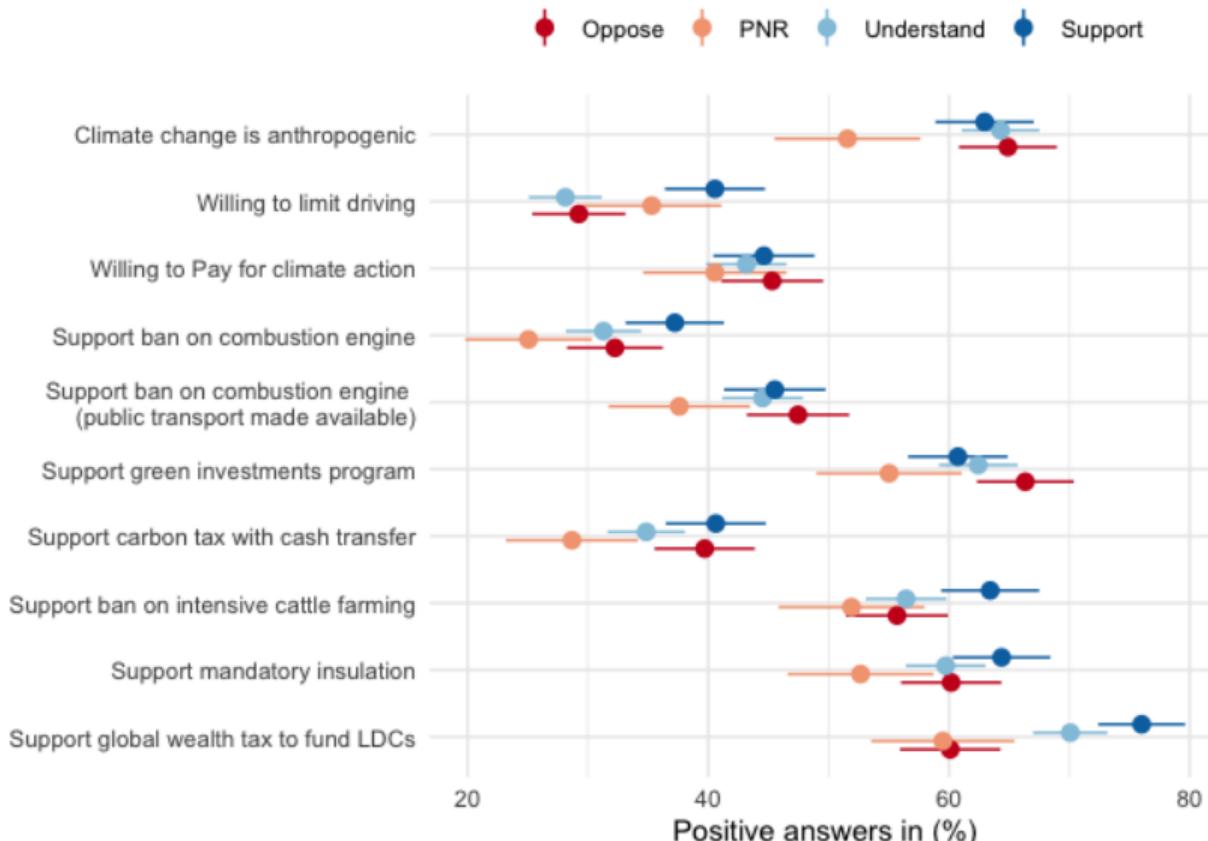
% of positive responses by urban category



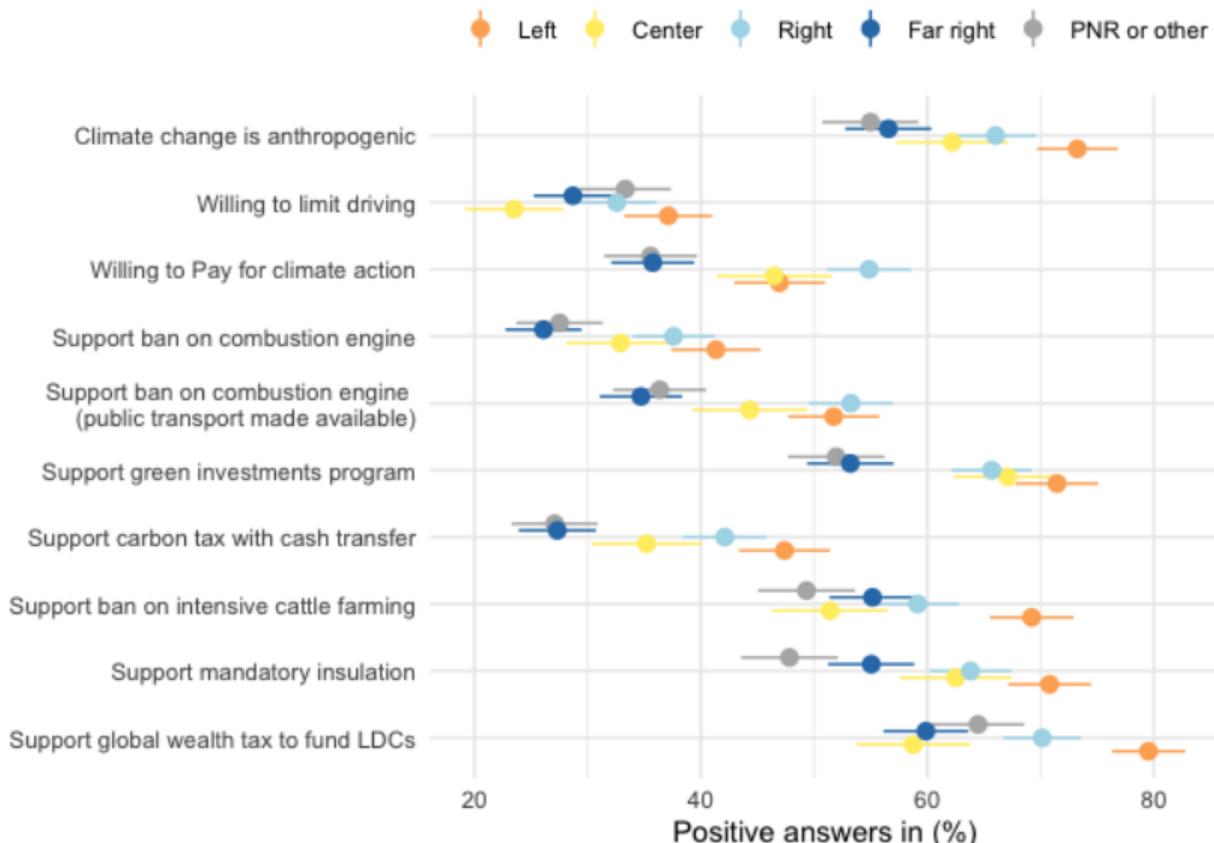
% of positive responses by income



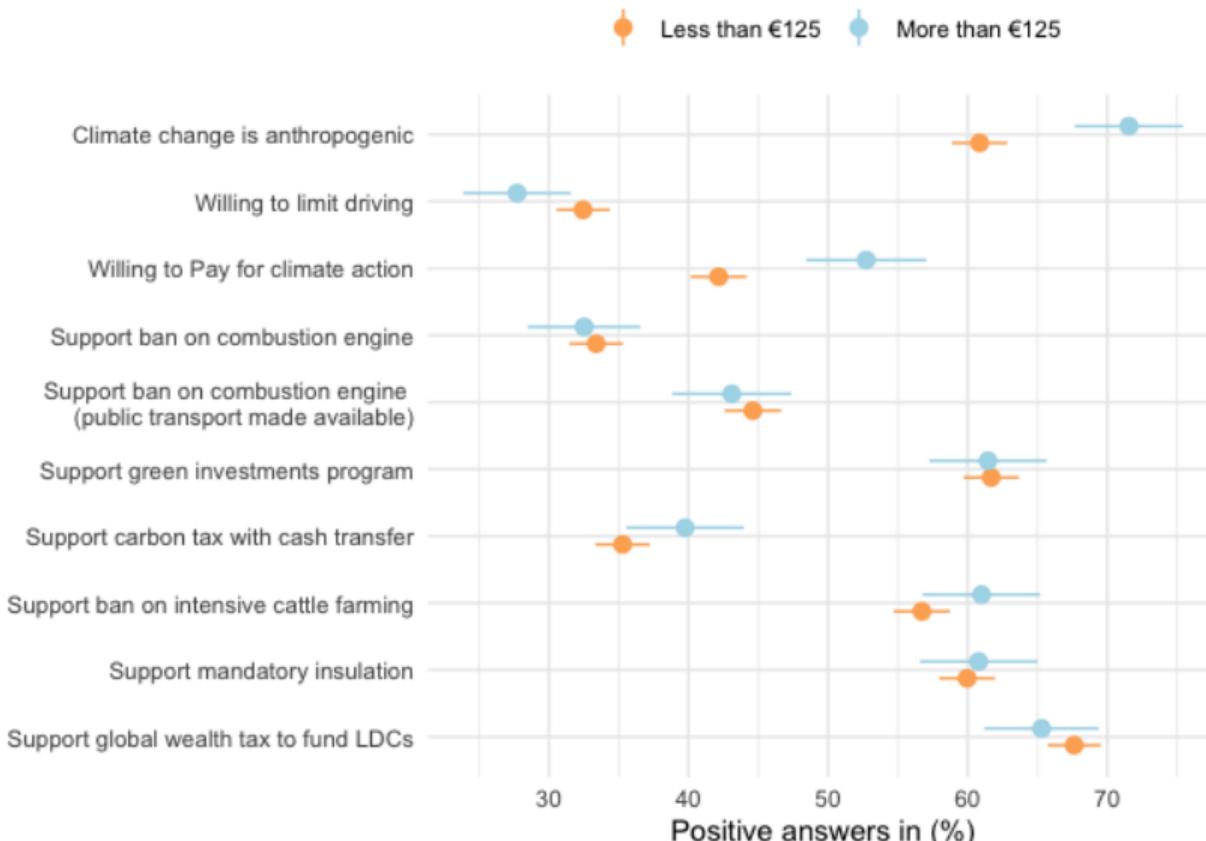
% of positive responses by support for the Yellow Vests



% of positive responses by vote



% of positive responses by gas expenses



Treatment Effects

Table 1: Attitudes towards Climate Change

	CC caused by humans	CC likely to cause extinction	Donation (in % of max)	FR should fight CC	Willing to limit driving
Control group mean	0.609	0.519	100.877	0.412	0.327
Treatment: Climate	0.073*** (0.016)	-0.022 (0.017)	5.910 (5.673)	0.015 (0.017)	-0.035** (0.016)
Treatment: Policy	0.004 (0.016)	-0.023 (0.017)	-6.393 (5.595)	-0.017 (0.016)	-0.010 (0.016)
Treatment: Both	0.063*** (0.016)	0.004 (0.018)	1.346 (5.730)	0.022 (0.017)	-0.005 (0.016)
Observations	5,989	6,005	6,005	6,005	6,005

Note: The *CC caused by humans* indicator variable equals one if the respondent thinks a lot or most of climate change is due to human actions. The *CC likely to cause extinction* indicator variable equals one if the respondent thinks climate change is somewhat likely or very likely to cause the extinction of humankind if nothing is done to limit it. The *Donation* variable is a continuous variable equal to the amount the respondent is willing to give to a charity. The *should fight CC* indicator variable equals one if the respondent strongly agrees that their country “should take measures to fight climate change”. The *Willing to limit driving* indicator variable equals one if the respondent is willing a lot or a great deal to limit driving. The three *treatment* indicator variables indicate difference in mean compared to the control group (people who did not see any video). Controls include socio-demographic, left-right leaning, last vote and whether the respondent’s household was hit by the COVID-19 pandemic. Standard errors are in parentheses. *p<0.1; **p<0.05; ***p<0.01

Table 2: Support for policies

	Support			
	Carbon tax with transfers	Green Infrastructure Program	Ban on combustion-engine cars	Average over 3 policies
Control group mean	0.282	0.582	0.274	0.444
Treatment: Climate	0.061** (0.030)	0.037 (0.030)	0.032 (0.029)	0.035 (0.031)
Treatment: Policy	0.079*** (0.029)	0.033 (0.029)	0.061** (0.028)	0.051* (0.030)
Treatment: Both	0.146*** (0.029)	0.037 (0.030)	0.100*** (0.029)	0.099*** (0.030)
Observations	1,988	1,988	1,988	1,988

Note: The dependent variables are indicator variables equal to one if the respondent ‘Strongly supports’ or “Somewhat supports” the policy. The *Average over 3 policies* takes the average of the respondent’s answers for the three policies. It equals one if the respondent supports all three policies, 2/3 if she supports two, 1/3 if she supports only one, and 0 if she supports none.

Controls include socio-demographic, left-right leaning, last vote and whether the respondent’s household was hit by the COVID-19 pandemic. Standard errors are in parentheses. * $p<0.1$; ** $p<0.05$; *** $p<0.01$

Table 3: Attitudes towards policies

	Fair	HH would win	Poor would win	Large economic effect	Negative economic effect
Control group mean	0.443	0.297	0.182	0.596	0.4
Treatment: Climate	0.009 (0.031)	0.021 (0.030)	0.003 (0.026)	0.004 (0.031)	0.015 (0.031)
Treatment: Policy	0.014 (0.030)	0.035 (0.029)	0.080*** (0.026)	0.022 (0.030)	0.029 (0.030)
Treatment: Both	0.068** (0.031)	0.067** (0.030)	0.117*** (0.026)	0.063** (0.030)	0.040 (0.030)
Observations	1,988	1,870	1,969	1,988	1,988

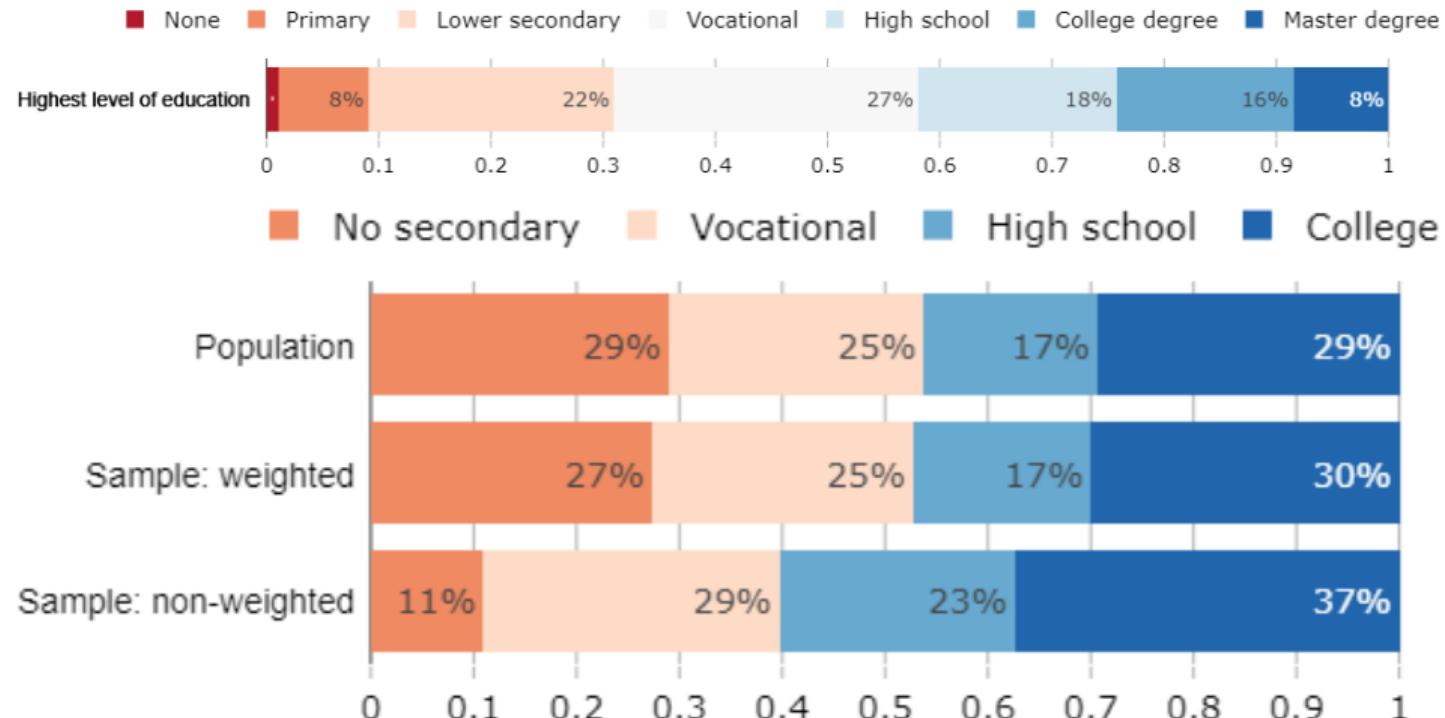
Note: The dependent variables are discrete variables equal either to 0, 1/3, 2/3, or 1. They are equal to the average over the three policies mentioned in Table “Support policies”. The *Fair* variable equals one if the respondent strongly agrees or somewhat agrees that each of the three policies are fair. The *HH/Poor would win* variables equal one if the respondent thinks her household/the poorest would win a lot or mostly win from the three policies. The *Large/Negative economic effect* variables equal one if the respondent strongly agrees or somewhat agrees that the three policies would have a large/negative impact on the French economy and employment.

Controls include socio-demographic, left-right leaning, last vote and whether the respondent’s household was hit by the COVID-19 pandemic. Standard errors are in parentheses. * $p<0.1$; ** $p<0.05$; *** $p<0.01$

Socio-Demographics

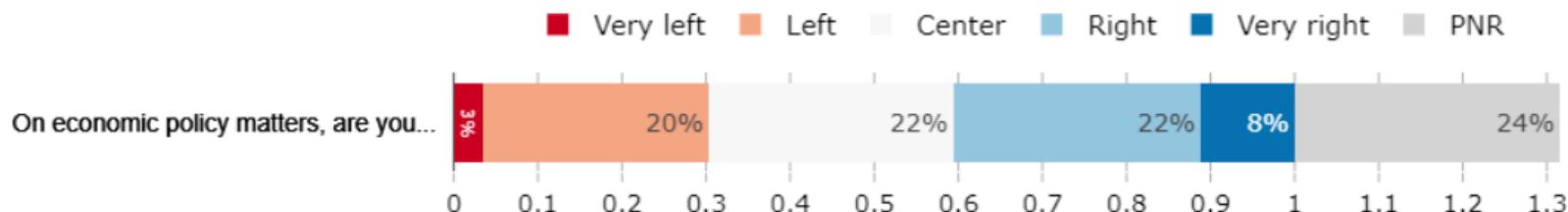
Education

What is the highest level of education you have completed?



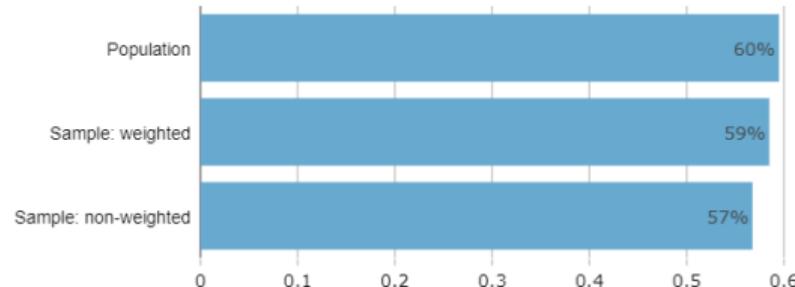
Left-right leaning

On economic policy matters, where do you see yourself on the liberal/conservative spectrum?



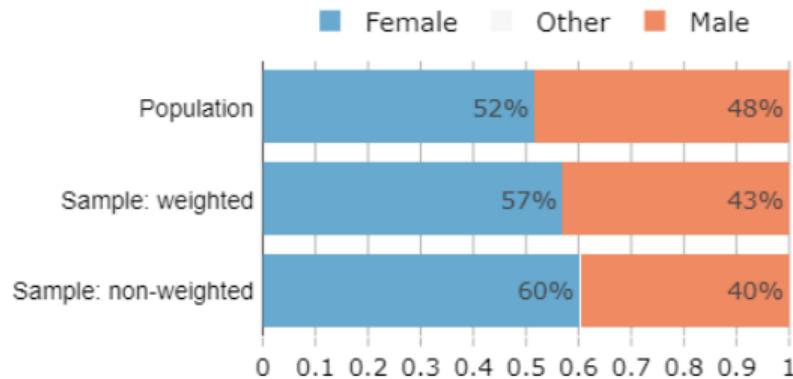
Geography

Lives in an urban area (town > 20k people), retrieved from zipcode

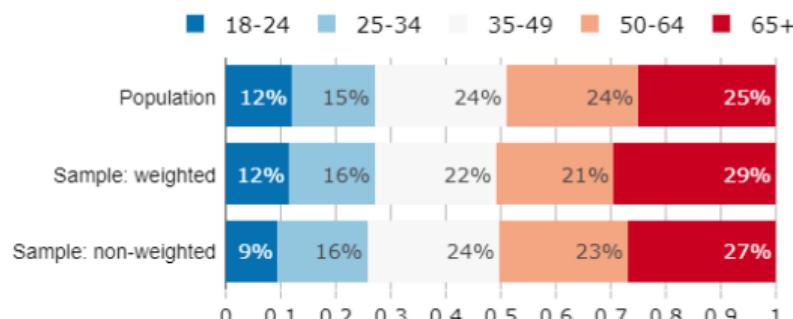


Gender and age

What is your gender?

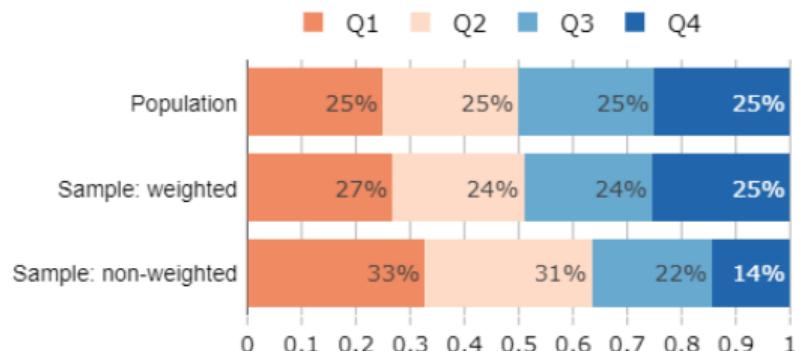


How old are you?

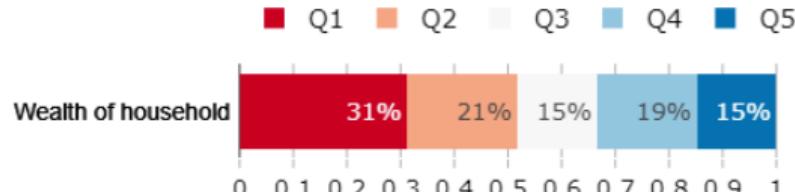


Income/wealth

What was the annual income of your household in 2019 (before withholding tax, for you and those who live with you)?



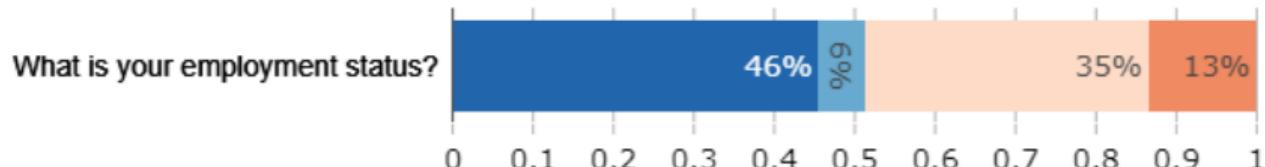
What is the estimated value of your assets, or the assets of your household if you are married (in French dollars)? Include here all your possessions (home, car, savings, etc.) net of debt. For example, if you own a house worth \$300,000 and you have \$100,000 left to repay on your mortgage, your assets are \$200,000.



Employment and hit by covid

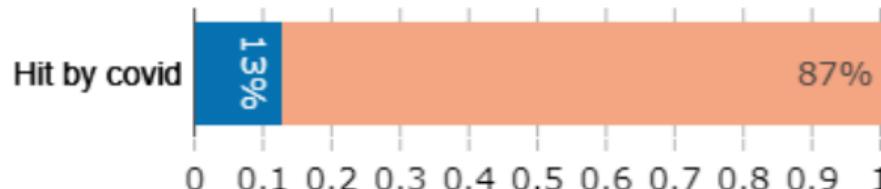
What is your employment status?

■ Working ■ Student ■ Retired ■ Not working



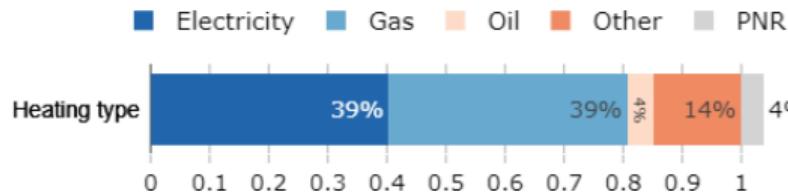
Have you or a member of your household been laid off or had to take a cut in your salary or wages due to the COVID-19 pandemic?

■ Yes ■ No

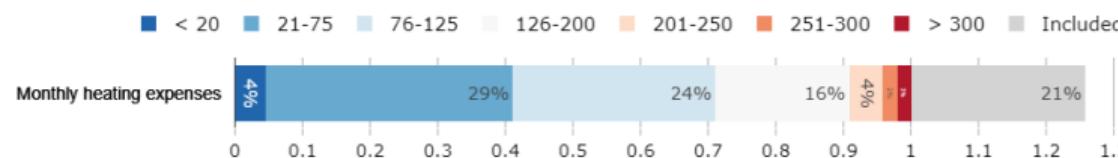


Household Composition and Energy Characteristics

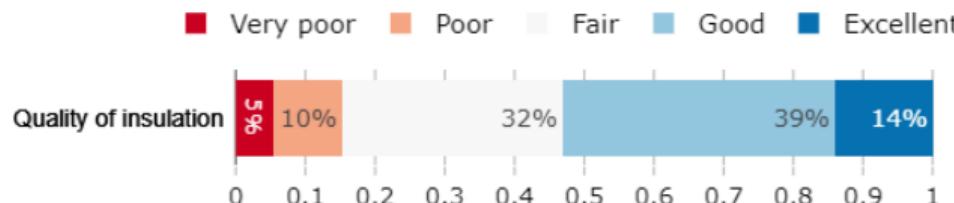
What is the main way you heat your home



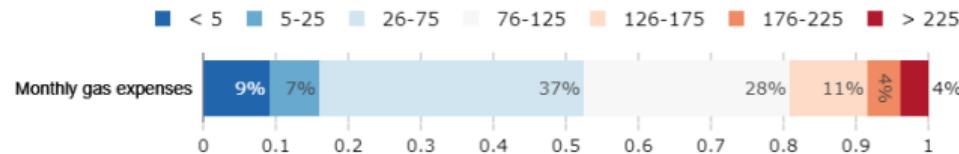
In a typical month, how much do you spend on heating for your accommodation (in €)?



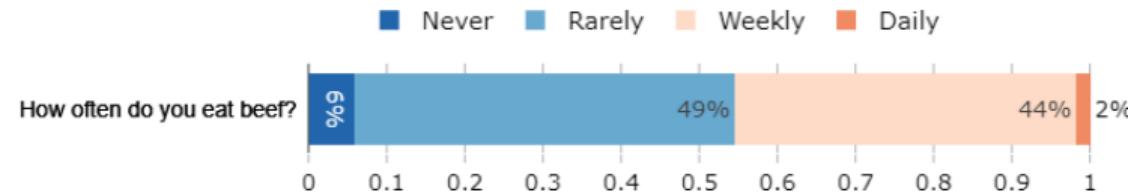
How do you rate the insulation of your accommodation?



In a typical month, how much do you spend on gas for driving (in €)?



How often do you eat beef?

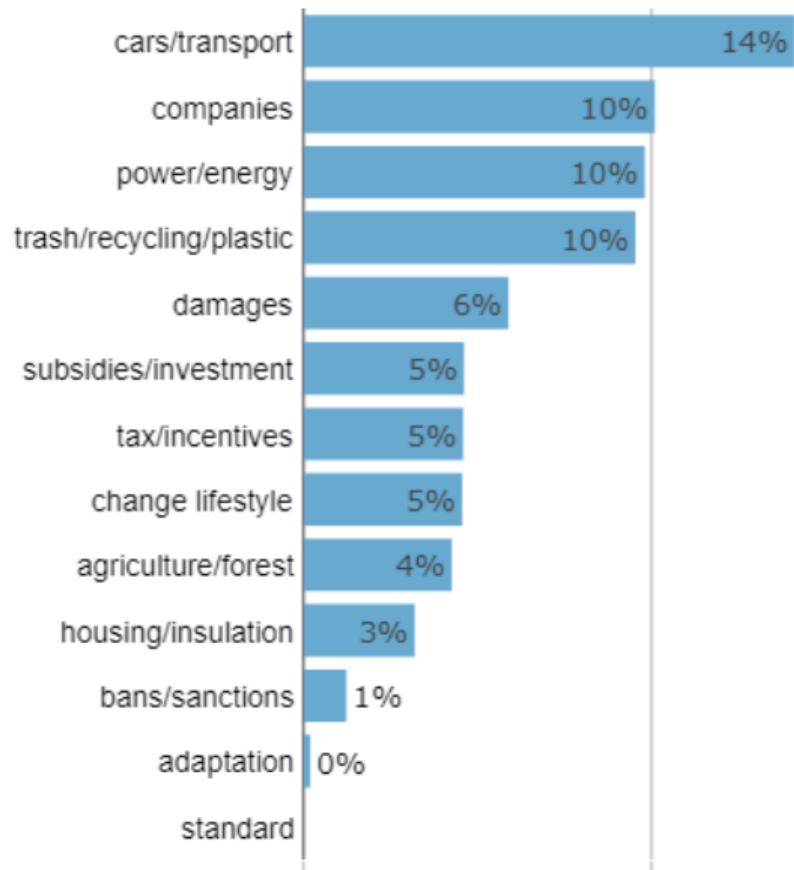


Essay

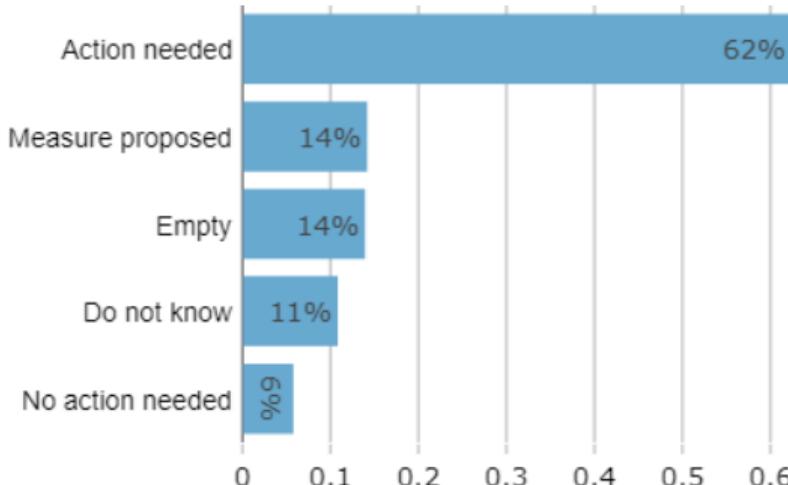
Word cloud – When thinking about climate change, what are your main considerations? What should the French government do regarding climate change? Please write as much as you would like, your response will be very useful.



Elements present in the open field (manually recoded).



Summary of elements present in the open field.

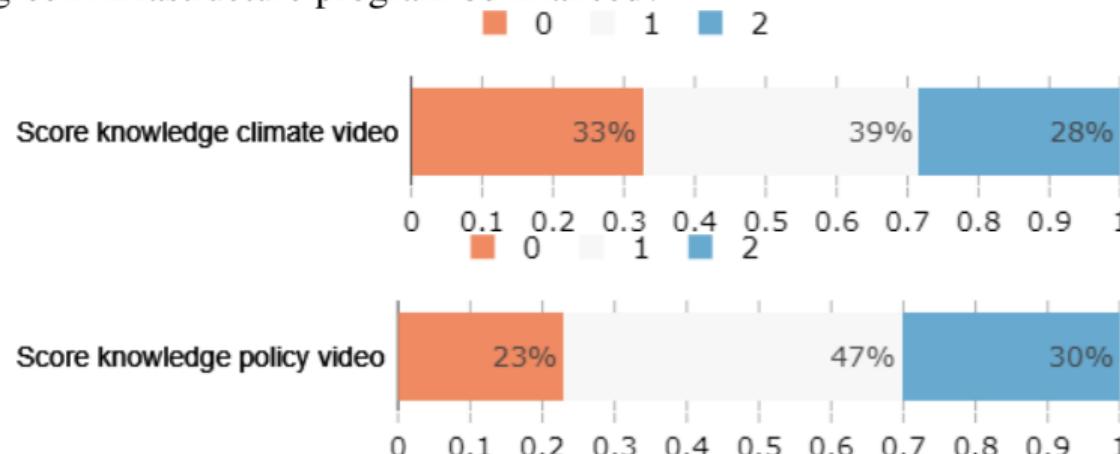


Treatments

Watched climate and/or policy videos attentively

Number of wrong answers when answering two knowledge questions about the content of the videos

- What will be the rise in global average temperature in 2100 if greenhouse gas emissions continue on their current trend?
- In the absence of ambitious action against climate change, how frequent will extreme temperatures occur across the French by the end of the century?
- What is the emission limit described in the video?
- How would a green infrastructure program be financed?



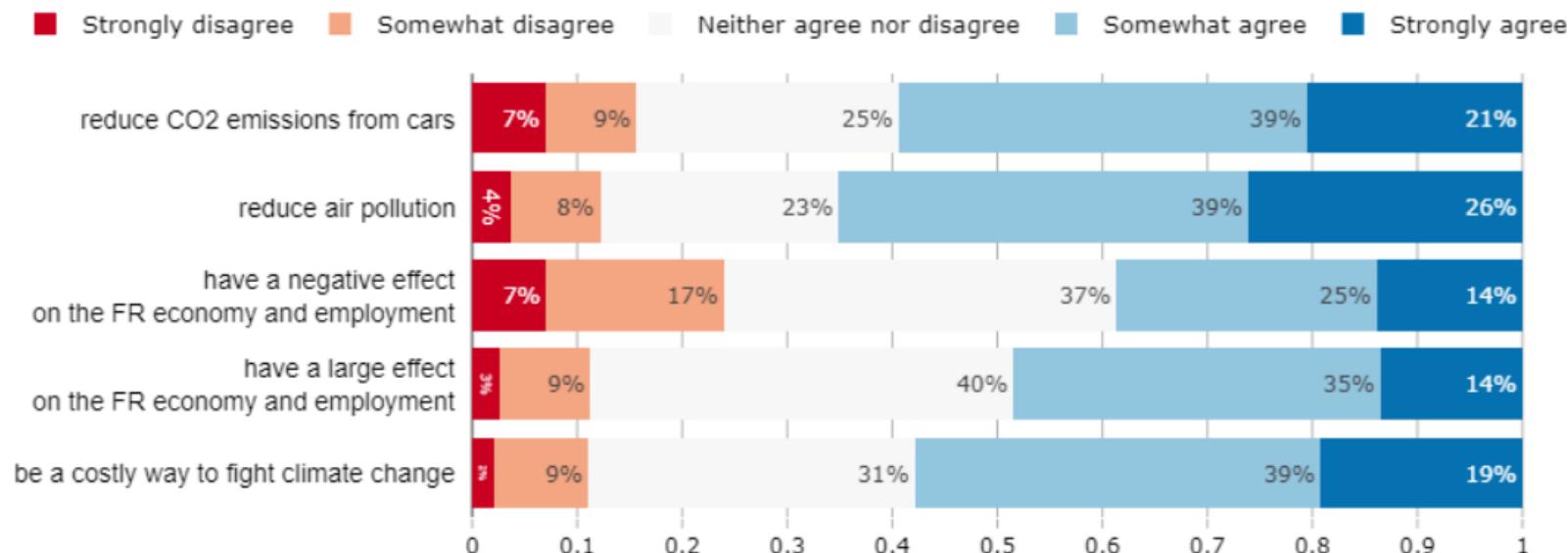
Policy 1: A ban on combustion-engine Cars

Policy description

To fight climate change, car producers can be required by law to produce cars that emit less CO₂ per mile of the cars they sell. The emission limit is lowered every year so that only electric or hydrogen vehicles can be sold after 2030. This policy is called a *ban on combustion-engine cars*.

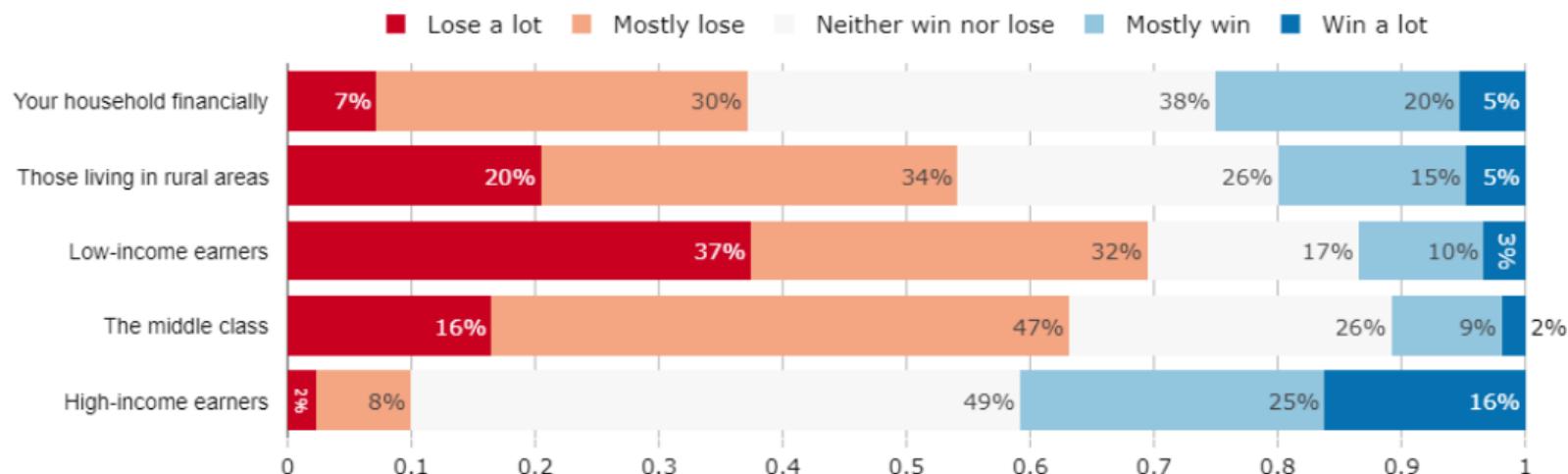
Effects of the policy

Do you agree or disagree with the following statements? A ban on combustion-engine cars would...



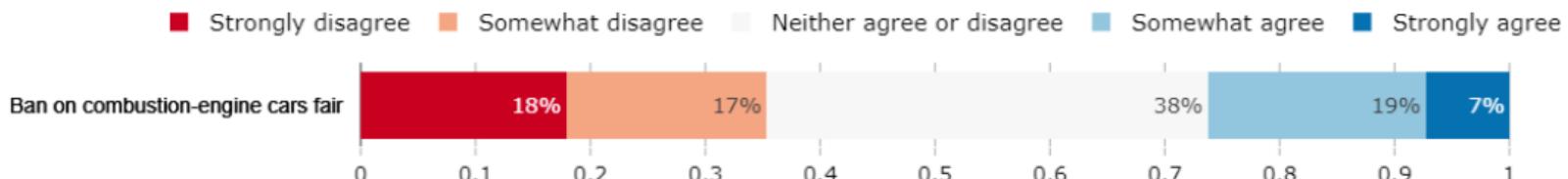
Incidence

In your view, would the following groups win or lose if a ban on combustion-engine cars was implemented in France?

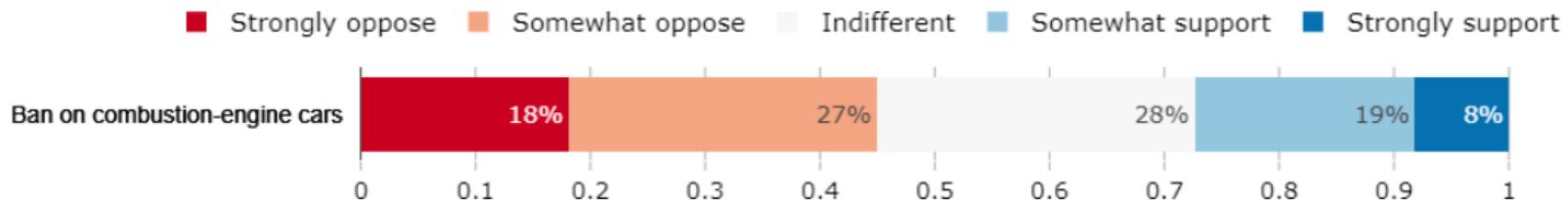


Fairness and support

Do you agree or disagree with the following statement: "A ban on combustion-engine cars is fair"?

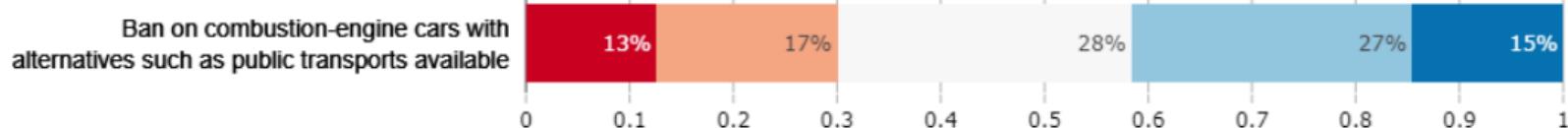


Do you support or oppose a ban on combustion-engine cars?



Do you support or oppose a ban on combustion-engine cars where alternatives such as public transports are made available to people?

■ Strongly oppose ■ Somewhat oppose ■ Indifferent ■ Somewhat support ■ Strongly support



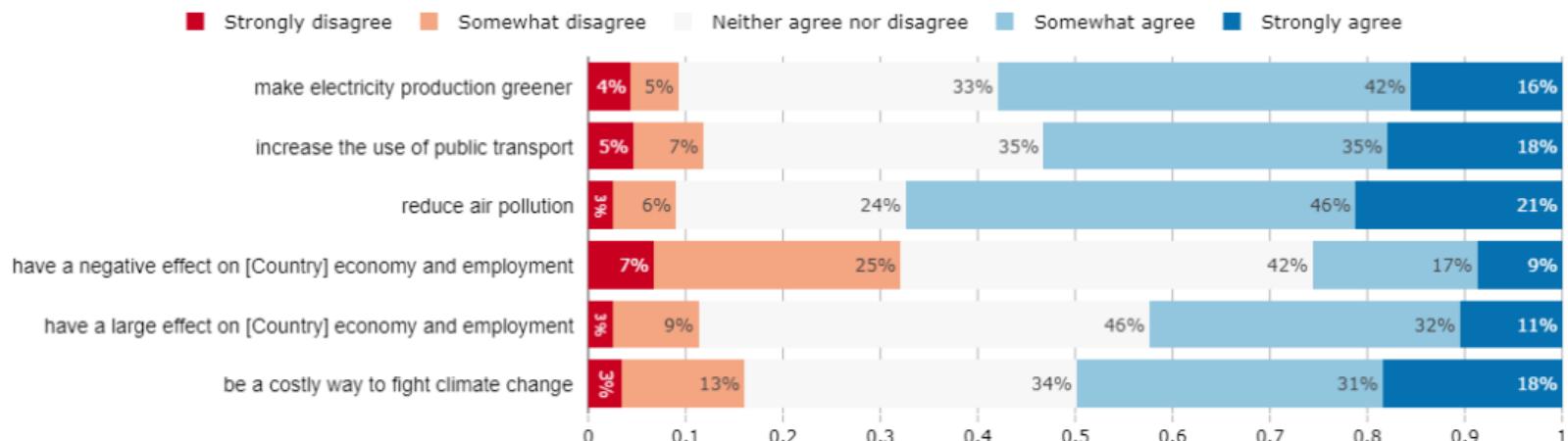
Policy 2: Green Infrastructure Program

Policy description

A green infrastructure program is a large public investment program, which would be financed by additional public debt, to accomplish the transition needed to cut greenhouse gases emissions. Investments would concern renewable power plants, public transportation, thermal renovation of building, and sustainable agriculture.

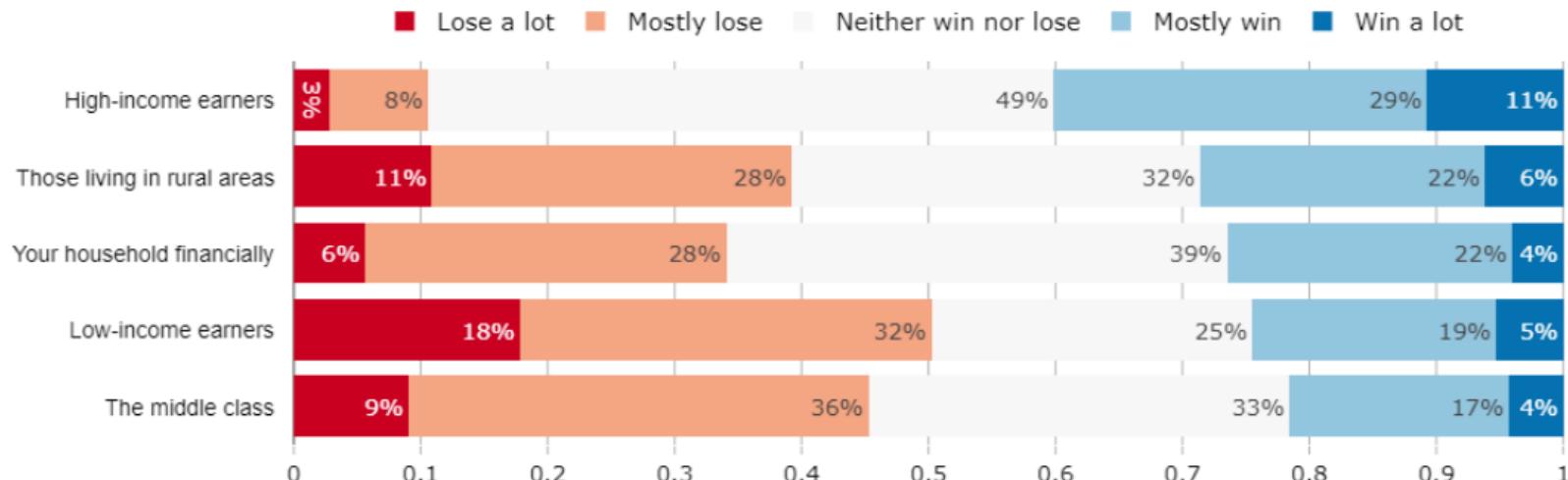
Effects of the policy

Do you agree or disagree with the following statements? A green infrastructure program would...



Incidence

In your view, would the following groups win or lose with a green infrastructure program?

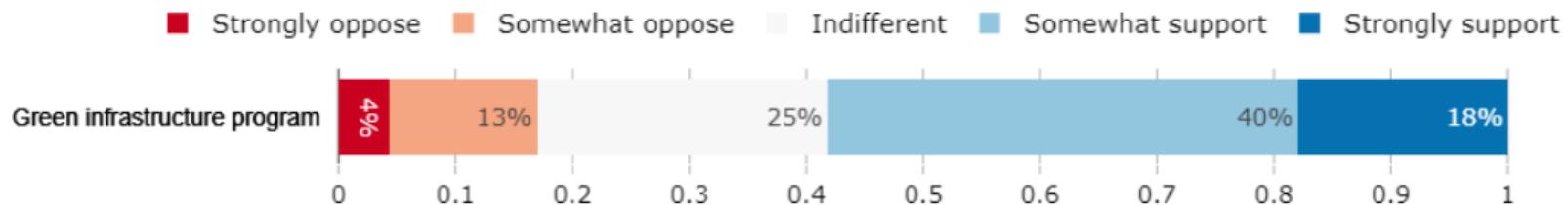


Fairness and support

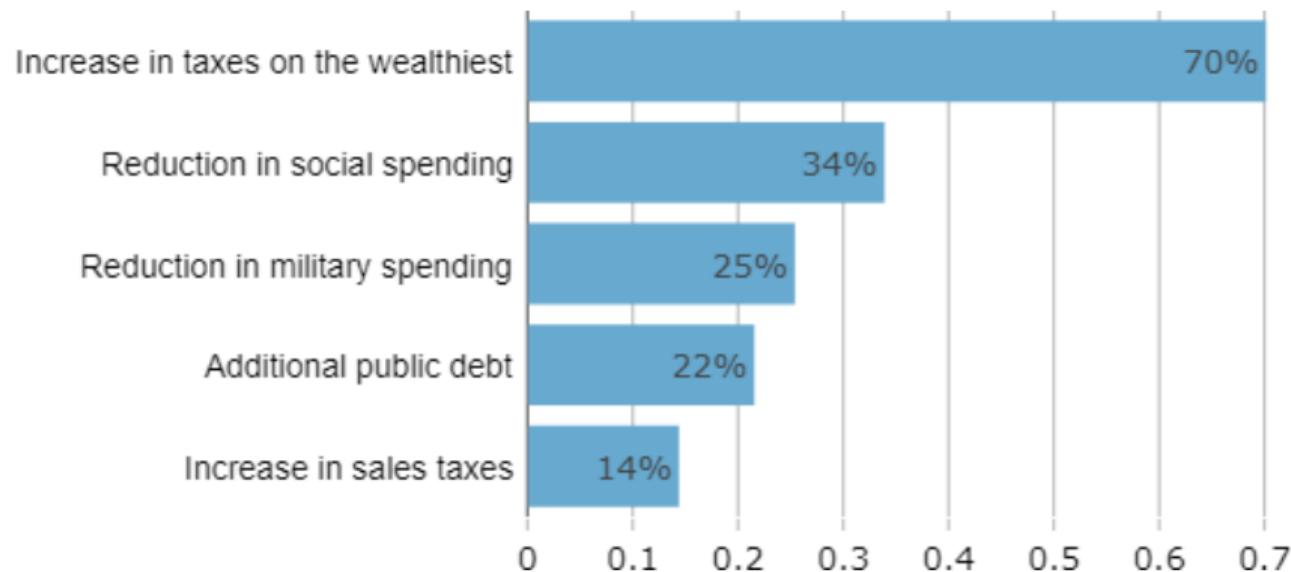
Do you agree or disagree with the following statement: "A green infrastructure program mainly financed by public debt is fair."



Do you support or oppose a green infrastructure program?



Until now, we have considered that a green infrastructure program would be financed by public debt, but other sources of funding are possible. What sources of funding do you find appropriate for a green infrastructure program? (Multiple answers are possible)



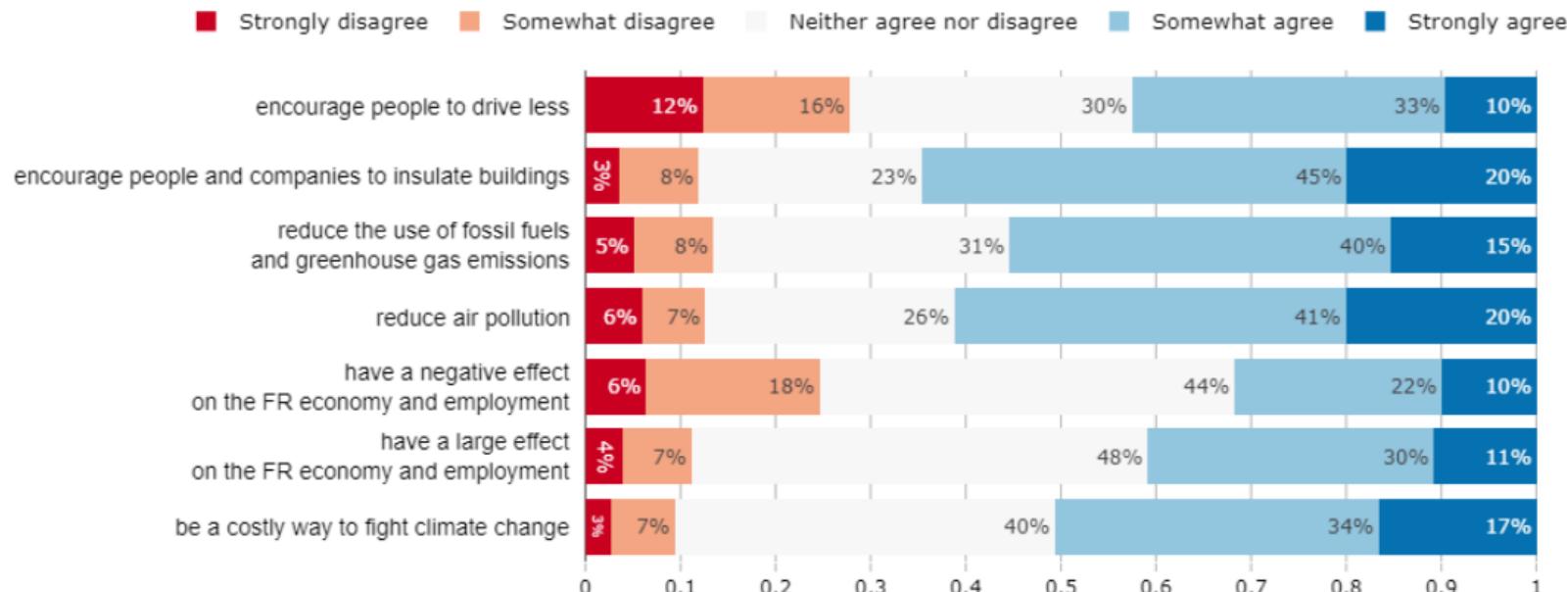
Policy 3: Carbon Tax with Cash Transfers

Policy description

To fight climate change, the French government can make greenhouse gas emissions costly, to make people and firms change their equipment and reduce their emissions. The government could do this through a policy called a carbon tax with cash transfers. Under such a policy, the government would tax all products that emit greenhouse gas. For example, the price of gasoline would increase by 10 cents per liter. To compensate households for the price increases, the revenues from the carbon tax would be redistributed to all households, regardless of their income. Each adult would thus receive 160€ per year.

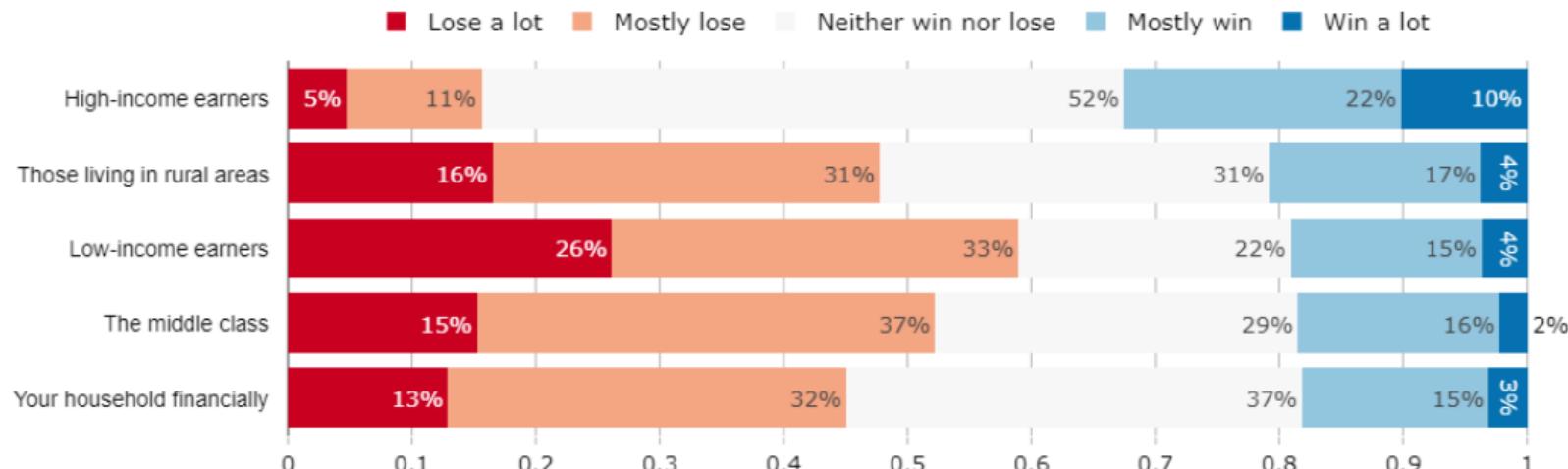
Effects of the policy

Do you agree or disagree with the following statements? A carbon tax with cash transfers would...



Incidence

In your view, would the following groups win or lose under a carbon tax with cash transfers?



Fairness and support

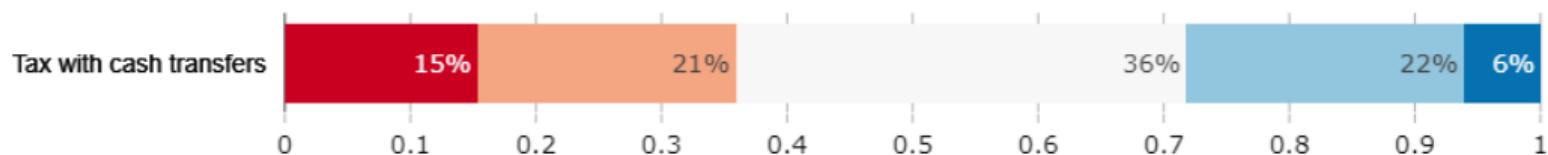
Do you agree or disagree with the following statement: "A carbon tax with cash transfers is fair."

- Strongly disagree ■ Somewhat disagree ■ Neither agree or disagree ■ Somewhat agree ■ Strongly agree



Do you support or oppose a carbon tax with cash transfers?

- Strongly oppose ■ Somewhat oppose ■ Indifferent ■ Somewhat support ■ Strongly support



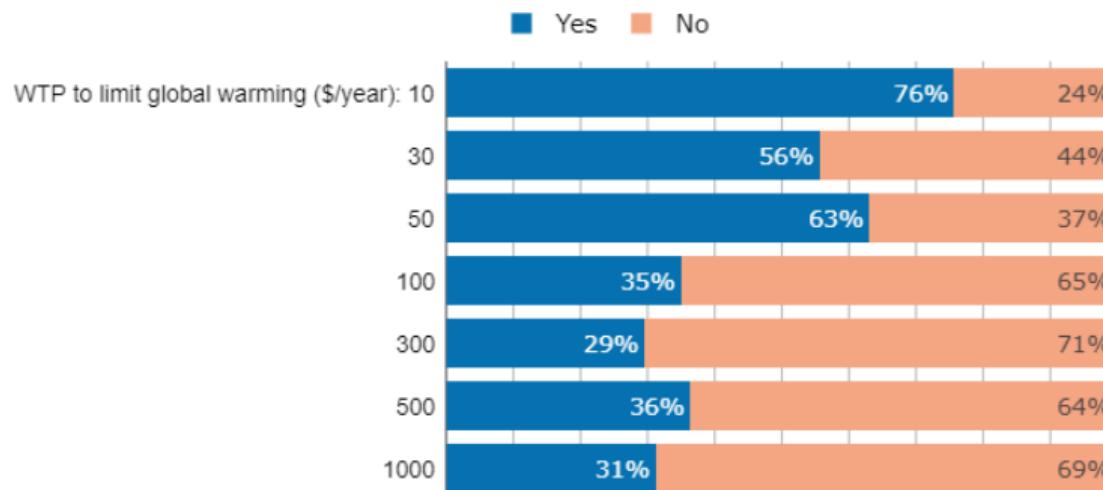
Willingness to Pay

WTP

To fight global warming, the French government could implement a policy package to reduce emissions, for example by investing in clean technologies (renewable energy, electric vehicles, public transport, more efficient insulation, etc.).

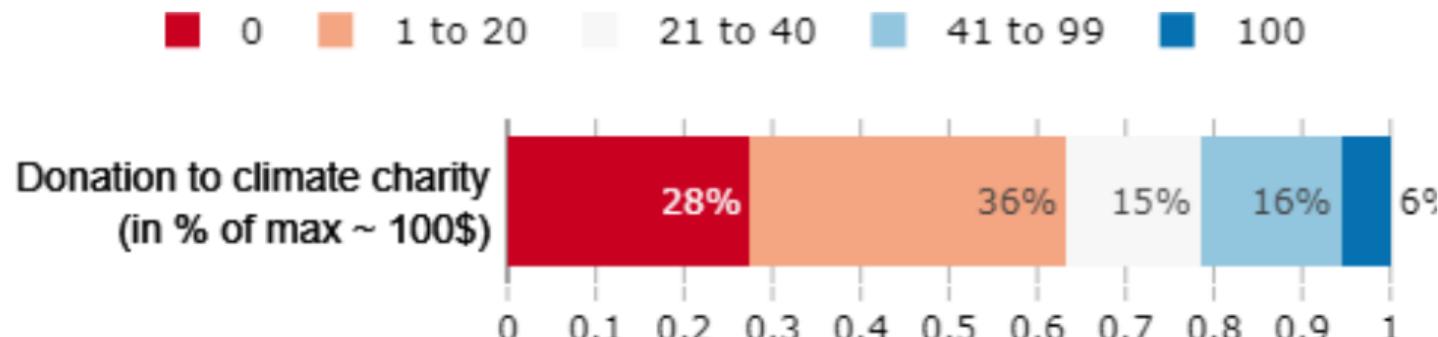
The funding for these investments could be collected annually through an additional individual contribution for the foreseeable future. Assume that everyone in France as well as citizens of other countries would be required to contribute according to their means.

Are you willing to pay [amount] annually through an additional individual contribution to limit global warming to safe levels (less than 2 °C)?



Donation

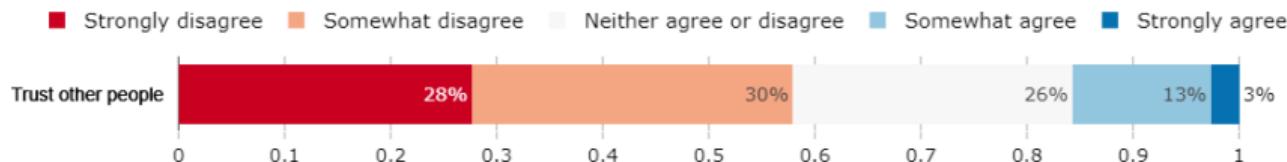
By taking this survey, you are entered into a lottery to win 100€. You can also donate a part of this additional compensation (should you be selected in the lottery) to a reforestation project through the charity The Gold Standard. If you win the 100€ lottery, how much will you donate to the Gold Standard charity?



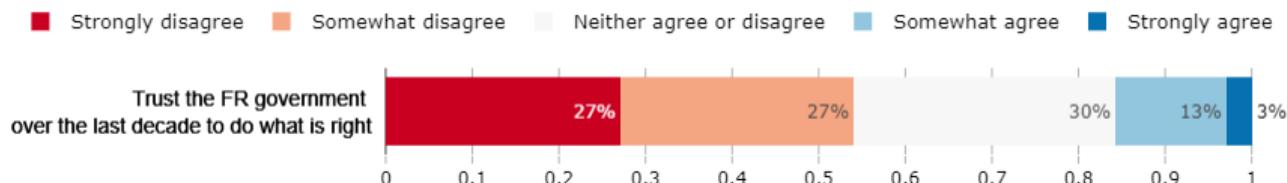
Trust and institutions

Trust

Do you agree or disagree with the following statement: "Most people can be trusted."

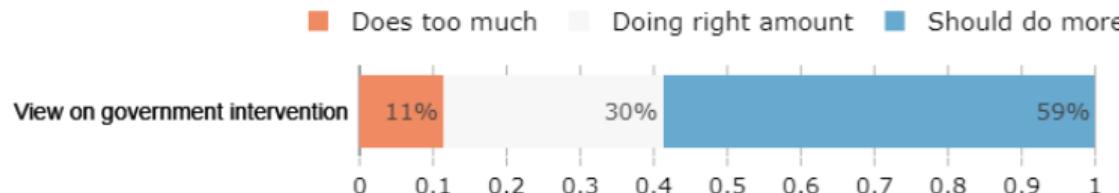


Do you agree or disagree with the following statement: "Over the last decade the French government could generally be trusted to do what is right."

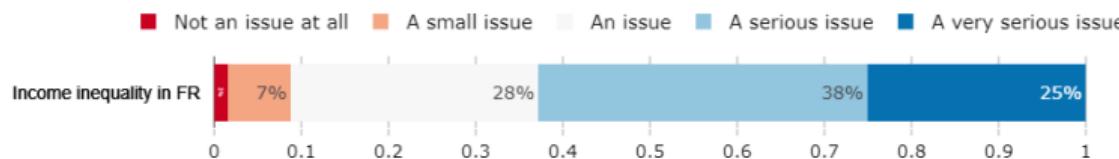


Perception of institutions, inequality, and the future

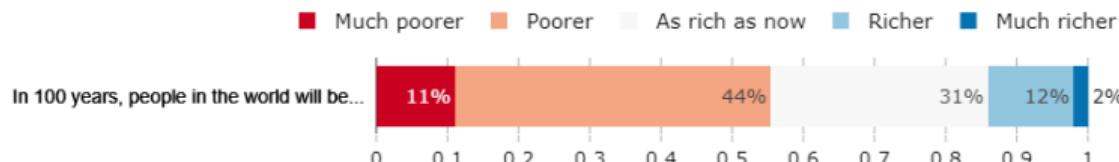
Some people think the government is trying to do too many things that should be left to individuals and businesses. Others think that government should do more to solve our country's problems. Which come closer to your own view?



How big of an issue do you think income inequality is in France?



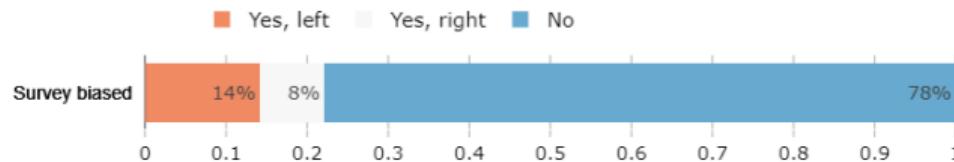
Do you think that overall people in the world will be richer or poorer in 100 years from now?



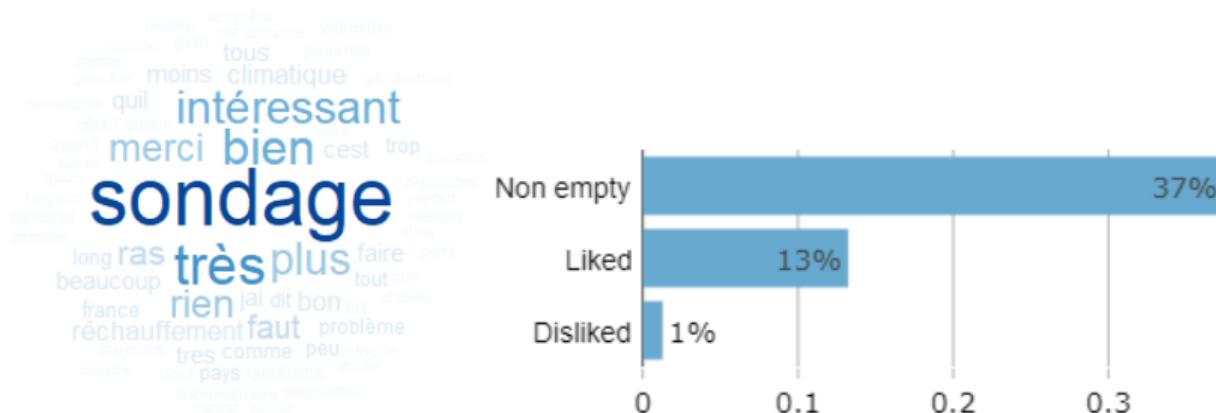
Feedback

Feedback on the survey

Do you feel that this survey was politically biased?



The survey is nearing completion. You can now enter any comments, thoughts or suggestions in the field below.
Right: recoded in *Non empty/Liked/Disliked*.



Variable Definitions

Knowledge Index

Index knowledge: average of following variables transformed in z-scores:

Score footprint transport: respondent's Kendall distance with true ranking on knowledge questions about transport emissions.

Score footprint electricity: respondent's Kendall distance with true ranking on knowledge questions about electricity production emissions.

Score footprint food: respondent's Kendall distance with true ranking on knowledge questions about food emissions.

Score footprint countries per capita: respondent's Kendall distance with true ranking on knowledge questions about countries' emissions per capita.

Score footprint countries total: respondent's Kendall distance with true ranking on knowledge questions about total countries' emissions.

Heating expenses: respondent's yearly heating or cooling expenses.

Climate change real: respondent indicates that climate change is real.

Dynamic of Climate change: respondent indicates that halving global emissions would not be sufficient to stop temperatures from rising.

Climate change anthropogenic: respondent indicates that "a lot" or "most" of climate change is due to human activity.

Score impacts of climate change: respondent's number of good responses on questions related to the impacts of climate change. Where we add 1 if the respondent indicates that it is "somewhat likely" or "very likely" that climate change will lead to severe droughts and heatwaves, and 1 if the respondent indicates that it is "somewhat likely" or "very likely" that it will lead to rising sea levels, and 1 if the respondent indicates that it is "somewhat unlikely" that climate change will lead to more frequent volcanic eruptions, and 2 if the respondent indicates that it is "very unlikely" that climate change will lead to more frequent volcanic eruptions.).

Score greenhouse gases: respondent's number of good responses minus wrong responses scaled up on [0,4] regarding whether CO₂, methane, hydrogen and particulate matter are greenhouse gases.