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UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF MONTANA
BUTTE DIVISION

EVA LIGHTHISER; et al.
Plaintiffs,

v.

DONALD J. TRUMP, in his official capacity as President of the United States; et al.
Defendants.

Case No: CV-25-54-BU-DLC

SUPPLEMENTAL DECLARATION OF MARK Z. JACOBSON, PhD, IN SUPPORT OF MOTION FOR PRELIMINARY INJUNCTION

I, Mark Z. Jacobson, hereby declare and if called upon would testify as follows:

1. I am submitting this Supplemental Declaration in support of Plaintiffs' Motion for Preliminary Injunction. I am offering this testimony in my personal capacity, and I have personal knowledge of the facts stated herein.

Grid Reliability

2. Defendants falsely state in their opposition brief (p. 45): "Plaintiffs' requested injunction would also inflict tremendous harm on the public, by reducing the reliability of the energy grid and domestic supply chains. It would greatly increase the potential for power outages, by 100 times (*i.e.*, 10,000%) in 2030. See Sawyer Ex. D, at 1." It is necessary to point out that Sawyer is an attorney and not an energy expert and Ex. D. of his report is not a peer-reviewed paper but an un-reviewed government report, apparently hastily assembled over 3 months between April 8 (page vi of the report) and July of 2025. Normal peer-reviewed scientific papers require 9-18 months to publication. Peer review is critical to the integrity of the scientific process and to assure that experts can report flaws in assumptions and methodology so that authors can fix them. Exhibit D has numerous flaws, as discussed shortly.

3. Further, Defendants do not bring any expert to disagree with my expert declaration or to support the statement in their brief. In particular, they do not rebut the conclusion in paragraph 20 of my Declaration, "Our findings demonstrate that it

is technologically and economically feasible to transition all 50 states, statewide, for all energy purposes, to 100% clean, renewable energy by 2050, meeting all energy needs across all sectors while keeping the electricity grid stable 100% of the time." This conclusion, which accounts for the electrification of all energy sectors and increased energy demand in 2050, comes from this peer-reviewed paper, referenced in my Declaration, Jacobson, M.Z., A.-K. von Krauland, S.J. Coughlin, F.C. Palmer, and M.M. Smith, Zero air pollution and zero carbon from all energy at low cost and without blackouts in variable weather throughout the U.S. with 100% wind-water-solar and storage, *Renewable Energy*, *184*, 430-444, doi:10.1016/j.renene.2021.11.067, 2022. This paper concludes that a fully-renewable U.S. grid with far more electricity demand than today will not incur blackouts, let alone blackouts at the rate of 100 times today. In my opinion, the claim by Sawyer of such a high risk of blackout is nonsensical.

4. Beyond being contradicted by the peer-reviewed literature, the July 2025 DOE report (Ex. D) attached to Sawyer's declaration not only ignores what is happening in the real world, but it has many simplifications and flaws in its assumptions. I address some of these below.

5. First, the report claims that Artificial Intelligence (AI) centers' demand for electricity will increase grid electricity demand thus making grid reliability more difficult. However, real data show that the growth of behind-the-meter (BTM) solar

photovoltaics (PV) can more than offset the increase in grid demand from not only the growth of AI, but also the growth of cryptocurrency, battery-electric vehicles, and electric heat pumps. For example, California is the most populated U.S. state and the state with the fourth largest economy among all countries or states in the world. The CAISO (California Independent System Operator) grid provides about 82% of California's grid electricity. As shown in Figure 1, CAISO grid demand in 2025 so far (Jan 1-July 15) is 0.3% below demand during the same period in 2024. From the same dataset,[1] 2025 demand is also 0.4% below the demand during the same period in 2023, despite the growth in AI, cryptocurrency mining, electric vehicles adoption, and electric heat pump adoption in California.

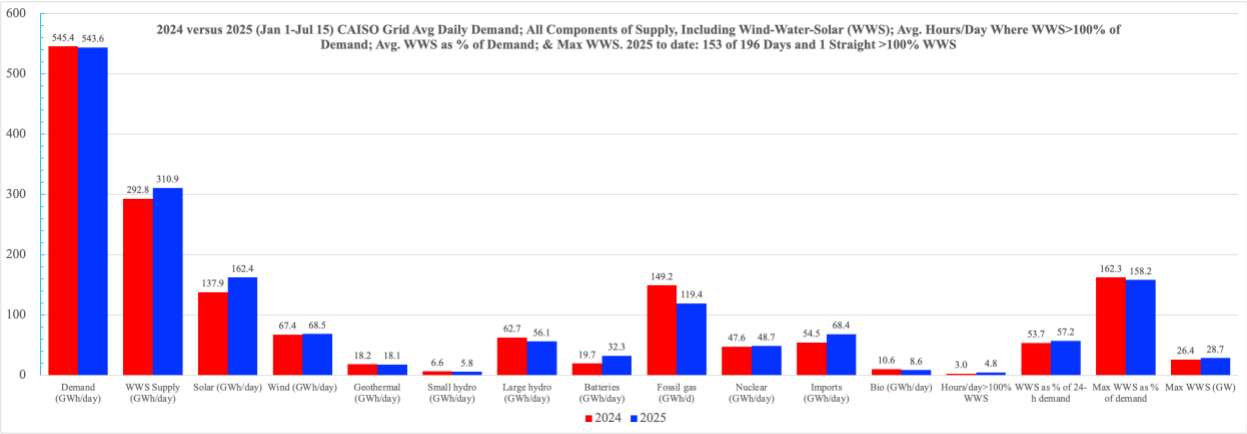

Figure 1. Comparison of CAISO grid electricity demand, total wind-water-solar (WWS) electricity supply, solar supply, wind supply, geothermal supply, small hydro supply, large hydro supply, battery supply, fossil gas supply, nuclear supply, imports, bioenergy supply, and other statistics between January 1 and July 15, 2024 and the same dates in 2025. Data compiled from https://www.caiso.com/todays-outlook

[1] https://www.caiso.com/todays-outlook

6. The reason for the reduction (rather than increase, as Defendants have assumed) in demand in California is largely due to the growth in BTM rooftop PV electricity.[2] When people install rooftop PV, they use this electricity first, reducing their need for grid electricity. California has installed an enormous amount of rooftop PV and home batteries in the past five years, helping to offset substantially the growth in grid electricity demand in the state.[3]

7. The Executive Orders are directly trying to stifle the very BTM rooftop PV energy that reduces grid demand for electricity. By hindering the growth of rooftop PV, the federal government is now creating the very problem they say fossil fuels are needed to solve. If, in fact, the federal government is enjoined from carrying out the Executive Orders and instead encourages the growth of BTM rooftop PV, then the problem they claim will occur (increased grid electricity demand) will not even occur. This factor alone renders Sawyer's Exhibit D faulty based on an erroneous premise of what is occurring in some of the U.S. and what can and should occur in every U.S. state with sufficient incentives and/or legislation.

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[2] Jacobson, M.Z., D.J. Sambor, Y.F. Fan, A. Mühlbauer, and M.A. Delucchi, No blackouts or cost increases due to 100% clean, renewable electricity powering California for parts of 98 days, *Renewable Energy, 240*, 122262, doi:10.1016/ j.renene.2024.122262, 2025.

[3] Jacobson, M.Z., D.J. Sambor, Y.F. Fan, A. Mühlbauer, and M.A. Delucchi, No blackouts or cost increases due to 100% clean, renewable electricity powering California for parts of 98 days, *Renewable Energy, 240*, 122262, doi:10.1016/ j.renene.2024.122262, 2025.

8. Second, Exhibit D of Sawyer's report claims blackouts will increase by 100-fold if lots of renewables are added to the grid. However, this claim is belied by the fact that there are already 11 states (South Dakota, Montana, Iowa, Washington, Kansas, Maine, Wyoming, New Mexico, Oregon, North Dakota, Oklahoma) with the equivalent of 50-121% of their electricity demand met by wind-water-solar (WWS) generation sources in the annual average from Q2-2024 to Q1-2025.[4] These 11 states have not suffered blackouts due to renewables. Ten of the 11 states, in fact, had retail residential electricity prices in 2024 that were at least 1.9 cents/kWh below the U.S. average. In other words, states with more WWS had lower prices, on average, and also did not experience any of the blackouts due to renewables the report asserts will occur. What is more, this peer-reviewed study, Jacobson, M.Z., D.J. Sambor, Y.F. Fan, A. Mühlbauer, and M.A. Delucchi, No blackouts or cost increases due to 100% clean, renewable electricity powering California for parts of 98 days, *Renewable Energy, 240*, 122262, doi:10.1016/j.renene.2024.122262, 2025, found that the spot price of electricity in California decreased by ~50% during a 98-day period in 2024 versus the same period in 2023 despite substantial growth in solar and batteries in 2024. A low spot price indicates it is easier to keep the grid stable.

9. Further, California as a whole is ranked 12th on the above list of meeting electricity demand with WWS, provided 48.16% of its electricity demand

[4] https://web.stanford.edu/group/efmh/jacobson/WWSBook/Countries100Pct.pdf

from WWS from Q2-2024 to Q1-2025[5]. However, California's main grid, CAISO, has not had a blackout since August of 2020, despite an enormous growth in solar, wind, and batteries on the grid and a large reduction in fossil gas use. For example, fossil gas use on the CAISO grid from January 1-July 15, 2025 is 20% lower than during the same period in 2024 (Figure 1) and 39% lower than during the same period in 2023.[6] While California electricity prices are comparatively higher than other states with significant WWS power generation, such higher prices have nothing to do with renewables. Instead, they have to do with utilities passing onto customers the costs of multiple wildfires caused by transmission-line sparks, of undergrounding transmission lines, of the San Bruno and Aliso Canyon fossil gas disasters, of strengthening underground gas pipes due to San Bruno, of the high cost of fossil gas in the state, of retrofitting an aging transmission system, and of keeping the Diablo Canyon nuclear plant open.[7]

10. Similarly, batteries, in combination with renewables, are making the Texas grid more and more reliable.[8]

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[5] https://web.stanford.edu/group/efmh/jacobson/WWSBook/Countries100Pct.pdf
[6] Data from CAISO: https://www.caiso.com/todays-outlook
[7] Jacobson, M.Z., D.J. Sambor, Y.F. Fan, A. Mühlbauer, and M.A. Delucchi, No blackouts or cost increases due to 100% clean, renewable electricity powering California for parts of 98 days, *Renewable Energy, 240*, 122262, doi:10.1016/j.renene.2024.122262, 2025.
[8] https://www.utilitydive.com/news/batteries-grid-state-of-reliability-nerc/750649/

11. The model used in Exhibit D of Sawyer's report also contains many simplifications, including an extraordinarily long time step of one hour (3,600 seconds), which is 120 times that used in the model in Jacobson et al. (2022) (30 seconds), less sector coupling than in Jacobson et al. (2022), fewer technologies considered, and the lack of a meteorological database that accounts for future weather and climate consistently with building heat demand and that accounts for competition among wind turbines for available kinetic energy.[9]

Critical Materials

12. The critical materials analysis of Kokkinos is misleading. First, it fails to state that the current fossil fuel infrastructure relies on critical minerals. For example, on page 2, Kokkinos acknowledges that platinum is classified as critical by 2035. Platinum is used in catalytic converters in most all diesel and gasoline internal-combustion-engine (ICE) vehicles. Phasing out ICE vehicles in favor of battery-electric vehicles will allow virtually all platinum in existing catalytic converters to be recycled, eliminate demand for new platinum for such applications, and free up platinum for other applications, such as hydrogen electrolyzers and fuel

[9] Jacobson, M.Z., A.-K. von Krauland, S.J. Coughlin, F.C. Palmer, and M.M. Smith, Zero air pollution and zero carbon from all energy at low cost and without blackouts in variable weather throughout the U.S. with 100% wind-water-solar and storage, *Renewable Energy*, *184*, 430-444, doi:10.1016/j.renene.2021.11.067, 2022

cells. Instead, the Executive Orders attempt to prevent battery-electric vehicles from replacing ICE vehicles, increasing the risk of platinum scarcity.

13. Second, the critical minerals needed for wind and solar generation require mostly one-time mining to build the infrastructure. Once the infrastructure is built, the infrastructure lasts on the order of 30 years or more, and the critical components are then recycled in new generators that last another 30 years. Conversely, fossil fuels require continuous mining and processing of fuels every day of every year for as long as they are continued to be used as an energy source, as well as materials for one-time mining to build the fossil-fuel infrastructure. Consequently, wind and solar require orders of magnitude less overall mining than fossil fuels. This reflects in land use. Approximately 1.3% of United States' land is occupied by the fossil fuel industry (and this is growing annually), more than the ~1% of new land needed for a 100% clean, renewable energy infrastructure to power the U.S. for all energy purposes and for mining the materials needed for the infrastructure. WWS land does not need to grow nearly so much as fossil-fuel land because WWS requires no land at all for the continuous mining of fuels.

14. Next, Kokkinos admits at ¶2 the critical materials listed will not be classified as "critical" until 2035. However, it is technically and economically feasible and necessary to build 90-100% of the WWS infrastructure before then. The Executive Orders and push for fossil fuels will slow down such a transition.

15. To illustrate the enormous continuous mining burden of fossil fuels, 50,000 new oil and gas wells are drilled in central North America alone EVERY year to satisfy oil and gas energy needs.[10] This mining must continue every year for as long as fossil fuels are burned for energy. This is unsustainable. Not only do these wells and the land destroyed around them take up more and more space every year, but these fuels will also run out at some point, and a conversion to WWS will be needed in any case, placing an additional burden on Plaintiffs.

16. With respect to lithium, lithium resources increase yearly, based on U.S. Geological Survey (USGS) data, because more lithium is discovered every year. As such, the 2022 numbers used by the DOE REE report attached to Kokkinos' Declaration are out of date (Ex. A). For example, according to the USGS, the United States has, in 2025, known lithium resources of ~19 million tons.[11] This is an increase from 14 million tons in 2024, thus an increase of 36% in just one year.[12] With resources of 19 million tons in 2025, and at 7.9 kg-Li/vehicle (70 kWh per vehicle divided by 8.87 kWh/kg-Li), the U.S. could produce 2.4 billion battery-electric vehicles with its own lithium resources. There are currently fewer than 300 million vehicles in the U.S., so there is enough lithium to electrify all U.S. vehicles

[10] Allred, B.W., W.K. Smith, D. Twidwell, J.H. Haggerty, S.W. Running, D.E. Naugle, and S.D. Fuhlendorf, Ecosystem services lost to oil and gas in North America, *Science, 348*, 401-402, 2015.
[11] https://pubs.usgs.gov/periodicals/mcs2025/mcs2025-lithium.pdf
[12] https://pubs.usgs.gov/periodicals/mcs2024/mcs2024-lithium.pdf

over 8 times over! Of course, this will never occur and is not necessary. The U.S. does not need more vehicles than it currently has.

17. In this vein of elemental reserves, Harker points out (¶4) a model result that indicates that if gallium and germanium were limited by China into the U.S., that would affect the U.S. economy. However, 95% of solar panels in the world are made from silicon, not gallium or germanium. Likewise, there are many other options from which solar panels can be produced. Lithium batteries do not need these elements either.

18. In addition, the focus on lithium reserves for batteries distracts from the fact that there are now many options for batteries, particularly for stationary batteries used to store grid electricity, that do not use lithium, including basalt-stone batteries, sodium-sulfur batteries, aluminum-ion batteries, salt-water batteries, and vanadium-flow batteries.[13]

19. Kokkinos attempts to raise the issue of the production of rare earth elements (REEs) from coal ash as a reason to continue to use coal (¶3). This makes no sense. First, just because REEs are found in coal or coal ash does not mean we need to burn more coal. We have over 200 years of accumulated coal ash that can be used to extract REEs. This existing coal ash in the United States holds over 11

[13] Jacobson, M.Z., *No Miracles Needed: How Today's Technology can Save our Climate and Clean our Air*, Cambridge University Press, New York, 437 pp., 2023.

million tons of REEs, which is about six times greater than the known domestic reserves of REEs (~1.9 million tons today).[14] Second, extracting REEs from coal ash is only at the experimental research phase and REEs occur at very low concentrations in coal ash. Instead, the dedicated Mountain Pass mine in California for REEs will likely provide much more REEs than from coal ash. Coal ash contains light REEs, which are the REEs that the Mountain Pass mine produce.

20. Rare earth elements are not rare elements in terms of their abundance or location on the planet. Rather, they are "rare" because they are not found in concentrated deposits due to their geochemical properties. Indeed, new deposits are found all the time in the United States. The USGS had domestic reserves at 1.8 million tons of REEs in 2024[15], which increased to 1.9 million tons in 2025[16], a 5.56% increase in just one year. To put these reserve masses in perspective, the United States consumed 6,600 tons of REEs in 2024 (domestic production plus imports less exports), or only 0.35% of proven domestic reserves. In fact, the U.S. exported over six times the REEs that it consumed in 2024, suggesting the U.S. has nothing close to a current shortage of REEs.[17] At this rate of REE consumption, the United States has about 290 years of REEs in reserve. Furthermore, many friendly

[14] https://news.utexas.edu/2024/11/19/enormous-cache-of-rare-earth-elements-hidden-inside-coal-ash-waste/
[15] https://pubs.usgs.gov/periodicals/mcs2024/mcs2024-rare-earths.pdf
[16] https://pubs.usgs.gov/periodicals/mcs2025/mcs2025-rare-earths.pdf
[17] Id.

U.S. trading partners like Canada, Australia, and Greenland have substantial REEs.[18] In short, the United States is not in a crisis when it comes to the availability of REEs that would necessitate extracting REEs from coal or coal ash using experimental methods.

United States vs. China

21. La Rose provides U.S. Energy Information Agency (EIA) data for CO_2 emissions from the U.S., China, and the world (¶¶4–6). However, because they are only up to 2023, the data are all out of date and thus irrelevant. Since 2023 (in 2024 and 2025), China has embarked on the largest and most rapid energy transformation in world history. Chinese nameplate capacity grew from 1.83 terawatts (TW) nameplate capacity of WWS (onshore and offshore wind, solar PV, CSP, geothermal electricity, hydroelectricity, tidal and wave electricity, geothermal heat, and solar heat) in 2023 to 2.20 TW in 2024.[19] That is a 20.2% increase (0.37 TW) in WWS capacity in a single year. China is projected to reach 2.79 TW capacity from WWS in 2025, which is a 26.8% increase (0.59 TW) in just one year, and illustrates the speed at which renewable energy can be deployed when policies do not block it.

22. Thus, based on my calculations, by the end of 2025, China may produce an estimated 23.3% of all the electricity and heat capacity they will need by year

[18] Id.
[19] https://www.irena.org/Publications/2025/Mar/Renewable-capacity-statistics-2025

2050 to be 100% WWS across all energy sectors. At the rate China is adding WWS capacity, they will meet 100% of their 2050 energy needs with WWS by the year 2043 (in 18 years). If China electrifies all energy sectors, their energy CO_2 emissions will go to zero by 2043. In contrast, at its 2025 rate of growth of WWS, slowed by the Executive Orders, I estimate that, the U.S. will not reach 100% WWS across all energy sectors until well after 2100, exacerbating deaths due to air pollution and climate damage for a far longer period than China.

Irreversible Harm

23. Right now, there are up to 100,000 air pollution deaths and millions more illnesses that are caused annually by fossil-fuel and bioenergy-fuel air pollution from all energy sources in the United States.[20] Directing more fossil fuel energy to be produced will lead to more pollution from energy and more avoidable deaths and illnesses. More pollution translates to more accumulated exposure to Plaintiffs who are at greater risk of illness or death than they otherwise be without this additional exposure. These Executive Orders directly increase air pollution from fossil fuels in the states where Plaintiffs live and thus increase their risk of fossil-fuel caused death and illnesses.

24. The Defendants do not present any expert opinions or credible disagreement with the fundamentals of fossil fuel pollution or climate damage, or

[20] https://pubs.acs.org/doi/10.1021/acs.estlett.0c00424

contest my or Dr. Running or Dr. Byron or the Intergovernmental Panel on Climate Change's conclusion in their 2023 sixth Assessment Report (AR6) Synthesis Report that "Every ton of CO_2 adds to global warming".[21] The cumulative and ongoing increase in United States GHG emissions due to the Executive Orders today and through 2027 may be more than 300 million tons CO_2eq[22] and every one of those 300 plus million tons matters to the Plaintiffs' lives.

25. In my expert opinion, there is no question that every one of those tons that could be easily avoided represents irreversible harm to these 22 young people.

26. In my first declaration, I showed the levelized cost of different electricity-generation technologies based on the most recent report by Lazard. Since that declaration, on June 16, 2025, Lazard published a new "Levelized Cost of Energy+" report. Figure 2 is the updated graph from that report, which I am providing so that the court has the most up-to-date information on the unsubsidized levelized cost of electricity in the U.S..

[21] https://www.ipcc.ch/report/ar6/syr/downloads/report/IPCC_AR6_SYR_LongerReport.pdf
[22] Supplemental Declaration of Jesse Jenkins, ¶5.

Figure 2. Unsubsidized levelized cost of different electricity-generation technologies in the United States.[23]

In accordance with 28 U.S.C. § 1746, I declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct. Executed on July 17, 2025 at Stanford, California.

Mark Z. Jacobson

[23] Lazard, 2025 Levelized Cost of Energy+ (June 2025), https://www.lazard.com/media/uounhon4/lazards-lcoeplus-june-2025.pdf