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Solar Panel Waste: A Disposal Problem

Charles Rotter / December 23, 2018

[From Canada Free Press](#)

Solar photovoltaic energy is not as environmentally conscious a choice as many think it is

Solar Panel Waste: A Disposal Problem



By [Jack Dini](#) — [Bio and Archives](#) — *December 7, 2018*

[Global Warming-Energy-Environment](#) |

The last few years have seen growing concern over what happens to solar panels at the end of their life. Consider the following statements:

– The problem of solar panel disposal will explode with full force in two or three decades and wreck the environment because it is a huge amount of waste which is not easy to recycle.¹

– Solar panels create 300 times more toxic waste per unit of energy than do nuclear power plants. If solar and nuclear produce the same amount of electricity over the next 25 years that nuclear produced in 2016, and the wastes are stacked on football fields, the nuclear

waste would reach the height of the Leaning Tower of Pisa (53 meters), while the solar waste would reach the height of two Mt. Everests (16 km).²

– Contrary to previous assumptions, pollutants such as lead or carcinogenic cadmium can be almost completely washed out of the fragments of solar modules over a period of several months by rain water.¹

– In countries like China, India, and Ghana, people living near e-waste dumps often burn the waste in order to salvage the valuable copper wires for resale. Since this process requires burning off plastic, the resulting smoke contains toxic fumes that are carcinogenic and teratogenic (birth-defect causing) when inhaled.²

Solar photovoltaic panels, whose operating life is 20 to 30 years, lose productivity over time. The International Renewable Energy Agency estimated that there were about 250,000 metric tons of solar panel waste in the world at the end of 2016 and that this figure would definitely increase. Solar panels contain lead, cadmium, and other toxic chemicals that cannot be removed without breaking apart the entire panel.³

In November 2016, Japan's Environment Ministry issued a warning that the amount of solar panel waste Japan produces each year is likely to increase from 10,000 to 800,000 tons by 2040, and the country has no plan for safely disposing of it.⁴ A recent report found that it would take 19 years for Toshiba Environmental Solutions to finish recycling all of the solar waste Japan produced by 2020. By 2034, the annual waste production will be 70 to 80 times larger than that of 2020.⁵

China has more solar power plants than any other country, operating roughly twice as many solar panels as the United States and also has no plan for the disposal of the old panels. In China, there could be 20 million metric tons of solar panel waste, or 2,000 times the weight of the Eiffel Tower by 2050.⁴

California, another world leader in deploying solar panels, likewise has no plan for disposal, despite its boast of environmental consciousness. Only Europe requires solar panel manufacturers to collect and dispose of solar waste at the end of their useful lives.

Another issue: according to federal data, building solar panels significantly increases emissions of nitrogen trifluoride (NF₃), which is 17,200 times more potent than carbon dioxide as a greenhouse gas over a 100 year time period. NF₃ emissions increased by 1,057 percent over the last 25 years. In comparison, US carbon dioxide emissions only increased by about 5 percent during that same time period.⁴

While disposal of solar panels has taken place in regular landfills, it is not recommended because the modules can break and toxic materials can leach into the soil, causing problems with drinking water. Solar panels can be recycled but the cost of recycling is generally more than the economic value of the material recovered. Used panels are also

sold to developing world countries that want to purchase them inexpensively despite their reduced ability to produce energy.³

Washington State is the only US state that requires the manufacture to develop a recycle plan, but the state requirement does not address the cost of recycling. Adding a fee to the cost of solar panels would help ensure that the disposal issue is addressed in the event the manufacturer goes bankrupt. Since 2016, Sungevity, Beamreach, Verengo Solar, SunEdison, Yingli Green Energy, Solar World and Suniva have gone bankrupt. The result of such bankruptcies is that the cost of managing or recycling PV waste will be born by the public.¹

Colorado-based Abound Solar that got hundreds of millions of dollars in federal loan guarantees before going belly-up and didn't just empty taxpayers wallets, it left behind a toxic mess of carcinogens, broken glass, and contaminated water. A Northern Colorado Business Report estimates it will cost up to \$3.7 million to clean and repair the building so it can again be leased.⁶

A multi-year effort by federal, state and local agencies to prop up an Oregon solar panel manufacturer (SoloPower) has ended in a shuttered factory, millions of tax payers dollars down the drain, and a heavily polluted manufacturing site. Although the county had the legal right to seize the plant's equipment for delinquent taxes, it was unlikely to do so because the plant was heavily polluted with cadmium and hydrochloric acid. Cleaning up the plant is estimated to cost more than \$500,000.⁷

Natural events such as storms, tornadoes, hurricanes, earthquakes, etc., can cause damage to the panels. For example, in 2015, a tornado broke 200,000 solar modules at southern California's solar firm Desert Sunlight. More recently, the second largest solar farm in Puerto Rico, generating 40 percent of the island's electricity, was severely damaged during a hurricane. With 100,000 pounds of cadmium contained in 1.8 million solar panels calculated for a proposed 6,350 acre solar farm in Virginia, any breakage is a cause for concern. Further, even rain water has been found to flush out cadmium within an intact solar panel.³

While nuclear units can easily operate 50 or 60 years, solar panels have relatively short operational lifespans (20 to 30 years), so their disposal will become a problem in the next few decades. While nuclear waste is contained in heavy drums and regularly monitored, very little has been done to deal with solar waste. Solar waste outside of Europe tends to end up in a large stream of electronic waste.⁴

Conclusion- Solar photovoltaic energy is not as environmentally conscious a choice as many think it is. Besides being an intermittent source of energy and more expensive than traditional technologies, it has serious waste disposal issues that few countries are tackling. The hazardous materials used in their construction are not easy to recycle and can contaminate drinking water.⁴

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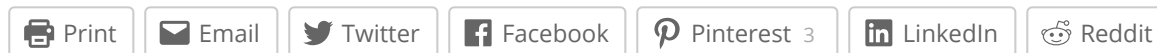


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141 thoughts on “Solar Panel Waste: A Disposal Problem”

Greg December 23, 2018 at 10:10 pm

Most of the components of solar panels can be recycled. Metal, glass, and wiring can all be recycled and reused. Specialty recycling companies are able to reuse silicon cells by melting them down and reclaiming the silicon and various metals.

Stephen Wilde December 23, 2018 at 10:16 pm

The point was that the cost of recycling is not financially viable.

Greg December 23, 2018 at 10:40 pm

Doesn't need to be.

Greg December 23, 2018 at 10:45 pm

I doubt ANY recycling is financially viable.

As you know, it's done for other reasons.

Craig from Oz December 23, 2018 at 11:06 pm

Are you playing with words here, Greg, or do you honestly believe that?

In many cases materials are financially viable to recover. This is why salvage companies exist.

In many other cases materials are recycled to make people feel better. This is why Green Votes exist.

It's not a binary world with one size fits all answers, but as a rule of thumb, if private industry has not evolved to fill a market, than that marker doesn't exist.

Alan Tomalty December 23, 2018 at 11:10 pm

Another huge cost that has not been taken into consideration for the Life cycle costs of the green industry. The green industry is a net drain on society.

Mr. December 23, 2018 at 10:48 pm

“Doesn’t need to be.”
Because the gubmint will meet the cost?

old white guy December 24, 2018 at 5:29 am

It sure as hell does.

Karlos51 December 24, 2018 at 6:25 am

I don’t understand that, the idea that recycling doesn’t have to be efficient.

recycling metallic aluminum is cheaper than mining new stuff, same with copper. It retains it value so for little expense and energy recovering waste and reprocessing it you get a good return. These things make sense and are viable. Recycling glass is not, the energy required to reprocess it costs more than it saves –

– this means more work must be done, more resources consumed and if less is gained it becomes a cost, it would be better to do nothing than to recycle it if the goal is to reduce total wastage as any handling beyond the profit point is throwing wealth and effort away.

OK sure there’s times when spending money to do a thing need not have a positive return, so collecting sewage or horse dung from the streets has a tangible benefit which may be difficult to calculate but the benefits are clear. Same with say eliminating hookworm from a population or treating iodine deficiency – the benefits outweigh the costs..

But I cannot see the rationale of how, for the purported goal of saving the world, or recycling just because.. reprocessing things at any cost can be of benefit.

Why not take it to it’s full extreme and see how it pans out IF reprocessing is totally good – a machine stamps out circuit boards for cheap electronic goods, robots place components, solders, constructs products which are shipped out and eventually break. Say like the Chinese a DVD player that can be bought in Oz for \$8. It serves it’s purpose and goes in landfil once it

is no longer needed after valuable metals are roughly salvaged (the ones that earn the \$) and the metal and plastic cases are pried off and reprocessed

Sure if labor is cheap repairs can be made and if it's profitable the item now refurbished can be resold and there's a net gain to the repairer.

Now go downstream and imagine recycling for recycling's sake because most of those myriad little components are still functional.. Don't be wasteful and grind everything down "because it's easier", this is about saving stuff after all – employ people to sit and go through all those diverse devices, carefully disassembling them, spending hours desoldering parts that the robot put on in a second. Recover the circuit boards and spend idiotic amounts of time identifying, testing and sorting those parts. (Hell, back in the '70's we interested in electronics happily pulled components for reuse because they were expensive and it gave us a good return for our efforts!) Since freshly manufactured they cost cents for hundreds of the things, these will be near zero value but hey – give them away if you can find someone prepared to risk potential failure.

You've gained no profit for all this, you still have to pay your workers for their time so they could feed and house themselves, time they could have spent actually making something that could be of value is gone forever as they diddle about over busted diodes.. the factory you built, the energy consumed de-soldering and driving screws and lighting and testing .. the storage facilities..

In actual fact this actually happens in places where labor is extremely cheap, On more than a few occasions re-used components have been found in electronic items, clearly somewhere there are individuals or groups who can make a profit above subsistence in recovering bits, but it is a cottage industry and does not scale otherwise we'd be seeing it.

what is gained? We've used as much if not more energy and time than was used in the original creation of the stuff and we're still spending more for nothing. All that time and energy is gone for good for nothing.

There's a reason individual folk make the decision to throw things out. "Hm, shall I spend \$100 repairing my \$8 DVD player or should I bin it and buy another?" They weigh the costs to themselves and make an educated decision. Often it's the right one.

If something like solar cells produce waste that must be cleaned due to toxic end products then the user of these things can't just foist the problem onto all of society by being permitted to just lob it into the waste stream. That's be like letting the dry cleaner profit from his solvents before dumping them in the river when they're no longer of use.

If recycling is being done not just for the sake of it but to eliminate a hazard then the user need be held accountable. If say a realistic tax or a waste

reprocessing fee was slapped atop the product that was fair and did the job of covering costs it'd soon be clear to consumers of the product whether the thing was viable or not. If the goal is "free" electricity and the cost of reprocessing was more than the savings, non-stupid people would conclude nope, not worth it and would drop solar cells like hot potatoes.

As it stands our Great Leaders have ignored the hazards and forgiven the polluters and shifted the costs to all of society just as if they'd permitted their mate who owned a mine to dump their leaching chemicals into the town water supply.

So maybe we need not think of this as a general recycling issue but more from that perspective and take it from there.

(damned hot in Perth at the moment, so i'm not sure if this is coherent or not or whether my brain melt is making it sound more sensible than it seems to me)

Juan Slayton December 24, 2018 at 8:06 am

Whether recycling is economic depends on how economically desperate you are. In Venezuela today there are people repairing damaged light bulbs:

<https://www.bloomberg.com/news/features/2018-10-15/venezuela-s-meltdown-creates-a-nation-of-desperate-capitalists>

A huge waste of human resources but a natural outcome of governmentally planned economy.

AWG December 24, 2018 at 1:34 pm

(sigh)

You folks are forgetting one very important thing. The Generation that is demanding this is the same Generation that isn't going to be around to pay for it or have to deal with the waste.

So the Boomers and older Gen 'X' ers are raking in huge money on the gullibility of their own generations plus the Mills and to some extent Generation Z. The cost of all of this foolishness is in the form of bonds, treasury bills, future inflation, lost opportunity, baked in high costs and taxes, and other deferred debt.

A score or so of years later, many Boomers are gone, Gen 'X' has cashed out and is leaving the debt and the mess to the Mills and Gen Z who are stupid enough to beg for more of this.

The Gift that keep on Giving – just like Pension debts are the previous generation's way of getting their spawn to pay discount prices on things the market would otherwise never offer.

Sam Pyeatte December 25, 2018 at 11:10 pm

When faced with the multitude of problems with much of the recycling, it is preferable to simply crush up and bury the stuff in the dark of night. There are certain things we have done well for decades like crushing old automobiles and sending them to the smelter to reclaim the metals...along with the occasional body stuffed in the trunk.

MarkW December 24, 2018 at 12:23 pm

Yet another reason why solar power is a really bad idea.

commieBob December 24, 2018 at 1:05 am

The financial cost is an indication of required inputs. One of the inputs, maybe the major one, required to recycle photovoltaic panels is energy.

One of the problems with photovoltaics is that they require a huge amount of energy to manufacture. [This article](#) points out that they require almost as much energy to manufacture as they will eventually produce.

If you add the energy required to recycle them to the energy required to manufacture them in the first place, you are likely to get back to the situation that photovoltaic panels are a net loss of energy. In other words, they are not sustainable.

Imagine having to use all the energy produced by all the solar panels to manufacture their own replacements. When you translate that into dollars, it is obvious that photovoltaics are not financially viable as a major source of energy.

There is a use case for solar panels where other sources of electricity have large associated costs. One example is parking meters where the alternatives are to run wires or replace batteries on a regular basis. In that case, solar is the clear winner. Many such cases do exist, mostly where not much electricity is required. As a major source of energy, on the other hand, they are a clear loser.

Rocky December 24, 2018 at 5:45 am

Unfortunately, the use of solar panels almost always requires the use of batteries as well. Although the lifespan of the batteries is reasonable they still need regular replacement. Those cheap solar garden lights are a good example. They seldom last more than a year or two and must already comprise a sizable proportion of landfilled contaminants.

Alastair McIntosh December 24, 2018 at 6:10 am

” they require almost as much energy to manufacture as they will eventually produce.”

Not according to the U.S. DOE.

<https://www.nrel.gov/docs/fy04osti/35489.pdf>

Their National Renewable Energy Lab reports payback estimates for rooftop PV systems at 4, 3, 2, and 1 years: 4 years for systems using current multicrystalline-silicon PV modules, 3 years for current thin-film modules, 2 years for anticipated multicrystalline modules, and 1 year for anticipated thin-film modules.

m December 24, 2018 at 8:24 am

”payback estimates for rooftop PV systems at 4, 3, 2, and 1 years...”
Pure BS.

ScottyB December 24, 2018 at 8:41 am

Except the estimate used to calculate that energy payback value is simply a combination of the average solar energy density of the US (stupid since a solar panel in northern Wisconsin has had less available energy than southern California), an efficiency factor (12%), and the average panel wattage.

Of course, this is farfetched as those doesn't account for average sunny days, partially cloudy days, dusty/snowy/dirty panels, etc. In other words, they're basically spitballing to make them seem better than they are.

In reality, the energy payback in the average case is probably at least half the life of the panel and that's ONLY if you exclude the energy required to recycle that dirty panel and as soon as you do that, it's a complete set loss and no one should ever use them.

commieBob December 24, 2018 at 10:55 am

Two words stand out in the link you provide: 'model' and 'anticipated'.

Renewable energy requires scientific breakthroughs, not just incremental improvements. Breakthroughs don't happen on demand. In fact, trying to manage breakthroughs is almost an ironclad guarantee that they won't happen.

MarkW December 24, 2018 at 12:26 pm

Even if it were true, that's only for the cell itself. It doesn't include the containment for the cell, nor does it include the material used to make the panel itself, nor the materials needed to mount the panel.

mario lento December 24, 2018 at 1:02 pm

Nor does it include the subsidies or externality costs of raising prices for other people through FIT and other costs to the utility that are passed onto consumers.

Cliff Hilton December 24, 2018 at 7:08 pm

“Their National Renewable Energy Lab reports payback estimates for rooftop PV systems at 4, 3, 2, and 1 years: 4 years for systems using current multicrystalline-silicon PV modules, 3 years for current thin-film modules, 2 years for anticipated multicrystalline modules, and 1 year for anticipated thin-film modules.”

Alastair McIntosh

I spend an average \$47.86 for my total electric bill (home) here in Texas. That's \$574.32 in Texas dollars per year. Tell me I can get my installation cost returned to me in any of the above systems.

Cliff

Tom Abbott December 24, 2018 at 6:59 am

“As a major source of energy, on the other hand, they are a clear loser.”

A *clear* loser is exactly right. The Greens/Alarmists are barking up the wrong tree in their pursuit of solar power as an alternative to fossil fuels.

There is a viable alternative to fossil fuels, nuclear powerplants. When considering the problems solar panels are going to create, nuclear power and its minor problems are looking pretty good.

Solar and windmills are a deadend for powering the world. We will all be better off when the Greens/Alarmists finally figure this out and stop trying to force this ignorance on humanity.

Rich Davis December 24, 2018 at 9:54 am

As Greg might say, it doesn't matter. The purpose is not to create a sustainable source of power. The purpose is to build a totalitarian socialist society by controlling every aspect of life that requires energy. Once socialism is in place worldwide, with no recourse, then we will surely burn high sulfur coal and use dangerous Soviet-era nuclear power plant designs to provide riches for the elite.

Solar panels and windmills are something like religious paintings and statues in baroque cathedrals. They are objects of religious devotion for the unwashed masses. There are other sacramental devotions as well, such as recycling glass bottles or mixed streams of plastics, or newsprint. These are also not sustainable, but they elevate the spirit of the devotees of the green religion. The sense of sacrifice helps mold them into obedient serfs in the new world order. It raises their self-esteem by making them believe that they are the sort of person who does the right thing for the earth goddess and doesn't complain about the lack of material wealth in their lives.

The day will come, if it is not here already, when such blasphemy as this will be severely punished.

Alastair McIntosh December 24, 2018 at 12:59 pm

My earlier post referred to a report from 2004. A recent report shows better results:

<https://www.ise.fraunhofer.de/content/dam/ise/de/documents/publications/studies/Photovoltaics-Report.pdf>

Executive Summary – Energy Payback Time

- Material usage for silicon cells has been reduced significantly during the last 13 years from around 16 g/Wp to about 4 g/Wp due to increased efficiencies, thinner wafers and wires as well as larger ingots.

- The Energy Payback Time of PV systems is dependent on the geographical location: PV systems in Northern Europe need around 2.5 years to balance the input energy, while PV systems in the South equal their energy input after 1.5 years and less, depending on the technology installed.

- A PV system located in Sicily with multi-Si modules has an Energy Payback Time of around one year. Assuming 20 years lifespan, this kind of system can produce twenty times the energy needed to produce it.

- The Energy Payback Time for CPV-Systems in Southern Europe is less than 1 year.

These costs are system costs, not cell costs.

A C Osborn December 24, 2018 at 1:42 pm

Yes, in southern Europe they may make some sense, except they are still totally intermittent.

In the UK our 13+GW of Solar Power has produced less than a peak value of 2GW per day, most of the time it is either ZERO or below 1GW, At that rate it takes an awfully long time to payback.

MarkW December 24, 2018 at 3:07 pm

“Assuming 20 years lifespan”

There goes your credibility.

I’m willing to bet they assume that there is no efficiency loss over time either.

David A December 24, 2018 at 11:56 pm

In addition consider that the greater the cost of electricity (driven high by solar and wind ladder stepping up ALL electric generation) the quicker the system cost is paid for. A rather self serving matrix for those proponents of solar and wind.

Also one year to four year cost returns are certainly a MAJOR fantasy! Everybody would be flocking to have this done and ZERO subsidies would be needed!

Perhaps your numbers are based on generation capacity, not the 15 to 30 percent of capacity solar and wind generally attain.

In either case we know such claims do not include waste and replacement.

Duane December 25, 2018 at 5:41 am

Actually, you must not have read the article you posted a link to. The article claims that early PV cells did require a large electrical input to manufacture, but that current PVs produce so much additional energy over energy consumed in manufacture that by next year – 2020 – the entire cumulative deficit over 40 years will have completely been eliminated.

In other words, your link says the opposite of what you said it said.

Craig December 24, 2018 at 7:39 am

On a per watt of power produced, the current cost of recycling a the material of a solar panel costs the equivalent of storing similar nuclear waste of 2.4 years. After that you have the solar materials that can be reused, whole nuclear your still having to pay to store it.

MarkW December 24, 2018 at 12:28 pm

The only reason why we have to store nuclear waste is because various panty waists have banned the reprocessing of it. Reprocess instead of store.

Duane December 25, 2018 at 5:47 am

You have no freaking idea what you're blabbing on about on nuclear waste.

First of all, by volume and mass, most "nuclear waste" isn't spent fuel, it is all the other stuff that gets contaminated by nuclear power production .. it has zilch recycle value, and can only be disposed in a safe cell. The amount of time that such waste needs to be kept away from humans and the environment depends upon the radionuclides involved, which can range from roughly 100 years to tens of thousands of years (varies with half life).

As for spent fuel, which is a relatively small fraction of all nuclear waste, the "panty waists" as you call them are concerned, as we all should be, with the fact that fissionable material suitable for nuclear warhead production is a byproduct of spent fuel, and that controlling such materials to keep them out of the hands of crazy nutjob countries and terrorists is a big boy pants worry, unless you're just a freaking idiot and don't care about nuclear proliferation.

And yes, the cost of reprocessing spent fuel is vastly higher than the cost of mining and processing new fuel from uranium ore.

David Middleton December 25, 2018 at 12:05 pm

“

SANDIA REPORT

SAND2009-4401
Unlimited Release
Printed July 2009

Deep Borehole Disposal of High-Level Radioactive Waste

Patrick V. Brady, Bill W. Arnold, Geoff A. Freeze, Peter N. Swift, Stephen J. Bauer,
Joseph L. Kanney, Robert P. Rechard, Joshua S. Stein
Prepared by
Sandia National Laboratories Albuquerque, New Mexico 87185 and Livermore,
California 94550

[...]

Preliminary evaluation of deep borehole disposal of high-level radioactive waste and spent nuclear fuel indicates the potential for excellent long-term safety performance at costs competitive with mined repositories. Significant fluid flow through basement rock is prevented, in part, by low permeabilities, poorly connected transport pathways, and overburden self-sealing. Deep fluids also resist vertical movement because they are density stratified. Thermal hydrologic calculations estimate the thermal pulse from emplaced waste to be small (less than 20° C at 10 meters from the borehole, for less than a few hundred years), and to result in maximum total vertical fluid movement of ~100 m. Reducing conditions will sharply limit solubilities of most dose-critical radionuclides at depth, and high ionic strengths of deep fluids will prevent colloidal transport.

[...]

DOE estimates that 109,300 metric tons heavy metal (MTHM) of high-level waste and spent nuclear fuel – primarily commercial spent nuclear fuel (CSNF), but also DOE spent nuclear fuel (DSNF), and high-level waste glass (HLWG) – will need to be disposed of in the US (the projected US HLW and SNF inventory is summarized in Appendix A). Deep borehole disposal, characterization and excavation costs should scale linearly with waste inventory: small inventories require fewer boreholes; large inventories require more boreholes. Not needing a specially engineered waste package would also lower overall borehole disposal costs. Both aspects might make borehole disposal attractive for smaller national nuclear power efforts (having an inventory of 10,000 MTHM or less). In the US, the 70,000 MTHM of waste currently proposed for Yucca Mountain could be accommodated in about 600 deep boreholes (assuming each deep borehole had a 2 km long waste disposal zone that contained approximately 400 vertically stacked fuel assemblies). The remainder of the projected inventory of 109,300 MTHM could be fit into an additional 350 or so boreholes.

Because crystalline basement rocks are relatively common at 2-5 km depth (See Figure 2; also see O'Brien et al. 1979; Heiken et al. 1996), the US waste disposal burden might be shared by shipping waste to regional borehole disposal facilities. If located near existing waste inventories and production, shipping would be minimized.

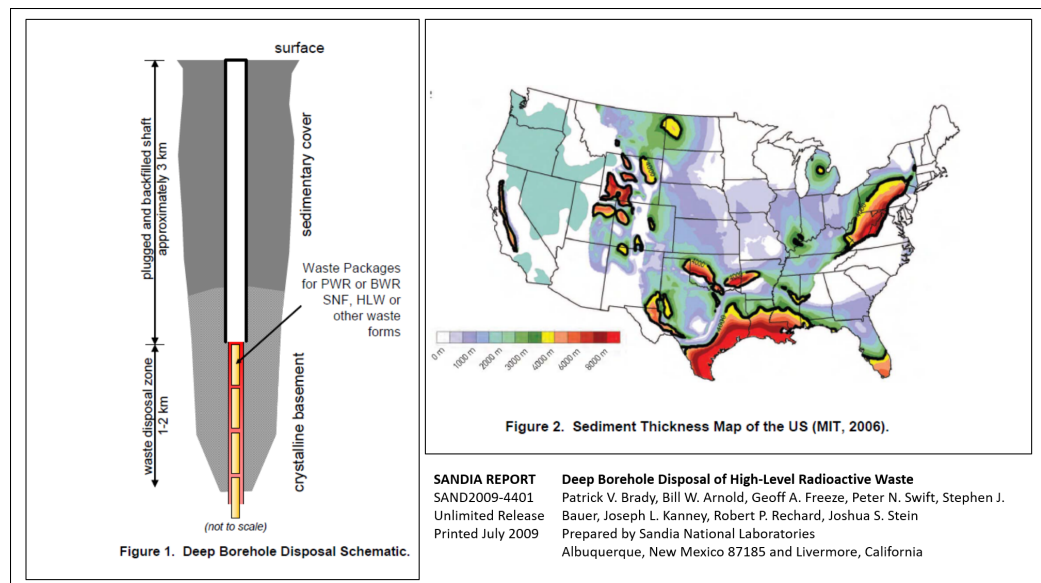
A disposal length of ~2km, and holes spaced 0.2km apart suggests the total projected US inventory could be disposed in several borehole fields totaling ~30 square kilometers.

Petroleum drilling costs have decreased to the point where boreholes are now routinely drilled to multi-kilometer depths. Research boreholes in Russia and Germany have been drilled to 8-12 km. The drilling costs for 950 deep boreholes to dispose of the entire 109,300 MTHM inventory, assuming a cost of \$20 million per borehole (see Section 3.1), would be ~ \$19 billion. Very rough estimates of other costs are \$10 billion for associated site characterization, performance assessment analysis, and license application, \$20 billion for disposal operations, monitoring, and decommissioning, \$12 billion for ancillary program activities, and \$10 billion for transportation, resulting in a total life-cycle cost for a hypothetical deep borehole disposal program of \$71 billion (in 2007 dollars). Although there are significant uncertainties in the cost estimates for deep borehole disposal presented here, the estimated total life-cycle cost may be significantly lower than the estimated total cost of Yucca Mountain. Note in particular the lower construction/operation and transportation outlays that borehole disposal would allow.

This document outlines a technical and performance assessment analysis of deep borehole disposal of US HLW and SNF.

[...]

[Sandia National Laboratories, 2009](#)



Left: Deep Borehole Disposal Schematic. Right: Depth the Crystalline Basement Map

This is worth repeating:

The drilling costs for 950 deep boreholes to dispose of the entire 109,300 MTHM inventory, assuming a cost of \$20 million per borehole (see Section 3.1), would be ~ \$19 billion. Very rough estimates of other costs are \$10 billion for associated site characterization, performance assessment analysis, and license application, \$20 billion for disposal operations, monitoring, and decommissioning, \$12 billion for ancillary program activities, and \$10 billion for transportation, resulting in a total life-cycle cost for

a hypothetical deep borehole disposal program of \$71 billion (in 2007 dollars).

\$71 billion (*in 2007 dollars*) to safely and permanently dispose of the entire inventory of 109,300 metric tons heavy metal (MTHM) of high-level waste and spent nuclear fuel.

That would be \$84 billion in 2017 USD.

According to BP's Statistical Review of World Energy June 2017, from 1965-2016, US nuclear generating stations produced 26,386 TWh of electricity (26.4 trillion kWh).

\$84 billion divided by 26.4 trillion kWh is \$0.0032/kWh... 1/3 of one penny per kWh to dispose of the entire inventory of high-level nuclear waste.

The geologic sequestration of high level nuclear waste is almost trivial.

[What are the proper pixel values for the image size? Now, width="2002" height="1127" .mod]

Samuel C Cogar December 24, 2018 at 3:59 am

Greg – December 23, 2018 at 10:10 pm

*“Specialty recycling companies are able to reuse silicon cells by melting them down **and reclaiming the silicon**”*

Shur nuff, they save tons of money by recycling a rare element.

*“**From Sand to Ingots***

The semiconductor manufacturing process begins with one of the most common elements on earth, silicon. Silicon is found in abundance in sand, but before it is used in semiconductor manufacturing it is refined to be virtually 100% pure. Purity of materials is fundamental to delivering chips that function as intended.”

commieBob December 24, 2018 at 6:05 am

Surprisingly, the sand required for making semiconductors isn't all that common. [link](#)

Chad Irby December 24, 2018 at 7:05 am

Also not surprisingly, once you put that pure silicon into a panel and add cadmium sulfide and lead to it to make it into an actual solar cell, it's not pure silicon any more, and recycling it into another solar cell just became much, much more expensive (if not impossible).

Steven F December 24, 2018 at 1:44 pm

Most of the solar cells in existence are made from silicon with no cadmium in them. Cadmium is only used to make cadmium telluride solar panels which don't have silicon. Cadmium telluride has some advantages over other types of solar but it doesn't dominate the market. Most solar panels are made from silicon.

commieBob December 24, 2018 at 2:38 pm

To make a semiconductor device, like a photovoltaic cell for instance, two different impurities are added to the silicon. One creates a P type semiconductor and the other creates an N type semiconductor. Without the impurities, called dopants, pure silicon is an insulator. [link](#)

Steven F December 24, 2018 at 1:39 pm

That article exaggerate the need for pure sand. No sand on the earth is even close enough to reach industry purity requirements. All of it has to be purified in a two step process. The first is to remove the oxygen which is done the same way we make iron. This also removes other impurities but gets it to about 95% purity. The next step is to convert the silicon to silicon tetrachloride which is a gas. This leaves the impurities behind which are solids and after additional filtering the gas is converted back to pure silicon and the chlorine is recycled to make more silicon Tetrachloride. The above processes will work with regular beach sand. Additionally the pure silicon

can and is converted back to pure quartz for making specialized optics or quartz crucibles.

Obviously the first steep of the process can be eliminated by recycling broken silicon scraps from the semiconductor industry. Also the removed impurities are rich in iron, aluminum calcium and magnesium which may also have market value.

Samuel C Cogar December 25, 2018 at 5:02 am

@ commieBob December 24, 2018 at 6:05 am

Thanks for that “link”, commieBob, it prompted a recall of a few old memories.

Like the first time a Texas Instrument salesman was telling me about those newly manufactured “inline” IC packs that would make my designs a lot simpler and easier to manufacture.

They were just simple AND, OR and Inverter gates but the savings in “real estate” and manufacturing labor was terrific.

commieBob December 25, 2018 at 8:17 am

The thrill of having new toys to play with never got old.

Roger December 23, 2018 at 10:10 pm

in the recent Sydney hail stone storm that must have damaged 1000s of solar panels, how will they dispose of all these solar panels?

Greg December 23, 2018 at 10:42 pm

Did or “Must have.”

Craig from Oz December 23, 2018 at 11:16 pm

Either/Or, Greg.

The evidence is readily available that solar panels were destroyed or damaged.

The reports also clearly describe the extent of the storm.

You take the evidence of damage and compare it to the extent of the storm and you would be foolish to claim the photos provided by the media were isolated events at the end of the bell curve.

You want exact figures then you are probably going to have to speak to the insurance companies, but until then the assumption of 'must have' is perfectly rational in relation to the query about disposal of solar panels.

Why do you ask anyway? Are you considering tendering for a NSW based Solar Recycle contract?

Jeff December 23, 2018 at 11:44 pm

It is very rare for the toughened glass of solar panels to be smashed by hail. I have had panels for 20 years with no damage from many hail storms. Car windscreens can be smashed by hail – it hasn't happened to me, probably not to you either.

<http://www.aresolar.com/can-hail-damage-solar-panels/>

A C Osborn December 24, 2018 at 1:45 am

Perhaps these are not toughened enough then

<https://pbs.twimg.com/media/Du5u-jkUwAAEcPY.jpg:large>

Jeff December 24, 2018 at 2:52 am

Next you'll show me a photo of someone struck by lightning and tell me not to go outdoors.

Everyone agrees it happens, the question is at what rate.

ozspeaksup December 24, 2018 at 4:10 am

the hailstones were massive
two only fitted on a mans spread hand
pics on aussie media and on youtube

jkneps73 December 24, 2018 at 10:34 am

Good report with picture of damage here

<http://joannenova.com.au/2018/12/sydney-hail-storm-just-how-hailproof-are-those-solar-panels/>

Stephen Wilde December 23, 2018 at 10:14 pm

Makes fracking pretty innocuous in comparison.
I'm never surprised by the ignorance of environmental activists.

WXcycles December 24, 2018 at 12:07 am

Most of that sort of inane bleating comes from the dumber-end of the spectrum of university students who know next to nothing about anything that's real as yet. The older ones still doing it are their professors who know very little of any worth or substance in practice about anything.

Blind guides.

Tom Halla December 24, 2018 at 6:34 am

Oh, but it is to be judged on intent only./sarc

Mr. December 23, 2018 at 10:49 pm

“Doesn’t need to be.”
Because the gubmint will meet the cost?

Dodgy Geezer December 23, 2018 at 10:50 pm

I don’t think WUWT commentators understand the basic tenets of Climate Science very well.

Nuclear Power = BAD. Therefore one drum of nuclear waste is a level of pollution that threatens all of Nature, and is impossible to dispose of.

Solar Power = GOOD. Therefore millions of tonnes of toxic wastes are an opportunity for humanity to show how woke they are by proposing complex expensive schemes for recycling. Which is also GOOD.....

mario lento December 23, 2018 at 11:07 pm

Dodgy: It’s late and I did not know exactly how I was going to respond to Greg, who seems to have missed the article text or willfully did not understand the point of it. Your response should give him food for thought. Thank you!

old white guy December 24, 2018 at 5:32 am

like man he willfully ignores the truth.

Walter Horsting December 24, 2018 at 6:50 am

Check Seaborg.co Molten Salt Reactor under development: 20' 30-ton shipping container with 250 MW Thermal output

Sheldon Walker December 23, 2018 at 10:51 pm

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Christmas is a time when Alarmists gather together, roast chestnuts, and share memories.

- They tell their children how there used to be a cold white substance, called snow.
- They reassure their children that Santa really does exist, and that he delivers presents to all of the good children (the ones who believe in global warming).
- And they give thanks for the 97% consensus (that global warming is real, that it is caused by humans, and that there was no recent slowdown).

In keeping with the true Christmas spirit, Alarmists have just published 2 new papers, which (they say) demonstrate convincingly that the recent slowdown wasn't a real phenomenon.

It is a pity that they didn't read my article first. They could have saved themselves a lot of time, and millions of dollars (of your money)!!!

The article is called "Alarmist thinking on the recent slowdown is one dimensional"

<https://agree-to-disagree.com/alarmist-thinking-on-the-slowdown>

Warning – this article contains undeniable proof, that the slowdown WAS a real phenomenon.

So if you want to continue believing that the recent slowdown doesn't exist, then don't read this article.

Hreg December 23, 2018 at 10:54 pm

Here is an example of just one recycler: Recycle PV Solar, LLC built a state of the art solar processing plant in Tucson and is accepting solar panels. Plans are to expand to three other locations in the USA. They charge \$25 per solar panel.

D. J. Hawkins December 24, 2018 at 5:37 am

That is a limited time introductory price. Let's check back in 6 months to a year.

Crispin in Waterloo December 23, 2018 at 11:21 pm

There is a great photo of solar panel waste on the "Deplorable" blog:

https://realclimatescience.com/wp-content/uploads/2018/12/2018-12-21203645_shadow.jpg

Nature is not kind...

tonyb December 23, 2018 at 11:49 pm

I don't think that's solar panel waste but surely the result of a devastating hail storm (although it is certainly waste now!)

tonyb

Ben Vorlich December 24, 2018 at 1:53 am

Having seen the destruction of rooves in various French Departments I would say that unless solar panels were built to resist a 2 minute storm with tennis ball sized hailstones (they're not called stones without good reason) then damage beyond economic repair will result. A friend had a 2 year old car damaged beyond economic repair by a hailstorm in the Dordogne region. All

glass broken and all panels that could be dented were severely dented. That picture looks a bit ereme but damage putting panels permanently out of action is to be expected. Areas in France with high temperatures and high sunshine hours tend to get severe storms which are often exported northwards.

Jeff December 23, 2018 at 11:22 pm

Solar panels would relatively easy to recycle.

I myself could take the aluminium frame off, remove the glass, remove the copper from the cables,

pull the plastic off the cells, melt the solder off the cells.

The cells themselves are made almost totally from silicon crystal, one of the most common element on earth.

Andy December 24, 2018 at 12:48 am

When doing this can you please measure how long it takes so you can factor in labor costs which I think \$25 dollars an hour would be reasonable.

Can you then tell us how you are going to handle the cadmium and any other poinsonous byproducts you may come across and the costs involved

Can you then say where you store the removed plastic so a value can be attributed to the storage costs.

Then we can make better comparisons

Thanking you in anticipation

Andy

jeff December 24, 2018 at 1:09 am

Panels generally last 20 – 30 years.

Machines like cars and appliances like TVs, fridges, computers etc are generally replaced after 5-10 years and are much more complicated to recycle.

Maybe we should stop using them because they are expensive to recycle ?

Power stations of all sorts need constant refurbishment, replacement of parts and have a limited life.

HotScot December 24, 2018 at 4:02 am

jeff

Much of the cost to recycle fridges, computers and cars is inherent in their purchase price. And all of them are capable of functioning for 24 hours a day if necessary. Solar panels operate for around ~50% of the time at best, absolute maximum. And if they are don't automatically track the sun so they are perpendicular 100% of that 50%, you can probably knock 20% off their effectiveness.

So we are paying a huge environmental and monetary cost to produce something about 30% efficient, then dispose of it after what amounts to around 5 or 6 years 100% effective use, if that. Notwithstanding the natural degradation of the performance of the panel panel itself over it's period of operation.

Meanwhile, the cost paid for the Intermittency of both solar and wind products is that fossil/nuclear/biomass powered sources must be built anyway, to stand by idling until the wind and sun appears again at which point the conventional sources of power are required to wind down or have their product transported over great distances by more expensive and environmentally destructive cables, with the associated infrastructure required to manage and distribute it to other areas.

What's astonishing is the scale of the deception surrounding different energy sources.

This is an aerial photograph of a lithium mine in Nevada:

<https://asterweb.jpl.nasa.gov/gallery/images/lithiummine.jpg>

This is considered acceptable by greens.

This is a shot of a fracking operation in Colorado:

http://3.bp.blogspot.com/-AwsybcUZe7E/T3kqgunv5ZI/AAAAAAAAABzM/fJsen2QS3_U/s1600/WTFRA CK.RG+++FRACKING+PICS+++AERIAL+FRACKING+PICS+++FRACKIN G+++%23FRACKING+++FRACKING+IMAGES+26.png

This is considered unacceptable by the greens (yet it actually produces reliable, despatchable power).

This is the aerial picture of Whitelee's onshore wind turbine farm in Scotland:

<https://www.sundaypost.com/wp-content/uploads/sites/13/2016/09/Wind-Energy-Whitelee-the-UKs-Largest-On-Shore-Windfarm-L2112-16-900x540.jpg>

This is considered acceptable by the greens (but produces intermittent power far below the relative value of fracked gas).

And a cute Panda shaped solar farm in China:

https://www.telegraph.co.uk/content/dam/business/2017/07/25/TELEMMGLPICT000135684245_1_trans_NvBQzQNjv4BquX7IRszhEnH5jlrEds59RgJX0eQK1wm8NMqSDApP_gw.jpeg?imwidth=1240

Yet this is also deemed acceptable by the green blob.

And finally, a shot of a Oil rig in the Norwegian sea producing millions of barrels of oil producing everything from petrol and diesel for vehicles and heating to plastics and chemicals for industry and agriculture.

https://www.annahenly.co.uk/wp-content/uploads/2016/02/Annahenly_Eddafonn2_128.jpg

But this also is deemed unacceptable to greens despite its small footprint relative to the amount of energy and products it's responsible for.

So lets all just ban big Oil shall we? So where do we get our plastics from, our chemicals, our industrial processes which maintain our lives to a standard that's seen poverty in the world tumbling by over 75% since the industrial revolution?

Wind turbines and solar panels produce one single commodity, electricity, not very efficiently either.

If you want to see the simple arithmetic on the subject the following TED talk by a leading 'green' mathematician (The late Sir David MacKay) who blows holes in the entire renewables scam.

https://www.ted.com/talks/david_mackay_a_reality_check_on_renewables

Then there's Sir Matt Ridley's equally simple illustration of the folly of wind power (a short easily readable article)

<http://www.rationaloptimist.com/blog/wind-still-making-zero-energy/>

Andy December 24, 2018 at 5:39 am

You say you can do the job yourself.
I ask you to cost and show us.
You completely dodge do anything of the sort

funny little speech where you then say don't use them !

A little cowardly isn't it?

MarkW December 24, 2018 at 12:35 pm

jeff, are you really as clueless as your post makes you look?
Do you honestly believe that because it's economical to recycle one thing,
therefore everything is recyclable?
Oh yea, 25 to 30 years for a solar panel. You're delusional man.

Alastair McIntosh December 24, 2018 at 1:31 pm

The lowest 25 year PERFORMANCE warranty for solar panels appears
to be 80%.

Sunpower is one of the best at 92%.

<https://news.energysage.com/shopping-solar-panels-pay-attention-to-solar-panels-warranty/>

Not all suppliers have a 25 year PRODUCT warranty

A C Osborn December 24, 2018 at 1:51 pm

And you are naive enough to believe that those Producers will still be
around in 25 Years?

I have a nice bridge over the Thames that I could sell you for \$1000 and
you can make the money back in a few weeks by introducing tolls to
cross it.

Honestly, I can guarantee it.

MarkW December 24, 2018 at 3:11 pm

The other point is how heavily pro-rated are the warranties. In many
cases, if 15 years out, the panel fails to meet advertised specs, the

payout is just pennies on the dollar. Assuming the company is still in business, of course.

Roger Knights December 24, 2018 at 8:04 pm

“Machines like cars and appliances like TVs, fridges, computers etc are generally replaced after 5-10 years”

Make that 10–15 years for flat-screen TVs and 25 years for fridges. (It used to be 40–50 years before energy star requirements kicked in.)

David A December 25, 2018 at 12:08 am

49 to 50 years for refrigerators??

Paul December 25, 2018 at 7:00 pm

5to 10 yr. replacement? I have a 8 year old car and expect to keep it 10 more years. And [sold] a 20 year [old] car a year ago that is still being used.

Robert of Ottawa December 24, 2018 at 1:51 am

The Cadmium and other “poisons” existed elsewhere before and will exist after. They are atomic elements dispersed around the environment. If the Cadmium is in high concentrations, then that would be a valuable resource.

Michael Jankowski December 24, 2018 at 6:14 am

It's the dose that makes the poison...cadmium doesn't exist naturally at those concentrations or exposure routes. There are reasons we've

dramatically reduced the use of lead in products. The lead still existed before and will continue to exist but exposure to it is now limited.

State can matter...I don't know much about cadmium, but compounds with hexavalent chromium, for example, are worse than other forms of chromium.

HotScot December 24, 2018 at 3:06 am

Andy

Then there's the cost of dismantling and transporting useless panels from site to a factory which also has to be heated/air conditioned/lit. Then there's the cost of the machinery/running/upkeep and processes to deal with individual waste elements, the transportation to processing centres e.g. glass/chemical/solder/pcb's etc.

Nor do I imagine even separating the glass panel from its backing will be an easy or safe matter as they are bonded together.

Then will there be 100% recovery of everything involved in the construction of new panels? I doubt it. So there are yet more monetary and environmental costs involved in disposing of non-recyclable parts.

Crispin in Waterloo December 24, 2018 at 7:28 am

It may be possible to put the damaged panels in an incinerator and evaporate the metals, burn the epoxies, condense what is useful and expel the rest.

The photo shows that solar panels are not up to the task of being "out in the sun" on a permanent basis. Africa, much vaunted as the solar panel site of the future, is dusty where there are no clouds, clouded where there is no dry season, and suffers massive thunderstorms and occasional hail nearly everywhere else. I have seen incredible damage in African hailstorms. The slate roofs of most houses in the town of Barberton were destroyed in one afternoon.

At what cost shall solar PV panels be made hail-proof? Consider how Florida would be solar powered with hurricane-proof panels. I would like to see a Cat 5 solar panel.

Solar panels, particularly installed on a large scale, get:
covered in snow
covered in dust
pooped on by birds
hit by lightning and destroyed
blown about
cracked or even punched through by hail (see above)
clouded over
darkened by night
de-rated by actinic degradation
fail for reasons of manufacturing faults
lower their power output when heated
generate low voltages unsuited to large scale installations

Solve these 12 problems and we can start to rely on them, somewhat. Until then they are “interesting”.

A C Osborn December 24, 2018 at 1:54 pm

And create house fires if poorly installed as they have Australia.

old white guy December 24, 2018 at 5:36 am

there is solar panel farm just outside my town, I would suggest it take the rest of your life to take them apart and then you would still have to smash and crush what I will call the glass part. You really seem to be someone who prefers denial to the truth, that you can do a small amount of something does not mean you will save anything.

Tim December 24, 2018 at 5:38 am

How about a wind turbine? Hmmm?

Estimates put the tear-down cost of a single modern wind turbine, which can rise from 250 to 500 feet above the ground, at \$200,000.
With more than 50,000 wind turbines spinning in the United States, decommissioning costs are estimated at around \$10 billion.

<https://www.energycentral.com/news/retiring-worn-out-wind-turbines-could-cost-billions-nobody-has>

MarkW December 24, 2018 at 12:33 pm

Once again, the worshipers of solar display their ignorance of the real world. What is the labor cost for doing all this hand dis-assembly? Or are you proposing to use slave labor? While silicon is common, the dopants required to turn silicon into a solar cell are much harder to remove. Or were you under the impression that these cells were pure silicon?

Alan Tomalty December 23, 2018 at 11:25 pm

The alarmists just blame the slowdown for some other natural cooling event that doesn't happen all the time and that without that cooling event, the earth would be frying. You can't win an argument against religion.

tonyb December 23, 2018 at 11:44 pm

We had an interesting case in our county in the UK whereby a fire broke out on a house that had solar panels. The fire brigade took the very unusual step of calling people's attention to two inherent problems in fighting such blazes.

The first was that spraying water onto a fire via a roof which had solar panels causes problems, because of all the electrics surrounding the panels.

The second being that physically gaining access to the roof and the loft space to fight the fire (removing tiles etc) was highly problematic because the way is effectively barred by firmly fixed in place panels which are dangerous to break.

The cause of this particular fire was a lightning strike and it seems that properties with solar panels are statistically more likely to be struck than those without (although still statistically unlikely)

It did set me wondering about whether those with solar panels need a special level of fire insurance as clearly fires can not be fought as effectively as with non solar panel roofs

tonyb

Robert of Ottawa December 24, 2018 at 1:48 am

No they're not dangerous to break. See next post.

Paul Blase December 24, 2018 at 1:29 pm

The panels themselves aren't. The current through and voltage across them is!

Aussiebear December 24, 2018 at 2:02 am

@tonyb

I read a similar story about firefighters having issues with homes fitted with solar panels and the problems that they face when dealing with fires especially when the panels are energised i.e. day time fires. Lots of water. Unconstrained electric current. What could go wrong?

The journo did not see this as a problem with the solar panels, but was blaming the firefighters for not being properly trained dealing with solar domiciles and not having specialist equipment such as insulated clothing and foam instead of water. Never mind the cost or logistics of foam for all fires, etc.

So the problem seems to be, it is not enough to just be a firefighter, but a structural engineer AND electrician. Clearly, these folks are being paid enough!

Samuel C Cogar December 24, 2018 at 4:14 am

If the firemen have to fight their way past/through solar roof panels they might as well sit back and watch it burn.

Robert of Ottawa December 24, 2018 at 1:45 am

While I enjoy the schadenfreud of stories like this, it really is just the old eco chemophobia at play. I personally don't like to use an ideological enemy's argument against them; while it gives a quick HA-HA, it undermines rigorous discussion, a battle field upon which they lose.

tonyb December 24, 2018 at 3:20 am

Robert

Here is an article by Fire rescue

<https://www.firerescuemagazine.com/articles/print/volume-9/issue-5/firefighting-operations/tackling-solar-power-challenges.html>

There certainly seems to be a problem fighting fires when the panels are installed

Unless you have any contrary information it seems these concerns are justified. If I were an insurer I would want to charge a higher premium to offset the problems with fighting fires where these are installed

tonyb

M Courtney December 24, 2018 at 4:26 am

I'm reminded of Hove Town Hall (in the only UK constituency with a Green MP). It caught fire and the Fire Brigade was able to put it out using foam despite the solar panels on the roof.

However, the fire was caused by [an electrical fault on the panels](#) in the first place. It turns out that putting extra electricals out in the open increases your risk of electrical fires.

Who knew?

MarkW December 24, 2018 at 3:13 pm

Once a DC current starts arc'ing, it's hard to stop. AC is a lot easier because both the current and voltage cross zero twice per cycle. 120 times a second at 60Hz.

Gaz December 24, 2018 at 2:04 am

In Australia, our largest city, Sydney, has just suffered a major hailstorm with hailstones as large as baseballs. As a result, probably up to half of the solar cells in the city have been trashed and will need to be disposed of. This is a NOW issue, not in 20 years.

Non Nomen December 24, 2018 at 5:20 am

To reduce or avoid climate change some put up solar panels. If these solar panels are damaged by hailstorm -of course as a result of climate change- these panels contaminate the environment. That mess has to be cleaned up thoroughly, which consumes energy -no longer generated by pv panels, they have just been crushed- so it's back to oil, coal and gas for the cleanup. To avoid the side effects of oil, coal and gas, like climate change, some buy and put up new solar panels...
...Catch 22 in the madhouse...

J Mac December 24, 2018 at 10:01 am

GAZ,
Greg, Craig, and Jeff are certain they know how to recycle solar panels. I'm sure they will be happy to come to Australia and 'put their money where their mouth is' in demonstrating how effectively they can 'green' recycle all of Sydney's smashed solar panels! Afterwards, they can publish their financial success right here on WUWT for all to admire.....

Bob Tisdale December 24, 2018 at 2:10 am

The article reads, "Contrary to previous assumptions, pollutants such as lead or carcinogenic cadmium can be almost completely washed out of the fragments of solar modules over a period of several months by rain water."

Which brings me to my comment...

<http://joannenova.com.au/2018/12/sydney-hail-storm-just-how-hailproof-are-those-solar-panels/#comment-2085085>

...on the thread of the post at Jo Nova's blog about damage to solar PV panels from a hailstorm. There I wrote, in a reply to a comment:

Tom, considering that hail accompanies rain storms, with the broken panels, is there any release (washing out) of lead and cadmium from the panels onto the homeowner's property (soil) and into the ground water? If so, what are the hazardous waste clean-up requirements? And what happens to the value of the property now that it's been doused with hazardous chemicals?

Until questions like those are answered, I wouldn't want a PV cell anywhere on a property I owned.

HAPPY HOLIDAYS,
Bob

Joe December 24, 2018 at 7:26 am

This article is reaching to conclusions with wrong premises.

It states that solar panels contain cadmium and lead, but that's only the case with thin film solar panels which account for less than 4% of the market and are not used in residential installations. Crystalline silicon panels have no toxic elements and are 100% recyclable and account for 96% of the market.

Then it goes on to state the whole volume of solar panel market to say that there will be an environmental disaster. It's willfully ignoring the fact that thin film solar could easily disappear if clients were to stop choosing it and with that solar could continue without environmental issues.

Crispin in Waterloo December 24, 2018 at 11:16 am

Cadmium is not "carcinogenic" unless there is adequate concentration, exposure, intake and duration.

Walking around on planet Earth is also carcinogenic because all rocks have uranium in them. Forest fires create dioxins. Lightning creates N₂O and NO₃. Thousands of plants are poisonous. There are terrible, wild and ravenous beasts wandering free. Millions of them.

Plus that thing in my closet that goes Bump in the night.

Tom Abbott December 25, 2018 at 5:28 am

Thin film solar cells. I recall a Solar Power Satellite (SPS) design that used flexible, thin film solar cells. It was designed as an inflatable balloon with the thin-film solar cells attached to the outside. A balloon SPS one mile in diameter would require about 40 pounds of helium to inflate it once it was in orbit.

At the time of the SPS design, thin-film solar cells were just starting to be developed and were not suitable for SPS duty. I have not kept up with thin-film solar cell design progress, and I'm wondering if they now have the capability of operating in a space environment.

If the Greens/Alarmist want to make use of solar energy, they should put all those solar panels in space and beam the power back to Earth. 😊

Alasdair December 24, 2018 at 2:30 am

Meanwhile solar panels heat up the planet by creating Urban Heat Islands.

griff December 24, 2018 at 3:33 am

In the EU the (unfortunately named!) WEEE directive makes manufacturers responsible for disposing of the PV panels they sell...

This covers it:

<http://www.solarwaste.eu/>

“All photovoltaic (PV) modules available on the European market can be disposed of, notwithstanding the type of technology used. Most parts of a solar module can be recycled, including glass, semiconductor materials, ferrous and non-ferrous metals.”

So, no problem...

Non Nomen December 24, 2018 at 4:10 am

“ This website is an informative source of information aiming to explain the Waste Electrical and Electronic Equipment Directive.

This website is maintained by PV CYCLE, the European non-for-profit association helping photovoltaic Producers to treat their discarded end-of-life panels.

For more information, visit <http://www.pvcycle.org>

Those who expect these lobbyists telling the truth might also believe Pope Francis converted to Islam (which, IMHO, isn't improbable, and in the age of pc you'll never know...)

DaveS December 24, 2018 at 4:37 am

Based on Australian and US experience, how many PV installation companies do you think will still be in business when it comes to removing and recycling panels after 15 or 20 years?

Non Nomen December 24, 2018 at 5:08 am

That is why I think that the costs of disposal must be paid upfront and in full by the buyers and kept separate in escrow in a fund. Else it's the taxpayer once again who has to fill the monetary gap.

Pop Piasa December 24, 2018 at 3:52 pm

That would have been a severe deterrence to the development of nuclear-derived electricity. It has to be based on toxic waste-per watt-hour to be fair at all.

tty December 25, 2018 at 2:44 am

It is, in Sweden for example. Money has been reserved to build and seal long term storage 500 meters underground. Incidentally quite unnecessary if the politicians hadn't stopped reprocessing spent fuel back in the seventies.

But nuclear power is *still* too cheap for wind and solar to compete. So our pc politician had clap an extra arbitrary “production tax” on top to make it uncompetitive.

MarkW December 24, 2018 at 12:52 pm

This assumes that the manufacturers are still in business when it is time to dispose of the panels they sell.

Unless they are posting a bond, this assurance is as worthless as your posts.

Non Nomen December 24, 2018 at 3:57 am

“Only Europe requires solar panel manufacturers to collect and dispose of solar waste at the end of their useful lives.”

This ought to become standard for all nations, with the costs of disposal to be paid upfront by the buyer, hold in escrow by a trust. This might reduce panelantics a bit.

George Daddis December 24, 2018 at 8:03 am

A few decades ago the supervisor of our very small town in western NY asked a few of us with technical backgrounds to make a study of the pros and cons of wind installations in our municipality. Industrial sites were being installed immediately south of us, continuing a long chain on north-south ridges up from the Pennsylvania border.

Being in the Finger Lakes region we may have had a slight NIMBY perspective but I think the report and recommendations were pretty honest. We laid out the pros and cons pretty evenly which were not disputed (many of our residents were “Birkenstock” greens from the city).

We included modifications to building codes and other related ordinances for residential, commercial and industrial installations (with virtually no restrictions on residential and commercial sites in our very libertarian area).

We placed height limits on **industrial** installations (somewhat higher than those erected in the town to our south) but very uniquely (compared to legislation in other

NY municipalities at the time) asked for a bond to cover the costs of removal of the turbines and their foundations at the end of their useful life, as well as for repair of town roads and bridges that would have to be constructed to gain access to otherwise pristine ridges between Finger Lakes.

To my knowledge, those regulations were never legally or practically challenged. Although the installations stopped in the town to our south we certainly couldn't be sure that it was the result of our new codes.

However, I DO have a sign on my front lawn in my new residence in a southern state that says "Elephants not Allowed", and it has been pretty damned effective.

ozspeaksup December 24, 2018 at 4:17 am

PV
the new asbestos

Pop Piasa December 24, 2018 at 4:01 pm

Not exactly.
Asbestos is a good thing in containing a house fire.
Rooftop solar panels can electrocute fire fighters with DC and can't be deactivated in sunlight.

Pop Piasa December 24, 2018 at 4:13 pm

It is quite accurate though, that both will eventually end up in landfill.

Pop Piasa December 24, 2018 at 4:37 pm

Perhaps the waste volume of spent PVs compared to obsolete electronics globally might be an informative study. I haven't a clue what that might reveal.

Ian Macdonald December 24, 2018 at 5:14 am

The Greens are always crowing about plastic pollution in the ocean, but what will happen when wind turbines reach the end of their life and are left to R.I.P? The blades contain vast amounts of thermosetting resin and glass matting. It's a reasonable guess that these glass strands will be a serious and long-lasting hazard for marine life, especially as they will not degrade in sunlight as plastics do .

The use of these particular materials is also highly irresponsible as they cannot be recycled. Metal blades could be reused. As could thermoplastics.

kent beuchert December 24, 2018 at 5:15 am

“Only Europe requires solar panel manufacturers to collect and dispose of solar waste at the end of their useful lives.” An idiotic idea – those solar panel companies aren't likely to still be in operation when their panels need disposal. They need to do what we do for nuclear plants – charge the providers a small fee for each unit of power produced to cover disposal of the plant and spent fuel. Our govt, naturally, charged too much and had to return tens of millions of dollars back to the nuclear power companies.

Bob Rogers December 24, 2018 at 1:27 pm

A perfectly logical solution would be to impose a small tax on new units sold that the government could use at the end of life. In South Carolina we do that for major appliances and automobile tires.

kent beuchert December 24, 2018 at 5:26 am

Nuclear wastes cannot be compared to solar panel toxic wastes. “Nuclear wastes” consists of spent fuel – uranium that can no longer radiate the thermal temps required by the reactor's steam powered electric generators. BUT – this spent fuel still retains an enormous amount of thermal energy – stored in dry casks above ground, it is virtually free energy and, unlike renewable energy, it is continuous energy, capable of desalinating huge amounts of ocean water for our nation. This thermal energy will last for a very long time and can be employed wherever there is a situation that can employ this energy. Only the world's stupid energy experts have decided that this free energy

should be stored miles below ground. The molten salt nuclear reactors that I believe will dominate future energy production produce a spent fuel which is unlike our current spent fuel, which will return to background radiation levels in 300,000 years – it will return to those levels in only 300 years.

There is no such thing as “nuclear wastes” according to the nuke experts – only stupid humans

who are hysterically afraid of nuclear radiation (except when it cures their cancers).

MarkW December 24, 2018 at 12:57 pm

Each uranium atom, when it splits, produces the same amount of energy. The reason why spent fuel rods no longer produce enough power is two fold. The concentration of uranium has decreased, the amount of decay by-products has increased.

The smart thing to do is to reprocess the rods, and recycle the remaining uranium into new fuel rods.

mario lento December 24, 2018 at 1:06 pm

France does this for their units and other countries' units. So we know reprocessing works.

MarkW December 24, 2018 at 3:15 pm

It worked in the US as well, prior to it being banned by Carter out of a phony concern regarding nuclear proliferation.

tty December 25, 2018 at 2:49 am

Possibly something better than 1942 technology built as part of a wartime rush project might be feasible today.

mario lento December 25, 2018 at 10:34 pm

Yes: In a sane world, the spent fuel would not be called waste, rather enriched nuclear fuel.ma

RACookPE1978 December 24, 2018 at 10:05 pm

And when 10^{19} Uranium atoms (of all mixes) fission each second, does that small difference between the minute amount of each U233 (in the active fuel), the mass of enriched U235 fuel itself, and the large number of U238-Np-Pu239 residual reactions matter?

Donald L. Klipstein December 24, 2018 at 5:59 am

Silicon solar cells don't have cadmium. Solar panels made with lead-free solder don't have lead.

Peta of Newark December 24, 2018 at 6:13 am

So many headless chickens:

1. Our story starts with a picture of some PV panels but then we hear about Cadmium. The panels in the picture are made of mono or poly crystalline silicon = No Cadmium
Thin Film panels contain Cadmium and are few & far between, certainly here in the UK and simply because they are less efficient at turning sunlight into elektrikery
2. We are told about Lead – coming from the solder used to weld the internal connection together.
Lead-free solder has been around since forever. No Lead. No problem.
In any case, Lead metal itself is fairly benign. Its when you oxidise the stuff you get into problems.
If you wanna worry about Lead, worry about car batteries – chock full of Lead Oxide = one the nastiest pieces of work since nasty pieces of work were ever invented. Almost as nasty as refined sugar, just a bit faster acting.
3. Energy content of manufacture – THREE THOUSAND DEGREES!!!!!!
Wow. I'm impressed. not
Inside the computer presently in front of you will be anything from 10, 20 or 30+ large

silicon chips.

EACH one of those chips will have taken more energy to make than the entire computer is going to use inside its typical 3 year lifespan.

Not from 3000 degrees to temperature.

The energy mostly went 'simply' into keeping the Clean-Room clean. Gobsmacking innit?

Silicon PV cells don't need that level of cleanliness, hence they are (haha) "As Cheap As Chips" to manufacture.

4. Somewhere railed about Nitrogen Trifluoride (NF₃)- exactly

2.582347848974581234567 Squillion Zillion times more potent than CO₂ as a Green Gasgas.

Oh well, we really are doomed now.

Apart from the fact that The Green Gasgas theory is total bunkum, NF₃ is an etchant inside the semiconductor business, used for making huuuuuuge chips like the ones in your Swankfone and the one in your computer, destined for the Land Fill Site in, on average, 18 months time.

PV cells don't need any etching worth talking about.

5. The PV panels on house roofs are not never earthed. It upsets the inverter, which ***has*** to be earthed if they are.

So, if a fireman wants to electrify his/her self on the roof of a burning house, the have to break into the PV circuit and simultaneously get hold of both the exposed red wire and the exposed black wire.

One in each hand.

OK, firemen are all Superheroes BUT, how many hands do they have? How are they holding onto the ladder, the fire-hose, their Smart Swankfones, the camera used to record the event, their radio-intercom etc

Are firemen all octopuses?

6. Plastic

Is it actually possible to permanently 'bond' ***anything*** to a sheet of glass?

7. Hailstones

The pictures we see are all of panels that have been fixed at shallow angles.

OK, they may be near The Equator but, to obtain maximum energy yield as you move away from the Equator, you fix the panels at steeper and steeper angles. (Angle from horizontal to = Latitude)

Apart from reducing the Lift Effect of wind blowing over them (steep angle = stall condition = no lift = they stay on the ground when its windy), it will reduce the effects of hailstones.

Unless the stones are coming at you horizontally (you really are in Deep Schist if that's happening), steeply angled panels will receive glancing blows and possibly survive.

And why not just use decent-strength glass in the first place. Is there a World Shortage of glass?

Its ***all*** just so poor

Unreasonable Behaviour as some might assert – you gonna ask her when she gets home from work/shopping, child caring, old-folk caring, the hair/beauty/clothes salon

Peta of Newark December 24, 2018 at 6:26 am

PS For the firemen and other folks with 8 or more arms, check out **Live Wire Working or Hotline Maintenance**

ResourceGuy December 25, 2018 at 3:51 am

CdTe thin film panels are safe and approved in the EU and ultra cautious California. They are the only panels priced with recycle included and their new efficiency now equals most silicon panels with lower cost. The Brits don't have many of these because they prefer high cost panels and high cost placement to go along with imported wood pellets from clear cut forests. The cadmium mentioned in the scare story might be from the glass backing of panels used by all manufacturers but not sure from such a dubious scare source rant citing vague lobbyist source for that claim.

Non Nomen December 24, 2018 at 7:46 am

The full report

“Schadstofffreisetzung aus Photovoltaik-Modulen”

(Pollutant release from photovoltaic modules) can be downloaded here (in German):

http://www.ipv.uni-stuttgart.de/news/2017_Projekt_Schadstoffe_Uni_Stuttgart_Abschlussbericht.pdf

bill mccarter December 24, 2018 at 9:34 am

Solar panels on rooftops may have a proper return in some (very few) locations. Here in Victoria BC I have studied some current installations that belong to my clients and they are not viable at all. A far far better use of the land appropriate for solar collection is to collect it with automatic systems that have had a very long history of redesign and improvement. They create valuable products for mankind and wildlife, are store-able and are very low maintenance. Plants,,, yep they work well, they may need some water, but they sure are efficient at absorbing and utilizing the energy of sunlight.

Charlie December 24, 2018 at 11:12 am

The recycling costs pale in comparison to the costs of inaction. Climate change being real AF, this article is the equivalent of yelling SQUIRREL!!!

top notch distraction you got here, watts.

(One should provide proof of ones assertions. Or else it is just a distraction. Mod.)

Roger Knights December 24, 2018 at 8:17 pm

“The recycling costs pale in comparison to the costs of inaction.”

Incommensurate entities.

yarpos December 24, 2018 at 12:13 pm

“Used panels are also sold to developing world countries that want to purchase them inexpensively despite their reduced ability to produce energy. ” and you just know they will be disposed of properly after that dont you? out of sight out of mind again in renewable world.

This will probably be Californias plan after making them compulsory in new homes. Dumping in the 3rd world cloaked in a vurtue signalling donation wrapper.

ResourceGuy December 24, 2018 at 6:10 pm

I’m not sure about the Chinese solar panels and all the silicon panel producers for that matter but First Solar is the only major producer that builds in the recycle cost guarantee in the pricing for its cdte panels. Furthermore they have passed all US, EU and international quality certifications. You could at least mention that in this otherwise scare menace post that rivals any of the global warming scare stories.

Also, reference number 3 is weak at best and only serves to name drop some scary sounding elements like a California epa would do.

R. de Haan December 24, 2018 at 8:17 pm

The Solar energy generated versus energy invested to produce the panel is a negative deal in Canada. Add disposal costs of the panels at the end of their life cycle and you end up with an “environmental night mare”.

Just like those “environmentally friendly light bulbs that were full off mercury and mercury gas that requiring a “disposal team” to clean up the mess.

Don’t let us start on wind turbines...

Enough said about that. Renewable energy is a pipe dream of sociopaths Governing bodies like the UN and stupid, very stupid politicians.

Chris Hoff December 24, 2018 at 10:21 pm

according to federal data, building solar panels significantly increases emissions of nitrogen trifluoride (NF3), which is 17,200 times more potent than carbon dioxide as a greenhouse gas over a 100 year time period. NF3 emissions increased by 1,057 percent over the last 25 years. In comparison, US carbon dioxide emissions only increased by about 5 percent during that same time period.

In the old days, that would have been called a show stopper. If it’s true then the people pushing solar don’t actually care about climate change one iota.

Davis December 25, 2018 at 6:30 pm

It never was about caring about climate change, the whole scam is another wealth redistribution scheme.

Jon Scott December 25, 2018 at 2:51 am

Come on guys! We are supposed by now to be robots to accept what our “betters” tell us without question. Education at all levels on both sides of the Atlantic has been taken over and weaponised by the left. The enactors of Critical Theory and global capitalists make unlikely bedfellows. There is frequent open discussion around the question of our dissent and how to deal with you and I as criminals against the planet and the (their)

greater good. "Gween is gween because they thay thow". Who needs empiricism in a world where the petulant metaphysics of the useful idiot is supported, encouraged and promoted as a wall behind which the real criminals despoil our culture, our history and bizarrely our nature as well as setting limiting rules for Western Mankinds future existance.....while they rake in all the lovely cash.

Davis December 25, 2018 at 6:28 pm

Just dispose of them the Canadian way, throw them in the dump! We have government recycling where we are. They really ONLY want metal and plastic beverage containers, after we rinse them out and remove the labels. If the recycling depot is full, the collection truck deposits the recycling at the landfill. If either the recycling or garbage truck is broken down, both bins sometimes get emptied into the same truck, at the same time.

Johann Wundersamer December 26, 2018 at 1:08 pm

Solar panels create 300 times more toxic waste per unit of energy than do nuclear power plants. If solar and nuclear produce the same amount of electricity over the next 25 years that nuclear produced in 2016, and the wastes are stacked on football fields, the nuclear waste would reach the height of the Leaning Tower of Pisa (53 meters), while the solar waste would reach the height of two Mt. Everests (16 km). 2

eventually solution :

package the waste into <http://www.world-nuclear.org/information-library/nuclear-fuel-cycle/transport-of-nuclear-materials/transport-of-radioactive-materials.aspx>

sink it bevore Fukushima where it's transported further into the subduction zone and it gets recycled.

john hall January 6, 2019 at 10:29 am

WHY isn't Jeremy Rifkin speaking out against this? Solar panels are essential to his Third Industrial Revolution.
Rifkin would never have let the Biotechnology industry get away with something like this.

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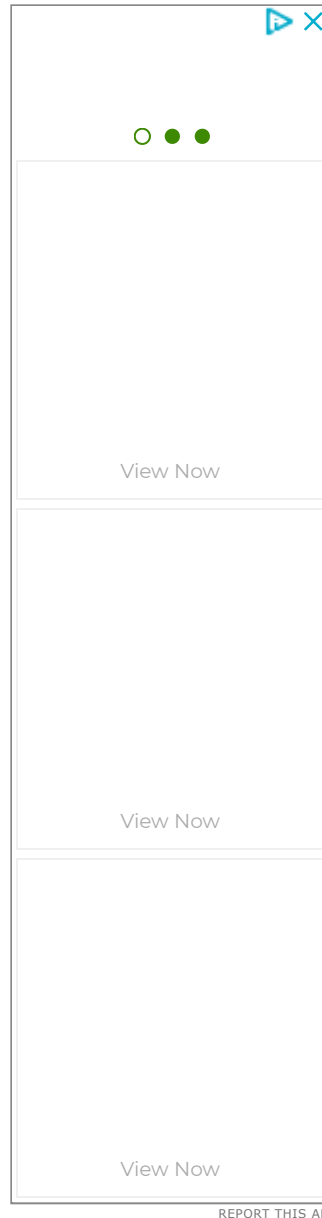
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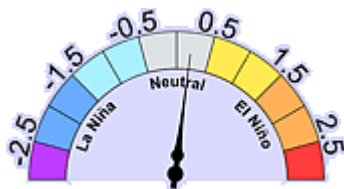


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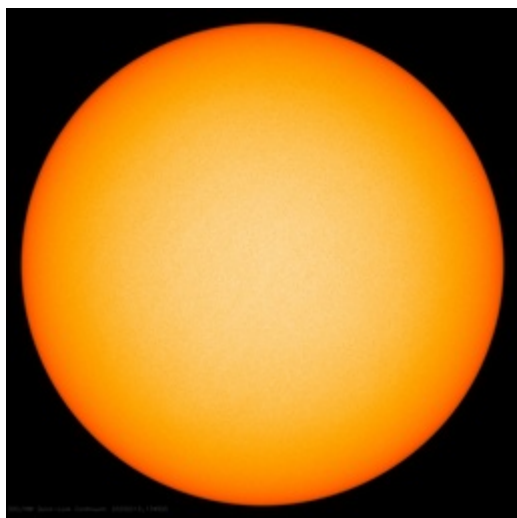
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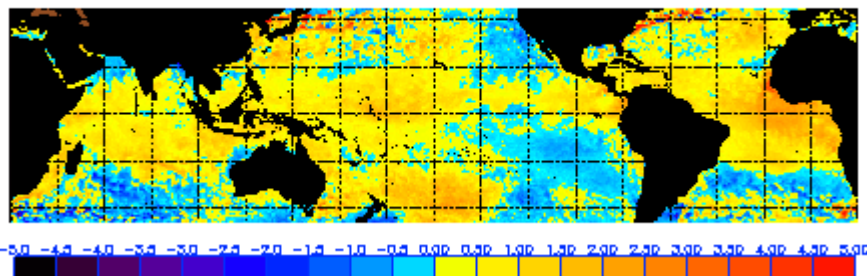
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