UNSETTLED: WHAT CLIMATE SCIENCE TELLS US WHAT IT DOESN'T AND WHY IT MATTERS

By Steven Koonin
Reviewed by Kenneth A. Barry[*]

The key messages of Dr. Steven E. Koonin's new book, *Unsettled,*[1] on the current state of climate science and its implications for energy policy, though cogently organized and expressed, are nonetheless disorienting. Rather than offering the consensus warnings of a collapsing climate and impending natural disasters, Koonin comes from the opposite direction.[2] He argues, with considerable passion, that much of what you have heard about the gravity and certainty of the science underlying the parade of doomsday predictions (absent a swift transition away from fossil fuels) is overwrought at best and deceptive at worst. Asking us to rethink the well-documented foundations and Cassandra prophesies of climate science is, well, unsettling.

Koonin cannot be dismissed as an anti-science kook or front man for the oil and gas industry. He boasts a long and distinguished resume, spanning the academic world, government service, and private industry. A longtime professor of theoretical physics and senior administrator at Caltech, he currently teaches at New York University. In between, he has had stints as BP's chief scientist in charge of researching alternative and renewable fuels and – perhaps most notably – with the Obama Administration as Undersecretary for Science within the U.S. Department of Energy.[3] Though not strictly a climate scientist, his career has taken him deep into the fields of energy use, weather phenomena, and the climate – leading him to express counter-consensus views in *Wall Street Journal* op-eds beginning in 2014.[4]

As can be readily imagined, the pushback from the climate science establishment to Koonin's book-length *cri de coeur* has been considerable.[5] Moreover, the publication of *Unsettled* narrowly preceded the latest U.N. International Panel on Climate Change (IPCC) report, issued in August 2021, so the volume

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1. STEVEN KOONIN, UNSETTLED: WHAT CLIMATE SCIENCE TELLS US, WHAT IT DOESN'T, AND WHY IT MATTERS (2021).

2. Also appearing in this edition of the *Energy Law Journal* is a review of a second book – *Electrify,* by Saul Griffith – that, conversely, insists climate change is a well-understood but dire threat, calling for a pervasive overhaul of the U.S. energy infrastructure to largely eliminate its greenhouse gas emissions.

3. For a more complete account of Dr. Koonin's professional career and credentials, *see* KOONIN, *supra* note 1, at 305-06.

4. Steven Koonin, *Climate Science is Not Settled*, WALL STREET JOURNAL (Sept. 19, 2014), https://www.wsj.com/articles/climate-science-is-not-settled-1411143565

5. *See, e.g.,* Marianna Lavelle, *A New Book Feeds Climate Doubters, but Scientists Say the Conclusions are Misleading and Out of Date*, INSIDE CLIMATE NEWS (May 4, 2021), https://insideclimatenews.org/news/04052021/a-new-book-feeds-climate-doubters-but-scientists-say-the-conclusions-are-misleading-and-out-of-date/

aims its fire at an older (2013) IPCC report of comparable scale and scope (among other official studies). The 2021 IPCC report raised louder alarm bells than ever, and only Koonin can defend the durability of his critique in light of the more recent findings. However, the focus of this review is on the core contentions of *Unsettled,* not the inevitable jousting between the author and his adversaries in the climate science and advocacy communities.

I. CENTRAL CONCERNS OF *UNSETTLED*

It should be emphasized at the outset that Koonin embraces certain concepts at the heart of the climate consensus. He acknowledges that carbon dioxide emissions from human activities (especially from fossil fuel burning) are on the increase; that they remain in the atmosphere for an exceptionally long time; and that, in combination with other greenhouse gases (GHG), they are contributing to the ongoing warming of the planet. In these respects, he separates himself from so-called climate change "deniers." His principal issues have to do with the *extent* to which human activities (versus natural cycles) are driving the warming; how the complexities of the climate may respond over time to "human influences"; whether recent incidences of extreme weather can be attributed to the build-up of atmospheric carbon dioxide in recent decades; whether serious adverse economic impacts are likely to result from the temperature increases foreseen by the IPCC and in similar reports; how much confidence can be placed on the climate models that ominous predictions rely upon; and, above all, whether it is realistic to expect that governments around the world will, anytime soon, mandate radical transformation of the systems and activities that generate GHG. In all these matters, Koonin casts a critical look at the reigning consensus and attempts to undermine it with a wealth of examples and graphs.

Where Koonin comes out is that:

- There is far too much uncertainty in the projections of global warming and attendant doom on which to base massive societal changes and investments in alternative systems;
- In any event, the transformative actions proposed have not been happening at anywhere near the pace sought by the 2015 Paris climate accords to achieve its ambitious milestones; and
- The world would be best served by researching geoengineered climate remedies and "adaptation" solutions if the feared outcomes of inaction do eventuate.

Koonin supports the development and deployment of cost-effective, lower-carbon technologies, but questions how far, realistically, they can get you down the path of stabilizing the seemingly inexorable increase of atmospheric carbon dioxide.

II. CLIMATE CHANGE'S GRIP ON THE PUBLIC CONSCIOUSNESS

Koonin covers a lot of ground in this 300-page assessment of climate change science and its collision with the world's (especially developing nations') increasing appetite for energy as part of the quest for a higher standard of living. The book's early chapters provide a concise primer on the elements that drive

climate and the complex interactions between them (stressing how the oceans and vegetation-covered land masses, the atmosphere protecting us from space, and the sun all interchange heat and energy). On these natural cycles, he superimposes the impacts of human intervention, most importantly GHG emissions from burning carbon fuels, from industrial processes, and from agriculture. The clarity of this basic science overview makes the book worthwhile for lay readers, even if they disagree with Koonin's doubts about the imminence of the "climate crisis."

The meaty middle chapters of *Unsettled* set forth the author's efforts to deconstruct the alarming conclusions of previous IPCC reports along with the parallel reports issued by the U.S. government – *i.e.,* the quadrennial National Climate Assessment (NCA).[6]

However important these sections may be to buttressing Koonin's argument, the introductory and concluding chapters of *Unsettled* capture best what animates the author. In the opening pages, he distills the essence of what he somewhat derisively terms "The Science":

> "*Humans have already broken the earth's climate. Temperatures are rising, sea level is surging, ice is disappearing, heat waves, storms, droughts, floods, and wildfires are an ever-worsening scourge on the world. Greenhouse gases are causing all of this. And unless they're eliminated promptly by radical changes to society and its energy systems, 'The Science' says Earth is doomed*" [emphasis in original].[7]

Having laid out these hyperbolic (in his view) claims, Koonin seeks to deflate them by asserting the data shows: (1) heat waves in the U.S. are no more common than in 1900; (2) the "warmest temperatures" have not risen in the U.S. in the past 50 years; (3) humans have had no detectable impact on hurricanes; (4) the ice sheet in Greenland isn't shrinking any more rapidly now than 80 years ago; and (5) the "net economic impact of human-induced climate change" is expected to be "minimal."[8] The book posits, in short, that there is a vast gap between the public's understanding of the impacts of climate change versus the actual data. Even worse, he believes, is that *policymakers* are being misled, as they get their information only after it has been "put through several different wringers."[9]

Unsettled is as much a subjective account of one scientist's journey through the maze of climate science as it is a skeptic's interrogation of the consensus. Koonin tells us how his career in 2004 began to concentrate on "the subject of climate and its implications for energy technologies," first as an inhouse scientist with BP and then in his tour of duty with the Obama Administration's Depart-

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6. As mentioned above, the most recent IPCC report dissected by Koonin is *not* relatively recent, dating from 2013. However, the NCAs also challenged by Koonin are more recent, dating from 2018. Koonin explains that these latest U.S. government reports came out in two volumes – one released in late 2017 entitled the "Climate Science Special Report," or CSSR, focusing on "physical climate science"; and a second issued in late 2018, focusing on the "impacts and risks" of the changing climate, and how mankind might adapt. *S*ee KOONIN, *supra* note 1, at 21-22.

7. *Id.* at 1 (emphasis in original).

8. *Id.* at 1-2.

9. *Id.*

ment of Energy. In these roles, reflects Koonin, "I found great satisfaction . . . helping to define and catalyze actions that would reduce carbon dioxide emissions, the agreed-upon imperative that would 'save the planet.'"[10] But his "doubts" began in late 2013, when a professional society of physicists asked him to lead a team to "update its public statement" on climate science, leading him to convene a workshop to "stress test" the current state of climate science.[11] Koonin emerged from this process "shaken," he claims, by "the realization that climate science was far less mature than I had supposed."[12]

Central to the revision of his view were his "discoveries" that:

- Human influences exert a "growing but physically small" warming effect, but the "deficiencies" of climate data hinder scientists' ability to "untangle the responses to human influences from poorly understood natural changes";
- The results of climate models disagree with each other, and "sometimes" the modelers apply "expert judgment" to "adjust the model results and obfuscate shortcomings";
- The government and UN press releases and summaries "do not accurately reflect" the reports themselves;
- The science is "insufficient to make useful projections" about how the climate is likely to change over time and the effect of human actions upon it.[13]

It was following his enlightenment, Koonin relates, that he went public with a lengthy essay published in the *Wall Street Journal* denouncing a "comfort of certainty" surrounding climate science that is, in reality, a hindrance to "the scientific enterprise."[14] Many online comments in response were supportive, but many of his scientific colleagues were "outraged," suggesting he had "broken some code of silence" by highlighting the uncertainties.[15]

Six years on, notes the author, "climate alarmism" has come to dominate U.S. politics, especially in Democratic circles (in which he otherwise feels most comfortable), while in the 2020 Democratic primaries, candidates sought to outdo one another in issuing "over-the-top statements about the 'climate emergency.'"[16] The political discussions included the sweeping "Green New Deal" and culminated with the appointment of John Kerry as "climate envoy," whose mission was to spend "almost two trillion dollars to fight 'this existential threat to humanity'" – all of which has left Koonin "increasingly dismayed."[17]

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10. KOONIN, *supra* note 1, at 3.

11. *Id.*

12. *Id.* at 4.

13. *Id.,*

14. KOONIN, *supra* note 1, at 4-5.

15. *Id.* at 4. Koonin recounts that the chair of a "respected university earth sciences department" informed him privately that he agreed with pretty much everything Koonin wrote but that he didn't "dare say that in public."

16. *Id.* at 5.

17. *Id.*

A bit later in the book, Koonin describes how the media amps up its climate change stories, with headlines often more alarming than the underlying content. Scientists, the media, and politicians all come in for their share of blame for the distortions Koonin finds are rife in the public's understanding of climate science. In the last paragraph of his "Apocalypses that Ain't" chapter, he lowers the boom on the lot of them:[18]

"It's clear that media, politicians, and often the assessment reports themselves blatantly misrepresent what the science says about climate and catastrophes. Those failures indict the scientists who write and too-casually review the reports, the reporters who uncritically repeat them, the editors who fan the fires of alarm, and the experts whose public silence endorses the deception. The constant repetition of these and many other climate fallacies turns them into accepted 'truths.'"

III. UNMOORED MODELS

While multiple chapters of *Unsettled* undertake to dissect the apprehensions raised by climate science researchers, one of the most central is his challenge to the respect accorded climate models. The point is pivotal because so many of the studies hinge on model-based predictions of upsets in the earth's climate and ecosystems. Koonin wades into the subject with enthusiasm, advising he has a deep background in the development of computer modeling as a tool of science (noting he "wrote one of the first textbooks on the subject.")[19] To foreground the chapter, he quotes the celebrated remark of a University of Wisconsin statistician: "All models are wrong, but some are useful."[20]

Far from opposing the use of modeling – to the contrary, he calls them "central to climate science [to] help us understand how the climate system works"[21] – he nonetheless warns that "usefully describing the earth's climate remains one of the most challenging scientific simulation problems there is." Despite such caveats, the temptation to lean on modeling to project the future of the climate in the face of GHG emissions is almost Faustian. Koonin states:[22]

"It's easy to be seduced by the notion that we can just feed the present state of the atmosphere and oceans into a computer, make some assumptions about future human and natural influences, and so accurately predict the climate decades into the future. Unfortunately, that's just a fantasy . . . ."

Koonin proceeds to offer a highly granular description of how climate models are built from the ground up. That is complicated enough stuff, but he then layers on nuances and challenges so "excruciatingly difficult [that] anyone who says climate models are 'just physics' either doesn't understand them or is being

18. KOONIN, *supra* note 1, at 163. Prior to the conclusion quoted below, the chapter examines several examples of climate science calamity predictions – involving deaths from weather-related events, adverse impacts to the food supply, and direct overall damage to the U.S. economy – and concludes the data does not support the headline fears.

19. *Id.* at 78.

20. *Id.* at 77 (Attributing the remark to George Box).

21. *Id.* at 78.

22. KOONIN, *supra* note 1, at 79.

deliberately misleading."[23] Koonin does his best to explain what the models can and can't take account of, the assumptions and "tunings" (*i.e.,* "necessary but perilous" fudge factors), and the problems of estimating "feedback" loops.[24] These "tunings," he elaborates, are required to make models match "the far more numerous observed properties of the climate system"; but this perforce "casts doubt on whether the conclusions of the models can be trusted," while making it "clear we don't understand features of the climate to anywhere near the level of specificity required given the smallness of human influences."[25]

Koonin maintains that periodic state-of-the-science assessments such as IPCC and NCA provide an illusion of general agreement among models by averaging the results of an "ensemble" of models; but, unless you read "deep into the IPCC report," this practice masks the fact that the models "disagree wildly with each other."[26] He is also troubled by the models being unable to duplicate or explain why the climate experienced a "strong warming" trend from 1910-40.[27] Finally, he posits that the failure of the models to reflect warming in the early part of the twentieth century "suggests that it's possible, even likely, that internal variability – the natural ebbs and flows of the climate system – has contributed significantly to the warming of recent decades."[28]

With such a "lot to fret about in the climate modeling business," Koonin concludes, "No wonder we've got a poor understanding of how the climate will respond to rising GHG concentrations. The more we learn about the climate system, the more we realize how complicated it is."[29]

IV. THE IMPRACTICABILITY OF DECARBONIZING THE ECONOMY

In several concluding chapters, Koonin swings back from the technical and granular to the macro. Here, his overriding question is whether it is realistic to suppose that societies will make the major changes, expenditures, and sacrifices necessary to achieve the IPCC's goal of "stabilizing" GHG emissions by mid-century and thereby imposing a ceiling on global temperature increases of either 2 or 1.5 degrees C.[30] In "The Chimera of Carbon Free" chapter,[31] he concludes that these emission goals, whether or not effective to halt warming, are simply unattainable.

He begins this discussion with the truism that energy systems evolve slowly over decades. The reasons, he elaborates, have to do with the complexity of the

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23. *Id.* at 81.

24. *Id.* at 84-85.

25. *Id.* at 85.

26. KOONIN, *supra* note 1, at 86. Indeed, he continues, the simulated global average surface temperatures vary by "about 3 degrees C, three times greater than the observed value of twentieth century warming they're purporting to describe and explain."

27. *Id.* at 88-89.

28. *Id.* at 90-91.

29. *Id.* at 95.

30. The global Paris conference of 2015 adopted a straddle of these two temperatures limitation goals, compared with a baseline of the pre-industrial age. The 1.5 degree ceiling is aspirational, while the 2 degree ceiling is viewed as the maximum tolerable increase.

31. KOONIN, *supra* note 1, at 211-224.

infrastructure, the long-lived investments in it, and society's need for reliability (leading to conservativism in making changes). In the U.S., the three most dominant sources of GHG emissions are transportation, electricity, and industry.[32] Koonin notes that, while the U.S. has reduced emissions by 16% since their peak in 2005 – a not inconsiderable feat, largely propelled by the transition from coal to natural gas fueling electric generators – *global* emissions increased by one-third over the same period.[33] This fact alone illustrates the uphill nature of the challenge.

The chapter then surveys the obstacles and headwinds to any rapid decarbonization of the systems that produce, transport, and consume energy in the U.S. alone. The discussion is substantive and detailed, raising issues about technical feasibility (including reliability), political will, and economics that any advocate of urgency in replacing fossil fuels with "clean energy" substitutes must address and solve. Koonin agrees that "government has an important role to play" in sponsoring research, both basic and developmental, and does not dismiss the notion that cleaner and technically feasible technologies are out there; but he cautions that they "aren't ready for the marketplace."[34] Likewise, he submits:

" . . . creating an emissions-free energy system will be broadly disruptive – both economically and behaviorally. The question is whether the country will choose to invest the financial and political capital needed to bring that transformation about . . . .I think that's unlikely to happen anytime soon.[35]

Moreover, Koonin challenges the notion that a more urgent transition to low-carbon fuels in the U.S. would make much of a difference to the global climate, since it represents only 13% of worldwide GHG emissions. While some, he acknowledges, would argue that the U.S., by setting an example, would see the rest of the world follow suit, he wonders "how likely they are to do so when their energy needs are so pressing and the benefits of reductions so murky."[36]

V. "PLANS B" AND CONCLUSION

In his last two chapters ("Plans B" and "Final Thoughts"), Koonin advances options deemed almost unthinkable by many climate scientists and advocates. The first is that "geoengineering" merits research and practical studies. The underlying premise is that, even though the more worrisome scenarios depicted by "consensus" climate scientists aren't likely to play out, neither can they be ruled out. Under the rubric of geoengineering, Koonin sketches two possibilities: (1) for a relatively economical cost, it is possible to spread reflective particles (aerosols) in the atmosphere to cut down on the solar energy reaching the earth (imitating what happens for extended periods after volcanic eruptions); and (2) at a

32. *Id.* at 226. Agriculture comes in a poor fourth, followed by commercial and residential.

33. *Id.* at 227.

34. *Id.* at 234. He cites advanced solar, fission, fusion, and next-generation biofuels as examples of technology worth "pursuing."

35. KOONIN, *supra* note 1, at 235 (citing the "barriers" he has already discussed and other, more pressing "demands on the nation's attention and resources" as the reasons for his skepticism).

36. *Id.*

higher cost, equipment could be deployed to directly remove carbon dioxide from the atmosphere.[37] While neither of these options is technologically pie in the sky (so to speak), neither is a panacea, and hence Koonin delineates the obstacles – practical, economic, and political – associated with each.

Plan B-2 in Koonin's book is simply "adaptation," a resort which most environmentalists consider anathema. The author argues that human beings have proven adaptable to many types of climates; and, besides, this recourse represents what he believes "*will* be our primary response," not necessarily what *ought* to happen.[38] Moreover, to the extent that climate change is partially due to natural cycles (a thesis that holds more water in Koonan's judgment than that of his adversaries) , it may be unavoidable.[39] Either way, Koonin recommends more studies on adaptation that go beyond mere "identification" (the main way it has been addressed so far) and delve into "implementation issues" and "cost/benefit analysis" directed to different strategies. Further, he notes, since adaptation is more accessible for wealthier societies, the precursor to enabling adaptation is to focus in the shorter term on "alleviating poverty, which would be a good thing for many reasons having nothing to do with the climate."[40]

In his closing paragraphs, Koonin first asserts that the role of the scientist is to describe, not to prescribe, and that he's written his book accordingly.[41] But after this disclaimer, he shifts gears to recommend (as you would expect, given his critique) that climate science need "more sustained and improved observations of the climate system" and a better understanding of "the tremendously complex climate models we've built."[42] He adduces to this a plea for "more honest discussion" that "goes beyond slogans and polemics, and is free of accusations of skullduggery . . . .Let's further our understanding, rather than repeating orthodoxy."[43]

It should be concerning that any scientist who casts doubt on the more ominous conclusions of climate scientists is branded an apostate. On that ground if no other, Koonin has a valid point; science does, indeed, thrive on skepticism and hard testing of hypotheses. On the other hand, his critics have alleged that the technical concerns outlined in *Unsettled* have been superseded by data in latest IPCC report. One can only hope that the scrutiny of The Science continues, with both sides keeping an open mind to the wide range of possibilities. Whether Koonin's book is mostly a compendium of quibbles or a dead-on-target critique of the "climate emergency" warnings is an issue that needs to be sorted out, not just in the scientific journals but also in the public square.

37. *Id.* at 237-48.
38. *Id.* at 245.
39. KOONIN, *supra* note 1, at 246.
40. *Id.* at 248.
41. *Id.* at 250.
42. *Id.* at 251.
43. KOONIN, *supra* note 1, at 251.