CLIMATE CHANGE

# US climate report stresses human role

*Analysis is at odds with the policies of President Donald Trump.*

BY JEFF TOLLEFSON

Humanity is fundamentally changing the planet by pumping greenhouse gases into the atmosphere, US government scientists said on 3 November in their latest assessment of climate science.

The average global temperature has increased by 1 °C since the pre-industrial era, the 477-page report says — adding that the past 115 years comprise the warmest period "in the history of modern civilization" (see go.nature.com/2hpj3bo). The analysis warns that temperatures could increase by another 4 °C by the end of the century, with dramatic consequences for people and ecosystems.

The findings are at odds with the policies of US President Donald Trump, who has questioned established climate science and vowed to protect and promote the country's fossil-fuel industry. Trump's stances led many scientists to worry that his administration would try to block or tamper with the climate-change assessment, but several scientists who helped to write the document reported that they experienced no problems.

"We weren't interfered with, and we ended up producing something that I think is of tremendous value," says David Fahey, an atmospheric scientist with the National Oceanic and Atmospheric Administration in Boulder, Colorado, and a coordinating lead author.

The climate-science report is the first volume of the next National Climate Assessment, a legally mandated analysis of the causes and impacts of global warming that is due in 2018. The second volume, released in draft form on 3 November, focuses on how climate change is affecting life in the United States, from crop yields to property damage caused by extreme weather. Another report, on the carbon cycle, was released in draft form on the same day. The US National Academy of Sciences is set to review the draft documents.

"The science speaks for itself," says Don Wuebbles, a climate scientist at the University of Illinois at Urbana-Champaign and a coordinating lead author of the climate-science report. "It's hard to counteract the basic observations and the truth of the science with any kind of political playing around." ■

Renewable energy, including wind power, is at the heart of a multi-million dollar lawsuit.

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ENERGY

# Lawsuit targets science academy

*Conflict over two journal articles leads to US libel case.*

BY CHRIS WOOLSTON

A scientific dispute about the future of alternative energy has ended up in a US court. Mark Jacobson, an environmental and civil engineer at Stanford University in California, has filed a libel lawsuit against the US National Academy of Sciences (NAS) and a researcher who published a study in the academy's journal that criticized Jacobson's work.

Jacobson, who filed suit in a superior court in Washington DC in late September, is seeking damages of US$10 million. He also wants the *Proceedings of the National Academy of Sciences* (*PNAS*) to retract a 2017 article, whose lead author was mathematician Christopher Clack. The NAS and Clack have until late November to respond, according to court documents. Some experts are worried that the lawsuit could dampen scientific progress on renewable energies. But others defend the move, saying researchers should be able to take advantage of all civil avenues in defence of their work.

Jacobson was the lead author of a high-profile *PNAS* paper[1] published in December 2015 making the case that the continental United States could meet nearly 100% of its energy needs using wind, water and solar sources as early as 2050. A rebuttal[2] written by Clack — then at the University of Colorado Boulder — and 20 co-authors, published in *PNAS* in June 2017, questioned Jacobson's methodology and challenged his conclusions. The authors argued, among other things, that Jacobson's paper overestimated the maximum outputs from hydroelectric facilities, and the nation's capacity to store energy produced by renewable sources.

In the lawsuit, Jacobson says that he alerted *PNAS* to 30 falsehoods and 5 "materially misleading statements" in Clack's paper before its publication. The complaint states that almost all of those inaccuracies remained in the published version. Jacobson also argues that "the decision by NAS to publish the Clack Paper in *PNAS* has had grave ramifications" for his reputation and career.

In a letter[3] accompanying Clack's paper in *PNAS*, Jacobson and three co-authors wrote that Clack's criticisms are "demonstrably false". They maintained that their projections regarding hydroelectric power were based on an assumed increase in the number of turbines and were not a "modeling mistake".

Some observers are disappointed to see the conflict play out in court. The diversity of engineering models that form the basis of long-term energy projections should be celebrated, not litigated, says chemical engineer Daniel Schwartz, director of the Clean Energy Institute at the University of Washington in Seattle. "Bringing this dispute into the court of law, regardless of outcome, is a step towards devaluing the debate of underlying engineering assumptions," he says.

"This dispute is likely to be most harmful to the scientific community, which has already been subject to lawsuits from groups sceptical of climate change," says David Adelman, who studies environmental law at the University of Texas at Austin.

### CONFLICT RESOLUTION

Suing a journal over a scientific disagreement is a rare move, says Adil Shamoo, a biochemist at the University of Maryland School of Medicine in Baltimore and editor-in-chief of the journal *Accountability in Research*, published by Taylor & Francis. But Shamoo thinks that scientists should be able to sue if they feel that a paper is "reckless" or "malicious". "I'm a great believer in using all of the avenues of a civil society," he says.

Shamoo does think that Clack's paper was "unduly harsh and personal". He says that "it was not written as if it was part of a scientific dialogue".

Clack declined to respond to Shamoo's characterization of his paper, but says that he is disappointed that Jacobson filed the lawsuit. Clack — now chief executive of Vibrant Clean Energy in Boulder — says that his rebuttal paper "underwent very vigorous peer review", and that the *PNAS* editors had considered Jacobson's criticisms but found them to be "without merit".

Jacobson says that he "cannot comment" on the lawsuit. And a spokesperson for the NAS says that "we do not comment on pending litigation". ■


1. Jacobson, M. Z., Delucchi, M. A., Cameron, M. A. & Frew, B. A. *Proc. Natl Acad. Sci. USA* **112,** 15060–15065 (2015).
2. Clack, C. *et al. Proc. Natl Acad. Sci. USA* **114,** 6722–6727 (2017).
3. Jacobson, M. Z., Delucchi, M. A., Cameron, M. A. & Frew, B. A. *Proc. Natl Acad. Sci. USA* **114,** E5021–E5023 (2017).


PARTICLE PHYSICS

# Dark-matter hunt comes up empty

*Results prompt physicists to rethink their theories.*

BY ELIZABETH GIBNEY

Physicists are growing ever more frustrated in their hunt for dark matter — the massive but hard-to-detect substance that is thought to comprise 85% of the material Universe. Teams working with the world's most sensitive dark-matter detectors report that they have failed to find the particles, and that the ongoing drought has challenged theorists' prevailing views.

The latest results from an experiment called XENON1T at the Gran Sasso National Laboratory in Italy, published on 30 October[1], continue a dry spell stretching back 30 years in the quest to nab dark-matter particles. An attempt by a Chinese team to detect the elusive stuff, the results of which were published on the same day[2], also came up empty-handed. Ongoing attempts by space-based telescopes, as well as at CERN, the European particle-physics laboratory near Geneva, Switzerland, have also not spotted any hints of dark-matter particles.

The findings have left researchers struggling for answers. "We do not understand how the Universe works at a deeper and more profound level than most of us care to admit," says Stacy McGaugh, an astrophysicist at Case Western Reserve University in Cleveland, Ohio.

Physicists have widely accepted the existence of dark matter since the 1980s as an explanation for why galaxies remain intact rather than flying apart, which would be expected given the amount of observable mass they contain and how fast they rotate. Researchers surmised that halos of invisible dark matter surround galaxies and stabilize them. Physicists grew more confident when dark-matter models successfully predicted the fluctuations detected in an observable echo of the Big Bang, known as the cosmic microwave background.

These observations became the most dramatic evidence for a proposal in the 1980s that dark matter might be formed of weakly interacting massive particles, known as WIMPs. The existence of such particles fits with how physicists think that the Universe evolved, and with the relative abundance of matter. Moreover, the properties of WIMPs would match those predicted by a branch of particle physics called supersymmetry.

The latest round of results seems to rule out the simplest and most elegant supersymmetry theories, casting doubt on the idea that the still-undetected particles are the missing dark matter. If simple supersymmetry theories are no longer viable, scientists say, any WIMP particle has to interact with matter much more feebly than physicists once thought. "It's not a wholesale retreat from the WIMP paradigm, but it is definitely a change in emphasis," says Dan Hooper, a physicist at the Fermi National Accelerator Laboratory in Batavia, Illinois.

***"We need to be thinking about other types of dark matter."***

Attitudes are shifting, and physicists are increasingly embracing other possible explanations for dark matter, says David Spergel, a theoretical astrophysicist at Princeton University in New Jersey, who was an early proponent of WIMP models. "These experiments haven't completely closed the window. However, we also need to be thinking about other types of dark matter and new experiments," he says.

### DEDICATED DETECTORS

It has taken decades to build experiments capable of detecting the minuscule rate at which WIMPs were thought to interact with matter. Only in the past ten years have experiments, carried out at about a dozen laboratories, reached the level of sensitivity needed to detect them. ▶


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