Rebuttals to Many False Claims made in relation to Utility-Scale Solar Projects in Yavapai County

by Stephen P. Cook

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False claim #1: These "solar farms" heat up the area they cover and surroundings.

My rebuttal: This false claim was advanced by comments made by members of the Prescott-based group Arizonans for Public Integrity (AZFPI) and in Part II of the article "Whispering Down the Solar Lane" on their website. I have written and sent to them a detailed rebuttal to this and other claims they have made. This is available from me on request.

In actuality, there's no significant temperature change. Basic physics / common sense suggests that, since a significant portion (roughly 20%) of the solar energy falling on the area is removed and transported elsewhere as electrical energy, a slight overall cooling is expected. This is documented by surface temperature measurements in some of the studies cited by those who advance this false claim. (The AZFPI detractors selectively ignore this part of the studies they cite.) Depending on the nature of the surrounding ground, the mostly darker solar panels may directly absorb more solar energy. Yes, that can raise daytime air temperatures very slightly—but this increase is typically much less than the decrease in surface temperatures.

A newer study—in *Renewable Energy*, Volume 221, February 2024 titled "Numerical model study on influences of photovoltaic plants on local microclimate" confirms this. It describes the typical effect in the area of a solar farm as "increased…daily 3 m air temperature difference [of] 0.55 °C and reduced the ground temperature [of] 3.6 °C in the day and 1.1 °C at night,."

Beyond local considerations, since solar photovoltaic (PV) panels don't emit greenhouse gases their widespread use replacing burning fossil fuels helps reduce global temperatures and mitigates climate change.

False claim #2: Solar panels are extremely toxic. (Note: Supervisor Oberg strongly advanced this claim at the September 4 BOS meeting. Besides wanting to challenge him on this, I otherwise appreciated his comments on the need to protect pronghorns and believe solar panels and these animals can co-exist!)

My rebuttal: To push this claim and ignore much more serious potential hazards to the environment (methane gas pipelines, leaking gasoline storage tanks, mining pollution, coal ash, plastics / PFAS, etc)—even from household consumer electronic appliances—seems hypocritical. But, just about anything can be a poison depending on the dose.

Any heavy metals in solar panels are not volatile and are embedded in insoluble materials that are contained in a weather-sealed enclosure. They are less toxic than many things commonly inside our houses—like flat screen TVs, some of which are as large as solar panels. Of potentially present heavy metals and other toxics — mercury, lead, cadmium, arsenic, etc—I believe mercury is of greatest concern. Unlike flat screen TVs—which may contain ten milligrams or so of mercury, **solar panels do not contain mercury.**

See this article for more on E-waste and toxics in consumer products inside houses:
"A Closer Look at E-Waste Materials: What's Inside Your Devices?" found at
https://hummingbirdinternational.net/e-waste-materials-inside-devices/

A good discussion of relative hazards posed by supposed toxicity of solar panels is provided by a November 15,

2023 report from the National Renewable Energy Lab (NREL) found here:

https://www.nrel.gov/news/program/2023/photovoltaic-toxicity-and-waste-concerns-are-overblown-slowing-decarbonization.html

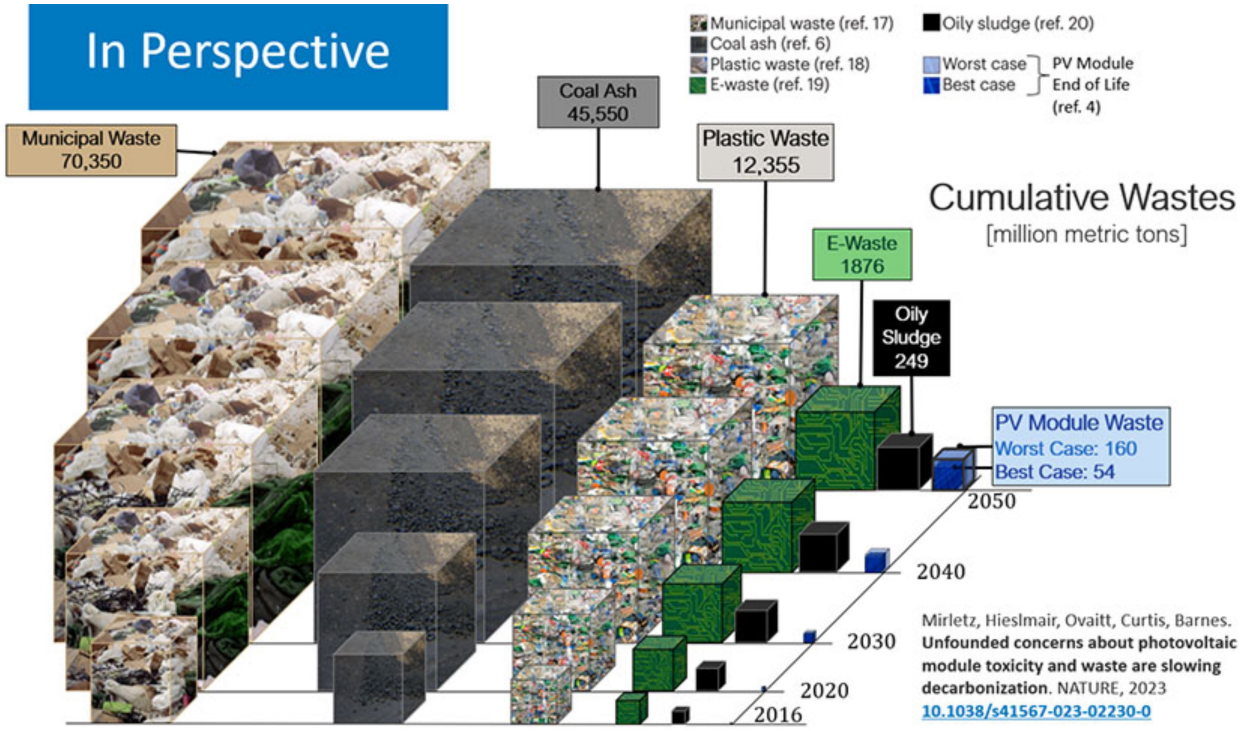
Note: like flat screen TVs, solar panels are extremely well-sealed . Only if they are severely damaged by accident or vandalism can the very tiny amounts of toxic materials they possess enter the environment as pollutants. Or this might eventually happen—without (more likely recycling)— after they sit in landfills years after decommissioning (See False claim #3 below).

False claim #3: Decommissioning solar farms / disposing of panels could be a nightmare

My rebuttal: The lifetime of solar panels is sometimes cited as 30 to 35 years (by the US Dept. of Energy,) but how long they will continue to provide useful electricity involves some guesswork. My own experience with panels bought new in 1980, and tested 33 years later in 2013, is that they were still producing nearly 90% of rated output. I can imagine after 100 years a majority of panels at an installation might still be putting out usable electricity. Even the ones not doing so contain useful materials –glass, aluminum, etc. and others in lesser amounts (even including gold) valuable for recycling purposes. In short, even at decommissioning, solar panels are an asset with significant monetary value—not something to be feared.

For a national perspective that compares solar panel disposal with other things that need disposing, again see the November 15, 2023 report from NREL found here:
https://www.nrel.gov/news/program/2023/photovoltaic-toxicity-and-waste-concerns-are-overblown-slowing-decarbonization.html

This contains the following diagram, which shows how the disposing of solar panel (photovoltaic PV module) waste compares to other disposal challenges.



Additional comment: Regarding disposing of toxic, mercury-containing, coal ash. My calculation suggests the Drake Cement plant in northern Yavapai County produces 33,600 tons of it every year (perhaps containing

nearly ten pounds of mercury.) Much of it is currently incoroprated in the finished cement product—something that could change as locally mined pozzolan is increasingly used as an additive. Burning coal, to produce the heat (to fire the kiln in cement-making) sends volatiles like mercury up the stack.

False claim #4: We can expect solar panels to be damaged by hailstones

My rebuttal: Solar panel specs typically say the panels can withstand being hit by hailstones of a certain size (golf ball?) traveling at a certain speed (100 mi/hr?) My research suggests 1) yes, panels covered with thinner glass protection have been thus damaged, 2) Arizona is much less prone to damaging hail than the USA Great Plains / Texas region. More importantly, Draconis / Light Source / BP engineers planning the solar project in Chino Valley tell me that state of the art solar farms (and their proposed project) employ sensors / equipment that will detect approaching dangerous thunderstorms and move panels out of harm's way.

False claim #5: Solar Panels Use Lots of Water

My rebuttal:
Other than a totally negligible amount that might be used to occasionally clean them in dusty areas, solar panels don't require any water. (In the decades I've been using them, I've never bothered doing this—I let the rain do it.) Yes, some water is used in mining the materials needed to manufacture them, but this is much less than for alternative ways of generating electricity. (see False Claim #6 below.) As far as water use associated with the sources of electricity supplying power to Arizona utility customers, Tucson-based energy analyst Russell Lowes put the water use associated with electricity used by a typical Arizona Public Service (APS) household at 359 gallons per month. If APS customers got 80 % of their electricity from renewables / solar—instead of just 15% as currently—he calculates that average household number drops to 83 gallons per month. This is a savings of 276 gallons per month or 77%. (I suspect this number could be much greater but haven't seen the details of Russell's calculation.)

Note: A related claim is that solar panels poison ground water. No way! The composition of rainwater falling on them runs off and—other than being a bit dirtier if dust on panels is washed off—is unchanged. Claims of solar installations poisoning ground water may involve accidents or fires at battery energy storage systems (BESS), not solar panels. (See False claim #11.)

False claim #6: Solar panels are associated with pollution. Solar power is dirty—that it is clean is another one of the lies spread by the solar energy industry.

My rebuttal: Of course there is some pollution and resource use associated with solar panel manufacture: no energy generation technology is completely without environmental impact. But compared to the alternatives—coal, natural gas, and uranium /nuclear—solar is clean and environmentally friendly. **We need electricity, so just where do these anti-solar (but supposedly pro-environment) folks and their "not-in-my-backyard" (NIMBY) allies expect it to come from?**

Below I consider the three alternatives listed above —associated with continuing "business as usual"…

Coal. Imagine 40 years of operation of two 500 megawatt power plants —one solar PV and one coal fired. My back of the envelope calculation suggests all the silicon in the former would weigh around 20,000 tons. Sounds like a lot, except when you realize that once that is in place you've got it for the whole FORTY YEARS lifetime of the installation. The "fuel"— supplied by the Sun—is free. In contrast the coal-fired power plant would use 20,000 tons of fuel in the form of coal (burned at 250 tons per hour) in the first roughly FOUR DAYS (80

hours) of
its operation—and keep using coal at the rate of 250 tons per hour for another 39 years and 361 days! Also associated with this 500 MW coal-fired power plant is the production of waste—including, after combustion, 2.5 million tons of coal ash. This contains, among other toxic substances, roughly 665 pounds of mercury. Note: roughly twice that amount—1330 pounds of mercury—is potentially released into the air by burning coal at this 500 MW power plant unless pollution control measures are taken to capture it.

Perhaps the more notorious environmental problem associated with coal —even worst than all the damage done by mining—is greenhouse gas (GHG) emission. Worldwide, coal-fired power plants emit 10 billion tons of carbon every year (roughly ¼ of all global emissions.)

Natural gas / methane. In focusing on carbon dioxide emissions, it is sometimes overlooked that methane (the chief component of natural gas) is a potent greenhouse gas. If methane leaks are taken into account, the Union of Concerned Scientists and others point out that the amount of GHG put into the atmosphere by natural gas related technology is as bad or worse than coal (in terms of tons GHG equivalent per MWh of electricity.) Besides that, associated with this technology are many other environmental / health problems— discussion of them would include water pollution /ground subsidence /earthquakes from fracking, explosions, toxic pollutants, water use, etc.

Nuclear power plants. We can build more of these as an alternative to solar PV /battery storage. Besides producing electricity costing (in $ / kWh) much more, doing this will add to a growing radioactive pile. This needs to be isolated from humans and the environment for tens of thousands of years. There is currently no long-term good way to do this, only temporary fixes. (Note: I could discuss the potential for reactor meltdown accidents or terrorist mischief.) It is thus laughable to me to focus on "The Waste-Management Issue of Utility-Scale Solar Facilities" (one section of the AZFPI article) —and ignore the radioactive waste at nuclear plants, like the Palo Verde plant west of Phoenix. Note: Palo Verde decommissioning is slated to begin in 2045. Contrary to what critics say, renewable energy (chiefly solar and wind) with storage (battery or pumped hydro) can replace the 3900 megawatts of "base load" power it provides.

False claim #7: Solar is subsidized by the government far more than fossil fuel.

My rebuttal: The AZFPI group claims something similar. The article on their website has a section "Social Costs of Utility-Scale Solar Facilities". It is very selective and employs narrow- minded economic thinking. In seemingly anti-solar / "axe to grind" fashion, it dwells on renewable energy subsidies and cites one narrowly-focused study from which one might conclude that government subsidies to the fossil fuel industry are small by comparison. It says nothing about the $ trillions dished out to oil & gas, and nuclear over many many decades. (A good starting point on resarching subsidies to nuclear would be googling "Price Anderson Act.")

A "big picture" look (from my 2022 book, *Choices We Make in the Global Village*) offers a different story: "You pay for climate change impacts in many ways—including higher insurance rates, higher product prices, and through higher taxes. Environmentalists have long claimed the taxpayer-funded US Defense budget is bloated by the need to protect US access to cheap Mideast oil. You similarly pay another "hidden cost" associated with burning fossil fuel: government subsidies to this industry."

"According to a June 15 2019 *Forbes* magazine report on a International Monetary Fund (IMF) study, the world spent $5.2 trillion in 2017 (representing 6.5% of that year's GDP) on subsidies to the coal, oil, and natural gas industry. The US figure of $649 billion represented an expenditure of roughly ten times more than what it spent on education. The IMF also concluded that reducing such subsidies "to create efficient fossil fuel pricing … would have lowered global carbon emissions by 28% and fossil fuel air pollution deaths by 46% and increased government revenue by 3.8% of GDP" based on 2015 data. Speaking of fossil fuel air pollution, a collaboration

of Harvard University, University of Birmingham, University of Leicester, and University College London scientists found this to be responsible for a staggering 8.7 million people globally dying in 2018—more deaths than from smoking and malaria combined."

Finally, I say: "We should be subsizing renewable energy. We should end fossil fuel subsidies.":

False claim #8: Solar Power is expensive and will increase our utility rates

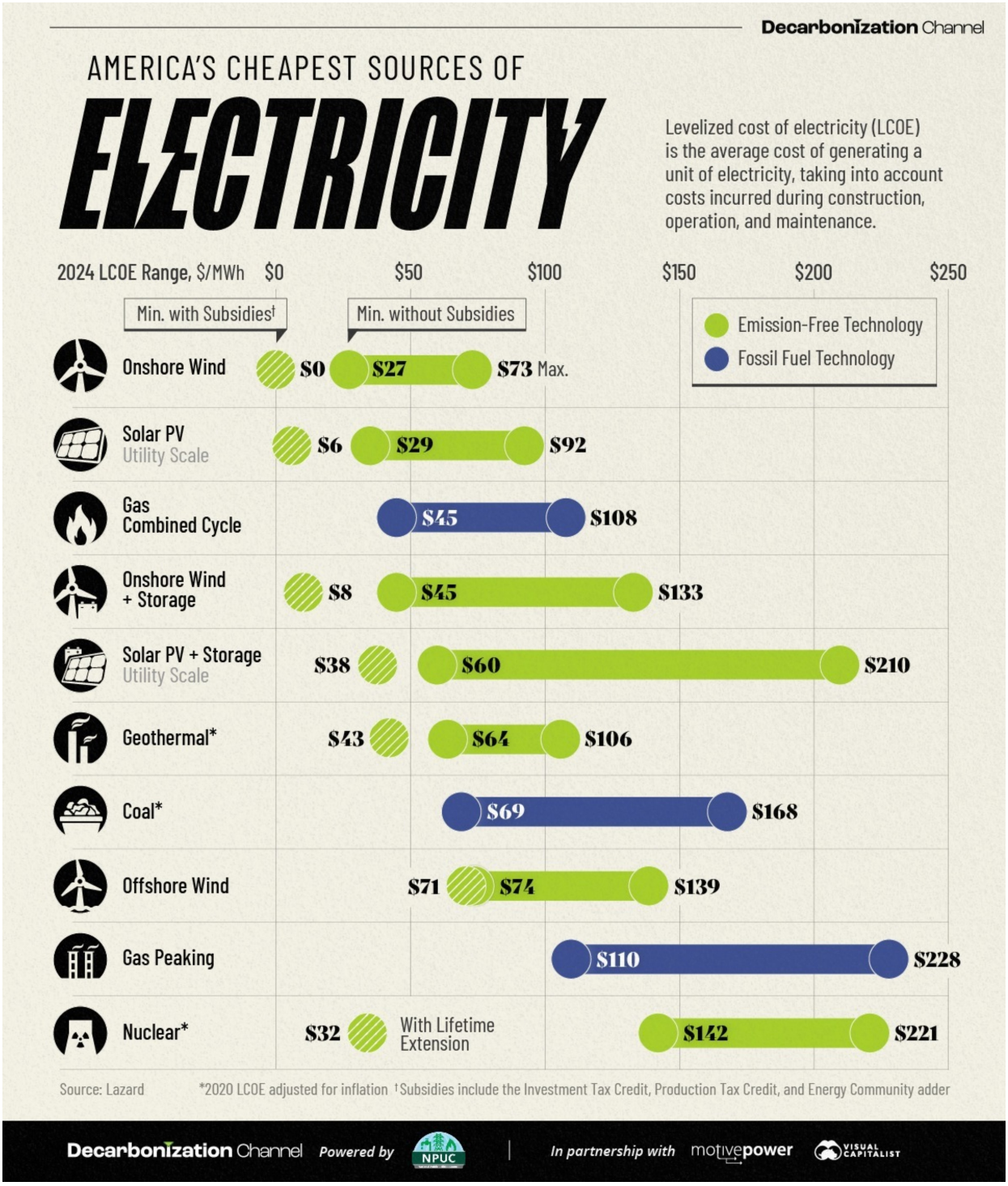
My rebuttal: Since I first started using them in 1980, solar panel costs have plunged by a factor of at least 100 in constant dollar (inflation adjusted terms.) Today, **solar power—especially in the sunny USA Southwest—is relatively cheap**. And could get cheaper…In its June 22 2024 special issue, *The Economist* projects solar to be "the largest source of electric power on the planet by the mid 2030s" and "less than half as expensive" as the cheapest electricity available today. By restricting solar development with its proposed Solar Facilities Zoning Ordinance, Yavapai County is turning its back on this economic boom—one that could bring more tax revenue, more jobs, and decreased pollution. It is also potentially costing consumers money.

In April 2022, the *Arizona Capital Times* reported: "New solar generated electricity paired with storage is selling electricity for between $15 and $25 per megawatt hour (MWh)" —[note: battery storage adds $20 to $30 per MWh to this]—"while electricity generated from natural gas plants has been selling anywhere between $45 and $73 per MWh." Natural gas-fired "peaker plant" electricity—which Arizona utilities have recently been turning to—is considerably more expensive. The 2024 chart, presented on the next page courtesy of the National Public Utilities Council, shows the ranges of levelized costs of various types of electricity throughout America.. Note solar in sunny Arizona is typically at the lowest (left) end of the cost ranges.

Arizona has abundant sunshine, but its utility ratepayers are not benefitting. Why not? I believe APS is partly responsible—along with those "foxes guarding the chicken coop" otherwise known as the Arizona Corporation Commission. If Arizona had Community Choice Energy (CCE) like a dozen or so other states, local municipalities could take control of where the electricity its citizens use comes from.

Specifically, I have urged Prescott General Plan writers to include this goal: "The City of Prescott needs to both help promote and be ready to take advantage of steps the Arizona Legislature takes to study first, then enable Community Choice Energy options**."** I agree with Diana Furchtgott-Roth who leads the Energy and Climate Program at the Heritage Foundation, a conservative think tank. She says, "Allow people to choose the least expensive electricity options that meet their needs." (Note, in the figure on the next page renewable, emission free sources of electricity are often the cheapest—especially in sunny Arizona.)

I add, "If environmental costs are factored in, we can't afford fossil fuel." The overwhelming scientific consensus tells us that —failing to rapidly ween ourselves from our addiction to fossil fuel burning and continuing business as usual—we can expect leaving our children and grandchildren a much warmer planet than the one we've lived on. Scientists agree that climate change impacts are here now, and —unless we act soon—they will only get worse.



False claim #9: Solar panels are ugly and people don't like seeing them.

My rebuttal: I suppose there are people who don't like seeing these sleek, modern-looking, high tech symbols of human technological prowess. Perhaps they would instead prefer seeing used car lots—or worse, junk car salvage yards? Or prefer having a high density subdivision, multi-story senior living facility, busy shopping mall, noisy race track or polluting industrial plant as neighbors, rather than a clean, quiet solar farm? Perhaps they are the same people who don't like seeing clothes hanging out to dry, and write rules for subdivision HOAs prohibiting clotheslines?

To me both solar panels and clotheslines are associated with not burning fossil fuel and are beautiful! Although

I have an electric dryer, I use it rarely (once a year?) I prefer hanging clothes in the sun to dry. This often gets me thinking of my grandkids' future, and thoughts like "I just spared the atmosphere about four pounds of carbon dioxide associated with the fossil fuel that could have been burned to make the 4 kWh my electric dryer would have used." This becomes a labor of love in thinking that I'm doing this as part of my individual effort in working for a more liveable planet for future generations."

False claim #10: Utility scale solar projects will hurt area farmers and ranchers.

My rebuttal: Not true. Solar projects can benefit farm and rangeland in several ways, including increasing biodiversity. Ranchers could economically benefit with a new stream of revenue from leasing land to solar utility developers—if planners will increase the County Solar Ordinance's 10,000 cumulative acre limit that otherwise slams shut economic opportunity doors that should remain open. The Ordinance seemingly encourages "agrivoltaics"—the practice of getting both agricultural production and electricity production out of the same piece of land. The most relevant example of this locally would be using grazing sheep to control unwanted vegetation around solar panel arrays—instead of manual or herbicide treatment. Certainly replacing herbicide use with grazing sheep is an environmental advantage. Another one: solar panels provide shade and reduce evaporation / soil drying out mitigating soil erosion.

False claim #11: At utility-scale solar installations with battery energy storage systems (BESS,) the incidence of battery fires is increasing. Battery fires emit toxic fumes and pose a risk to the community and surrounding environment.

My rebuttal: These fires are extremely rare and studies have found no deaths or environmental pollution. Energy storage battery fires are decreasing as a percentage of deployments, according to the American Clean Power Association (see "Claims vs. Facts: Energy Storage Safety" https://cleanpower.org/resources/claims-vs-facts-energy-storage-leading-on-safety/) They add "Past incidents demonstrate that fires are contained within the facility, and air quality in neighboring areas remains at safe levels.

Since the above was written, the January 2025 fire at the Moss Landing, California battery facility / warehouse has made news. Sloppy practices—installation of an air vent upside down and stacking of batteries—contributed to this. The batteries involved (lithium-ion with cathodes made of nickel-manganese-cobalt) have several disadvantages (one being potential for heavy metal soil pollution which was found in the aftermath of the Moss Landing facility.) The newest utility scale solar / BESS installations with lithium ion batteries no longer use the NMC cathodes them— they have been replaced with iron-phosphate ones.

I believe the safest—and perhaps the simplest—course for jurisdictions to follow in drafting related ordinances is to require utility-scale solar project BESS facilities follow the National Fire Protection Association guidelines (NFPA) as to setbacks, buffers and other stipulations in the latest edition of NFPA section 855 according to type (lithium, etc,) size (in MWh,) etc.

False claim #12: Utility Scale Solar installations kill birds.

My rebuttal: Audubon Society is the world's foremost science-based group supporting birds. As to the above claim, here is some of what you'll find on their website (https://www.audubon.org/news/solar-power-and-birds)

"Audubon strongly supports properly sited photovoltaic solar power."

False claim #13: The glare from solar panels is dangerous. Even looking at them can damage eye retinas.

My rebuttal: The above claim is false, but like many conspiracy theories it builds on a grain of truth: glare from solar panels can complicate landing airplanes. That concern is addressed in "Research and Analysis Demonstrate the Lack of Impacts of Glare from Photovoltaic Modules" on the National Renewable Energy Lab (nrel.gov) website. It states, "PV modules exhibit less glare than windows and water. Solar PV modules are specifically designed to reduce reflection, as any reflected light cannot be converted into electricity. PV modules have been installed without incident at many airports."

Glare can be a problem, but... It does not last very long given that as the Earth turns the Sun moves. Given glare is from reflected light, governed by basic physics Law of Reflection (reflected angle = incident angle, where these are measured with respect to the normal (perpendicular) to the surface), the Sun's movement in minutes will soon dissipate annoying glare seen by a fixed observer.

If the observer does not want to wait, then he or she can move slightly to where glare is not visible. Or they can simply not look. Solar PV is not perfect, but alternatives are much worse. For comparison, those down-wind from a coal or gas fired power plant don't have these options—and the air pollution they breathe causes big, well-documented health problems.

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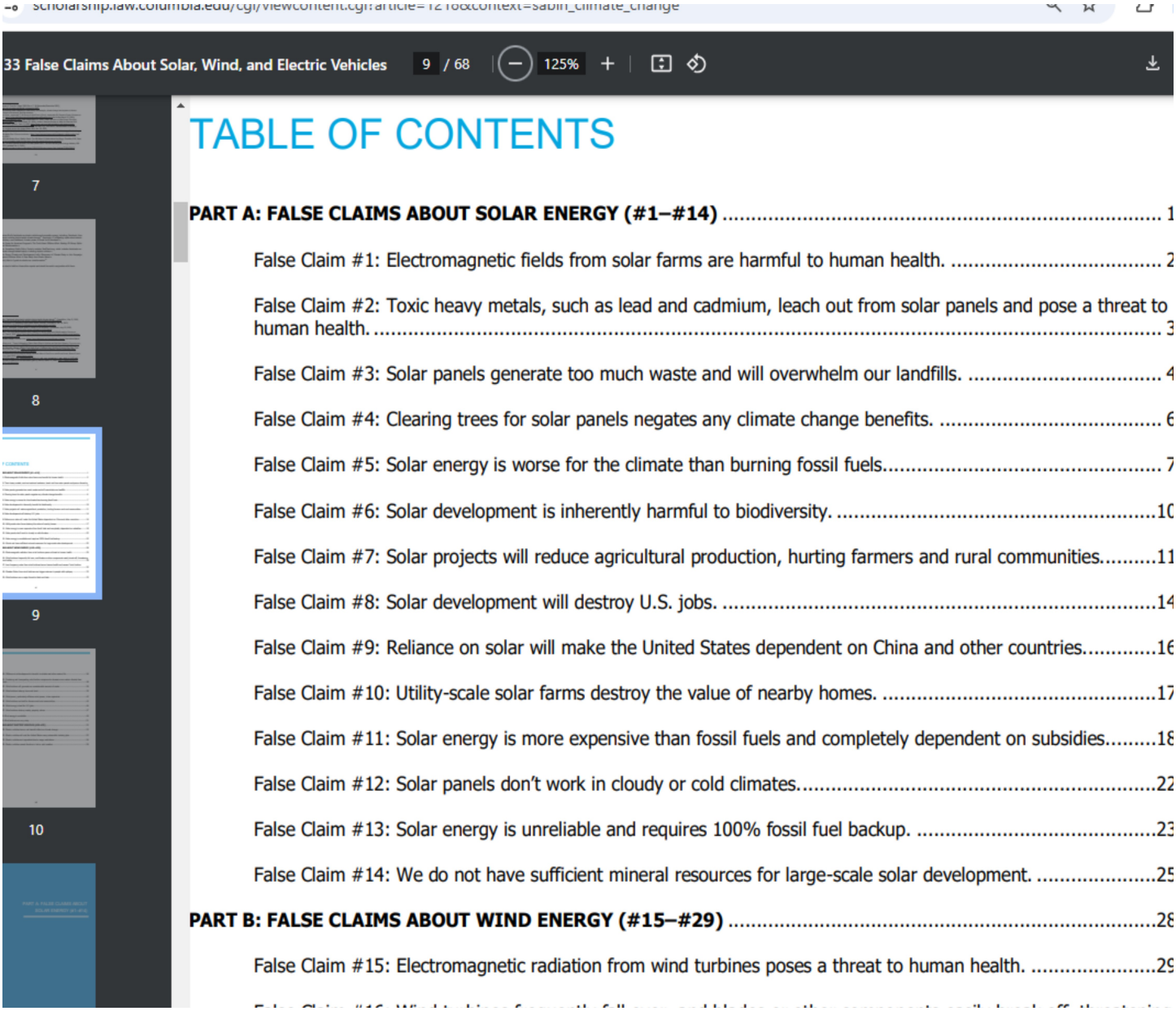
Many additional claims have been made by anti-solar utility scale projects and their NIMBY allies. Many of them could surface here in Yavapai County— and may already have—I simply have yet to hear them raised. (Note: I attended three public meetings — July 3 BOS , August 8 P &Z , and September 4 BOS.) **Example: Electromagnetic fields from solar farms are harmful to human health**—this is #1 in the table on the next page.)

My rebuttal:
Anti-solar folks—some fans of baseless conspiracy theories, some right-wing extremists, some supported by the fossil fuel industry—are increasingly fighting utility-scale solar installations throughout America with false claims. In this regard you may want to read:
a) the *NPR* story "Activists spread misleading information to fight solar" (from March 2023)
https://www.npr.org/2023/03/16/1164050912/activists-spread-misleading-information-to-fight-solar
and
b) the Columbia University / Sabin Center for Climate Change Law / 68 page report
(from April 2024) "Rebutting 33 False Claims About Solar wind and electric vehicles"
https://scholarship.law.columbia.edu/sabin_climate_change/217/

Here is an excerpt from the beginninmg of this report::



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Related Bio / Contact Info:

Prescott resident **Stephen P. Cook** is a phi beta kappa graduate of UCLA and holds an M.S. in physics degree from that university. Before becoming a professor at Arkansas Tech University, he was a pioneer in residential use of both solar and wind-generated electricity, directed a photovoltaic demonstration project at North Arkansas Community College, worked as energy educator, solar engineering consultant, and ran nationally recognized business compuSOLAR. He is founder / Managing Director of educational non-profit *Project Worldview*, writes the "Science Works" column for the Prescott *Daily Courier* and serves as Vice Chair of the Yavapai Group of the Grand Canyon Chapter of the Sierra Club.

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Note: **the author wishes to thank Gary Beverly** for reading a draft of this article and making helpful

suggestions. Nonetheless the author is responsible for any errors in this document.