

4) I have been the primary author or coauthor on 164 peer-reviewed scientific journal articles, including 70 as first author. Most of these papers involved development or application of computer models.

5) This document is divided into four sections: Damage to my reputation and a discussion of the three false facts in Clack Paper (PNAS, 2015) that led to that damage.

Damage to my Reputation

6) Based on my 30 years of computer modeling and publishing experience, I can avow that a person's stating a paper contains "modeling errors" is equivalent to stating that the author of the computer code is "sloppy," "incompetent," "stupid," or "doesn't check his or her work." Indeed, that is what news headlines from around the world stated or implied following publication of the Clack Paper. These comments have made me feel and appear "odious, infamous, and ridiculous."

7) For my own clarity to understand what these words specifically mean and to ensure I was not misstating my feelings, I looked the terms up in the Cambridge Dictionary. It defines the word "ridiculous" as "stupid or unreasonable and deserving to be laughed at;" the word "infamous" as "famous for something considered bad;" and the word "odious" as "extremely unpleasant and causing or deserving hate".

8) The headlines used terms such as "errors," "tooth-fairy research," "lie," "scam," "fantasy," "wishful thinking," "flawed," "smacked down," and "debunked." These words collectively and individually, as well as the collective contents of the many articles, made me feel and appear stupid and unreasonable and deserving to be laughed at (ridiculous). They also made me feel famous for something bad, namely sloppy research (infamous). The words such as "lie" and "scam" also subjected me to online hate (odious).

9) Additional results of this onslaught were damaging comments in research grant and journal paper reviews that referred to the Clack Paper's false modeling error claims. One reviewer, for example, rejected a paper with the claim that the paper applied the "same modelling tools" as in "Jacobson's notorious PNAS paper." This comment could have arisen due only to the false claims of model error by the Clack Authors. I and a co-author of mine, Dr. Mark Delucchi, also lost at least one prestigious research award along with 200,000 Euros. I was told that we were about to receive and share the award based on a preliminary vote. But, right before the final vote, two scientists stood up in front of the entire voting body, humiliating us to them by stating that, because of the Clack Paper, we should not receive the award, and we did not.

False Fact #1 – False Claim of Modeling Bug With Respect to Flexible Loads

10) I wrote the LOADMATCH computer program, which was used in our 2015 paper (Jacobson et al., PNAS, 2015 – hereinafter Jacobson Paper) that is the subject of this case.

11) The first false fact in the Clack Paper centers around a claim under the heading of their paper, "Modeling Errors" (P. 6724), "In fact, the flexible load used by LOADMATCH is more than double the maximum possible value from table 1 of [the Jacobson Article]. The maximum possible from table 1 of [the Jacobson Article] is given as 1064.16 GW, whereas figure 3 of [the Jacobson Article] shows that flexible load (in green) used up to 1,944 GW (on day 912.6). Indeed, in all the figures in [the Jacobson Article] that show flexible load, the restrictions enumerated in table 1 of [the Jacobson Article] are not satisfied."

12) Figure 3 of the Jacobson Article, referred to in this claim, contains LOADMATCH model results, as stated in the figure's caption. Thus, the Clack Author claim that LOADMATCH results in Figure 3 are inconsistent with data from Table 1 of the Jacobson Paper is a claim that the LOADMATCH model contains a "modeling bug." Indeed, this claim of bug falls in the

“Modeling Errors” section of the Clack Article, not in the separate “Implausible Assumptions” section. Thus, the Clack Authors themselves believed this alleged “modeling error” was due to a “modeling bug” and not due to an implausible assumption. I brought up this false claim of an error in the LOADMATCH code in Paragraph 43 of my original Complaint: “Dr. Clack and his co-authors fabricated the assertion that it was a maximum load as well as their concomitant conclusion that it was a modeling error. Even after Dr. Clack was notified of the falsehood, he knowingly refused to correct it.”

13) As such, Dr. Clack, on Page 8 of his Opposition, made an egregious false statement by claiming “nowhere in the Clack Paper, the Complaint in this case or any of the filings has the question of a ‘bug in the source code’ of LOADMATCH been raised... Rather, the Clack Paper simply asserts that the assumptions made in the paper were not scientifically reasonable or possible.” This is false because I brought up the claim in the Complaint, and the Clack Paper itself defined modeling errors as modeling bugs, not as poor assumptions. This is why it used separate sections for “Modeling Errors” and “Implausible Assumptions.”

14) The Clack Authors reinforced their intention to differentiate between modeling errors and implausible assumptions when they separated the terms on P. 6723, claiming that the Jacobson Paper contained “modeling errors; incorrect, implausible, and/or inadequately supported assumptions...” If they meant that modeling errors were the same as implausible assumptions, they would not have developed separate Section headings or separate terms for them. In sum, it has always been clear to me on the face of the Clack Paper that modeling errors meant modeling bugs. I filed the lawsuit because the false factual claims of modeling errors (bugs) damaged my reputation.

15) Further, a “modeling error” is by definition, a “bug in the source code,” and vice versa: “A software bug is an error, flaw or fault in a computer program or system that causes it to produce an incorrect or unexpected result, or to behave in unintended ways” (https://en.wikipedia.org/wiki/Software_bug, accessed June 3, 2020). In the present case, the Clack Authors claimed (P. 6724) that LOADMATCH model results from Figure 3 of the Jacobson paper were inconsistent with data from Table 1: “The maximum possible from table 1 of [the Jacobson Article] is given as 1064.16 GW, whereas figure 3 of [the Jacobson Article] shows that flexible load (in green) used up to 1,944 GW (on day 912.6).” Thus, they claimed that LOADMATCH results were “incorrect or unexpected, or behave in unintended ways” compared with the table. Thus, they claimed, by definition, LOADMATCH had a bug.

16) The claim that LOADMATCH model flexible loads, as presented in the figures, do not satisfy “the restrictions enumerated in table 1” are proven false factually simply by proving that the values in Table 1 are annual average values, not maximum values. When viewed correctly as annual average values, which the values are, there is no discrepancy whatsoever between the figures and Table 1 of the paper. The Clack Authors made a simple, non-scientific mistake by assuming values in Table 1 were maximum values rather than annual average values. The mistake became intentional, in my opinion, when both Dr. Clack and PNAS refused to correct the mistake and falsely claimed to the Court, without offering a shred of evidence, that the issue was one of scientific disagreement rather than a provable question of fact. This false claim made it to the Court Order (at 24): “The Court... finds that the three asserted “egregious errors” are statements reflecting scientific disagreements.”

17) Below I detail why Table 1 has annual average values and why Dr. Clack’s claim that their factual mistake is a scientific disagreement, is provably false.

18) I derived the data for and developed Table 1 of the Jacobson Paper myself. I designed the table intentionally so that it contains annual average values, not maximum values. Thus, I am the originator of the table, so I know factually exactly what type of values the table contains. I never contemplated putting maximum values in that table and it would make no sense scientifically to do so. As the originator of the table, I know for a fact that it is not a question of debate or a scientific question as to what type of values are contained in the table. The table absolutely contains average values, and any claim otherwise is a false claim with no foundation.

19) It is an easily-provable fact and truth that Table 1 of the Jacobson Paper contains average values, not maximum values. The fact is provable through the paper itself, through model results presented in the paper, and through the paper referenced in the footnote to Table 1 as the source of the load data for the table (Jacobson et al., Energy and Environmental Sciences, 2015). For example, my Motion for Reconsideration, and specifically its Exhibit 2, clearly shows that Table 1 of the Jacobson Paper factually contains annual average, not maximum values. In addition Exhibit 4 of my Motion for Reconsideration, the relevant text of which was also presented in the original Complaint on P. 20, Paragraph 48, shows that the data in Table 1 are average values based on an entirely independent methodology, using model results. Thus, Table 1 contains average values based on published reference to the data, model results, and my sworn testimony.

20) From my reading, there is no explanation anywhere in the Clack Paper as to why or how the Clack Authors came to believe that Table 1 of the Jacobson Paper contains maximum values. Further, the word “maximum” is never even used anywhere in the Jacobson Paper with respect to Table 1 of the Jacobson Paper. If Dr. Clack or NAS wanted to show that there is a scientific debate about the contents of Table 1, they would have shown evidence to contradict the factual evidence I provided proving the values are average values. However, they have never offered a

shred of evidence, and no such evidence exists. If no contrary evidence exists, there can be no scientific debate. Scientific debates work only if contradicting evidence exists and it is not possible to prove which set of evidence is correct. No contradicting evidence exists, and it is easily provable that the existing evidence shows the values in the table are average values, and that if the values are average values, they explain the “discrepancy” between Table 1 and figures in the Jacobson Paper.

21) Because I was the author of Table 1 and know exactly what type of data I put in the table, and I clearly referenced those data (in the first footnote to Table 1) to the paper that defines the data as average values, I can state with certainty that the Clack Authors and NAS are not telling the truth to the Court by continuing to deny the fact that the table contains average values, not maximum values. Their claim that the Table contains maximum values is arbitrary and false.

22) As such, it is my opinion, as a scientist with 30-years of programming and publishing experience, that a correction of the Clack Paper is warranted. Such a correction should correct the erroneous claim that Table 1 of the Jacobson Paper is inconsistent with figures in the paper, and that a modeling error therefore arises.

23) I have read Dr. Ken Caldeira’s Declaration of May 26, 2020 (Exhibit A of Dr. Clacks’s Opposition), in which Dr. Caldeira discusses his response to a tweet that I directed at him on February 16, 2019.

24) In my opinion, Dr. Caldeira not only admitted (by stating, “Yes”) in his response that Table 1 of the Jacobson Paper contains average, and not maximum values, but he then subsequently explained in the rest of his response why he made his error in the first place (“I should have realized that when someone writes that 67.66% of the load is flexible, they might

mean to communicate that 100% of the load is flexible but only 67.66% of the time.”) As such, he has admitted twice in the tweet that Table 1 contains average values.

25) In fact, his new explanation for why he made a mistake, which did not appear anywhere in the Clack Paper, was false as well, which is why I responded, “Seriously, Ken, you made that up out of thin air. Fig. 2C clearly shows that flexible and inflexible loads were separated the entire 6y simulation. You owe it to the science community to correct your paper of its egregious misrepresentation of facts I enumerated.”

26) In fact, Dr. Caldeira’s new false explanation, even if he believed it were true, would not explain the Clack Paper’s false claim that Table 1 of the Jacobson Paper contains maximum values instead of average values. That claim has no basis in reality. The Clack Authors and NAS refused to correct that error prior to publication despite being provided with evidence of the falsity of the claim.

27) In sum, Table 1 of the Jacobson Paper unequivocally contains average, not maximum values, and this is provable from the paper, its main reference, and the model output. This false claim by the Clack Authors led to a factually false conclusion that the Jacobson Authors computer program had a modeling error (= modeling bug) in it.

False Fact #2 – False Factual Claim Based on Omitting Canadian Hydropower

28) Next, I am the person who included existing imported Canadian hydropower as part of existing and future continental U.S. (CONUS) hydropower capacity in the Jacobson Paper.

29) I clearly stated this assumption first in Jacobson et al. (Energy and Environmental Sciences, 2015). That paper specifically defined hydropower capacity for 23 states as including imported Canadian hydropower. It stated, “In addition, 23 U.S. states receive an estimated 5.103 GW of delivered hydroelectric power from Canada. Assuming a capacity factor of 56.47%,

Canadian hydro currently provides ~9.036 GW worth of installed capacity to the U.S. This is included as part of existing hydro capacity in this study to give a total existing (year-2010) capacity in the U.S. in Table 2 of 87.86 GW.”

30) That paper was clearly referred to in Footnote 1 of Table S2 of the Jacobson Paper as the source of hydropower data for the Jacobson Paper. I specifically included Footnote 1 in the Jacobson Paper to ensure readers had a reference that explained the data.

31) Thus, it is a provable fact and truth that the Jacobson Paper unequivocally included Canadian plus United States hydropower output, not just United States hydropower output, as part of its projected 2050 average annual hydropower output. The fact is provable from Footnote 1 of Table S2 of the Jacobson Paper, which clearly states that the data for Table S2 originate from Reference 4 (Jacobson et al., Energy and Environmental Sciences, 2015).

32) I have read Dr. Clack’s response to my Motion for Reconsideration. In it, Dr. Clack admits for the first time to the Court that the Jacobson Paper factually includes Canadian plus United States, rather than just United States, hydropower output. As such, Figure 3 and the corresponding text of the Clack Paper, which claim that Jacobson Paper hydropower output is 43% above historical U.S. averages, is false as well.

33) It is my opinion as an expert scientist with a 30-year career in publishing, that Dr. Clack’s admission renders his previous briefs to the Court intentionally misleading, since Dr. Clack was well aware of his own presentation of September 21, 2017, which was made before the lawsuit was even filed (September 29, 2017). In other words, even though Dr. Clack agreed on September 21, 2017 that the Jacobson Paper factually contained Canadian hydropower, he not only refused to correct the false claims in the Clack paper, he intentionally hid his knowledge

from the Court once the lawsuit was filed, pretending as if there was a scientific disagreement about the subject rather than a settled issue.

34) In fact, the intentional false claim by Dr. Clack made its way into the Court Order. The Court Order (at 24) stated, “The Court...finds that the three asserted “egregious errors” are statements reflecting scientific disagreements.” However, Dr. Clack has now admitted that he knew for a fact, prior to the lawsuit, that Canadian hydropower was included in the Jacobson Paper. As such, he knew there was not a scientific disagreement over this issue and that he had made a mistake in the Clack Paper. Yet, he intentionally misled the Court into thinking there was still a disagreement.

35) In other words, in my opinion, the claim of a “scientific disagreement” with respect to Canadian hydro by Dr. Clack was an intentionally false claim, because Dr. Clack knew the factual truth about the claim. Now that PNAS and Dr. Clack know they have made an error with respect to Canadian hydropower, there is no excuse for not correcting the Clack paper and addressing this false claim of scientific disagreement in the Court Order.

36) In Dr. Clack’s Opposition, he goes on to falsely claim that I made a mistake by not stating in the Jacobson Paper that it included Canadian hydropower, and this is why Dr. Clack made his original error. He also falsely claims that Table S2 of the Jacobson Paper, which contains the hydropower capacity, was not accurately labeled.

37) These claims by Dr. Clack are both factually false. Nowhere in the Jacobson Paper is there a “mistake” about Canadian hydropower, and Table S2 was accurately labeled. The problem was that Dr. Clack failed to read the clearly-labeled source of data in the table. Footnotes and captions are both part of the labeling of a table. Footnote 1 of Table S2 of the Jacobson Paper, clearly refers to Jacobson et al. (Energy and Environmental Sciences, 2015) as

the source of hydropower data in the table, and that paper clearly states that U.S. hydropower output used includes imported Canadian hydropower that “is included as part of existing hydro capacity in this study.” The reference even calculates how much Canadian capacity is assigned to the U.S.

38) Thus, it is only Dr. Clack who made a factual mistake and falsely portrayed the Jacobson Paper as not including Canadian hydropower based on his own failure to read carefully the reference specified in Footnote 1 of Table S2 of the Jacobson Paper.

39) The statements by Dr. Clack and NAS that “Dr. Jacobson sought to publish errata seeking to clarify the inconsistency in the Jacobson Paper relating to the Canadian output issue and the hydropower assumptions” is also absolutely false, as there was no “inconsistency” in the Jacobson Paper regarding Canadian hydropower. Footnote 1 of Table S2 of the Jacobson Paper clearly identified the source of the hydropower data, and that source (Jacobson et al., Energy and Environmental Science, 2015) specifically defines hydropower data for 23 U.S. states as including imported Canadian hydropower. Thus, CONUS (continental U.S.) hydropower is clearly defined in the reference listed in Footnote 1 of Table S2 to include imported Canadian hydropower.

40) The “errata” I published online referring to Canadian hydropower was written solely to prevent people like Dr. Clack, who didn’t read carefully Footnote 1 of Table S2 and the corresponding reference, from erroneously claiming the Jacobson paper did not include Canadian hydropower. It has nothing to do with the false claim by Dr. Clack and NAS that Table S2 of the Jacobson Paper did not contain that information or that there was an “inconsistency.”

False Fact #3 – False Claim of Modeling Bug With Respect to Hydropower

41) Next, I designed the treatment of hydropower in the LOADMATCH code. I designed the code to conserve water flowing through hydropower turbines during a year, thus annual hydropower energy supply. Indeed, the code does exactly this. This conservation was the meaning of the statement in Footnote 4 of Table S2 of the Jacobson Paper, “Hydropower use varies during the year but is limited by its annual power supply.” The fact is provable through the Jacobson Paper, through model results, and through the main paper that Jacobson Paper references (Jacobson et al., Energy and Environmental Sciences, 2015). Thus, there was no “modeling error” in LOADMATCH with respect to hydropower.

42) Dr. Clack now makes the egregiously false claim that the Clack Paper and the original Jacobson Complaint contain no allegations of LOADMATCH model bugs. On page 8 of his Opposition, Dr. Clack falsely states that “First, nowhere in the Clack Paper, the Complaint in this case or any of the filings by any party has the question of a “bug in the source code” of LOADMATCH been raised...Rather, the Clack Paper simply asserts that the assumptions made in the paper were not scientifically reasonable or possible.”

43) This claim was disproven earlier in this document with respect to the Clack Paper’s false claim of model error concerning flexible loads. The same arguments apply to the false claim by the Clack Authors of model error concerning hydropower.

44) The Clack Paper itself falsely claimed that the LOADMATCH model had software bugs, and this is the main reason why I filed the lawsuit. The Clack Authors stated under the section “Modeling Errors” on p. 6724, “As we detail in SI Appendix, section S1, ref. 11 includes several modeling mistakes that call into question the conclusions of the study. For example, the numbers given in the supporting information of ref. 11 imply that maximum output from hydroelectric facilities cannot exceed 145.26 GW (SI Appendix, section S1.1), about 50% more than exists in

the United States today (15), but figure 4B of ref. 11 (Fig. 1) shows hydroelectric output exceeding 1,300 GW.”

45) Figure 4B of ref. 11 (the Jacobson Paper) is output from the LOADMATCH model. Per the above paragraph, the Clack Paper claims that peak discharge rates shown in Figure 4B are inconsistent with other data from the Jacobson Paper. Because the Clack Authors claim that results from the LOADMATCH code are “incorrect or unexpected, or behave in unintended ways,” they claim, by definition, that the model has a software bug (https://en.wikipedia.org/wiki/Software_bug).

46) Second, by putting this claim under the section heading “Modeling Errors” rather than “Implausible Assumptions,” they claim that the problem they are identifying is not due to an Implausible Assumption, but due to a modeling bug. If the Clack Authors believed these “modeling errors” were due to implausible assumptions, they would have put them under “Implausible Assumptions,” but they did not.

47) The fact that Dr. Clack meant the term, “modeling error” in the paper to mean “modeling bug” and not “poor assumption” with respect to hydropower is evidenced by Dr. Clack’s own admission. On June 20, 2017, Dr. Clack posted a tweet stating that he believed our hydropower model results were due to a mistake, not a poor assumption. He states, “It is a mistake. If was an assumpt. For review would have been rejected straight away. Also, all evidence in their paper suggest mistake.” (<https://twitter.com/DrChrisClack/status/877258178278379520> accessed June 3, 2020). Thus, Dr. Clack himself denies his own attorney’s interpretation that Dr. Clack’s criticisms were criticisms of assumptions rather than claims of a modeling bug.

48) The factually false claim of a hydropower software bug (modeling error) was brought up in the original Complaint in Paragraph 40: “Among the most damaging falsehoods is the Clack

Article's claim that the Jacobson Article contains modeling errors that "invalidate the results in the studies, particularly with respect to the amount of hydropower available..." Exhibit 11 at p. 3 (Clack Article at 6724)."

49) In Paragraph 40 of my original Complaint, I also addressed the false claims of modeling bugs (= "modeling errors") by stating, "Baseless allegations of modeling errors can be found throughout the Clack Article. These allegations are relevant and particularly damaging to Dr. Jacobson, whose main research work is on the development and application of numerical computer models." In no way did I file this lawsuit over disagreements about the modeling assumptions in the model. The lawsuit was over two provably false factual claims about modeling bugs in the LOADMATCH model and a provably false comparison of Canadian + U.S. versus U.S. only hydropower, all of which made me appear, "odious, infamous, or ridiculous."

50) In his Opposition, Dr. Clack falsely claims that his statement, "one possible explanation for the errors in the hydroelectric modeling is that the authors assume they could build capacity in hydroelectric plants for free" means that he claims that "modeling errors" really mean "poor assumptions." This claim is absolutely false since the cost of the turbines plays zero role in the LOADMATCH model results of Figure 4B of the Jacobson Paper. Yet, under the Section "Modeling Errors" of the Clack Paper, Dr. Clack falsely claims that Figure 4B of the Jacobson Paper is inconsistent with Table S2 of the paper, thereby claiming a modeling bug occurred (as discussed earlier). Thus, this Clack Paper sentence points out a poor assumption in the Jacobson Paper, not a modeling error. I have acknowledged (e.g., in the "errata" and Court documents) that we neglected the cost of hydropower turbines, which was a poor assumption. However, this was not a modeling error, as claimed by Dr. Clack. As proof that, despite making this statement

in the Supplemental Information of his paper, Dr. Clack still claimed that the Jacobson Paper contained a modeling bug, Dr. Clack still separated “Modeling Error” claims from “Poor Assumption” claims in the main paper and never moved the hydropower claim of modeling error out of the “Modeling Error” section to the “Poor Assumption” section. As such, he is again not telling the truth about his reckless false claims of modeling bugs in the Jacobson Paper.

51) On July 10, 2017, two weeks after publication of the Clack Paper, Dr. Clack asked for model results at 30-second resolution for several parameters although that was not the resolution of the model output used in the paper, which was 1-hour. Although I had no requirement to produce output not already coded or used in the paper, as a good-faith gesture and to show in an additional way that there was no model error in LOADMATCH with respect to hydropower or flexible loads, I spent several hours adding code to the model to produce output at 30-second resolution for the following three parameters relevant to the Clack Paper: **30-second hydropower output; 30-second flexible load plus load coupled with thermal-energy storage (TES); and 30-second hydrogen production and compression output.**

52) I then summarized the results from these three outputs and **offered Dr. Clack to send him the three 30-second files.** Specifically, in Exhibit 5 of my May 18, 2020 Motion for Reconsideration, I stated at the end, “If you want to see these three series at 30 second resolution, I can make these available to you.”

53) As such, Dr. Clack falsely claimed on Page 3 of his Opposition to my Motion for Reconsideration, “Dr. Jacobson refused to provide the requested data claiming it was too time consuming for him to do (despite the fact that the Jacobson Paper states the data would be provided upon request). He agreed to provide a different set of data instead.” No, I did produce and offer to Dr. Clack the three 30-second time series that he requested that were relevant to the

issues under contention (Exhibit 5 of my May 18, 2020 Motion for Reconsideration) in addition to providing him with a broader set of data actually used in the paper, at 1-hour resolution.

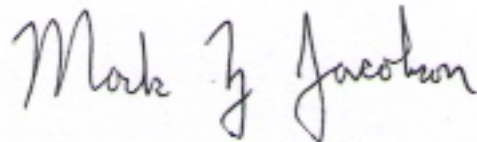
54) It is Dr. Clack who never responded specifically to my offer for the three 30-second resolution files. I made the offer despite the fact that the 30-second data requested were never produced or used in the Jacobson Paper (as falsely insinuated by Dr. Clack).

55) Similarly, the NAS Opposition statement on this issue on their Page 3, which appears to have been cut and pasted from Dr. Clack's Opposition, is also false.

56) After receiving the 1-hour data, neither Dr. Clack nor any of his coauthors ever told me subsequently that he found any errors or inconsistencies.

57) Finally, in my opinion, there is absolutely no reason Dr. Clack would have asked for model output after publication of his paper unless he thought there was a bug in the code that he was trying to prove. No such bug was ever reported by Dr. Clack, and now Dr. Clack says in his Opposition that he never alleged any modeling bugs by Prof. Jacobson. If that were the case, Dr. Clack would never have requested model output.

I solemnly affirm, under the penalties of perjury, that the contents of the foregoing affidavit are true and correct.



Mark Z. Jacobson

Dated: June 8, 2020