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Dark Side To Solar? More Reports Tie Panel Production To Toxic Pollution

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A major new study of the economics of solar, published in Harvard Business Review, finds that the ... [+] GETTY

Three years ago I published a column at *Forbes* arguing that solar panels weren't clean but in fact produced 300 times more toxic waste than high-

level nuclear waste. But in contrast to nuclear waste, which is safely stored and never hurts anyone, solar panel waste risks exposing poor trash-pickers in sub-Saharan Africa. The reason was because it was so much cheaper to make new solar panels from raw materials than to recycle them, and would remain that way, given labor and energy costs.

My reporting was near-universally denounced. The most influential financial analyst of the solar industry called my article, "a fine example of 'prove RE [renewable energy] is terrible by linking lots of reports which don't actually support your point but do show that the RE industry in the West considers and documents its limited impacts extremely thoroughly.'" An energy analyst who is both pro-nuclear and pro-solar analyst agreed with her, saying "I looked into this waste issue in the past and concur with [her]."

The Guardian UG +1.1% said solar panel waste was a "somewhat ironic concern from [me], a proponent of nuclear power, which has a rather bigger toxic waste problem" adding that "broken panels... are relatively rare except perhaps in the wake of a natural disaster like a hurricane or earthquake."

But when reporters eventually looked into the issue they came to the same conclusions I had. In 2019, *The New York Times* NYT +1.6% published a long article about toxic old solar panels and batteries causing "harm to people who scavenge recyclable materials by hand" in poor African communities. In 2020, *Discover* DISCA +2.3% magazineconfirmed that "it is often cheaper to discard them in landfills or send them to developing countries. As solar panels sit in dumps, the toxic metals they contain can leach out into the environment and possibly pose a public health hazard if they get into the groundwater supply."

Still, each of those articles stressed that some solar panels were already being recycled, and that more of them one day would be, which was what many of my original critics had pointed out. "The European Union requires

solar companies to collect and recycle their panels," noted *Discover*, "with the cost of recycling built into the selling price." The solar analyst who accused me of making unsubstantiated claims said the reason "there are few solar panels being recycled to date [is] because most of them are still working fine."

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But a major new study of the economics of solar, published in *Harvard Business Review* (HBR), finds that the waste produced by solar panels will make electricity from solar panels four times more expensive than the world's leading energy analysts thought. "The economics of solar," write Atalay Atasu and Luk N. Van Wassenhove of Institut Européen d'Administration des Affaires, one of Europe's leading business schools, and Serasu Duranof the University of Calgary, will "darken quickly as the industry sinks under the weight of its own trash."

Solar's Dark Side

The problem is the sheer quantity of the hazardous waste, which far exceeds the waste produced by ... [+] AFP VIA GETTY IMAGES

Conventional wisdom today holds that the world will quadruple the number of solar panels in the world over the next decade. “And that’s not even taking into consideration the further impact of possible new regulations and incentives launched by the green-friendly Biden administration,” Atasu, Wassenhove, and Duran write in *HBR*.

But the volume of solar panel waste will destroy the economics of solar even with the subsidies, they say. "By 2035,” write the three economists, “discarded panels would outweigh new units sold by 2.56 times. In turn, this would catapult the LCOE (levelized cost of energy, a measure of the overall cost of an energy-producing asset over its lifetime) to four times the current projection.”

The solar industry, and even supposedly neutral energy agencies, grossly underestimated how much waste solar panels would produce.
The *HBR* authors, all of whom are business school professors, looked at the economics from the point of view of the customer, and past trends, and calculated that customers would replace panels far sooner than every 30 years, as the industry assumes.

"If early replacements occur as predicted by our statistical model," they write, solar panels "can produce 50 times more waste in just four years than [International Renewable Energy Agency] IRENA anticipates."

The *HBR* authors found that the price of panels, the amount solar panel owners are paid by the local electric company, and sunlight-to-electricity efficiency determined how quickly people replaced their panels.

"Alarming as they are," they write, "these stats may not do full justice to the crisis, as our analysis is restricted to residential installations. With commercial and industrial panels added to the picture, the scale of replacements could be much, much larger."

What about recycling? It's not worth the expense, note the *HBR* authors. "While panels contain small amounts of valuable materials such as silver, they are mostly made of glass, an extremely low-value material," they note. As a result, it costs 10 to 30 times more to recycle than to send panels to the landfill.

The problem is the sheer quantity of the hazardous waste, which far exceeds the waste produced by iPhones, laptops, and other electronics. The volume of waste expected from the solar industry, found a team of Indian researchers in 2020, was far higher than from other electronics.

"The totality of these unforeseen costs could crush industry competitiveness," conclude the *HBR* authors. "If we plot future installations according to a logistic growth curve capped at 700 GW by 2050 (NREL's estimated ceiling for the U.S. residential market) alongside the early replacement curve, we see the volume of waste surpassing that of new installations by the year 2031."

It's not just solar. "The same problem is looming for other renewable-energy technologies," they write. For example, barring a major increase in processing capability, experts expect that more than 720,000 tons worth of

gargantuan wind turbine blades will end up in U.S. landfills over the next 20 years. According to prevailing estimates, only five percent of electric-vehicle batteries are currently recycled – a lag that automakers are racing to rectify as sales figures for electric cars continue to rise as much as 40% year-on-year."

But the toxic nature of solar panels makes their environmental impacts worse than just the quantity of waste. Solar panels are delicate and break easily. When they do, they instantly become hazardous, and classified as such, due to their heavy metal contents. Hence, they are classified as hazardous waste. The authors note that this classification carries with it a string of expensive restrictions — hazardous waste can only be transported at designated times and via select routes, etc."

Beyond the shocking nature of the finding itself is what it says about the integrity and credibility of IRENA, the International Renewable Energy Agency. It is an intergovernmental organization like the Intergovernmental Panel on Climate Change, funded by taxpayers from the developed nations of Europe, North America, and Asia, and expected to provide objective information. Instead, it employed unrealistic assumptions to produce results more supportive of solar panels.

IRENA acted like an industry association rather than as a public interest one. IRENA, noted the HBR reporters, "describes a billion-dollar opportunity for recapture of valuable materials rather than a dire threat." IRENA almost certainly knew better. For decades, consumers in Germany, California, Japan and other major member nations of IRENA, have been replacing solar panels just 10 or 15 years old. But IRENA hadn't even modeled solar panel replacements in those time frames.

IRENA wasn't the only organization that put out rose-tinted forecasts to greenwash solar. For years, the solar industry and its spokespersons have claimed that panels only "degrade" — reduce how much electricity they produce — at a rate of 0.5% per year.

But new research finds that solar panels in use degrade twice as fast as the industry claimed. And that report came on the heels of a separate report which found that solar panels have been suffering a rising failure rate even before entering service. “One in three manufacturers experienced safety failures relating to junction box defects, an increase from one in five last year,” noted an industry reporter. The “majority of failures were prior to testing, straight from the box.”

Blinded by the Light

Love of solar panels blinded people to its dark side. GETTY

Dealing with the problem requires that government regulators clamp down on solar. “A first step to forestalling disaster,” write the *HBR* authors, “may be for solar panel producers to start lobbying for similar legislation in the United States immediately, instead of waiting for solar panels to start clogging landfills.”

But that’s unlikely since such legislation would significantly increase the cost of solar, and thin profit margins mean that many solar companies

would likely go bankrupt. The result is a self-reinforcing feedback loop. “If legislation comes too late, the remaining players may be forced to deal with the expensive mess that erstwhile Chinese producers left behind.”

As such, taxpayers will likely have to subsidize the clean up of solar panel waste. “Government subsidies are probably the only way to quickly develop capacity commensurate with the magnitude of the looming waste problem,” they write.

None of this means there’s no role whatsoever for solar panels, nor that they are not ingenious machines. Like many others I have long been filled by a sense of wonder in how they convert sunlight, photons, into electrons, and I have solar panels in my backyard. Solar panels power satellites. And they can be an important way to generate electricity in off-grid areas.

But solar panels cannot be a primary energy source like nuclear, natural gas, or coal, for inherently physical reasons relating to the unreliable and dilute nature of their “fuel,” sunlight. Low power densities *must*, for inherently physical reasons, induce higher material intensity and spatial requirements, and thus higher physical costs.

Even as the cost of solar panels has come down, the cost of producing reliable grid electricity with solar panels has risen, due to their weather-dependent nature, something that became evident in 2018, was recognized by University of Chicago economists in 2019, and was further supported by spiraling costs in renewables-heavy Germany and California in 2020.

The new research on the coming solar waste crisis, along with rising blackouts from renewables, reinforces the inherent flaws in solar and other forms of renewable energy. Over-relying on solar panels, and underestimating the need for nuclear and natural gas, resulted in California’s blackouts last summer. It’s now clear that China made solar appear cheap with coal, subsidies, and forced labor. And in the U.S., we pay

one-quarter of solar's costs through taxes and often much more in subsidies at the state and local level.

And none of this even addresses the biggest threat facing solar power today, which are revelations that perhaps both key raw materials and the panels themselves are being made by forced labor in Xinjiang province in China.

The subsidies that China gave solar panel makers had a purpose beyond bankrupting solar companies in the U.S. and Europe. The subsidies also enticed solar panel makers to participate in the repression of the Uyghur Muslim population, including using tactics that the US and German governments have called "genocide."

Today, many companies, including Facebook, Google GOOG +1.9%, and Microsoft MSFT +1%, buy immense quantities of solar panels with no awareness of their impact. "I tried to bring up this issue [of solar waste] when I worked at Microsoft," said a former employee. "I was told 'That's not the problem we're trying to solve.'"

The *Guardian* reporter claimed, "it's valid to note that end-of-life solar panel recycling and disposal is an issue that we'll have to address smartly, but unlike climate change, it's not a big or urgent concern," but the *Harvard Business Review* study shows that this was never the case.

The idea that humankind should turn our gaze away from urgent problems like genocide, toxic waste, and land use impacts because they complicate longer-term concerns is precisely the kind of unsustainable thinking that allowed the world to become dependent on toxic solar genocide panels in the first place.

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