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The Practice and Assessment of Science: Five Foundational Flaws in the Department of Energy's 2025 Climate Report

A Statement of the American Meteorological Society

(Adopted by the Executive Committee of the AMS Council on 27 August 2025)

Here we identify five foundational flaws in the Department of Energy's (DoE's) 2025 Climate Synthesis report[1]. Each of these flaws, alone, places the report at odds with scientific principles and practices. For the report to accurately characterize scientific understanding and to be useful as a basis for informed policy and decision making, the DoE must first rectify all five flaws and then conduct a comprehensive assessment of scientific evidence. Were DoE to do so, the result will almost certainly be conclusions that are broadly consistent with previous comprehensive scientific assessments of climate change, such as those from the National Academies of Sciences, Engineering, and Medicine (NASEM); American Association for the Advancement of Science (AAAS); Intergovernmental Panel on Climate Change (IPCC), American Meteorological Society (AMS), and a wide-range of other scientific organizations.

The Department of Energy's recent attempt to synthesize climate science has five foundational flaws as a scientific effort:

1) **Lack of breadth across scientific fields**. The science of climate change spans dozens of fields and sub-fields within the physical, natural, and social sciences relating to the Earth and environment. These include (but are not limited to): atmospheric physics; atmospheric chemistry; oceanography (physical, chemical, and biological); cryology; glaciology; biology; physiology; biogeography;

[1] This document emphasizes overarching flaws with the process used in the development of the DoE report. Point-by-point rebuttals of specific evidence and conclusions also have value but are beyond the scope of this document (and are available from and being prepared by other climate scientists).

biogeochemistry; health; and economics; among others. Each of these disciplines has hundreds of practicing scientists—tens of thousands of scientists overall. No group of five scientists can possess the disciplinary breadth encompassed by all who study climate change[2]. To be credible, scientific assessments must include authors who can characterize the full breadth of scientific evidence.

2) **Lack of depth within scientific fields and specific topics**. Comprehensive assessment of any specific scientific topic must account for the full range of scientifically defensible views among the relevant subject matter experts—those who are familiar with the evidence of that specific topic[3]. For virtually any specific scientific field or topic within that field, five authors would be insufficient to capture the depth of knowledge and range of views, even if all were narrowly focused on that specific topic and independent of one another.

   To be credible, scientific assessments must include authors who reflect the full range of defensible views among the subject matter experts within every specific area of science that is included in the assessment.

3) **The DoE Report is based on an unrepresentative group of subject matter experts**. The five DoE authors do not appear to be a random sample of climate scientists but a biased selection. They seem to have been chosen based on a shared disagreement with the larger community of subject matter experts.

   Unusual perspectives and disagreement are important within the scientific process because they can generate alternative plausible explanations; identify needs for additional inquiry; or challenge the thinking of the larger community of subject matter experts. However, scientific assessments that emphasize unusual views are unrepresentative of the larger community of subject matter experts.

   Valid assessments need to consider all evidence and all views and weigh them only on their merits. Scientific merit increases with independent replication, corroboration, and conclusions that withstand the scrutiny of those who know the subject. Scientific merit decreases with obvious flaws in logic or experimental

[2] For illustration, the scientific assessments by the IPCC include three distinct working groups each of which has hundreds of scientists serving as contributing authors distributed among twelve or more chapters. Each chapter synthesizes the results from hundreds of scientific papers. Thousands of additional scientists provide independent reviews of each IPCC chapter. Assessments from the National Academies of Sciences involve similar numbers of experts for comparable scientific topics.

[3] For illustration, the chapter on Water Cycle Changes in the most recent IPCC synthesis (one of 47 chapters in the full assessment) included more than 60 authors: 3 coordinating lead authors, 12 lead authors, and 47 contributing authors. Two chapter scientists and two review editors also contributed to assessment of evidence.

design, biased selections of scientific evidence (i.e., cherry picking), or emphasis on weakly supported evidence.

Notably, the views put forth in the DoE report are not new. They have been thoroughly tested and considered by the larger community of scientists. Those views have been incorporated in previous comprehensive assessments—to the extent justified by their scientific merit. In contrast, robust conclusions of the larger scientific community that follow from comprehensive assessment of the evidence, are not represented in the DoE report. To be credible, scientific assessments must be representative of expert judgement that is based only on the scientific merit of the evidence.

4) **The DoE Report selectively emphasizes a small set of unrepresentative findings, particularly those that might appear beneficial on superficial examination. This "cherry picking" also downplays and excludes scientific findings that might be widely understood to be harmful**. For example, the document focuses simplistically on one of the direct effects of carbon dioxide on photosynthesis and does not consider other important aspects of biological responses to carbon dioxide[4] or the impact that warming is having on organisms and biological systems, which include altering: species locations; timing of key life events; and the provision of goods and services from natural and managed systems[5]. The report also downplays or ignores the impact of warming on the physical characteristics of the Earth (weather patterns; where land meets ocean; where ice and snow occur; the location, amount, and timing of water flows)[6]; and impacts of climate change on virtually every aspect of social and economic life, including: public health; agricultural productivity; transportation; energy supply and demand; and national security.[5]

   Notably, the writing team of this report does not appear to include any authors with subject matter expertise in biology (foundational flaw 1) and does not seem to reflect the views of biologists with respect to the impacts of carbon dioxide and climate change (foundational flaw 2). Both flaws likely contribute to the report reaching conclusions so inconsistent with the conclusions of comprehensive assessments (see IPCC WG 2, for example).

[4] A wide range of direct impacts of carbon dioxide on crops and natural biological systems have been identified, including ones that are disruptive and understood to be harmful: variable responses among species; decreases in plant nutritional quality; greater success of weedy species and pests; ocean acidification; and impacts that cascade throughout systems and food webs.
[5] IPCC WG2, AR6: https://www.ipcc.ch/report/ar6/wg2/
[6] IPCC WG1, AR6: https://www.ipcc.ch/report/ar6/wg1/

5) **The DoE Report extrapolates from a limited subset of findings to reach conclusions that do not follow from comprehensive consideration of the scientific evidence.** The impacts of climate change will be vast and will touch virtually every aspect of our lives. Given the vastness of impacts, it is not surprising that a small fraction of impacts may be beneficial (or seem beneficial with cursory examination). However, it is misleading to extrapolate from a small and biased selection of potential impacts to suggest the outcomes for humanity will be positive.

   Why are negative impacts from global-scale environmental disturbance vastly more likely? The changes in climate that people are causing are larger and faster than any humanity is known to have endured over the last 10,000 years[7]. Furthermore, physical, biological, economic, and social systems are tuned to climate and highly sensitive to climate change. A wide range of harmful impacts are already occurring and are expected to greatly outnumber and outweigh positive outcomes (as described above).

   To be credible, scientific assessments cannot: extrapolate from a small and unrepresentative subset of potential outcomes; emphasize contentious or weakly supported scientific evidence; dismiss scientifically robust contradictory evidence; or ignore—in the case of climate change—the wide range of harmful impacts that are occurring and expected.

The five foundational flaws described here demonstrate that the report is inconsistent with the scientific principles and practices needed to accurately assess evidence. Furthermore, the total number of foundational flaws at least suggests that the underlying motivation of the report was not to comprehensively assess the science of climate change—wherever the evidence may lead—but to arrive at pre-drawn conclusions that are at odds with comprehensive assessments of scientific evidence. Therefore, its representation of scientific understanding and its conclusions are not scientifically defensible. As such, the report findings cannot be used as the basis for informed decisions about climate change, including with respect to emissions policy, adaptation, and investments in infrastructure.

Notably, the evidence relating to climate change has been comprehensively assessed hundreds of times by independent subject matter experts and scientific organizations

[7] D. Kaufman et al., *Sci. Data* **7**, 201 (2020). https://doi.org/10.1038/s41597-020-0530-7

that are motivated to be scientifically accurate (whose credibility increases with scientific accuracy or diminishes with scientific errors).[8]

Five conclusions are robust when accounting comprehensively for the scientific evidence. They have been consistently reaffirmed by independent subject matter experts and independent scientific institutions worldwide. Decades of intensive research on climate change demonstrate that:

1) **Climate is changing, and the rate and magnitude of change are unusual in human experience.**
2) **People are the primary cause of modern climate change, mostly through burning fossil fuels.**
3) **Climate change is harmful to humanity, and the threats to people and all life are increasing.**
4) **A wide range of response options is available that can reduce the dangers of climate change.**
5) **Those who study the scientific evidence overwhelmingly agree.**

[8] The NASEM, AAAS, and AMS all represent many fields of science and what they say about any one field reflects on their credibility in all other fields. Rigorous, robust, and accurate assessments of scientific evidence for one field (e.g., climate change) enhances credibility and standing. In contrast, scientific errors and inaccuracies in any one area diminish credibility and standing in all other areas of science.