

Climate Insights 2020: Opinion in the States Technical Report

Jared McDonald

Bo MacInnis

Jon A. Krosnick

Stanford University

October 2020

The authors thank the Stanford Geospatial Center for preparing the maps shown here. Jon Krosnick is University Fellow at Resources for the Future. Funding for this research was provided by the Woods Institute for the Environment at Stanford University, the Precourt Institute for Energy at Stanford University, the School of Earth, Energy, and Environmental Sciences at Stanford University, Resources for the Future, and ReconMR. Sponsors of the surveys analyzed here include Ohio State University, Stanford University, University of Arizona, ABC News, USA Today, Time Magazine, The Washington Post, New Scientist Magazine, Planet Green, the Associated Press, Reuters, Resources for the Future, and ReconMR. Data for those surveys were collected by ReconMR, Abt SRBI, SSRS, GfK Custom Research (formerly known as Knowledge Networks), Ipsos, TNS, the American Life Panel (ALP), and the Ohio State University Center for Survey Research. Address correspondence to Jon A. Krosnick, Stanford University, 432 McClatchy Hall, Stanford, California, 94305 (krosnick@stanford.edu); Jared McDonald (jaredmcd@stanford.edu); Bo MacInnis (bmacinni@stanford.edu).

Section 1: Estimating State-Level Opinions

Survey Methodology

The surveys of nationally representative samples of American adults that we analyzed are listed by year of data collection in Table 1. In most of these surveys, almost all of the questions were about global warming. The remaining surveys were so-called “omnibus surveys” that included questions on many different topics, only a few of which were about global warming. Most surveys involved random digit dialing telephone interviewing (landlines only in the early years; landlines and cellphone in the later years), and a few involved data collected from probability samples via the Internet.

Data from a total of 27,661 respondents were analyzed. Predictions for states with fewer than 50 observations are not reported.

A total of 22 measures are used to examine public opinion on climate change, including items gauging the fundamentals of climate change, engagement on the issue, and policy attitudes:

Fundamentals

- 1) Global warming been happening (1997, 2006-2015, 2018, 2020)
- 2) Warming will continue in the future (2010-2012, 2015, 2018, 2020)
- 3) Past warming has been caused by humans (1997, 2006-2012, 2014-2015, 2018, 2020)
- 4) Warming will be a serious problem for the U.S. (1997, 2006-2010, 2012, 2015, 2018, 2020)
- 5) Warming will be a serious problem for the world (2006, 2009-2010, 2012; 2015, 2018, 2020)
- 6) 5 degrees of warming in 75 years will be bad (2007-2010, 2012, 2015, 2018, 2020)

7) The government should do more to address global warming (1997, 2006-2010, 2012, 2015, 2018, 2020)

Engagement

8) Warming is extremely important personally (1997, 2006-2012, 2015, 2018, 2020)

9) Highly knowledgeable about global warming (1997, 2006-2010, 2012, 2018, 2020)

Policies

10) The U.S. should take action regardless of what other countries do (2008, 2010, 2012, 2015)

11) The government should limit greenhouse gas emissions (2009-2010, 2012, 2015, 2018, 2020)

12) Favor limit on greenhouse gas emissions by businesses (2006-2007, 2009-2012, 2014-2015, 2018, 2020)

13) Favor a national cap and trade program (2008-2010, 2012, 2015, 2020)

14) Increase fuel efficiency of cars (2006, 2007, 2009-2012, 2015, 2018, 2020)

15) Build electric vehicles (2009-2012, 2015)

16) Build appliances that use less electricity (2006, 2007, 2009-2012, 2015, 2018, 2020)

17) Build more energy-efficient buildings (2006, 2007, 2009-2012, 2015, 2018, 2020)

18) Tax breaks to produce renewable energy (2006, 2009-2012, 2015, 2018, 2020)

19) Tax breaks to reduce air pollution from coal (2009-2012, 2015, 2018, 2020)

20) Tax breaks for nuclear power (2006, 2007, 2009-2012, 2015, 2018, 2020)

21) Increase consumption taxes on electricity (2006, 2007, 2009-2012, 2015, 2018, 2020)

22) Increase consumption taxes on gasoline (2006, 2007, 2009-2012, 2015, 2018, 2020)

Table 1: Survey Characteristics

Number	Year	Mode	Topic	Firm	Sponsor 1	Sponsor 2	Sponsor 3	Reach	State	Respondents
1	1997	RDD	full length	OSU	OSU			national		688
2	1998	RDD	full length	OSU	OSU			national		725
3	2006	RDD	full length	TNS	Stanford	ABC News	Time	national		1,002
4	2007	RDD	full length	TNS	Stanford	ABC News	Washington Post	national		1,002
5	2007	Internet	full length	GfK	Stanford	New Scientist		national		1,491
6	2008	RDD	full length	TNS	Stanford	ABC News	Planet Green	national		1,000
7	2009	RDD	omnibus	TNS	ABC News			national		1,001
8	2009	RDD	full length	GfK	Stanford	AP		national		1,005
9	2010	RDD	full length	GfK	Stanford			national		1,000
10	2010	RDD	full length	Abt SRBI	Stanford			state	Mass.	600
11	2010	RDD	full length	Abt SRBI	Stanford			state	Maine	600
12	2010	RDD	full length	Abt SRBI	Stanford			state	Florida	600
13	2010	RDD	omnibus	GfK	Stanford			national		1,004
14	2010	RDD	full length	Abt SRBI	Stanford			national		1,001
15	2011	RDD	omnibus	Ipsos	Stanford	Reuters		national		1,075
16	2011	RDD	omnibus	Ipsos	Stanford	Reuters		national		1,055
17	2012	RDD	omnibus	Ipsos	Stanford	Reuters		national		1,033
18	2012	RDD	omnibus	Ipsos	Stanford	Reuters		national		1,084
19	2012	RDD	full length	Abt SRBI	Stanford	Washington Post		national		804
20	2012	RDD	omnibus	GfK	AP			national		1,002
21	2012	Internet	full length	GfK	Stanford			national		1,080
22	2012	Internet	full length	ALP	Stanford			national		1,020
23	2013	Internet	full length	GfK	Stanford			national		1,174
24	2013	RDD	full length	Abt SRBI	Stanford	RFF	USA Today	national		786
25	2014	RDD	omnibus	SSRS	Stanford	RFF		national		1,023
26	2014	RDD	full length	Abt SRBI	Stanford	University of Arizona		State	Ariz.	803
27	2015	RDD	full length	SSRS	Stanford	RFF		national		1,006
28	2018	RDD	full length	Recon MR	Stanford	ABC News	RFF	national		1,000
29	2020	RDD	full length	Recon MR	Stanford	RFF		national		999

Next, we describe the data collection methodologies of all of the surveys.

1997 Ohio State University Survey. Interviews were conducted in English by telephone with a random digit dial national probability sample of 688 U.S. adults aged 18 and older, via landlines by the Ohio State University Survey Research Unit between September 17, 1997, and October 5, 1997. The AAPOR RR3 was 30%.

1998 Ohio State University Survey. Interviews were conducted in English by telephone with a random digit dial national probability sample of 725 U.S. adults, aged 18 and older, via landlines by the Ohio State University Survey Research Unit between December 20, 1997, and February 13, 1998. The AAPOR RR3 was 38%.

2006 Stanford/ABC News/Time Magazine Survey. Interviews were conducted in English and Spanish by telephone with a random digit dial national probability sample of 1,002 U.S. adults aged 18 and older, via landlines by TNS of Horsham, PA, between March 9 and March 14, 2006, commissioned by ABC News, Time Magazine, and Stanford University. The sample was provided by Survey Sampling International, and interviews were conducted in English and Spanish. The AAPOR RR3 was 38%.

2007 Stanford/AB News/Washington Post Survey. Interviews were conducted in English and Spanish by telephone with a random digit dial national probability sample of 1,002 U.S. adults aged 18 and older, via landlines by TNS of Horsham, PA, between April 5 and April 10, 2007, commissioned by ABC News, the Washington Post, and Stanford University. The sample was provided by Survey Sampling International, and interviews were conducted in English and Spanish. AAPOR RR3 was 29%

2007 Stanford/New Scientist Survey. Interviews were conducted via the Internet between April 12 and April 18, 2007 by GfK Custom Research North America. Respondents

were a nationally-representative probability sample of 1,491 U.S. adults aged 18 or older who were recruited by random digit dial telephone calls to landlines to complete regular Internet surveys. Respondents who did not have computers or Internet access were given them at no cost to them. Interviews were conducted in English. The AAPOR RR3 response rate was 26%.

2008 Stanford/ABC News/Planet Green Survey. Interviews were conducted in English and Spanish by telephone with a random digit dial national probability sample of 1,000 U.S. adults ages 18 and older, via landlines by TNS of Horsham, PA, between July 23 and July 28, 2008, commissioned by ABC News, Planet Green, and Stanford University. The sample was provided by Survey Sampling International, and interviews were conducted in English and Spanish. AAPOR Response Rate 3 (RR3) was 29%.

2009 ABC News Survey. Interviews were conducted in English and Spanish by telephone with a random digit dial national probability sample of 1,001 U.S. adults aged 18 or older, between November 12 and November 15, 2009, with 881 respondents on landlines and 120 respondents on cellular telephones. The samples were provided by Survey Sampling International. The AAPOR RR3 was not available.

2009 Stanford/Associated Press Survey. Interviews were conducted in English and Spanish by telephone with a random digit dial national probability sample of 1,005 U.S. adults aged 18 and older between November 17 and November 29, 2009, with 705 respondents on landlines and 300 respondents on cellular telephones by GfK Roper Public Affairs & Media, commissioned by Stanford University and the Associated Press. The samples were provided by Survey Sampling International, and interviews were conducted in English and Spanish. AAPOR Response Rate 3 (RR3) was 12%. The AAPOR RR3 was 12%.

2010 Stanford University/Associated Press Survey. Interviews were conducted in

English and Spanish by telephone with a random digit dial national probability sample of 1,000 U.S. adults aged 18 and older between June 1 and June 7, 2010, with 699 respondents on landlines and 301 respondents on cellular telephones by GfK Custom Research North America. The samples were provided by Survey Sampling International. The AAPOR RR3 was 9%.

2010 Stanford University Omnibus Survey. Interviews were conducted in English and Spanish by telephone with a random digit dial national probability sample of 1,004 U.S. adults aged 18 and older between June 18 and June 20, 2010 via landlines by GfK Custom Research North America. The AAPOR RR3 was not available.

2010 Stanford University Florida Survey. Interviews were conducted by telephone with a random digit dial probability sample of 600 adults aged 18 and older living in Florida between July 9 and July 18, 2010 by Abt SRBI. Approximately 400 respondents were interviewed on a landline telephone, and approximately 200 respondents were interviewed on a cellular phone. Samples were provided by Survey Sampling International, and interviews were conducted in English and Spanish. The AAPOR RR3 was 17%.

2010 Stanford University Maine Survey. Interviews were conducted by telephone with a random digit dial probability sample of 600 adults aged 18 and older living in Maine between July 9 and July 18, 2010 by Abt SRBI. Approximately 400 respondents were interviewed on a landline telephone, and approximately 200 respondents were interviewed on a cellular phone. Samples were provided by Survey Sampling International, and interviews were conducted in English and Spanish. The AAPOR RR3 was 12%.

2010 Stanford University Massachusetts Survey. Interviews were conducted by telephone with a random digit dial probability sample of 600 adults aged 18 and older living in Massachusetts between July 9 and July 18, 2010 by Abt SRBI. Approximately 400 respondents

were interviewed on a landline telephone, and approximately 200 respondents were interviewed on a cellular phone. Samples were provided by Survey Sampling International, and interviews were conducted in English and Spanish. The AAPOR RR3 was 13%.

2010 Stanford University Survey. Interviews were conducted by telephone with a random digit dial national probability sample of U.S. adults aged 18 and older conducted between November 1 and November 14, 2010, by Abt SRBI. 671 respondents were interviewed on a landline telephone, and 330 respondents were interviewed on a cellular phone. Samples were provided by Survey Sampling International, and interviews were conducted in English and Spanish. The AAPOR RR3 was 17%.

2011 September Reuters Survey. Interviews were conducted by telephone with a random digit dial national probability sample of U.S. adults aged 18 and older between September 8 and September 12, 2011, by Ipsos Public Affairs of Washington, DC, and sponsored by Reuters. 890 respondents were interviewed on a landline phone, and 244 respondents were interviewed on a cell phone. Samples were provided by Survey Sampling International, and interviews were conducted in English and Spanish. The AAPOR RR3 was 8%.

2011 October/November Reuters Survey. Interviews were conducted by telephone with a random digit dial national probability sample of U.S. adults aged 18 and older between October 31 and November 2, 2011, by Ipsos Public Affairs of Washington, DC, and sponsored by Reuters. 867 respondents were interviewed on a landline phone, and 188 respondents were interviewed on a cell phone. Samples were provided by Survey Sampling International, and interviews were conducted in English and Spanish. The AAPOR RR3 was not available.

2012 February Omnibus Ipsos Survey. Interviewing was conducted by telephone with a random digit dial national probability sample of U.S. adults aged 18 and older between February

2 and 8, 2012, by Ipsos Public Affairs. Samples were provided by Survey Sampling International, and interviews were conducted in English and Spanish. 824 respondents were interviewed on a landline phone, and 209 respondents were interviewed on a cell phone. The AAPOR RR3 was 6%.

2012 March Ipsos Omnibus Survey. Interviewing was conducted by telephone with a random digit dial national probability sample of U.S. adults aged 18 and older between March 8 and 11, 2012, by Ipsos Public Affairs. Samples were provided by Survey Sampling International, and interviews were conducted in English and Spanish. 853 respondents were interviewed on a landline phone, and 231 respondents were interviewed on a cell phone. The AAPOR RR3 was 7%.

2012 Stanford University Survey. Interviewing was conducted by telephone with a random digit dial national probability sample of 804 U.S. adults aged 18 and older between June 13 and 21, 2012, by Abt SRBI. Samples were provided by Survey Sampling International, and interviews were conducted in English and Spanish. 603 respondents were interviewed on a landline phone, and 201 respondents were interviewed on a cellular phone. The AAPOR RR3 was 15%.

2012 Associated Press Survey. Interviewing was conducted by telephone with a random digit dial national probability sample of 1,002 U.S. adults aged 18 and older between November 29 and December 3, 2012, by GfK Custom Research North America. Samples were provided by Survey Sampling International, and interviews were conducted in English and Spanish. 600 respondents were interviewed on landlines, and 402 respondents were interviewed on cellular telephones. The AAPOR RR3 was 15%.

2012 Stanford University/GfK Survey. Interviews were conducted via the Internet

between November 10 and 27, 2012, by GfK Custom Research North America. Respondents were a nationally-representative probability sample of 1,080 U.S. adults aged 18 or older who were recruited by mailed invitations to a random sample of American households and by random digit dial telephone calls to landlines and cellphones to complete regular Internet surveys. Respondents who did not have computers or Internet access were given them at no cost to them. Interviews were conducted in English. The AAPOR RR3 was not available.

2012 Stanford University/American Life Panel Survey. Interviews were conducted via the Internet between November 2 and December 13, 2012, by the RAND Corporation. Respondents were a nationally-representative probability sample of 1,020 U.S. adults aged 18 or older who were recruited by random digit dial telephone calls to landlines and cellphones to complete regular Internet surveys. Respondents who did not have computers or Internet access were given them at no cost to them. Interviews were conducted in English. The AAPOR RR3 was not available.

2013 Stanford University Survey. Interviews were conducted via the Internet between March 3 and 18, 2013, by GfK Custom Research North America. Respondents were a nationally-representative probability sample of 1,174 U.S. adults aged 18 or older who were recruited by mailed invitations to a random sample of American households and by random digit dial telephone calls to landlines and cellphones to complete regular Internet surveys. Respondents who did not have computers or Internet access were given them at no cost to them. Interviews were conducted in English and Spanish. The AAPOR RR3 was 2%.

2013 Stanford University & Resources for the Future Survey. Interviews were conducted in English between November 20-December 5, 2013. Interviews were conducted by Abt SRBI via landline (521 interviews) and cellphones (280). Respondents were a nationally-representative

probability sample of 801 U.S. adults aged 18 or older who were recruited by random digit dial telephone calls. The AAPOR RR3 was 13%.

2014 Stanford University & Resources for the Future Survey. Interviews were conducted in English and Spanish between June 4 and June 8, 2014. Interviews were conducted by SSRS via landline (512 interviews) and cellphones (511). Respondents were a nationally-representative probability sample of 1,023 U.S. adults aged 18 or older who were recruited by random digit dial telephone calls. The AAPOR RR3 was 8%.

2014 Stanford University and the University of Arizona Survey. Interviews were conducted in English and Spanish between November 18 and December 9, 2014. Interviews were conducted by Abt SRBI via landline (443 interviews) and cellphones (360). Respondents were a representative probability sample of 803 Arizona adults aged 18 or older who were recruited by random digit dial telephone calls. The AAPOR RR3 was 10%.

2015 Stanford University and Resources for the Future Survey. Interviews were conducted in English and Spanish between January 7 and January 22, 2015. Interviews were conducted by SSRS via landline (483 interviews) and cellphones (523). Respondents were a nationally-representative probability sample of 1,006 U.S. adults aged 18 or older who were recruited by random digit dial telephone calls. The AAPOR RR3 was 12%.

2018 Stanford University, ABC News, Resources for the Future Survey. Interviews were conducted in English and Spanish between May 7 and June 11, 2018. Interviews were conducted by ReconMR via landline (323 interviews) and cellphones (677). Respondents were a nationally-representative probability sample of 1,000 U.S. adults aged 18 or older who were recruited by random digit dial telephone calls. The AAPOR RR3 was 17%.

2020 Stanford University, Resources for the Future, and ReconMR Survey. Interviews

were conducted in English and Spanish between May 18 and August 16, 2020. Interviews were conducted by ReconMR via landline (310 interviews) and cellphones (689). Respondents were a nationally-representative probability sample of 999 U.S. adults aged 18 or older who were recruited by random digit dial telephone calls. The AAPOR RR3 was 10%.

Survey Question Wordings and Codings

FUNDAMENTALS

Global warming has been happening

2012-2020: What is your personal opinion? Do you think that the world's temperature probably has been going up over the past 100 years, or do you think this probably has not been happening?

2012: What is your personal opinion? Do you think that the world's temperature probably has been going up slowly over the past 100 years, or do you think this probably has not been

happening? **2012:** What is your personal opinion? Do you think that the world's temperature probably has been going up over the past 100 years, or do you think this probably has not been

happening? **1997-2011:** You may have heard about the idea that the world's temperature may have been going up slowly over the past 100 years. What is your personal opinion on this - do you think this has probably been happening, or do you think it probably has not been happening?

Coding: 1 = "has probably been happening", 0 = otherwise.

Warming will continue in the future

2012-2020: If nothing is done to prevent it, do you think the world's temperature probably will go up over the next 100 years, or do you think the world's temperature probably will not go up

over the next 100 years? **2012:** If nothing is done to prevent it, do you think the world's

temperature probably will go up slowly over the next 100 years, or do you think the world's

temperature probably will not go up slowly over the next 100 years? **2010-2011:** If nothing is done to prevent it, do you think the world's temperature probably will go up slowly over the next 100 years, or do you think the world's temperature probably will not go up slowly over the next 100 years?

Coding: 1 = "will probably go up", 0 = otherwise.

Past warming has been caused by humans

2012-2020: Do you think that the increase in the world's temperature over the past 100 years was caused mostly by things people did, mostly by natural causes, or about equally by things people did and by natural causes? **2012:** Do you think a rise in the world's temperature is being caused mostly by things people do, mostly by natural causes, or about equally by things people do and by natural causes? **2012-2020:** Assuming it's happening, do you think a rise in the world's temperature would be caused mostly by things people do, mostly by natural causes, or about equally by things people do and by natural causes? **2012:** If the world's temperature did increase over the past 100 years, do you think this increase was caused mostly by things people did, mostly by natural causes, or about equally by things people did and by natural causes? **1997-2011:** Do you think a rise in the world's temperature is being caused mostly by things people do, mostly by natural causes, or about equally by things people do and by natural causes? **1997-2011:** Assuming it's happening, do you think a rise in the world's temperature would be caused mostly by things people do, mostly by natural causes, or about equally by things people do and by natural causes?

Coding: 1 = "caused mostly by things people do" or "about equally by things people do and by natural causes", 0 = otherwise.

Warming will be a serious problem for the U.S.

2012-2020: If nothing is done to reduce global warming in the future, how serious of a problem do you think it will be for THE UNITED STATES – very serious, somewhat serious, not so serious, or not serious at all? **2012:** Assuming it's happening, if nothing is done to reduce global warming in the future, how serious of a problem do you think it would be for THE UNITED STATES – very serious, somewhat serious, not so serious, or not serious at all? **1997-2011:** If nothing is done to reduce global warming in the future, how serious of a problem do you think it will be for THE UNITED STATES – very serious, somewhat serious, not so serious, or not serious at all? **1997-2011:** Assuming it's happening, if nothing is done to reduce global warming in the future, how serious of a problem do you think it would be for THE UNITED STATES – very serious, somewhat serious, not so serious, or not serious at all?

Coding: 1 = “very serious” or “somewhat serious”, 0 = otherwise.

Warming will be a serious problem for the world

2012-2020: If nothing is done to reduce global warming in the future, how serious of a problem do you think it will be for THE WORLD – very serious, somewhat serious, not so serious, or not serious at all? **2012:** Assuming it's happening, if nothing is done to reduce global warming in the future, how serious of a problem do you think it would be for THE WORLD – very serious, somewhat serious, not so serious, or not serious at all? **1997-2011:** If nothing is done to reduce global warming in the future, how serious of a problem do you think it will be for THE WORLD

– very serious, somewhat serious, not so serious, or not serious at all? **1997-2011:** Assuming it's happening, if nothing is done to reduce global warming in the future, how serious of a problem do you think it would be for THE WORLD – very serious, somewhat serious, not so serious, or not serious at all?

Coding: 1 = “very serious” or “somewhat serious”, 0 = otherwise.

5 degrees F of warming in 75 years will be bad

2011-2020: If the world's average temperature is about five degrees Fahrenheit higher 75 years from now than it is now, overall, would you say that would be good, bad, or neither good nor bad? **1997-2010:** Scientists use the term “global warming” to refer to the idea that the world's average temperature may be about five degrees Fahrenheit higher in 75 years than it is now.

Overall, would you say that if the world's average temperature is five degrees Fahrenheit higher in 75 years than it is now, would that be good, bad, or neither good nor bad?

Coding: 1 = “bad”, 0 = otherwise.

The government should do more to address global warming

2009-2020: How much do you think the U.S. government should do about global warming? A great deal, quite a bit, some, a little, or nothing? **2009-2012:** How much do you think the U.S. government is doing now to deal with global warming? A great deal, quite a bit, some, a little, or nothing? **2008:** Do you think the federal government should do more than it's doing now to

try to deal with global warming, should do less than it's doing now, or is it doing about the right amount?

Coding: 1 = "should do" is greater than "is doing" in 2009-2012 and "should do more" in 2008, 0 = otherwise.

ENGAGEMENT

Warming is extremely important personally

How important is the issue of global warming to you personally – extremely important, very important, somewhat important, not too important, or not at all important?

Coding: 1 = "Extremely important", 0 = otherwise.

Highly knowledgeable about global warming

How much do you feel you know about global warming - a lot, a moderate amount, a little, or nothing?

Coding: 1 = "A lot" or "A moderate amount", 0 = otherwise.

POLICIES

The U.S. should take action regardless what other countries do

2008-2015: Do you think the United States should take action on global warming only if other major industrial countries such as China and India agree to do equally effective things, that the United States should take action even if these other countries do less, or that the United States should not take action on this at all?

Coding: 1 = “the United States should take action even if these other countries do less”, 0 = otherwise.

The government should limit greenhouse gas emissions by businesses

2012-2020: As you may have heard, greenhouse gases are thought to cause global warming. In your opinion do you think the government should or should not limit the amount of greenhouse gasses that U.S. businesses put out? **2008-2011:** Some people believe that the United States government should limit the amount of air pollution that U.S. businesses can produce. Other people believe that the government should not limit air pollution from U.S. businesses. What about you? Do you think the government should or should not limit air pollution from U.S. businesses?

Coding: 1 = “should limit”, 0 = otherwise.

Limit greenhouse gas emissions by power plants

2020: For the next items, please tell me for each one whether it's something the government should require by law to try to reduce future global warming, should encourage with tax breaks but not require, or stay out of entirely. Each of these changes could increase the amount of money that you pay for things you buy. Lowering the amount of greenhouse gases that power plants are allowed to release into the air? **2012-2018:** For the next items, please tell me for each one whether it's something the government should require by law to try to reduce future global warming, should encourage with tax breaks but not require, or stay out of entirely. Each of these changes would increase the amount of money that you pay for things you buy. Lowering the amount of greenhouse gases that power plants are allowed to release into the air? **1997-2011:** For

the next items, please tell me for each one whether it's something the government should require by law, encourage with tax breaks but not require, or stay out of entirely. Lowering the amount of greenhouse gases that power plants are allowed to release into the air?

Coding: 1 = "should require by law" or "encourage with tax breaks but not require", 0 = otherwise.

Favor a national cap-and-trade program

2015-2020: There's a proposed system called 'cap-and-trade.' The government would issue permits limiting the amount of greenhouse gases companies can put out. Companies that did not use all their permits could sell them to other companies. Companies that need more permits can buy them, or these companies can pay money to reduce the amount of greenhouse gases that other people or organizations put out. Economists say that this system is likely to cause companies to figure out the cheapest way to reduce greenhouse gas emissions. Would you favor or oppose a cap-and-trade system to reduce the amount of greenhouse gases that companies put out? **2013:** There's a proposed system called "cap and trade." The government would sell permits to companies limiting the amount of greenhouse gases they can put out. Companies that do not use all their permits could sell them to other companies. Companies that need more permits can buy them, or these companies can pay money to reduce the amount of greenhouse gases that other people or organizations put out. Economists say that this system is likely to cause companies to figure out the cheapest way to reduce greenhouse gas emissions. The money the government makes from selling the permits would be returned to all Americans equally by reducing the amount of income taxes they pay. Would you favor or oppose this cap and trade system? **2013:** There's a proposed system called "cap and trade." The government would give

permits to companies limiting the amount of greenhouse gases they can put out. Companies that do not use all their permits could sell them to other companies. Companies that need more permits can buy them, or these companies can pay money to reduce the amount of greenhouse gases that other people or organizations put out. Economists say that this system is likely to cause companies to figure out the cheapest way to reduce greenhouse gas emissions. Would you favor or oppose this cap and trade system? **2013:** There's a proposed system called "cap and trade." The government would issue permits limiting the amount of greenhouse gases companies can put out. Companies that did not use all their permits could sell them to other companies. Companies that need more permits can buy them, or these companies can pay money to reduce the amount of greenhouse gases that other people or organizations put out. This will cause companies to figure out the cheapest way to reduce greenhouse gas emissions. Would you favor or oppose a cap and trade system to reduce the amount of greenhouse gases that companies put out? **2010-2012:** There's a proposed system called "cap and trade." The government would issue permits limiting the amount of greenhouse gases companies can put out. Companies that did not use all their permits could sell them to other companies. Companies that need more permits can buy them, or these companies can pay money to reduce the amount of greenhouse gases that other people or organizations put out. This will cause companies to figure out the cheapest way to reduce greenhouse gas emissions. This type of permit system has worked successfully in the past to reduce the air pollution that companies put out. For example, in 1990, the federal government passed a law like this, called the Clean Air Act, which caused companies to put out a lot less of the air pollution that causes acid rain. Would you favor or oppose a cap and trade system to reduce the amount of greenhouse gases that companies put out? **2009:** There's a proposed system called "cap and trade." The government would issue permits limiting the

amount of greenhouse gases companies can put out. Companies that did not use all their permits could sell them to other companies. Companies that need more permits can buy them, or these companies can pay money to reduce the amount of greenhouse gases that other people or organizations put out. This will cause companies to figure out the cheapest way to reduce greenhouse gas emissions. Would you favor or oppose this system? **2008:** There's a proposed system called "cap and trade." The government would issue permits limiting the amount of greenhouse gases companies can put out. Companies that did not use all their permits could sell them to other companies. The idea is that many companies would find ways to put out less greenhouse gases, because that would be cheaper than buying permits. Would you support or oppose this system? Coding: 1 = "favor", 0 = otherwise.

Increase fuel efficiency of cars

2020: For the next items, please tell me for each one whether it's something the government should require by law to try to reduce future global warming, should encourage with tax breaks but not require, or stay out of entirely. Each of these changes could increase the amount of money that you pay for things you buy. Building cars that use less gasoline? **2013-2018:** For the next items, please tell me for each one whether it's something the government should require by law to try to reduce future global warming, should encourage with tax breaks but not require, or stay out of entirely. Each of these changes would increase the amount of money that you pay for things you buy. Building cars that use less gasoline? **2012:** For the next items, please tell me for each one whether it's something the government should require by law, encourage with tax breaks but not require, or stay out of entirely. Each of these changes would increase the amount of money that you pay for things you buy. Building cars that use less gasoline? **1997-2011:** For

the next items, please tell me for each one whether it's something the government should require by law, encourage with tax breaks but not require, or stay out of entirely. Building cars that use less gasoline?

Coding: 1 = "should require by law" or "encourage with tax breaks but not require", 0 = otherwise.

Build more all-electric vehicles

2013-2015: For the next items, please tell me for each one whether it's something the government should require by law to try to reduce future global warming, should encourage with tax breaks but not require, or stay out of entirely. Each of these changes would increase the amount of money that you pay for things you buy. Building cars that run completely on

electricity? **2012:** For the next items, please tell me for each one whether it's something the government should require by law, encourage with tax breaks but not require, or stay out of entirely. Each of these changes would increase the amount of money that you pay for things you

buy. Building cars that run completely on electricity? **1997-2011:** For the next items, please tell me for each one whether it's something the government should require by law, encourage with tax breaks but not require, or stay out of entirely. Building cars that run completely on

electricity?

Coding: 1 = "should require by law" or "encourage with tax breaks but not require", 0 = otherwise.

Build appliances that use less electricity

2020: For the next items, please tell me for each one whether it's something the government should require by law to try to reduce future global warming, should encourage with tax breaks but not require, or stay out of entirely. Each of these changes could increase the amount of money that you pay for things you buy. Building air conditioners, refrigerators, and other appliances that use less electricity? **2013-2018:** For the next items, please tell me for each one whether it's something the government should require by law to try to reduce future global warming, should encourage with tax breaks but not require, or stay out of entirely. Each of these changes would increase the amount of money that you pay for things you buy. Building air conditioners, refrigerators, and other appliances that use less electricity? **2012:** For the next items, please tell me for each one whether it's something the government should require by law, encourage with tax breaks but not require, or stay out of entirely. Each of these changes would increase the amount of money that you pay for things you buy. Building air conditioners, refrigerators, and other appliances that use less electricity? **1997-2011:** For the next items, please tell me for each one whether it's something the government should require by law, encourage with tax breaks but not require, or stay out of entirely. Building air conditioners, refrigerators, and other appliances that use less electricity?

Coding: 1 = "should require by law" or "encourage with tax breaks but not require", 0 = otherwise.

Build more energy-efficient buildings

2020: For the next items, please tell me for each one whether it's something the government should require by law to try to reduce future global warming, should encourage with tax breaks

but not require, or stay out of entirely. Each of these changes could increase the amount of money that you pay for things you buy. Building new homes and offices that use less energy for heating and cooling? **2013-2018:** For the next items, please tell me for each one whether it's something the government should require by law to try to reduce future global warming, should encourage with tax breaks but not require, or stay out of entirely. Each of these changes would increase the amount of money that you pay for things you buy. Building new homes and offices that use less energy for heating and cooling? **2012:** For the next items, please tell me for each one whether it's something the government should require by law, encourage with tax breaks but not require, or stay out of entirely. Each of these changes would increase the amount of money that you pay for things you buy. Building new homes and offices that use less energy for heating and cooling? **1997-2011:** For the next items, please tell me for each one whether it's something the government should require by law, encourage with tax breaks but not require, or stay out of entirely. Building new homes and offices that use less energy for heating and cooling?

Coding: 1 = "should require by law" or "encourage with tax breaks but not require", 0 = otherwise.

Tax breaks to produce renewable energy

2012-2020: For each of the following, please tell me whether you favor or oppose it as a way for the federal government to try to reduce future global warming. Each of these changes would increase the amount of money that you pay for things you buy. Do you favor or oppose the federal government giving companies tax breaks to produce more electricity from water, wind, and solar power? **1997-2011:** For the next items, please tell me whether you favor or oppose it as a way for the federal government to try to reduce future global warming. Do you favor or oppose

the federal government giving companies tax breaks to produce more electricity from water, wind, and solar power?

Coding: 1 = “favor”, 0 = otherwise.

Tax breaks to reduce air pollution from coal

2012-2020: For each of the following, please tell me whether you favor or oppose it as a way for the federal government to try to reduce future global warming. Each of these changes would increase the amount of money that you pay for things you buy. Do you favor or oppose the federal government giving tax breaks to companies that burn coal to make electricity if they use new methods to reduce the air pollution being released from their smokestacks? **1997-2011:** For the next items, please tell me whether you favor or oppose it as a way for the federal government to try to reduce future global warming. Do you favor or oppose the federal government giving tax breaks to companies that burn coal to make electricity if they use new methods to put the air pollution they generate into underground storage areas instead of letting that air pollution go up the smokestacks at their factories?

Coding: 1 = “favor”, 0 = otherwise.

Tax breaks to build nuclear power plants

2012-2020: For each of the following, please tell me whether you favor or oppose it as a way for the federal government to try to reduce future global warming. Each of these changes would increase the amount of money that you pay for things you buy. Do you favor or oppose the federal government giving companies tax breaks to build nuclear power plants? **1997-2011:** For the next items, please tell me whether you favor or oppose it as a way for the federal government

to try to reduce future global warming. Do you favor or oppose the federal government giving companies tax breaks to build nuclear power plants?

Coding: 1 = “favor”, 0 = otherwise.

Increase consumption taxes on electricity

2012-2020: For each of the following, please tell me whether you favor or oppose it as a way for the federal government to try to reduce future global warming. Each of these changes would increase the amount of money that you pay for things you buy. Do you favor or oppose the federal government increasing taxes on electricity so people use less of it? **1997-2011:** For the next items, future global warming. Do you favor or oppose the federal government increasing taxes on electricity so people use less of it?

Coding: 1 = “favor”, 0 = otherwise.

Increase consumption taxes on gasoline

2012-2020: For each of the following, please tell me whether you favor or oppose it as a way for the federal government to try to reduce future global warming. Each of these changes would increase the amount of money that you pay for things you buy. Do you favor or oppose the federal government increasing taxes on gasoline so people either drive less, or buy cars that use less gas? **1997-2011:** For the next items, please tell me for each one whether it’s something the government should require by law, encourage with tax breaks but not require, or stay out of entirely. Do you favor or oppose the federal government increasing taxes on gasoline so people either drive less, or buy cars that use less gas?

Coding: 1 = “favor”, 0 = otherwise.

Analytical Approach of the Aggregation Disaggregation Technique (the ADT)

To generate an estimate of the percent of people in each state holding each opinion in 2020 (or 2015 for two measures for which we did not have more recent data), we conducted what social scientists call a “secondary analysis” of existing data that were previously collected for other purposes. Specifically, a statistical modeling procedure was implemented using the survey data. The procedure modeled differences between states, effects of survey mode (e.g., telephone interviewing vs. self-completion of Internet questionnaires), effects of the topic of the survey (full length questionnaire on the topics of global warming vs. single or few questions about global warming on omnibus surveys), and trends in opinions over years. Using the parameter estimates from logistic regression equations, distributions of opinions in 2020 were generated assuming random digit dialing telephone interviewing in a survey with full-length topic on global warming.

The conceptualization underlying the analysis is captured in this equation:

$$\text{Reported Opinion} = \text{State} + \text{Year of Survey} + \text{Mode of Data Collection} + \\ \text{Topic of the Survey} + \text{Intercept}$$

The independent variables in this equation were represented by a series of dichotomous dummy variables, and parameter estimates were generated via logistic regression for each global warming measure. Using those parameter estimates, we generated sets of the predicted opinion for each respondent answering each question, setting the state variable over and over to specify each of the different states, and setting the other variables always at specific values (Mode = telephone interviewing, Topic of the Survey = almost all questions about global warming).

More formally, the parameters of the following equation were estimated for each dependent variable, for the illustrative purpose, let the dependent variable be the measure that

"global warming has been happening":

$$y_i = \alpha + \sum_{j=1997,2006-2020} \beta_j year_j + \sum_{\substack{k=50 \text{ states} \\ - \text{Alabama,} \\ + \text{District of Columbia}}} \gamma_k state_k + \delta_1 mode + \delta_2 topic$$

where i indicates respondents, y is the dependent variable which was set to 1 if respondent believed that global warming has been happening and 0 otherwise, $year_j$ is an indicator for year of survey that was set to 1 if the year of survey was j and 0 otherwise, $state_k$ is an indicator for the state of the respondent which was set to 1 if the respondent lived in state k and 0 otherwise, $mode$ is set to 1 if the survey was administrated on Internet and 0 for telephone interviews, and $topic$ is set to 1 if the dependent measure was asked in an omnibus survey and 0 for full length global warming survey. Omitted base categories are $year_{2020}$ and $state_{Alabama}$. α is the intercept, and β 's, γ 's, and δ 's are coefficient parameters to be estimated.

Section 2: Correlates of State-Level Opinion

Variable Codings for Regressions

% Trump Vote 2016

Variable coded using data from the states' election administrators. The value represents the percent of votes cast for Donald Trump in 2016.

Average temperature

The state-level average temperature is the 24 months average temp from September 2018 to Aug 2020 (accessed September 30, 2020

from <https://www.ncdc.noaa.gov/cag/statewide/mapping/110/tavg/202008/24/value>).

1980-2020 Climate Disasters Cost (logged)

Cost of natural disasters in millions of dollars from 1980-2020. Includes drought, floods, freezes, severe storms, tropical cyclones, wildfires, and winter storms. Data from the National Oceanic and Atmospheric Administration (accessed September 30, 2020 from <https://www.ncdc.noaa.gov/billions/state-cost-data.csv>)

2019 Per Capita Income (logged)

Per capita personal income in each state in 2019, according to data released by the Bureau of Economic Analysis at the U.S. Department of Commerce (Released March 24, 2020).

2018 Residential Electricity Cost (logged)

Electricity retail prices as of 2018, reported by the U.S. Energy Information Administration (accessed September 30, 2020 from

https://www.eia.gov/state/seds/data.php?incfile=/state/seds/sep_sum/html/sum_pr_res.html&sid=US).

2020 Gasoline Retail Cost (logged)

September 2020 Gasoline per gallon cost in each state, as reported by AAA (accessed September 30, 2020 from <https://gasprices.aaa.com/state-gas-price-averages/>)

2018 Coal Production in State as Percent of Total Coal Production

2018 coal production by state in million cu ft., divided by total coal production in the United States. (accessed September 30, 2020 from <https://www.eia.gov/state/rankings/#/series/48>).

2018 Natural Gas Production in State as Percent of National Natural Gas Production

2018 natural gas production by state in million cu ft., divided by total natural gas production in the United States. Data are reported from the U.S. Energy Information Administration, divided by the national total (accessed September 30, 2020 from <https://www.eia.gov/state/rankings/#/series/47>).

Analytical Approach

To explore potential explanations for variations in state-level opinion, we estimated the parameters of seemingly unrelated ordinary least squares (OLS) regression equations predicting opinions about global warming in the states using the aforementioned factors. We categorized the 22 global warming opinions into three types: fundamentals, engagement, and policy support, and created an index of each by averaging the measures within each category, thus yielding an index of the seven measures of fundamentals of global warming, an index of the two measures that measure engagement on the issue, and an index of the 11 policy measures for which we have estimates of public opinion in 2020.¹ Because these three indices are correlated, seemingly unrelated (OLS) regression was employed.

¹ The seven measures of fundamentals have a Cronbach's alpha of 0.93; the two measures assessing engagement have a Cronbach's alpha of 0.71; and the 12 measures of policy attitudes have a Cronbach's alpha of 0.81. Thus, it is reasonable to build these indices.

The predictors are percent of votes for President Trump in the 2016 election, which is to capture each state's general political orientation, average temperature, economic damage due to climate disasters in the state, per capita income (to measure the economic buffer, consumer electricity costs and retail gasoline costs to measure energy costs, and the amount of coal production and the amount of natural gas production in the state.²

Results

Predicting fundamentals. As expected, people in states that conferred more votes to President Trump in the 2016 election exhibited a lower level of acceptance of the fundamentals of global warming ($b=-.174$, $p<.05$; row 1 column 1 in Table 2). The magnitude of the association of political orientation with the fundamentals is surprisingly small: a ten percentage points increase in the share of votes for President Trump in 2016 (ten percentage points was about the difference between Connecticut, in which President Trump received 41% of the votes, and Iowa, where President Trump received 51% of the votes) correlates with a decrease of 1.7 percentage points in fundamentals.

As expected, people in warmer states manifested more belief in fundamentals ($b=2.218$, $p<.05$; row 2 column 1 in Table 2). The magnitude of the association of average temperature with fundamentals is considerable: a one-unit increase in the square root of average temperature (a one-unit increase in the square root of average temperature is about the difference between Texas, where the average temperature was 64.6 and its square root is 8, and Nevada, where the average temperature was 49.5 and its square root is 7) correlates with an increase of 2.2

² To account for the nonlinearity and ensure that the estimates are not unduly influenced by outliers, the square root of the average temperature and the natural log of price and incomes were used: the natural log of per capital income, consumer energy price, retail gasoline prices, and climate damage.

percentage points in fundamentals.

Consistent with expectations, higher consumer electricity prices predict greater acceptance of global warming fundamentals ($b=8.83$, $p<.01$; row 4 column 1 in Table 2). The magnitude of the influence of average temperature on fundamentals is markedly large: for every one percent increase in consumer energy prices, there is an 8.8 percentage point increase in the proportion of people accepting global warming fundamentals. Other covariates were not significant.

Predicting engagement. As expected, people in states that conferred more votes to President Trump in the 2016 election exhibited a lower level of engagement in the issue of global warming ($b=-.402$, $p<.001$; row 1 column 2 in Table 2). A ten percentage-point increase in the share of votes for President Trump in 2016 (ten percentage points was about the difference between Connecticut and Iowa) correlates with a decrease of 4.0 percentage points in engagement.

As expected, people in warmer states are more engaged in the issue of global warming ($b=2.767$, $p<.05$; row 2 column 2 in Table 2). The magnitude of the association of average temperature with issue engagement is sizable: a one-unit increase in the square root of average temperature (a one-unit increase in the square root of average temperature was about the difference between Texas and Nevada) correlates with an increase of 2.8 percentage points in issue engagement. Remaining covariates did have statistically significant relationships.

Predicting policy support. As expected, people in states that conferred more votes to President Trump in the 2016 election exhibited a lower level of support for mitigation policies to reduce future global warming ($b=-.155$, $p<.01$; row 1 column 3 in Table 2). The magnitude of the influence of political orientation on engagement is relatively small: a ten percentage-point

increase in the share of votes for President Trump in 2016 (ten percentage points was about the difference between Connecticut and Iowa) correlates with a decrease of 1.6 percentage points in engagement.

Also consistent with expectations, higher-income states are more supportive of mitigation policies ($b=5.976$, $p<.10$; row 10 column 3 in Table 2). The magnitude of the influence of income on policy support is quite large: for every one percent increase in consumer income, there is an associated 6.0 percentage point increase in the level of favoring those mitigation policies.

As hypothesized, people in states with higher coal production are more likely to embrace mitigation policies, and people in states with higher natural gas production are less likely to support mitigation policies ($b=.455$, $p<.01$; $b=-.154$, $p<.10$; rows 7-8 column 3 in Table 2). The magnitude of the influence of coal production on policy support is larger than that of natural gas production. For a two percentage points increase in coal production (approximately the difference between Texas, which has 3.3 percent in coal production and Montana, which has 5.1 percent in coal production), there is an approximately one percentage point increase in the level of favoring those mitigation policies. Likewise, a ten percentage-point increase in natural gas production (approximately the difference between Oklahoma, which has 9.3 percent in natural gas production and Pennsylvania, which has 19.5 percent in natural gas production), there is an approximately 1.5 percentage point decrease in the level of favoring those mitigation policies. Remaining covariates were not significant.

Table 2. Predicting the State-Specific Global Warming Opinions

Predictor	Unstandardized regression coefficients		
	GW fundamentals	GW engagement	GW policy support
Percent of votes for President Trump in 2016	-0.174* (0.074)	-0.402*** (0.090)	-0.155** (0.059)
Average temperature (squared root)	2.218* (1.109)	2.767* (1.351)	-0.221 (0.878)
Per capita income (log)	3.269 (3.860)	-6.653 (4.702)	5.976+ (3.055)
Residential energy price (log)	8.828** (3.042)	4.019 (3.706)	0.562 (2.408)
Gasoline price in 2020 (log)	-4.165 (5.312)	-1.769 (6.472)	-4.403 (4.205)
Economic costs from climate change (log)	-0.090 (0.454)	-0.061 (0.553)	0.297 (0.359)
Percent of national coal production	0.092 (0.209)	0.097 (0.254)	0.455** (0.165)
Percent of national natural gas production	-0.066 (0.099)	0.019 (0.121)	-0.154+ (0.078)
Constant	4.885 (40.765)	108.078* (49.663)	2.623 (32.270)
N	46	46	46

Notes: Cell entries are unstandardized OLS regression coefficient with standard errors in parentheses. Each column is a sperate regression.

***p<.001 **p<.01 *p<.05 +p<.10

Section 3: Using State-Level Opinions to Predict LCV Voting Scores

Analytical Approach

To assess the strength of the connection between public opinion and legislator behavior, we tested two models of representation simultaneously via OLS regression. The first model proposes that the opinions of all residents of a state might influence policy makers via surveys of representative samples of those individuals. The greener the state as a whole, the more likely their representatives might be to vote for policies intended to protect the natural environment. The second model proposes that members of the issue public may send signals directly and indirectly to elected representatives (via phone calls, letters, emails, visits to their offices, and participation in town halls). Thus, because the global warming issue public is more than 90% on the green side of the issue, the larger the issue public in a state, the more likely their representatives might be to vote for policies intended to protect the natural environment.

To test these models, we used these two attributes of each state (the entire population's endorsement of mitigation policies and the size of the issue public) to predict green voting by members of Congress. The latter was gauged using the score for each member in the first session of the 116th Congress from the League of Conservation Voters (LCV). This LCV scorecard is based on the consensus of experts from approximately 20 environmental and conservation organizations who selected the key votes on which members of Congress should be scored, on climate change, energy, public health, public lands use and wildlife conservation, and spending for environmental programs. Each state produced three voting scores to be predicted: one for each of the two U.S. Senators representing the state, and another the average of the scores of all the members of U.S. House for the state. A total of 46 states were included in this analysis because they each had sufficient numbers of survey respondents to generate reliable measures of

opinions. Regressions were performed using clustered standard errors at the state level.

Variable Codings for Regressions

LCV Score

The League of Conservation Voters assigned all U.S. Senators and all representatives in the U.S. House of Representatives a score ranging from 0 to 100, with 0 meaning the least pro-environmental voting and 100 meaning the most pro-environmental voting

(http://scorecard.lcv.org/sites/scorecard.lcv.org/files/LCV_2019_Scorecard.pdf).

Policy Index

An average of state-level estimates across all 11 policy items for which we could calculate a 2020 estimate.

Issue Public

The estimated issue public in the state for 2020.

Results

An ordinary least squares regression predicting pro-environment voting in the states lends support to both models of public representation in Congress (see Table 3). As expected, the larger the majority in the state expressing green opinions on global warming, the more likely their representatives were to vote for green policies ($b = 5.355$, $p < .001$). Every percentage point increase in green policy views was associated with a nearly 5.4-point increase in the grade assigned to the legislator by the LCV. And the larger the global warming issue public in the state, the more likely their representatives were to vote for green policies ($b = 1.640$, $p < .05$). Every extra percentage point of citizens in a state for whom global warming is extremely important was associated with a roughly 1.6-point increase in the LCV score.

Table 3: Ordinary Least Squares Regression
 Predicting Green Voting by Members of Congress

Predictor	Unstandardized Regression Coefficient
Index of green policy attitudes for the entire state population	5.355*** (1.059)
Proportion of the state in the global warming issue public	1.640* (0.714)
Constant	-318.220*** (60.413)
N	138

***p<.001 *p<.05