Scientific Consensus on Global Warming

Results of an
international survey
of climate scientists

by

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Introduction

Global warming is one of the most controversial topics of debate today. Is Earth's temperature rising? If it is, how rapid is the increase and will it benefit or harm humanity and nature? Are human greenhouse gas emissions to blame, or is the increase a natural return to temperatures that prevailed during the planet's previous warm periods?

The issue has gotten tremendous attention by the mainstream media, perhaps because it makes for exciting headlines and "specials" for television, but also because the stakes are very high. If a major warming is occurring and it is due to human activities, then public policies may be justified to tax or regulate a wide range of activities and encourage or subsidize others. Because carbon dioxide (CO_2) – the most important man-made greenhouse gas – is emitted whenever fossil fuels are burned, programs to reduce CO_2 levels necessarily affect energy prices, and with them much of the U.S. and global economies.

How Can We Decide?

Because the issues involved in the global warming debate are complex, few people are truly competent to judge the evidence presented by those who are sounding the alarm over potential catastrophic warming, on the one hand, or by the "skeptics"– those who say the modern warming is very modest, probably due to natural causes, and might even be beneficial. As a consequence, most of the public and even policymakers rely on popular accounts of the issues in newspapers and magazines. Some read surveys of the scientific and economic literature, or follow the lead of individuals they trust who stake out positions in the debate.

Another option is to poll scientists to see what they think. Such polling must be done carefully due to the complexity of the issues, and the results must be carefully weighed. Science does not advance through "consensus," but rather by scientists repeatedly testing current hypotheses and proposing new ones. In the case of global warming, much of the science is so new that more is unknown than known. Nevertheless, scientists bring expertise to the debate that most people do not have, and knowing what they believe can be a useful guide for students of the topic.

Global warming is also not only, or even primarily, a scientific issue. Computer models that attempt to predict future climates depend critically on assumptions about economic, political, and social trends such as population growth, prosperity, and technological innovation, to estimate future greenhouse gas emissions. Economists, political scientists, and sociologists know much more about these things than physicists and climatologists. Without their specialized knowledge, the big computer models used to run

future climate scenarios are useless.

With these caveats in mind, we conclude that the views of climate scientists on some aspects of the global warming debate are important and deserve more attention in the current debate than they have received. This is why The Heartland Institute has produced this booklet.

An International Survey of Scientists

This booklet summarizes the results of international surveys of climate scientists conducted in 1996 and 2003 by two German environmental scientists, Dennis Bray and Hans von Storch. Bray is a research scientist at the GKSS Institute of Coastal Research in Geesthacht, Germany. Von Storch is a climatology professor at the University of Hamburg and director of the Institute of Coastal Research.

More than 530 climate scientists from 27 different countries provided numerical answers each time the survey was conducted. All responses were anonymous. The same questions were asked each time the survey was conducted, plus an additional 32 questions were asked in 2003. The 2003 survey was conducted online. Notice of the survey was posted in the *Bulletin of the American Meteorological Society* and on the Climlist server (Climlist is a moderated international electronic mail distribution list for climatologists and those working in closely related fields). Notices also were sent to institutional lists in Germany, Denmark, and the U.K. The survey was password protected to ensure that scientists in climate-related fields were the only ones with access to it.

The surveys presented dozens of assertions regarding climate change and asked respondents to give a numerical score, on a scale of 1 to 7, indicating the extent to which the respondents agreed or disagreed with each assertion. The entire results of both surveys can be found online at a site created and maintained by Bray and von Storch.[1]

The average responses to every question in both the 1996 and 2003 surveys are reported in the appendix of this booklet. This is all valuable and accurate data, of course, but it can be difficult for a layperson to interpret. What does it mean, for example, to say the average response to a question is 3.39?

To make the survey results more transparent, we singled out 18 questions from the 2003 survey and present the answers here in a simplified and less academic style. For each question, we combined the percentages of those respondents who gave numeric scores of 1, 2, or 3 and called this "agree."

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[1] Bray, Dennis and von Storch, Hans. Survey of Climate Scientists 1996, 2003, http://w3g.gkss.de/staff/bray/BrayGKSSsite/BrayGKSS/surveyframe.html.

We combined those who gave numeric scores of 5, 6, or 7 and called this "disagree." Those who answered with the numeric score of 4 we called "uncertain." Using these numbers, we then illustrate the answers to each question with a simple pie chart. Tables containing the underlying data appear in the appendix.

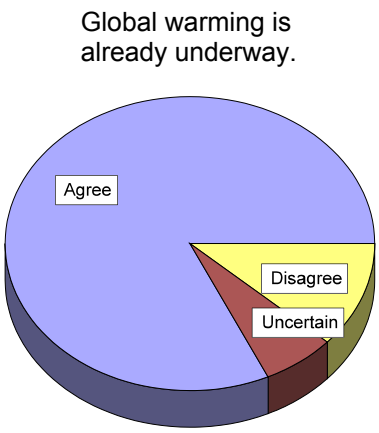
What the 2003 Survey Found

The 2003 survey results show climate scientists at laboratories, universities, and offices around the world nearly all agree that global warming is already underway and the media influences the public's perception of climate change. On all other questions, there was significant disagreement.

Specifically, there is no consensus regarding the causes of the modern warming period, how reliable predictions of future temperatures can be, and whether future global warming would be harmful or beneficial. Assertions that "the debate is over" are certainly not supported by the survey results.

1. Is global warming occurring?

Eighty-two percent of climate scientists agreed with the statement, "We can say for certain that global warming is a process already underway." Approximately one-third (31.9 percent) said they "strongly agree" with the statement and only 2.6 percent said they "strongly disagree."



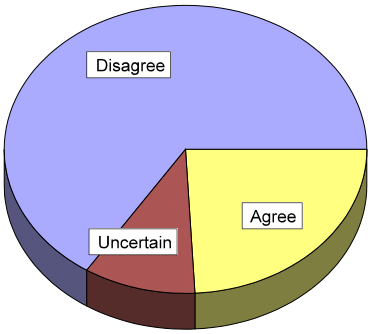
Whether or not some warming has occurred was a matter of controversy during the 1980s and 1990s when satellite data appeared to show no warming trend since the satellites first began sending data in 1979. Temperatures taken from instruments suspended from weather balloons also showed little or no warming trend during the past 50 years.

More recently, however, re-analysis of the satellite data shows an upward trend, though still less than land-based temperature stations and much less than the amount predicted by computer models. Most climate scientists believe Earth has warmed slightly (about 0.8° Celsius, or about 1° Fahrenheit) during the past century.

2. Is rising CO_2 causing climate change?

The claim that human activities are responsible for most or all of the recent warming trend relies on a theory, called the greenhouse theory, that predicts rising levels of carbon dioxide (CO_2) will trap more heat in the atmosphere and lead to rising temperatures. "Skeptics" in the debate over global warming contend CO_2 has played a relatively small role in past climate changes and that natural processes and complex feedback loops counteract the effects of rising levels of CO_2.

We can assess the effects of greenhouse gases.

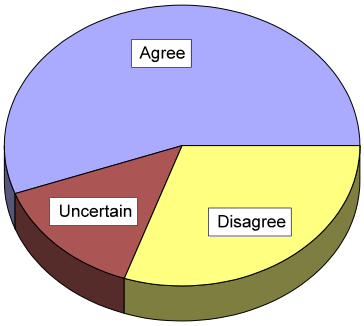


The survey asked scientists if "the current state of scientific knowledge is developed well enough to allow for a reasonable assessment of the effects of greenhouse gases." Two-thirds of the scientists surveyed (65.9 percent) *disagreed* with the statement, with nearly half (45.7 percent) scoring it with a 1 or 2, indicating strong disagreement. Only 10.9 percent scored it with a 6 or 7, indicating strong agreement.

3. Are humans causing climate change?

The question most people are most keen to ask climate scientists is probably **"do you agree or disagree that climate change is mostly the result of anthropogenic (man-made) causes?"** Slightly more than half (55.8 percent) of climate scientists surveyed agreed, 14.2 percent were unsure, and 30 percent disagreed. Interestingly, more scientists "strongly disagree" than "strongly agree" that climate change is mostly the result of anthropogenic causes.

Human activity is causing climate change.

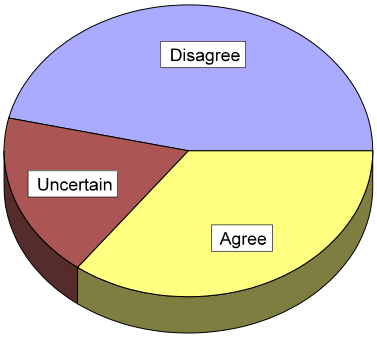


The survey clearly shows that the debate over *why* the climate is changing is still underway, with nearly half of climate scientists disagreeing with what is often claimed to be the "consensus" view. Note that the question asked was not whether or not human activities have *any* effect on climate – most climate scientists probably believe they do. Rather, the question (and the international public policy debate) is whether climate change is "mostly the result" of human activity.

4. Is scientific knowledge sufficient to predict future climate?

Before scientists can predict future climate they must decipher the complex code of the global climate. Billions of dollars have been spent creating global circulation models that run on super-computers and generate different scenarios based on data entered and assumptions incorporated into their codes. The models have come under fierce criticism from many skeptics who say the data are often inaccurate and the climate is too dynamic for computer models to predict how it will change.

Climate models can accurately predict future climates.

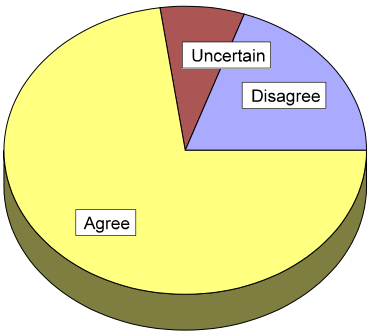


When climate scientists were asked if "climate models can accurately predict climate conditions in the future," only a third (35.1 percent) agreed, while 18.3 percent were uncertain and nearly half (46.6 percent) disagreed. This finding is surprising given the heavy reliance on computer models by the IPCC and many scientists who work in the field. The survey suggests that a key tool relied on by those who believe in man-made global warming is considered to be inaccurate by nearly half of the world's climate scientists.

5. Is the IPCC a reliable guide to scientific consensus?

Probably the most commonly cited evidence that a "consensus" of scientists believe it is possible to predict future climates based on computer models are the reports of the United Nations' Intergovernmental Panel on Climate Change (IPCC). The IPCC is controversial because it is a political, not a scientific, body and its widely circulated "summaries for policymakers" are edited by government officials.

The IPCC reflects the scientific consensus.

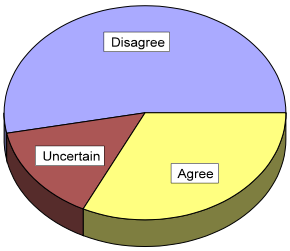


Surprisingly, the survey shows roughly three of four climate scientists (72.7 percent) believe "the IPCC reports accurately reflect the consensus of thought within the scientific community." However, nearly one in five (19.8 percent) disagree. Only 24.4 percent of respondents "strongly agreed" with the statement.

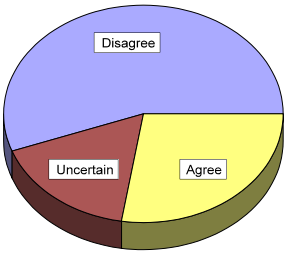
6. Can we predict what the climate will do ten years from now? 100 years from now?

The survey asked scientists to indicate "the degree [to which] you think the current state of scientific knowledge is able to provide reasonable predictions of climate variability of time scales" of 10 years, 100 years, and greater than 100 years. Note these questions do not single out computer models, which many climate scientists apparently do not believe are reliable. Rather, they ask if all the current knowledge about global climate is sufficient to produce "reasonable predictions."

We can predict climate variability on time scales of 10 years.



We can predict climate variability on time scales of 100 years.



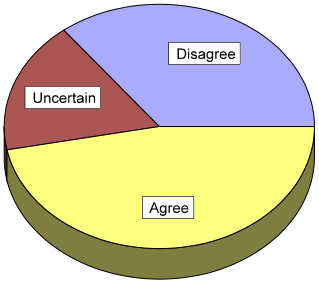
Only one-third (32.1 percent) of scientists reported having confidence in our ability to make predictions in time scales of 10 years, while more than half (53.3 percent) reported little or no confidence in such predictions. When asked about time scales of 100 years, slightly more than a quarter (27.4 percent) of scientists reported being confident while 55.6 percent had little or no confidence.

Apparently, few climate scientists believe we can accurately predict what the climate will be like in as little as 10 years, or as far off as 100 years.

7. Why do computer models fail?

One reason so few scientists trust computer models is because the data fed into them is often incomplete, contaminated, and not subject to peer review. Even scientists who rely on computer models and endorse their output admit to "tweaking" the models to produce results in line with their expectations. The survey confirmed these views are widely held by climate scientists.

Climate models accurately verify climate conditions.

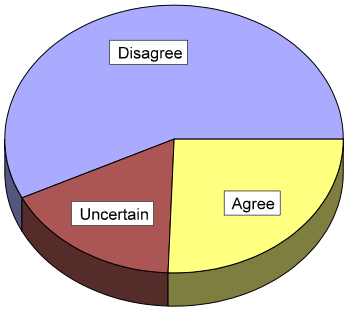


Asked to respond to the statement, "Climate models accurately verify the climatic conditions for which they are calibrated," barely half (46.8 percent) of scientists agreed, 17.6 percent were uncertain, and more than a third (35.6 percent) disagreed. Four times as many scientists "strongly disagreed" with the statement as "strongly agreed" with it.

8. How well do climate models deal with precipitation?

Precipitation plays at least two roles in the global warming debate. First, it is a cause of temperature change by reducing the amount of moisture in the atmosphere, and consequently its ability to retain heat. It also affects vegetation and consequently the extent of groundcover, which shades and cools the ground. Second, it is a consequence of climate change. Two of the most-often described hazards caused by global warming – storms and flooding – are alleged to be driven by changes in precipitation.

Climate models adequately deal with precipitation.



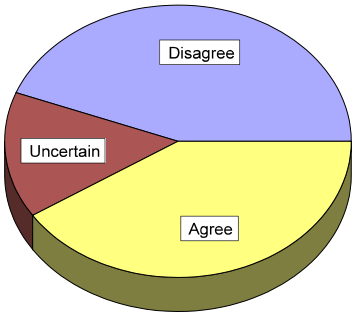
Scientists were asked, "How well do you think atmospheric climate models can deal with precipitation?" More than half (57.5 percent) said models are "inadequate" while only a quarter (25.4 percent) expressed any confidence in the models. The remaining 17.1 percent were undecided.

Based on these answers, there is no consensus on the effect of global warming on precipitation.

9. How well do climate models deal with water vapor?

Water vapor plays a major role in the debate over global warming. It is by far the largest greenhouse gas, accounting for about 60 percent of the natural greenhouse effect. (CO_2 accounts for about 20 percent.) Some climate scientists say water vapor will amplify the warming effects of rising CO_2 and cause more violent weather and flooding.

Climate models adequately deal with water vapor.



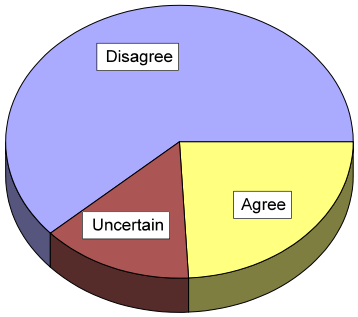
Scientists were asked, "How well do you think atmospheric climate models can deal with water vapour in the atmosphere?" The answer showed a scientific community almost evenly split between those who believe climate models are "inadequate" (44.4 percent) and those who believe the models are "adequate" (40.8 percent), while 14.8 were unsure.

If there is no consensus on how well climate models deal with water vapor, there probably cannot be consensus on matters less central to the science of climate change.

10. How well do climate models deal with clouds?

Fifteen years ago Richard Lindzen, professor of meteorology at MIT, observed, "Unfortunately, the way current [climate] models handle factors such as clouds and water vapor is disturbingly arbitrary. In many instances the underlying physics is simply not known."[2] Clouds are important because even a small change in cloud cover can more than offset whatever warming effect might come from CO_2. Are climate models today better than they were 15 years ago?

Climate models adequately deal with clouds.



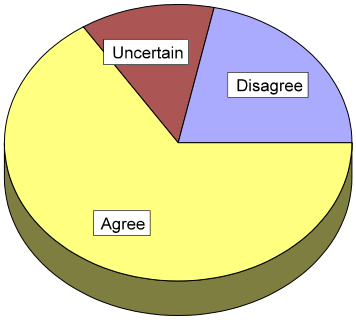
Asked, "How well do you think atmospheric climate models can deal with clouds?" nearly two-thirds (61.8 percent) of scientists said the models are "inadequate," while only one fourth (24.1 percent) said the models are "adequate." Nearly four times as many scientists scored the models as "very inadequate" (11.7 percent) as scored them "very adequate" (3.2 percent).

It appears climate models have not improved very much at all.

11. How accurately do climate models deal with variation in solar radiation?

A controversial issue in the global warming debate is how large a role solar variability plays in Earth's climate. A growing number of scientists believe variation in solar radiation explains most or even all of the modern warming, just as it explains past warming and cooling periods. In recent decades, the sun has been relatively active, sending more solar radiation to Earth.

Climate models adequately deal with solar radiation.



Climate scientists were asked, "How well do you think atmospheric climate models can deal with radiation?" Most scientists – 65.7 percent – believe the models are "adequate" or "very adequate." About one in five – 21.7 percent – believe the models are "inadequate" or "very inadequate."

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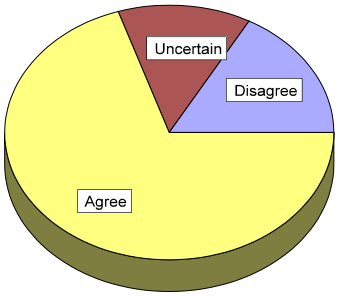
[2] Richard Lindzen, "Global Warming: The Origin and Nature of the Alleged Scientific Consensus," *Regulation*, 15 (Spring 1992).

12. Would climate change have beneficial effects?

Earth experienced warmer temperatures than today's during recorded history, and records indicate human civilization thrived during those times. Climate scientists may not be as well-positioned as historians, economists, and agricultural scientists to speculate about the costs and benefits of the modern warming. Nevertheless, media reports about global warming seldom mention such benefits as lower morbidity and mortality rates, more plentiful and less expensive food supplies, and lower heating bills.

Climate change might have beneficial effects for some societies.

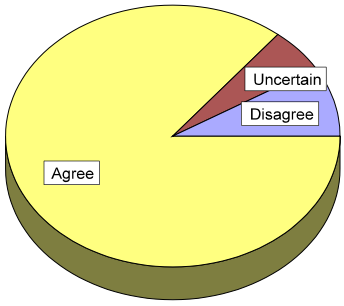


When asked, "To what degree do you think that climate change might have some positive effects for some societies?" most scientists (69.9 percent) expressed some degree of support (giving it a score of between 1 and 3) while only 17.0 percent gave it little or no support (a score of 5 - 7). Nearly nine times as many scientists had a "great degree" of confidence in benefits resulting from global warming as those who had "none at all."

13. Would climate change have detrimental effects?

In a relatively rare show of near-consensus, 85.8 percent of scientists expressed agreement to some degree with the statement, "Climate change will have detrimental effects for some societies." Only 5.5 percent were uncertain and 8.6 percent disagreed.

Climate change will have detrimental effects for some societies.



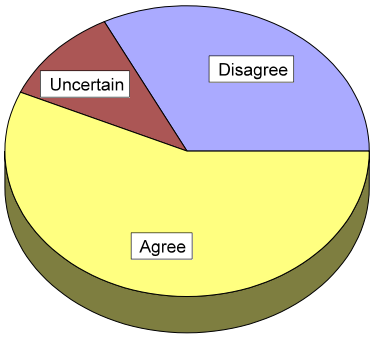
Most experts, including skeptics, recognize that global warming could be accompanied by rising sea levels and heavier rains, though in both cases the amount of increase and when and where they might occur are hotly debated.

Any time the climate changes there are winners and losers, and the way this question is phrased solicits acknowledgment of that fact. Note, however, that the question doesn't ask if *every* society or even *many* societies would face detrimental effects, or if those effects would outweigh the beneficial effects of warming.

15. Does the media influence climate research?

The extraordinary coverage given to global warming by the media means scientists and others who comment on the subject can expect to get lots of attention. This can advance a young academic's career or, if the academic is labeled a "skeptic," could hurt his career. Either way, media coverage of the global warming debate can influence scientific research.

Publicity influences future research.

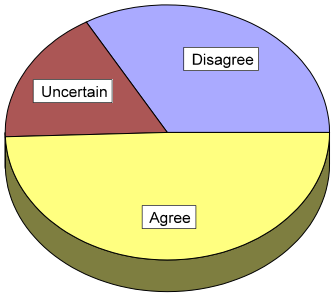


Climate scientists were asked "How much do you think that a scientist's exposure to publicity influences the direction of his or her future research?" Half of the scientists (51.1 percent) said exposure to publicity influences scientific research while 12.3 percent were unsure and 36.5 percent didn't think there was much influence or none at all.

14. Would climate change occur suddenly and have devastating effects?

Much of the public's fear of climate change concerns how quickly it may occur and whether societies would have time to respond. Alarmists portray flood waters engulfing entire cities and massive storms emerging with little warming. Some scientists reinforce these fears by raising the possibility of "abrupt climate change."

Climate change will happen suddenly.



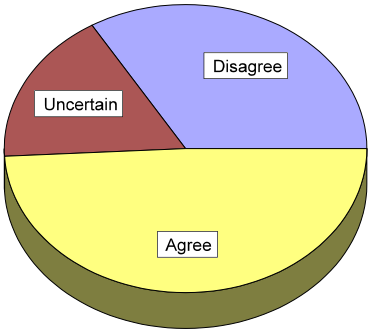
Skeptics, on the other hand, contend any warming caused by rising CO_2 levels would be gradual and mostly affect temperatures at night and during the winter. A warming of 1° or 2° Celsius over a 100-year period, they way, would hardly be noticeable.

The survey suggests the scientific community is divided between these two scenarios. In response to the statement, "Assuming climate change will occur, it will occur so suddenly that a lack of preparation could result in devastation of some areas of the world," 49.3 percent of scientists agreed, 33.4 percent disagreed, and 17.3 percent were uncertain.

16. Do climate change "skeptics" get too much attention?

Some journalists and politicians have expressed concern that climate change "skeptics" get too much attention in the press, given their minority position in the academic community. Since this survey indicates the skeptics are in fact in the majority on some important questions, and represent sizeable minorities on many other questions, perhaps the premise of these commentators is wrong. But it is instructive to see whether climate scientists think their skeptical colleagues get too much attention.

Skeptics receive too much media attention.

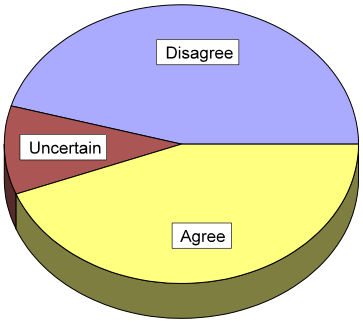


When asked if "the claims of skeptical scientists who dispute the IPCC consensus get too little or too much coverage?" 12.4 percent said skeptics receive "too little" attention and 18.6 percent said they receive "too much" attention. One could interpret this as meaning 81.4 percent *don't* believe skeptics get too much attention. Using the convention we used for other questions, though, we would say the 49.1 percent scoring the question 5 - 7 "agree" that skeptics get too much attention, the 33.7 percent scoring it 1 - 3 "disagree" and think skeptics deserve *more* attention, and the 17.2 percent who scored it 4 think the current amount of coverage is just right.

17. Is the scientific debate over climate change over?

Those who fear global warming and believe human activities are its cause have been calling for "action, not more debate" since the early 1990s. But the survey shows climate scientists do not believe the debate over the science is over, so the time is not right for politicians and policy analysts to begin crafting plans to "stop global warming."

The science is sufficiently settled that policymakers can now take over.

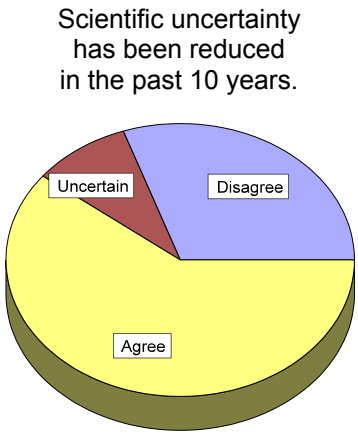


Climate scientists were asked to score this statement: "Natural scientists have established enough physical evidence to turn the issue of global climate change over to social scientists for matters of policy discussion." Once again, the scientific community split, this time almost exactly down the middle. Nearly half (45.8 percent) disagreed with the statement, nearly half

(44.1 percent) agreed, and the remainder (10.2 percent) were undecided. Those who say the time for debate is over are at odds with half of the scientists they claim to be speaking for.

18. Will the debate end soon?

If half the scientific community doesn't believe the science of global warming is sufficiently established to "turn the issue ... over to social scientists for matters of policy discussion," then when do they think the science of global warming *will* be sufficiently firm for policymakers? One hint of the possible answer can be found in the answer to this question: "How much has the uncertainty regarding climate change been reduced in the last ten years?"



About a third of the climate scientists (30.5 percent) who answered this question said uncertainty has not been reduced in the past 10 years. About one in 10 (9.2 percent) scored the question a 4 – what we've been calling undecided. And 60.3 percent said uncertainty has been reduced. Remarkably, only 8.3 percent scored the question a 7, indicating that uncertainly has been reduced by "a significant amount."

With so much uncertainty about whether or not the amount of scientific uncertainty has declined during the past decade, it seems implausible that the debate is nearing an end. Indeed, some of the brightest thinkers in the global warming debate warn that the more we learn about climates, the less confident we can be in our ability either to understand how climates "work" or to predict what tomorrow's climate will look like.

Appendix

1. We can say for certain that global warming is a process already underway.

Score	Percent	Cumulative Percent	Label
strongly agree	31.9	82.2	**Agree**
2	34.2		
3	16.1		
4	6.4	6.4	**Uncertain**
5	3.8	11.3	**Disagree**
6	4.9		
strongly disagree	2.6		
Total	100.0	99.9	

2. The current state of scientific knowledge is developed well enough to allow for a reasonable assessment of the effects of greenhouse gases.

Score	Percent	Cumulative Percent	Label
strongly disagree	10.0	65.9	**Disagree**
2	35.7		
3	20.2		
4	10.0	10.0	**Uncertain**
5	12.8	24.1	**Agree**
6	8.7		
strongly agree	2.6		
Total	100.0	100.0	

3. To what extent do you agree or disagree that climate change is mostly the result of anthropogenic causes?

Score	Percent	Cumulative Percent	Label
strongly agree	9.4	55.8	**Agree**
2	25.3		
3	21.1		
4	14.2	14.2	**Uncertain**
5	8.5	30	**Disagree**
6	11.3		
strongly disagree	10.2		
Total	100.0	100	

4. Climate models can accurately predict climate conditions in the future.

Score	Percent	Cumulative Percent	Label
strongly agree	.4	35.1	**Agree**
2	6.1		
3	28.6		
4	18.3	18.3	**Uncertain**
5	13.1	46.6	**Disagree**
6	18.6		
strongly disagree	14.9		
Total	100.0	100	

5. The IPCC reports accurately reflect the consensus of thought within the scientific community.

Score	Percent	Cumulative Percent	Label
strongly agree	24.4	72.8	**Agree**
2	33.4		
3	15.0		
4	7.5	7.5	**Uncertain**
5	6.7	19.7	**Disagree**
6	8.4		
strongly disagree	4.6		
Total	100.0	100	

6.a. To what degree do you think the current state of scientific knowledge is able to provide reasonable predictions of climatic variability on time scales of 10 years?

Score	Percent	Cumulative Percent	Label
a great degree	.5	32	**Agree**
2	8.2		
3	23.3		
4	14.6	14.6	**Uncertain**
5	23.3	53.3	**Disagree**
6	21.1		
none at all	8.9		
Total	100.0	99.9	

6.b. To what degree do you think the current state of scientific knowledge is able to provide reasonable predictions of climatic variability on time scales of 100 years?

Score	Percent	Cumulative Percent	Label
a great deal	.6	27.4	Agree
2	9.8		
3	17.0		
4	16.1	16.1	Uncertain
5	15.2	56.6	Disagree
6	23.1		
none at all	18.3		
Total	100.0	100.1	

7. Climate models accurately verify the climatic conditions for which they are calibrated.

Score	Percent	Cumulative Percent	Label
strongly agree	2.0	46.7	Agree
2	18.4		
3	26.3		
4	17.6	17.6	Uncertain
5	16.5	35.6	Disagree
6	10.8		
strongly disagree	8.3		
Total	100.0	99.9	

8. How well do you think atmospheric climate models can deal with precipitation?

Score	Percent	Cumulative Percent	Label
very inadequate	11.8	57.5	Disagree
2	26.3		
3	19.4		
4	17.1	17.1	Uncertain
5	16.2	25.4	Agree
6	7.7		
very adequate	1.5		
Total	100.0	100	

9. How well do you think atmospheric climate models can deal with water vapour in the atmosphere?

Score	Percent	Cumulative Percent	Label
very inadequate	6.5	44.5	Disagree
2	15.4		
3	22.6		
4	14.8	14.8	Uncertain
5	25.8	40.8	Agree
6	13.3		
very adequate	1.7		
Total	100.0	100.1	

10. How well do you think atmospheric climate models can deal with clouds?

Score	Percent	Cumulative Percent	Label
very inadequate	11.7	61.9	Disagree
2	28.4		
3	21.8		
4	14.1	14.1	Uncertain
5	15.4	24.1	Agree
6	5.5		
very adequate	3.2		
Total	100.0	100.1	

11. How well do you think atmospheric climate models can deal with radiation?

Score	Percent	Cumulative Percent	Label
very inadequate	1.1	21.7	Disagree
2	9.0		
3	11.6		
4	12.6	12.6	Uncertain
5	31.2	65.7	Agree
6	30.9		
very adequate	3.6		
Total	100.0	100	

12. To what degree do you think that climate change might have some positive effects for some societies?

Score	Percent	Cumulative Percent	Label
a great degree	9.7	69.8	Agree
2	26.0		
3	34.1		
4	13.1	13.1	Uncertain
5	8.4	17	Disagree
6	7.5		
none at all	1.1		
Total	100.0	99.9	

13. To what degree do you think climate change will have detrimental effects for some societies?

Score	Percent	Cumulative Percent	Label
a great degree	33.1	85.8	Agree
2	37.3		
3	15.4		
4	5.5	5.5	Uncertain
5	4.0	8.6	Disagree
6	3.7		
none at all	.9		
Total	100.0	99.9	

14. How much do you think that a scientist's exposure to publicity influences the direction of his or her future research?

Score	Percent	Cumulative Percent	Label
very much	7.4	51.1	Agree
2	15.3		
3	28.4		
4	12.3	12.3	Uncertain
5	12.1	36.5	Disagree
6	20.5		
not at all	3.9		
Total	100.0	99.9	

15. Assuming climate change will occur, it will occur so suddenly, that a lack of preparation could result in devastation of some areas of the world.

Score	Percent	Cumulative Percent	Label
strongly agree	10.1	49.3	Agree
2	16.9		
3	22.3		
4	17.3	17.3	Uncertain
5	11.1	33.3	Disagree
6	12.3		
strongly disagree	9.9		
Total	100.0	99.9	

16. Media coverage: The claims of skeptical scientists who dispute the IPCC consensus get too little or too much coverage?

Score	Percent	Cumulative Percent	Label
too little	12.4	33.7	Disagree
2	12.8		
3	8.5		
4	17.2	17.2	Uncertain
5	12.4	49	Agree
6	18.0		
too much	18.6		
Total	100.0	99.9	

17. Natural scientists have established enough physical evidence to turn the issue of global climate change over to social scientists for matters of policy discussion.

Score	Percent	Cumulative Percent	Label
strongly agree	8.6	45.8	Agree
2	19.9		
3	17.3		
4	10.2	10.2	Uncertain
5	11.2	44.1	Disagree
6	16.5		
strongly disagree	16.4		
Total	100.0	100.1	

18. How much has the uncertainty regarding climate change been reduced in the last ten years?			
Score	**Percent**	**Cumulative Percent**	**Label**
not at all	5.9	30.5	**Disagree**
2	13.9		
3	10.7		
4	9.2	9.2	**Uncertain**
5	32.2	60.3	**Agree**
6	19.8		
a significant amount	8.3		
Total	100.0	100	

Reported below are the average scores for each question in the 1996 and 2003 surveys.

On a scale of 1 to 7, with 1 being "strongly agree" and 7 being "strongly disagree":

1. We can say for certain that global warming is a process already underway.
1996 – Average response 3.39
2003 – Average response 2.41

2. We can say for certain that, without change in human behavior, global warming will definitely occur some time in the future.
1996 – Average response 2.67
2003 – Average response 2.35

3. Climate should be considered a natural resource.
1996 – Average response 1.98
2003 – Average response 2.07

4. Assuming climate change will occur, it will occur so suddenly, that a lack of preparation could result in devastation of some areas of the world.
1996 – Average response 4.26
2003 – Average response 3.79

5. There is enough uncertainty about the phenomenon of global warming that there is no need for immediate policy decisions.
1996 – Average response 5.48
2003 – Average response 5.67

6. Climate models accurately verify the climatic conditions for which they are calibrated.
1996 – Average response 3.93
2003 – Average response 3.94

7. Climate models can accurately predict climatic conditions of the future.
1996 – Average response 4.69
2003 – Average response 4.53

On a scale of 1 to 7, with 1 being "very inadequate" and 7 being "very adequate":

8. To what extent can atmospheric climate models deal with hydrodynamics?
1996 – Average response 4.60
2003 – Average response 4.45

9. To what extent can atmospheric climate models deal with radiation?
1996 – Average response 4.63
2003 – Average response 4.71

10. To what extent can atmospheric climate models deal with water vapour and liquid vapour in the atmosphere?
1996 – Average response 3.62
2003 – Average response 3.85

11. To what extent can atmospheric climate models deal with the influence of clouds?
1996 – Average response 3.06
2003 – Average response 3.22

12. To what extent can atmospheric climate models deal with precipitation?
1996 – Average response 3.16
2003 – Average response 3.29

13. To what extent can atmospheric climate models deal with atmospheric convection?
1996 – Average response 3.57
2003 – Average response 3.48

14. To what extent can ocean models deal with hydrodynamics?
1996 – Average response 4.60
2003 – Average response 4.71

15. To what extent can ocean models deal with heat transport in the ocean?
1996 – Average response 4.42
2003 – Average response 4.49

16. To what extent can ocean models deal with oceanic convection?
1996 – Average response 3.71
2003 – Average response 3.82

17. To what extent can ocean models deal with the coupling of atmospheric models and ocean models?
1996 – Average response 3.29
2003 – Average response 3.62

On a scale of 1 to 7, with 1 being "strongly agree" and 7 being "strongly disagree":

18. The current state of scientific knowledge is developed well enough to allow for a reasonable assessment of the effects of turbulence.
1996 – Average response 3.68
2003 – Average response 4.32

19. The current state of scientific knowledge is developed well enough to allow for a reasonable assessment of the effects of surface albedo.
1996 – Average response 4.58
2003 – Average response 3.09

20. The current state of scientific knowledge is developed well enough to allow for a reasonable assessment of the effects of land surface processes.
1996 – Average response 3.71
2003 – Average response 3.99

21. The current state of scientific knowledge is developed well enough to allow for a reasonable assessment of the effects of sea ice.
1996 – Average response 3.86
2003 – Average response 3.91

22. The current state of scientific knowledge is developed well enough to allow for a reasonable assessment of the effects of greenhouse gases.
1996 – Average response 4.47
2003 – Average response 3.16

On a scale of 1 to 7, with 1 being "a great degree" and 7 being "none at all":

23. The current state of scientific knowledge is able to provide reasonable predictions of inter-annual variability.
1996 – Average response 4.63
2003 – Average response 4.01

24. The current state of scientific knowledge is able to provide reasonable predictions of climatic variability of time scales of 10 years.
1996 – Average response 4.89
2003 – Average response 4.51

25. The current state of scientific knowledge is able to provide reasonable predictions of climatic variability of time scales of 100 years.
1996 – Average response 5.24
2003 – Average response 4.78

26. The current state of scientific knowledge is able to provide reasonable predictions of climatic variability of time scales of greater than 100 years.
1996 – Average response 5.47
2003 – Average response 5.11

27. To what degree do you think that, through the process of downscaling, it is now possible to determine local climate impacts?
1996 – Average response 4.75
2003 – Average response 4.57

28. To what degree can we explicitly state the detrimental effects that climate change will have on society?
1996 – Average response 4.43
2003 – Average response 4.22

29. To what degree do you think climate change will have detrimental effects for some societies?
1996 – Average response 2.47
2003 - Average response 2.25

30. To what degree do you think climate change will have a detrimental effect for the society in which you live?
1996 – Average response 3.81
2003 – Average response 3.70

31. To what degree do you think that climate change might have some positive effects for some societies?
1996 – Average response 3.39
2003 – Average response 3.11

32. To what degree do you think that climate change might have some positive effects for the society in which you live?
1996 – Average response 4.70
2003 – Average response 4.30

On a scale of 1 to 7, with 1 being "strongly agree" and 7 being "strongly disagree":

33. Climate change is mostly the result of anthropogenic causes.
1996 – Average response 4.17
2003 – Average response 3.62

34. The IPCC reports are of great use to the advancement of climate science.
1996 – Average response 3.04
2003 – Average response 2.61

35. The IPCC reports accurately reflect the consensus of thought within the scientific community.
1996 – Average response 3.38
2003 – Average response 2.83

36. Climate change is an extremely complex subject, full of uncertainties, and this allows for a greater range of assumptions and interpretations than many other scientific endeavors.
1996 – Average response 2.34
2003 – Average response 2.52

37. The users of the information produced by General Circulation Models are most often aware of the uncertainties associated with such models.
1996 – Average response 4.10
2003 – Average response 4.24

38. In general, those scientists producing GCMs are knowledgeable about what data are needed by those scientists that endeavor to study the impacts of climate change.
1996 – Average response 3.64
2003 – Average response 3.47

39. CO^2 will have controlled emission levels in the near future.
1996 – Average response 4.41
2003 – Average response 4.79

40. Natural scientists have established enough physical evidence to turn the issue of global climate change over to social scientists for matters of policy discussion.
1996 – Average response 4.27
2003 – Average response 4.11

41. Stabilizing CO^2 emissions will require a fundamental restructuring of the global economy.
1996 – Average response 2.36
2003 – Average response 2.42

42. The climate sciences are developed well enough to provide information for local social impact assessments.
1996 – Average response 4.56
2003 – Average response 4.53

43. Climate scientists are well attuned to the sensitivity of human social systems to climate impacts.
1996 – Average response 3.87
2003 – Average response 4.70

On a scale of 1 to 7, with 1 being "very often" and 7 being "not at all":

44. How often are you contacted by the media for information pertaining to climate change?
1996 – Average response 4.95
2003 – Average response 5.12

On a scale of 1 to 7, with 1 being "a great deal" and 7 being "not at all":

45. To what degree do you think exposure to the media has the potential to change the attitude of the scientist?
1996 – Average response 3.95
2003 – Average response 3.77

On a scale of 1 to 7, with 1 being "very much" and 7 being "not at all":

46. How much do you think scientists actually enjoy the attention they receive in the popular media?
1996 – Average response 3.24
2003 – Average response 3.13

47. How much do you think that a scientist's exposure to publicity influences the direction of his or her future research?
1996 – Average response 3.65

2003 – Average response 3.84

48. How much have you been involved with those people who make climate related policy decisions?
1996 – Average response 5.37
2003 – Average response 5.24

49. How much would you rate global climate change as a problem that concerns the social and economic aspects of societies?
1996 – Average response 2.57
2003 – Average response 2.55

50. How much do you think global climate change is one of the leading problems facing humanity?
1996 – Average response 3.21
2003 – Average response 2.92

51. How much do you think the IPCC reports are used in the decision making process of climate related policy issues?
1996 – Average response 3.65
2003 – Average response 3.14

On a scale of 1 to 7, with 1 being "a great extent" and 7 being "none at all":

52. To what extent are those who present the extremes of the climate debate, for example, those presenting the worst case scenarios or those claiming that climate change is a hoax, the people most likely to be listened to by those involved in making policy decisions?
1996 – Average response 3.13
2003 – Average response 2.72

On a scale of 1 to 7, with 1 being "very good" and 7 being "very poor":

53. How would you describe what you see as the working relationship between climate scientists and policy makers?
1996 – Average response 4.72
2003 – Average response 4.74

On a scale of 1 to 7, with 1 being "very aware" and 7 being "not aware at all":

54. How much do you think climate scientists are aware of the information that policy makers incorporate into their decision making process?
1996 – Average response 4.59
2003 – Average response 4.56

On a scale of 1 to 7, with 1 being "very much" and 7 being "not at all":

55. To what degree do you think that the results of scientific inquiry are instrumental in causing policy makers to redefine their perception of a climate related issue?
1996 – Average response 4.01
2003 – Average response 3.99

On a scale of 1 to 7, with 1 being "always" and 7 being "never":

56. How often do you think policy makers draw on the most current and state-of-the-art knowledge of the climate sciences?
1996 – Average response 4.62
2003 – Average response 4.66

57. How often do you think that experts frame problems so that the solution fits his or her area of expertise?
1996 – Average response 3.04
2003 – Average response 3.07

On a scale of 1 to 7, with 1 being "very much" and 7 being "not at all":

58. How much do you feel that scientists have played a role in transforming the climate issue from being a scientific issue to a social and public issue?
1996 – Average response 3.15
2003 – Average response 3.22

On a scale of 1 to 7, with 1 being "a great degree" and 7 being "not at all":

59. To what degree do you think climate science has remained a value-neutral science?
1996 – Average response 4.23
2003 – Average response 4.29

On a scale of 1 to 7, with 1 being "very much" and 7 being "not at all":

60. Some scientists present the extremes of the climate debate in a popular format with the claim that it is their task to alert the

public. How much do you agree with this practice?
1996 – Average response 4.09
2003 – Average response 4.75

On a scale of 1 to 7, with 1 being "very much" and 7 being "none at all":

61. How much influence do you think the IPCC has over what areas come to be considered worthy research topics?
1996 – Average response 3.31
2003 – Average response 2.82

On a scale of 1 to 7, with 1 being "very much" and 7 being "not at all":

62. How much do you think the direction of research in the climate sciences has been influenced by external politics?
1996 – Average response 3.14
2003 – Average response 2.82

On a scale of 1 to 7, with 1 being "a great degree" and 7 being "none at all":

63. To what degree do you think climate scientists have control over what information gets transferred to the policy makers?
1996 – Average response 4.06
2003 – Average response 4.23

On a scale of 1 to 7, with 1 being "a great degree" and 7 being "not at all":

64. To what degree do you think policy makers are influential in causing scientists to redefine their perceptions of an issue?
1996 – Average response 4.37
2003 – Average response 4.27

On a scale of 1 to 7, with 1 being "a great degree" and 7 being "none at all":

65. To what degree do you think there is growing pressure for climate research to be justified in terms of policy relevance?
1996 – Average response 2.98
2003 – Average response 2.63

On a scale of 1 to 7, with 1 being "a great degree" and 7 being "not at all":

66. How much do you think climate scientists should be involved in alerting the general public to the possible social consequences arising from changes in the climate?
1996 – Average response 2.65
2003 – Average response 2.77

On a scale of 1 to 7, with 1 being "always" and 7 being "never":

67. How often do you think the members of the general public are being given only part of the picture?
1996 – Average response 2.34
2003 – No results given

On a scale of 1 to 7, with 1 being "not at all" and 7 being "a significant amount":

68. How much has climate science advanced in the understanding of climate change in the last 5 years?
2003 – Average response 5.04

69. How much does new scientific discovery in the last decade confirm the anthropogenic influence on climate?
2003 – Average response 5.24

70. How much has the uncertainty regarding climate change been reduced in the last ten years?
2003 – Average response 4.40

71. Are we beginning to experience the effects of climate change?
2003 – Average response 5.10

On a scale of 1 to 7, with 1 being "not feasible at all" and 7 being "very feasible":

72. How feasible is adaptation to climate change an option for the society in which you live?
2003 – Average response 5.38

73. How feasible is adaptation as a global option?
2003 – Average response 2.12

On a scale of 1 to 7, with 1 being "not at all" and 7 being "very much":

74. To what degree is mitigation still an option?
2003 – Average response 4.52

On a scale of 1 to 7, with 1 being "hardly varied" and 7 being "greatly varied":

75. The region in which you live could be defined as having a pattern of seasonal change that is
2003 – Average response 5.12

On a scale of 1 to 7, with 1 being "very easy" and 7 being "very difficult":

Concerning the ease of adaptability of certain social and economic sectors, how easy would it be for the following to adapt to climate change:

76. The general daily routine of the people who live in your local region
2003 – Average response 2.95

77. The general daily routine of the people who live in your nation
2003 – Average response 3.29

78. Agriculture in your region
2003 – Average response 3.89

79. Housing design in your region
2003 – Average response 2.74

80. Transportation in your region
2003 – Average response 3.06

81. Public utilities in your region: water
2003 – Average response 3.94

82. Public utilities in your region: natural gas, heating/air conditioning fuel
2003 – Average response 3.46

83. Public utilities in your region: electricity
2003 – Average response 3.57

84. Forestry in your nation
2003 – Average response 3.84

85. Tourism in your nation
2003 – Average response 2.93

86. Manufacturing in your nation
2003 – Average response 3.02

On a scale of 1 to 7, with 1 being "strongly agree" and 7 being "strongly disagree":

87. How much would you agree that future research efforts and funding should focus more on adaptation and less on detection?
2003 – Average response 4.31

On a scale of 1 to 7, with 1 being "very much" and 7 being "not at all":

88. How much do you think the media influences the public perception of climate change?
2003 – Average response 1.56

On a scale of 1 to 7, with 1 being "a great extent" and 7 being "not at all":

89. To what extent do you think that the media provides the public with adequate information to understand the basics of climate change?
2003 – Average response 5.00

On a scale of 1 to 7, with 1 being "too little" and 7 being "too much":

Does the media provide too much coverage, about the right amount of coverage (middle of the scale) or too little coverage for the following:

90. The most current state of the art knowledge of the climate sciences
2003 – Average response 2.59

91. The likely effects of climate change on the society in which you live
2003 – Average response 3.01

92. The likely effects of climate change in other societies
2003 – Average response 2.74

93. Conflicting findings or conclusions reached by climate scientists
2003 – Average response 3.62

94. The changes that would be necessary to adapt to climate change in their region
2003 – Average response 2.42

95. The worst case scenarios of climate change
2003 – Average response 4.78

96. The claims of skeptical scientists who dispute the IPCC consensus
2003 – Average response 4.33

97. The possible costs of implementing the Kyoto Accords
2003 – Average response 3.42

98. The gains that might be made through energy efficiency
2003 – Average response 2.25

99. Personal differences among claims-makers who differ about the reality of climate change
2003 – Average response 3.58

About the Authors

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About The Heartland Institute

The Heartland Institute is a national nonprofit public policy research organization based in Chicago. Founded in 1984, its mission is to discover, develop, and promote free-market solutions to social and economic problems. Heartland publishes books and policy studies, hosts an online clearinghouse for public policy research and commentary called *PolicyBot*, organizes events featuring experts on public policy issues, and supports a growing network of prominent senior fellows.

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