Human Caused Climate Change? A Skeptical Look at the Narrative

The Downsides of Green Energy

(seventh PDF of 12)

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Other PDFs on various subjects, exposing the machinations behind the mainstream narrative about our world, can be found here on my website.

Should anyone feel like supporting my continuing this work, a donation button is to be found on my website (left sidebar and on a page shown in the menu). Thank you.

> Note: Please read the first PDF, *Introduction to Human Caused Climate Change? A Skeptical Look at the Narrative* first, where the intent and scope of this project are explained.
>
> Note: Text that is indented both from the right and left (like this paragraph) is quoted from the noted source.

Sections

Introduction

We are told that our only way to survive and reverse the deadly trend of global warming is to get completely off of hydrocarbon usage for energy and transportation. To do this wind power and solar power are championed as sustainable ways to save the planet.

I am no fan of hydrocarbon burning but are the sources of "green" energy actually cleaner, sustainable, and renewable? Like everything else in the mainstream narrative, we are never supposed to question the solutions that are promoted. This PDF will look at some of the downsides to "green" energy and transportation.

For the sake of simplicity I will not continue to use quotation marks around the words "green", nor for "sustainable" and "renewable", although they warrant it. This PDF endeavors to bring attention to the fact that green energy is not magically sustainable or renewable. While the sun is renewable, lithium is not.

Resource Usage in Green Energy

Some Data About Rare Mineral Usage in Green Energy

On the website of the International Energy Agency, there is a report on The Role of Critical Minerals in Clean Energy Transitions. The Executive Summary, In the transition to clean energy, critical minerals bring new challenges to energy security, has lots of graphs showing comparisons. Their introduction:

> An energy system powered by clean energy technologies differs profoundly from one fuelled by traditional hydrocarbon resources. Solar photovoltaic (PV) plants, wind farms and electric vehicles (EVs) generally require more minerals to build than their fossil fuel-based counterparts. A typical electric car requires six times the mineral inputs of a conventional car and an onshore wind plant requires nine times more mineral resources than a gas-fired plant. Since 2010 the average amount of minerals needed for a new unit of power generation capacity has increased by 50% as the share of renewables in new investment has risen.

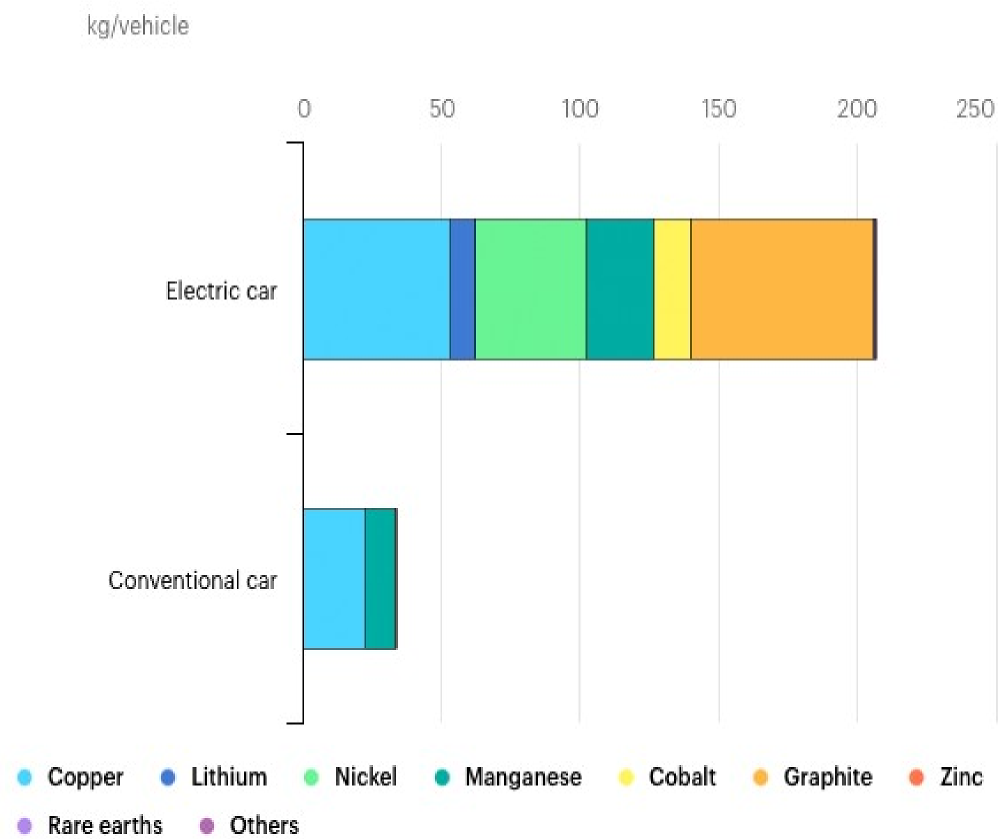
Their summary:

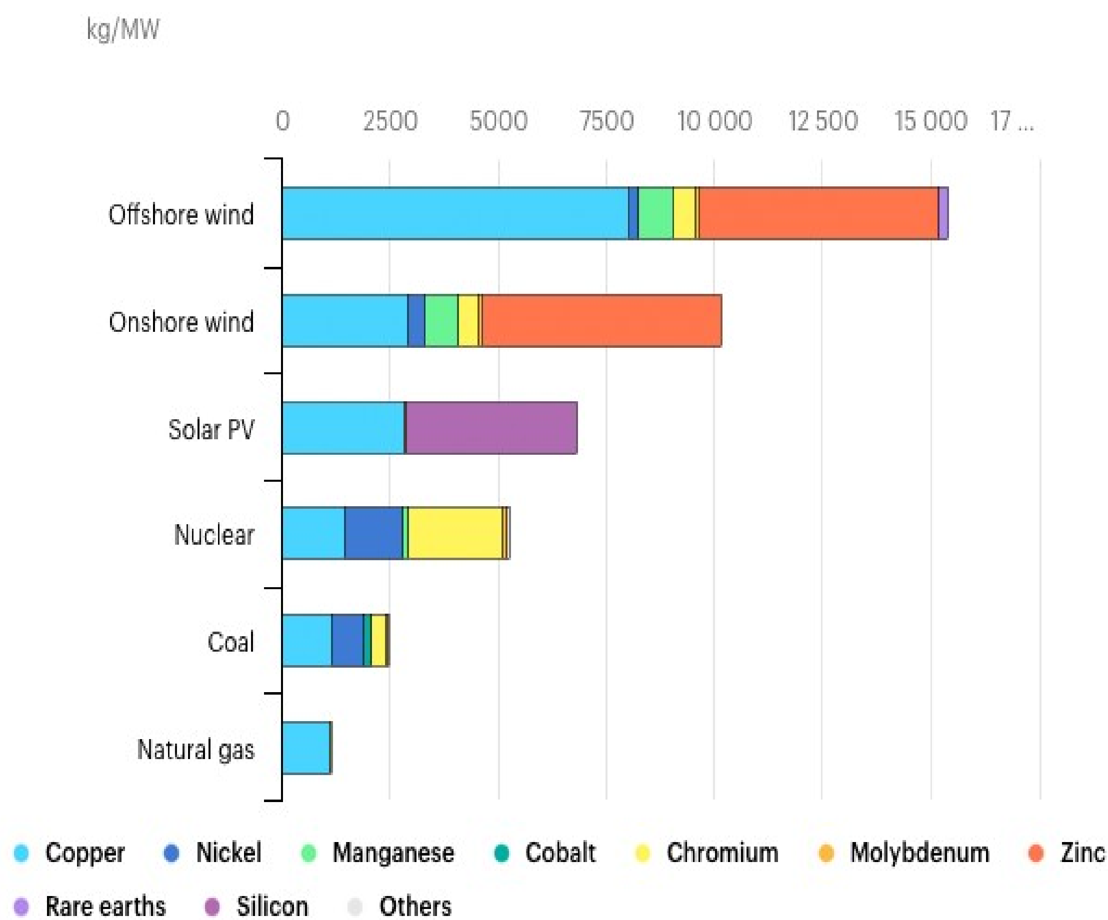
> The types of mineral resources used vary by technology. Lithium, nickel, cobalt, manganese and graphite are crucial to battery performance, longevity and energy density. Rare earth elements are essential for permanent magnets that are vital for wind turbines and EV motors. Electricity networks need a huge amount of copper and aluminium, with copper being a cornerstone for all electricity-related technologies.

The two graphs below show:

Minerals Used in Electric Cars Compared to Conventional Cars

Minerals Used in Clean Energy Technologies Compared to Other Power Generation Sources


kg/vehicle
0
50
100
150
200
250
Electric car
Conventional car
Copper
Lithium
Nickel
Manganese
Cobalt
Graphite
Zinc
Rare earths
Others


kg/MW
0
2500
5000
7500
10 000
12 500
15 000
17 ...
Offshore wind
Onshore wind
Solar PV
Nuclear
Coal
Natural gas
Copper
Nickel
Manganese
Cobalt
Chromium
Molybdenum
Zinc
Rare earths
Silicon
Others

Lots of Minerals (and Oil) are Needed for Sustainable Energy

Two 2020 articles by Mark P. Mills, on the Washington Examiner and Manhattan Institute websites, offer food for thought about the transition from oil to renewables. As he says in one of his articles, "Fundamentally, replacing a standard car with an EV is a swap from using a liquid as the primary energy source to a mélange of solid materials."

Excerpts from the articles, The Myth of the Great Energy Transition (1st two paragraphs) and Mines, Minerals, and "Green" Energy: A Reality Check (3rd paragraph):

> The mining industry necessarily uses oil for heavy machinery, often to generate electricity in remote locations. Global mining already uses nearly twice as much petroleum as the entire country of Germany, and that's before the emerging "gold rush" for energy minerals. The global push for EVs will drive up demand for a variety of other energy minerals from 200% to 8,000%. Mining can be done responsibly, but new mines aren't likely to open in America or Europe. Consequently, a handful of environmentalists have begun to worry about the invasion of pristine and fragile ecosystems around the world in hot pursuit of mineral wealth.
>
> A single EV battery weighs in at about 1,000 pounds. Its fabrication requires digging up roughly 500,000 pounds of materials somewhere. That constitutes a greater-than-tenfold increase in the quantity of material (liquids) that is used by a standard car over its entire operating life.
>
> Oil, natural gas, and coal are needed to produce the concrete, steel, plastics, and purified minerals used to build green machines. The energy equivalent of 100 barrels of oil is used in the processes to fabricate a single battery that can store the equivalent of one barrel of oil.

500,000 Pounds of Earth Extracted per Electric Car Battery

The following is from the Mark P. Mills article referenced above, Mines, Minerals, and "Green" Energy: A Reality Check, but is a list of information, all with footnoted sources. It shows how much "earth" must be dug up to obtain the refined mineral needed:

> A lithium EV battery weighs about 1,000 pounds. While there are dozens of variations, such a battery typically contains about 25 pounds of lithium, 30 pounds of cobalt, 60 pounds of nickel, 110 pounds of graphite, 90 pounds of copper, about 400 pounds of steel, aluminum, and various plastic components. (a)(b)(c)
>
> Looking upstream at the ore grades, one can estimate the typical quantity of rock that must be extracted from the earth and processed to yield the pure minerals needed to fabricate that single battery:

・Lithium brines typically contain less than 0.1% lithium, so that entails some 25,000 pounds of brines to get the 25 pounds of pure lithium. (d)

・Cobalt ore grades average about 0.1%, thus nearly 30,000 pounds of ore. (e)

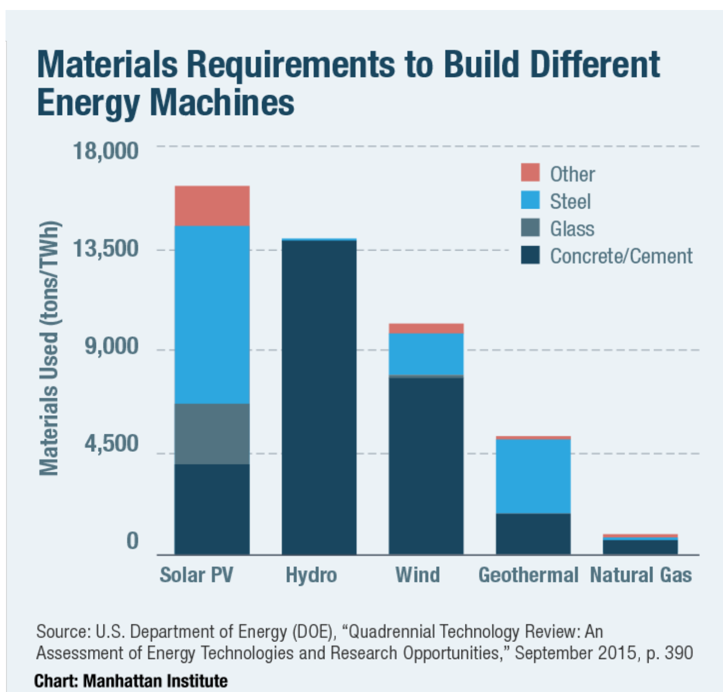
・Nickel ore grades average about 1%, thus about 6,000 pounds of ore. (f)

・Graphite ore is typically 10%, thus about 1,000 pounds per battery. (g)

・Copper at about 0.6% in the ore, thus about 25,000 pounds of ore per battery. (h)

In total then, acquiring just these five elements to produce the 1,000-pound EV battery requires mining about 90,000 pounds of ore. To properly account for all of the earth moved though—which is relevant to the overall environmental footprint, and mining machinery energy use—one needs to estimate the overburden, or the materials first dug up to get to the ore. Depending on ore type and location, overburden ranges from about 3 to 20 tons of earth removed to access each ton of ore. (i)

This means that accessing about 90,000 pounds of ore requires digging and moving between 200,000 and over 1,500,000 pounds of earth—a rough average of more than 500,000 pounds per battery. The precise number will vary for different battery chemistry formulations, and because different regions have widely variable ore grades. It bears noting that this total material footprint does not include the large quantities of materials and chemicals used to process and refine all the various ores. Nor have we counted other materials used when compared with a conventional car, such as replacing steel with aluminum to offset the weight penalty of the battery, or the supply chain for rare earth elements used in electric motors (e.g., neodymium, dysprosium). Also excluded from this tally: the related, but non-battery, electrical systems in an EV use some 300% more overall copper used compared with a conventional automobile. (j)(k)



The article, *Mines, Minerals, and "Green" Energy: A Reality Check*, is 20 pages long and covers a lot of related issues. It includes 127 sources, footnoted and listed at the end, but the footnotes list appears only in the PDF format which can be accessed here.

The Human Cost of Harvesting Resources for Green Energy

As seen in the articles and information above, the push for so called green energy is demanding a huge increase in minerals. This translates into an increase in the labor force for harvesting those minerals. And it's not a pretty picture.

Child Labor in the Congo Mining Cobalt

A March 5, 2018 article on the CBS website, CBS News finds children mining cobalt for batteries in the Congo, tells of visiting the Democratic Republic of Congo to see for themselves what was happening with the Cobalt mining:

> A CBS News investigation has found child labor being used in the dangerous mining of cobalt in the Democratic Republic of Congo. The mineral cobalt is used in virtually all batteries in common devices, including cellphones, laptops and even electric vehicles.
>
> On a recent trip to the southern part of the country, CBS News found what looked like the Wild West. There were children digging in trenches and laboring in lakes -- hunting for treasure in a playground from hell.
>
> The work is hard enough for an adult man, but it is unthinkable for a child. Yet tens of thousands of Congolese kids are involved in every stage of mining for cobalt. The latest research by the United Nations Children's Fund (UNICEF) estimates 40,000 children are working in DRC mines.

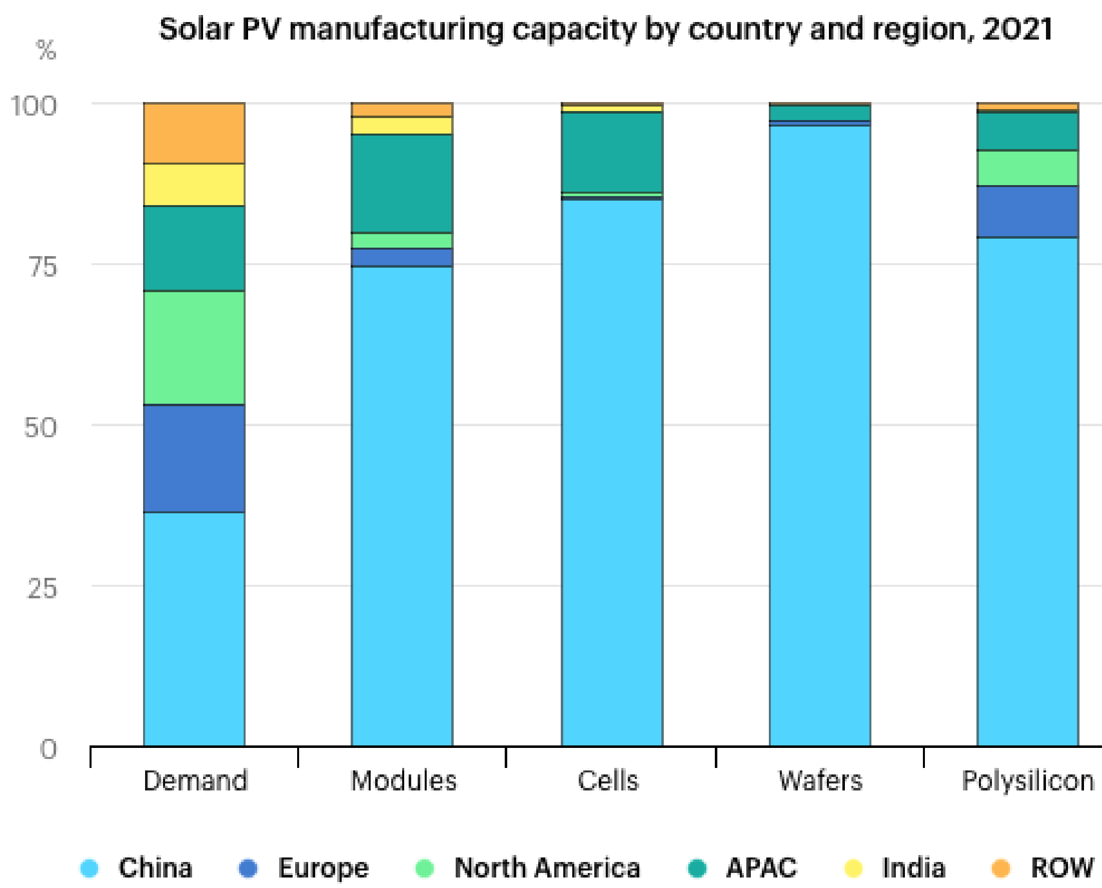
Also check out a follow up article on the CBS website: Apple, Google, Microsoft, Tesla and Dell sued over cobalt mined by children in Congo for batteries.

Solar Panels Now in “Top Five” Worst Slave Industries

An article by Jo Nova, Solar Panels now in “top five” worst slave industries, includes some excerpts from others regarding the slave labor being used for the manufacture of solar panels:

> It’s just another unintended consequence on the road to Climate Heaven. If solar panels were actually efficient and competitive they’d make network electricity cheaper and theoretically, at least, there would be money to pay for real wages. Instead competition is cut-throat, and no country with a lot of solar panels can actually afford to make solar panels.
>
> “For the first time, we have solar panels in our top five most vulnerable products of modern slavery. This is a confronting reality, one that speaks to compounding an intersecting crisis,” Grace Forrest told The Australian. Ms Forrest said. “You can‘t harm people to save the planet.”
>
> It’s no accident 84% of all the world’s solar panels are made in China.

No one else can compete with slave labour, and no one else has as much coal fired electricity.



Graphic from the [International Energy Agency]

Global Slavery Index

On the Walk Free website page, [Global Slavery Index], they have lots of information and statistics. This from the page in a section called *Understanding how we are linked to modern slavery through the products we buy:*

In 2021, G20 countries imported US$468 billion worth of goods at-risk of modern slavery. We present breakdowns of the top five highest-value at-risk products imported by each G20 country.

Of the products at-risk of being produced with modern slavery, G20 countries spent the most on:

1	Electronics	US $243.6B
2	Garments	US $147.9B
3	Palm oil	US $19.7B
4	Solar panels	US $14.8B
5	Textiles	US $12.7B

Windmills and Solar Panels

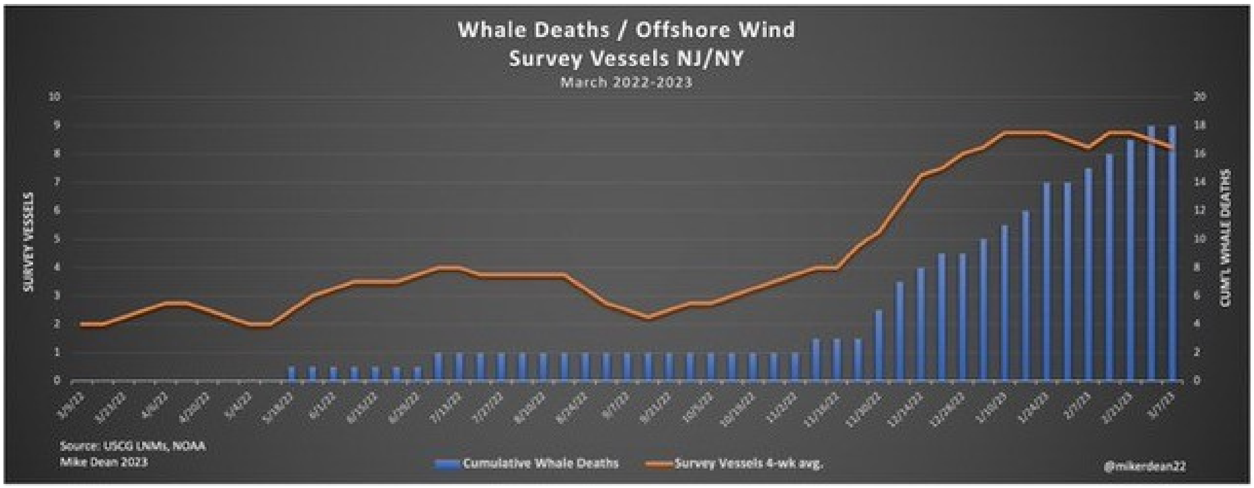
Rise in Whale Deaths Coincides with Windmill Development

A January 23, 2023 article on the CFact website by David Wojick, Evidence says offshore wind development is killing lots of whales, gives evidence that suggests offshore wind farms off of New Jersey are likely responsible for killing whales:

> The federal NOAA Fisheries agency is responsible for whales. An outrageous statement by their spokesperson got me to do some research on humpback whale deaths.
>
> Here is the statement as reported in the press:
>
> > “NOAA said it has been studying what it calls 'unusual mortality events' involving 174 humpback whales along the East Coast since January 2016. Agency spokesperson Lauren Gaches said that period pre-dates offshore wind preparation activities in the region.” Gaches is NOAA Fisheries press chief.

While there is no direct proof that the windmills are responsible, the author shows that the amount of grants for more windfarms and the consequent increase in vessel activity and soundings in preparation for them, coincide with the increase in whale deaths:

> To begin with, offshore lease sales really geared up 2015-16, with nine big sales off New Jersey, New York, Delaware and Massachusetts. These sales must have generated a lot of activity, likely including potentially damaging sonar.
>
> In fact 2016 also saw the beginning of what are called geotechnical and site characterization surveys. These surveys are actually licensed by NOAA Fisheries, under what are called Incidental Harassment Authorizations or IHA’s.
>
> There is some seriously misleading jargon here. IHA’s are incidental to some other activity, in this case offshore wind development. They are not incidental to the whales. In fact the term “harassment” specifically includes injuring the whales. That is called “level A harassment”.
>
> To date NOAA has issued an astounding 46 one-year IHA’s for offshore wind sites. Site characterization typically includes the protracted use of what I call “machine gun sonar”. This shipboard device emits an incredibly loud noise several times a second, often for hours at a time, as the ship slowly maps the sea floor.
>
> Mapping often takes many days to complete. A blaster can log hundreds of miles surveying a 10-by-10 mile site. Each IHA is typically for an entire year.



Neodymium, Praseodymium, Terbium, and Dysprosium

In a September 16, 2020 article on the MDPI website, Energy and Climate Policy—An Evaluation of Global Climate Change Expenditure 2011–2018, they offer some information about windmills (see the article for the sources), that's very interesting and disturbing:

> Several types of wind turbine, such as the permanent magnet synchronous generator (PMSG), require magnets that orient wind turbines into the wind. These magnets contain rare metals such as neodymium (Nd), praseodymium (Pr), terbium (Tb), and dysprosium (Dy). The estimated demand for Nd is projected to increase from 4000 to 18,000 tons by 2035, and for Dy from 200 to 1200 tons. These values represent a quarter to a half of current world output. There are also concerns over the amount of toxic and radioactive waste generated by these mining activities.

The Problem with the Huge Windmill Blades Waste

A September 10, 2019 article on the NPR website, Unfurling The Waste Problem Caused By Wind Energy, looks at the problem of dealing with decommissioned, huge windmill blades:

> Ninety percent of a turbine's parts can be recycled or sold, according to Van Vleet, but the blades, made of a tough but pliable mix of resin and fiberglass — similar to what spaceship parts are made from — are a different story.
>
> "The blades are kind of a dud because they have no value," he said.
>
> Decommissioned blades are also notoriously difficult and expensive to transport. They can be anywhere from 100 to 300 feet long and need to be cut up onsite before getting trucked away on specialized equipment — which costs money — to the landfill.

Cindy Langstrom manages the turbine blade disposal project for the municipal landfill in Casper, Wyo. Though her landfill is one of the only ones in the state — not to mention the entire U.S. — with enough space to take wind farm waste, she said the blades' durability initially posed a financial hurdle.

"Our crushing equipment is not big enough to crush them," she said.

Why Do We Burn Coal and Trees to Make Solar Panels?

A 2019 PDF, by Thomas A. Troszak, Why do we burn coal and trees to make solar panels?, explains in an extensive outline format how solar panels are made, including some exotic processes. Following are several of the steps that are outlined:

> 2. Why do we need to burn carbon to make solar PV? – Elemental silicon (Si) can't be found by itself anywhere in nature. It must be extracted from quartz (SiO_2) using carbon (C) and heat (from an electric arc) in the "carbothermic" (carbon+heat) reduction process.
>
> 3. Even more fossil fuels are burned later, to generate electricity for the polysilicon, ingot, wafer, cell, and module production steps shown. As a result of all these processes, the solar PV industry generates megatons of CO and CO_2. But as shown below (fig 4), some often-cited descriptions of solar module production omit the raw materials and smelting process from the PV supply chain which obscures the use of fossil fuels and the vast amount of deforestation necessary for solar PV production.
>
> 6. Hardwood Chips (also called Metchips) – Matchbox-sized fragments of shredded hardwood must be mixed into the silicon smelter "pot" for many reasons – to allow the reactive gasses to circulate, so the liquid silicon that forms can settle to the bottom for tapping, and to allow the resulting CO (and other gasses) to escape the smelter "charge" safely.

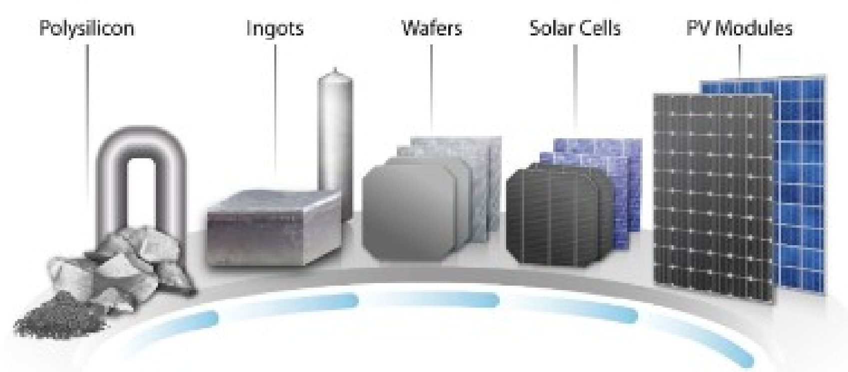


Figure 1. Schematic of c-Si PV module supply chain

Figure 4. (source: National Renewable Energy Laboratory, 2018)

The Solar Panels Waste Problem

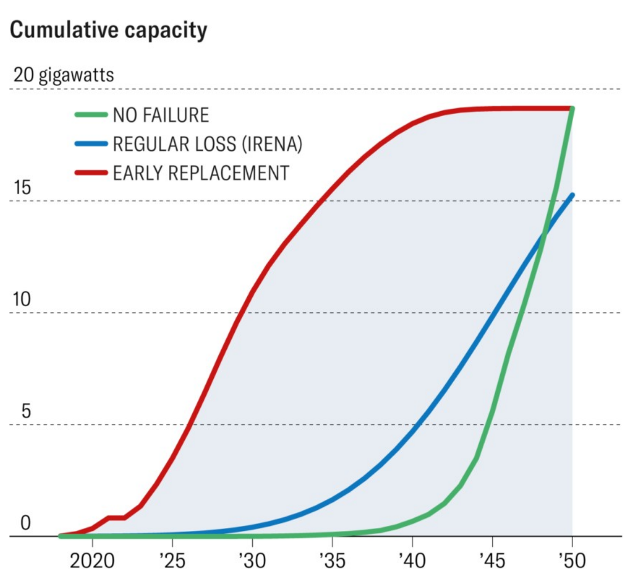
A December 2, 2020 article by Kristina Panos, [The Dark Side Of Solar Power](), explains how the solar panel waste issue is growing:

> Everybody loves solar power, right? It's nice, clean, renewable energy that's available pretty much everywhere the sun shines. But solar isn't all apples and sunshine — there's a dark side you might not know about. [Manufacturing solar panels is a dirty process from start to finish](). Mining quartz for silicon causes the lung disease silicosis, and the production of solar cells uses a lot of energy, water, and toxic chemicals.
>
> The other issue is that solar cells have a guaranteed life expectancy of about 25 years, with average efficiency losses of 0.5% per year. If replacement begins after 25 years, time is running out for all the panels that were installed during the early 2000s boom. The International Renewable Energy Agency (IREA) projects that by 2050, we'll be looking at 78 million metric tons of bulky e-waste. The IREA also believe that we'll be generating six million metric tons of new solar e-waste every year by then, too. Unfortunately, there are hardly any measures in place to recycle solar panels, at least in the US.
>
> In the US, there are no federal mandates for recycling solar panels, and only Washington state and New York have any kind of laws about them. As a result, only about 10% of American panels are recycled. The other 90% get shipped to countries without mandates for reuse, or end up in landfills, leaching lead and other toxic chemicals into the Earth.
>
> Right now in the US, recycling solar panels is difficult, and recovering the silver, copper, and silicon requires custom solutions. Scrapping the aluminum frames and silver from the metallization paste doesn't net that much, and it costs $12-25 per panel plus transportation costs to recycle them. Dumping them in landfills only costs about $1 per panel.

Graphic from [The looming solar trash wave]():

The Solar Trash Wave

According to our research, cumulative waste projections will rise far sooner and more sharply than most analysts expect, as the below graph shows. The green "no failure" line tracks the disposal of panels assuming that no faults occur over the 30-year life cycle; the blue line shows the official International Renewable Energy Agency (IRENA) forecast, which allows for some replacements earlier in the life cycle; and the red line represents waste projections predicted by our model.



Source: International Renewable Energy Agency, Electricity Data Browser, Global Solar Atlas

HBR

Are Solar Panels Hazardous Waste?

Solar panels have a lifespan of about 25 years. And once spent, they may be considered "hazardous waste". An article on the EPA website, End-of-Life Solar Panels: Regulations and Management, discusses the subject of solar panels waste:

> Hazardous waste testing on solar panels in the marketplace has indicated that different varieties of solar panels have different metals present in the semiconductor and solder. Some of these metals, like lead and cadmium, are harmful to human health and the environment at high levels. If these metals are present in high enough quantities in the solar panels, solar panel waste could be a hazardous waste under RCRA. Some solar panels are considered hazardous waste, and some are not, even within the same model and manufacturer.
>
> It’s hard to compare the damage done by the solar panel manufacturing process to the damage caused by burning fossil fuels for energy. Neither one is good, so are we solving one problem while creating another? If we don’t figure out a global scheme for recycling panels, we’re certainly headed for a crisis.

Zero Carbon

The Cost of Storage to Make Renewable Energy Viable

A November 20, 2017 article by Euan Mearns on the Energy Matters website, Grid-Scale Storage of Renewable Energy: The Impossible Dream, goes into great detail and looks at a number of options for storage of electricity. His calculations are based on statistics about the UK's renewable energy production in 2016.

His introduction:

> The utopian ambition for variable renewable energy is to convert it into uniform firm capacity using energy storage. Here we present an analysis of actual UK wind and solar generation for the whole of 2016 at 30 minute resolution and calculate the grid-scale storage requirement. In order to deliver 4.6 GW uniform and firm RE (renewable energy) supply throughout the year, from 26 GW of installed capacity, requires 1.8 TWh of storage. We show that this is both thermodynamically and economically implausible to implement with current technology.
>
> The mean wind and solar production for 2016 was 4.574 GW and the 1.8 TWh of storage is therefore required to guarantee this fairly meagre

amount of generation. If we want to contemplate grid-scale RE in the UK with 25 GW of guaranteed firm supply we would need 9.8 TWh of storage. I will however confine the following discussion to the 1.8 TWh required for 2016 since this amount of storage is already implausible to consider seriously.

Image below:
The Tesla big battery takes shape in S Australia.
13,954 of these 129 MWh facilities costing £405 billion
would have been required to back up UK wind and solar in 2016.

Excerpts from his section, *How to Build 1.8 TWh of Storage*:

- Pumped Hydro Energy Storage (PHES)

My basic unit of currency in PHES is the proposed Coire Glas PHES scheme in Scotland that I described in The Coire Glas pumped storage scheme – a massive but puny beast.

To provide 1.8 TWh of storage would require 60 such schemes at a notional cost of £48 billion. 60 Coire Glas schemes would deliver 36 GW of power, 4 times more than is required. The design therefore is over-dimensioned and could be scaled back to 150 MW that would reduce the cost.

I am going to cut this discussion short since it should be clear that we are unlikely to build 60 gigantic PHES schemes in Scotland or the UK to back up the promise of 4.574 GW of firm RE capacity, let alone 5 times this much to up-scale to ~ 25 GW. The latter is an impossible dream.

- Lithium Ion Battery Storage

Elon Musk, Tesla and the Big South Australian Battery (BSAB) has been very much in the news recently. Musk promised to deliver the battery for free if the delivery date of 1 December was not achieved. The clock is ticking. The BSAB is my standard unit of battery currency.

To provide 1.8 TWh would require 13,954 BSABs at a cost of £405 billion, 8.5 times more expensive than the PHES option. The BSAB is a toy designed for short-time-scale frequency control and for bridging short-time-scale grid interruption. It is not grid scale storage and referring to it as such is deception. I think it is time to halt this discussion too.

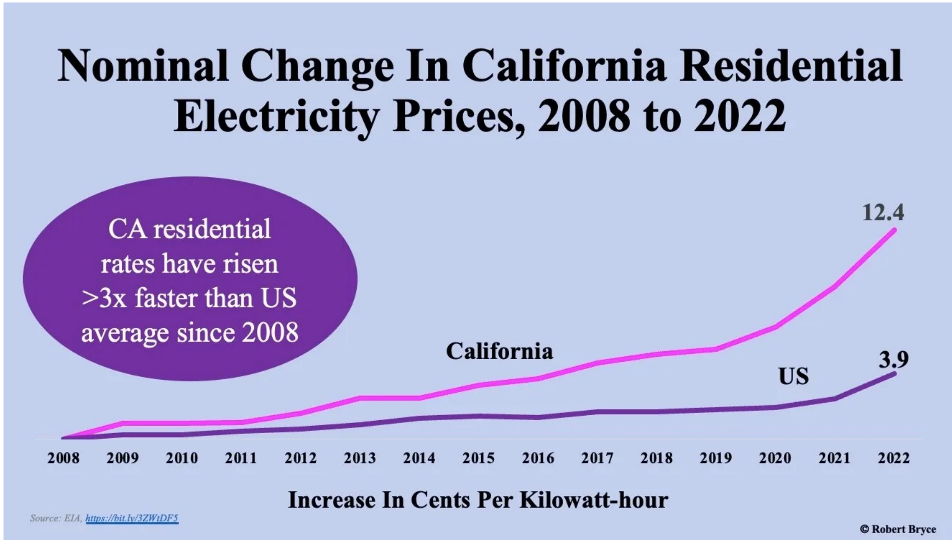
California's Push to Go Green

The March 24, 2023 article by Robert Bryce, California Screamin', reports on two facets of the net zero mania; legislation to force the green agenda and the economic fallout. See the article for sources.

From the article:

> The move [banning the use of natural gas-fired water heaters] is the latest example of how California policymakers are adopting a phalanx of regulations that are forcing residents to use electricity instead of natural gas. According to the Sierra Club, which has been leading the effort to ban the direct use of natural gas, 74 California communities have passed forced electrification measures since 2019. And these regulations are being approved at the same time electricity costs in the state are soaring. Two weeks before the BAAQMD passed its ban on natural gas appliances, the Energy Information Administration released data showing that California's residential electricity prices jumped by 14.7% in 2022.
>
> In 2015, Governor Jerry Brown signed a law that boosted the mandate to 50% by 2030. In 2018, California lawmakers imposed yet another mandate that requires the state's electric utilities to procure at least 60% of their electricity from renewables by 2030 and 100 percent "zero-carbon" electricity by 2045. In 2022, Gov. Gavin Newsom signed into law a measure that "creates clean electricity targets of 90% by 2035" and reaffirmed the state's target of 100% "clean electricity" by 2045.
>
> Since 2008, when Schwarzenegger mandated renewables in the electric sector, California's residential electricity prices have increased more than three times faster than those in the rest of the country. As can be seen in

the graphic below, residential electricity prices in the state jumped by 12.4 cents per kilowatt-hour while prices in the rest of the country increased by less than four cents per kilowatt-hour.



Those prices will continue soaring. Last year, the California Public Utilities Commission unanimously approved a scheme that aims to add more than 25 gigawatts of renewables and 15 gigawatts of batteries to the state's electric grid by 2032 at an estimated cost of $49.3 billion. In addition, the California Independent System Operator released a draft plan to upgrade the state's transmission grid at a cost of some $30.5 billion. The combined cost of those two schemes is about $80 billion. Dividing that sum among 39 million residents works out to about $2,050 for every Californian.

The punchline here is obvious: California provides a stark warning to the rest of the United States about how NOT to manage an electric grid. Aggressive renewable energy mandates may be politically popular, but they come with exorbitant price tags that punish the poor and provide negligible (if any) cuts in CO_2 emissions.