

3 April 2019

Senator Markey  
255 Dirksen Senate Office Building  
Washington, DC 20510

Representative Ocasio-Cortez  
229 Cannon HOB  
Washington, DC 20515

Cc: Speaker Pelosi, Sens. Booker, Feinstein, Klobuchar, Sanders, Warren, Whitehouse,  
all Dem Pres Candidates, and news media

Dear Senator Markey, Representative Ocasio-Cortez and all addressed above,

I'm writing you today with some suggestions for how H.R. 109 (The Green New Deal) might win Senate approval without sacrificing any of the long-term ideals to which you aspire. It's been alleged that we have "12 years" left to get cracking on planetary problems – we do not.

But, congratulations on your election, Rep. Ocasio-Cortez, even as well as a write-in in a district you don't represent. My mother was the first woman to be elected to my NJ hometown's Council. Your incisive questioning at Congressional hearings reminds me of her, so it is especially appreciated.

Associates and I have been working here and in other countries to inform people on the facts of global warming and threats to oceans and species. Some of us are PhDs, some are writers, artists or videographers, some are teachers, some are in business, but most are ordinary citizens. All are directly working to educate our legislators and fellow citizens on environmental and energy facts -- the first fact being that unless we're magically still in the Nixon Administration, there is no time left.

My science/engineering qualifications allowed me to write this letter: three degrees in electrical engineering (including plasma physics), a statistics degree, and a degree in mathematical models for educational research. With that background, my main goal is to help correct common misperceptions which abound in public discourse on energy and the environment. Addressing these issues in California has allowed me to serve as an expert witness in some proceedings at the California Public Utilities Commission. I hope what I express below will benefit us all. I'll be happy to answer any questions.

Sincerely,

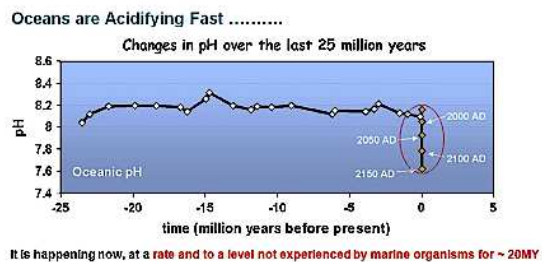
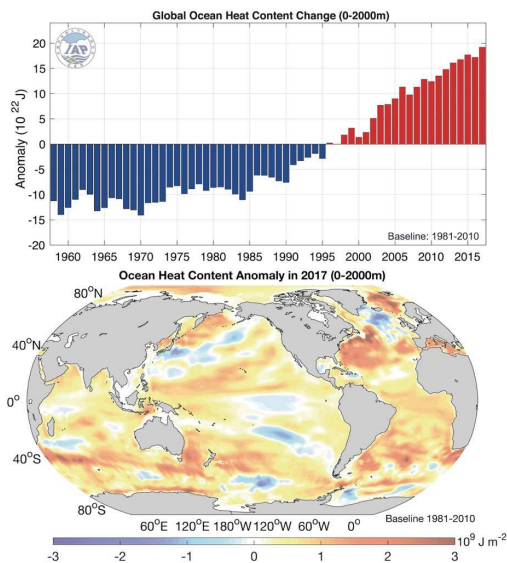
Dr. Alexander Cannara [cannara@sbcglobal.net](mailto:cannara@sbcglobal.net)  
Menlo Park, Calif.  
650-400-3071

## Preface

Though the goals of the Green New Deal (GND) are admirable, there are some technical mistakes in HR109 (<http://tinyurl.com/y54exovj>) which, if corrected, would help to win support from all parties, and maximize environmental benefits. Here are some comments on HR109 as read today:

### Comment on HR109: **RESOLUTION**

It fails to mention the immediate threats of ocean acidification, oxygen loss and warming. It mentions coral reefs, but fails to mention the far larger population of sea life that depends on ocean chemistry (pH and temperature) being maintained much as they have for the past ~50 million years. These calcifying creatures are, in fact, the dominant source of CO<sub>2</sub> removal from air & sea – they remove ~1 billion tons of CO<sub>2</sub> each year to ocean sediment/limestone. Land plants and soils don't come close. Soil organisms actually add multiple GHGs via their digestion of plant material. There are drivers of ocean extinctions that soon will begin eliminating species from coccoliths to whales, and thus about 15% of all human food protein. GND must be cognizant of more than climate “warming”...



A few years back, when talking with an IPCC group leader, an atmospheric physicist friend summed up IPCC's blinkered forecasts of 2100 temperatures by: “Why care about 2100 temperatures if oceans are dead by 2050?”

The only solution to this threat is to cease emissions that change ocean chemistry and temperature and actively correct/protect ocean chemistry, such as pH. One of these introductions below may be useful (more references appear later in this letter)...

<http://tinyurl.com/zprh78l>

<http://tinyurl.com/hhlrd4o>  
<https://tinyurl.com/yafgmlmd>

Comment on HR109: *(2) the goals described in subparagraphs (A) through (E)...*

*2(B) (i) by eliminating pollution and greenhouse gas emissions as much as technologically feasible;*

*2(C) meeting 100 percent of the power demand in the United States through clean, renewable, and zero-emission energy sources,*

Both above goals have long been addressed – first by President Kennedy: <http://tinyurl.com/6xgpkfa> later by France, Sweden, Japan, S. Korea, Canada... and now by China, India, Russia and other jurisdictions around the world. More detail appears later, below. Scientists around the world exhort us to take note.

Comment on HR109: *2(D) building or upgrading to energy-efficient, distributed, and “smart” power grids, and ensuring affordable access to electricity;*

*4(D) making public investments in the research and development of new clean and renewable energy technologies and industries;*

Goals 2D & 4D are related and need some adjustment. Indeed, affordable, adequate electricity is a worldwide need. In remote areas, sources we think are clean, like a solar panel and battery for a remote African family’s home, is a start. But, in industrialized (OECD) regions, the smartest approach is to treat electricity like water/sewer/fire... services – reliable, regulated “utilities”. Our Rural electrification Act of 1935 provides a good example of legislation that raised the quality of life throughout remote regions of America by bringing utility-grade electric service (and later telecom service) to almost all of us.

Sadly too often the meaning of “utility” is sacrificed to an imagined good, like “renewable energy”, which neither exists nor ever could cleanly provide “utility-grade” electricity. This is discussed in more detail later, but we all should recall our science classes and the principle of “conservation of energy”, which makes clear why “renewable” energy is a marketing term, not a real thing.

The term “smart” is also a marketing invention, since we’ve long mastered the ability to distribute electricity widely and reliably. The goal is to replace polluting sources in electric and other utilities. Adding unnecessary complexity is not smart, in the normal sense of the word.

Comment on HR109: *2(M) identifying other emission and pollution sources and creating solutions to remove them;*

Indeed, we must be relentless in eliminating pollution sources and rectifying polluted lands and waters. This means we must fully understand any technologies we support for any purpose, such as for generating clean electricity. One unfortunate happening is the pollution created by mistaking wind and solar power as inherently clean. Chinese farmers sadly suffer most from the effects of that misperception – a former fertile valley now turned to poisonous sludge from processing key wind-generator and electronics manufacturing materials...



Similar issues with our various technology choices appear later here. GND must take these realities into consideration before proposing legislated policies.

Each day, we're reminded nature has no political party -- the consequences of onrushing climate/ocean changes affect everyone. Now, it's more important than ever to present a plan which can bring all Americans: Democrats, Republicans, Independents, Libertarians, Greens... everyone, to the table so we can move forward together. There's no time to lose, because there's no time left.

## Discussion

I hope all addressed here find the following statements clear.

Regarding the draft Green New Deal (GND) – its support for social issues like jobs, healthcare, fair wages & taxes... is great! Its intent to stave off global warming and oceanic extinctions via emissions reductions plus a carbon tax -- also great – late, but great. If JFK's plan had been followed by later Presidents, we'd have eliminated combustion power by about 2000.

Many of us scientists/engineers and ordinary voters have been working to those ends for years, in the spirit of James Lovelock's Gaia. If you're unfamiliar with why climate & ocean threats are tied...

<http://tinyurl.com/zprh78l>

<http://tinyurl.com/hhlrd4o>

<https://tinyurl.com/yafgmlmd>

<https://youtu.be/0NUe-pUVE8>


<https://tinyurl.com/ycxlszvj>




However, the present GND's statements on energy need work. We see anti-science from profit-seeking quarters, and even from our present DC Administration. GND will fail our descendants if it does the same. After all, the fundamental purpose of expanding clean energy is environmental protection.

Mark Twain said: "It's easier to convince someone of a lie than to convince someone they've been lied to".

Unfortunately, we've indeed been lied to and we're being lied to, especially by those harvesting subsidies from the many to the few and especially by combustion folks knowing how so-called 'renewables' increase their sales – recent TV and print ads by BP, Shell, Exxon-Mobil, etc. illustrate their joy in seeing natural-gas sales expand as low performance energy sources like wind/solar expand. BP even reveals their hope -- >50% of 2030 energy produced from combustion products...



Wind turbines are flying high. But how do you keep the lights on when the wind stops blowing? At BP, we see a simple answer: We see cleaner-burning natural gas. It's a perfect partner to renewables.

Share of fuel 1990-2030 (% shares of world energy use)			
		1990	2030
	Renewables*	0.4	6.3
	Nuclear	5.6	6.0
	Hydroelectric	6.0	6.8
	Coal	27.3	27.7
	Natural gas	21.8	25.9
	Oil	38.9	27.2

\* Renewable energy includes biofuels

"Democracy depends on education" – FDR, who created the original New Deal.

The GND should respect that advice, plus what JFK warned us: "...too often we choose the comfort of opinion over the discomfort of knowledge".

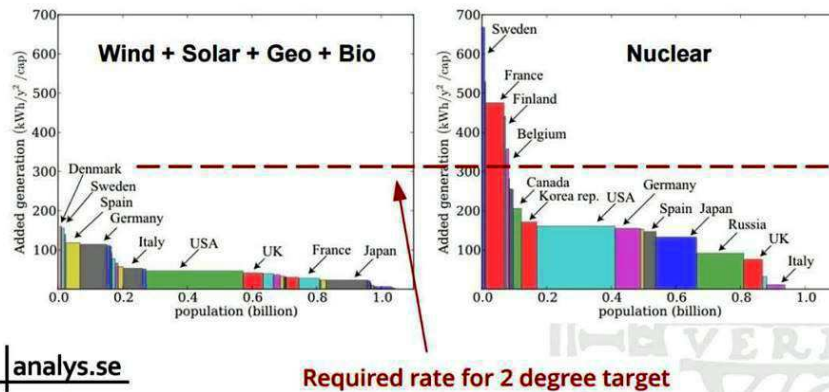
We all depend on studying facts. We all depend on those chosen to represent us to study facts before affecting us with decisions – "When Congress makes a joke, it's the law" (Twain again). We and our descendants depend on you all to govern through facts.

To meet its goals, here are some facts that GND must countenance. This graphic below, from a Swedish study, shows how woefully inadequate 'renewables' are to meet our clean-energy growth needs – even just IPCC-suggested needs...



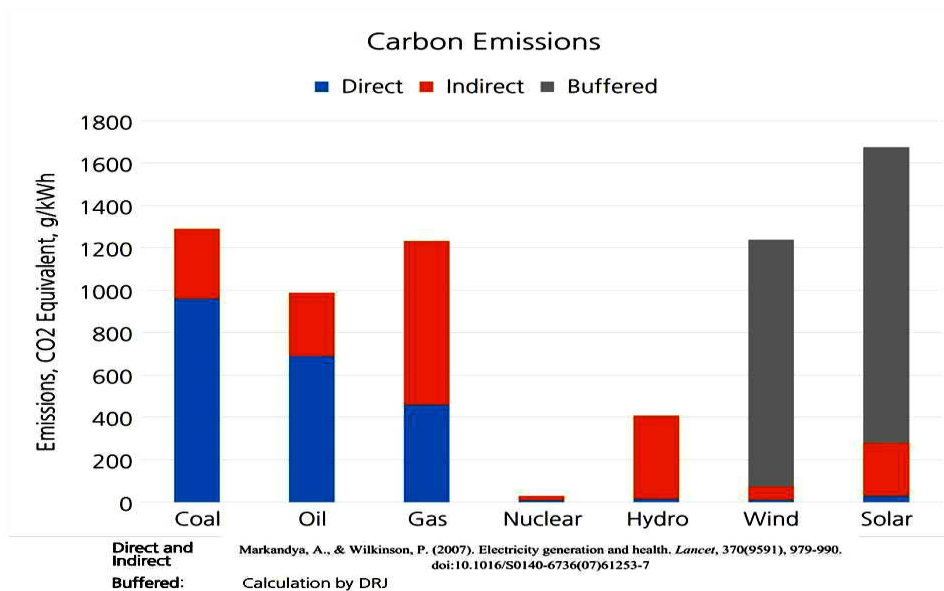
## How fast is fast enough?

### Fastest added generation of electricity per person and year



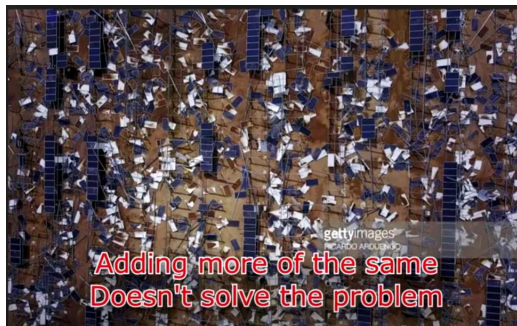
Source: World Bank & BP Statistical Review, picture by Carl Hellesten

Without great expansion of nuclear power we fail ourselves, our descendants and all species on our planet. Simple. The lie that wind/solar can do anything useful at utility scale is a lie GND must reject, or it will do more than fail us. A President who cared determined a proper course even without then knowing the environmental depth of our emissions disaster: <http://tinyurl.com/6xgpkfa> The combustion industry always studies facts. It has long known nuclear power could supplant it, cleanly so.



Now, combustion interests support 'renewables' because they guarantee the fact of combustion backup (buffering). And storage guarantees both a 3-4 times 'renewables' overbuild, resource conscription, pollution and combustion for manufacturing & backup.

Any energy plan that depends on wind/solar deployments suffers a breathtaking denial of knowledge that FDR, JFK and others\*\*\*\*\* have warned us against. It is, in fact, unethical. Some Puerto Ricans were killed after hurricane Maria simply because their electrical system had partly depended on fragile wind/solar that never should be installed in storm-prone regions: <https://tinyurl.com/y83g6htx> The Virgin Islands suffered similarly...

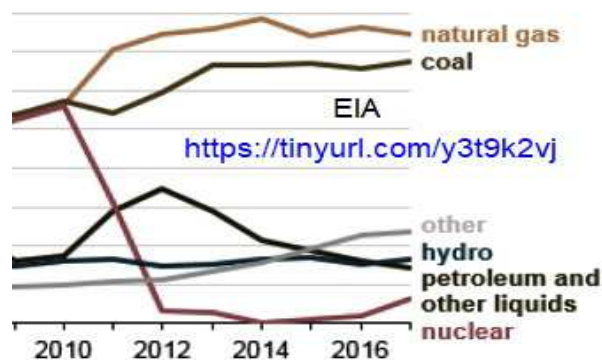


Even the occurrences of the Polar Vortex and other severe weather events have shown the wisdom of JFK's study: <https://tinyurl.com/y6bxq46s> & <http://tinyurl.com/yy4etjht>

We can make the right choices, if we study facts and take Einstein to heart...  
 "The most incomprehensible thing about the world is that it is comprehensible."

Fortunately, the public is becoming informed on what we and the GND should do...  
<https://tinyurl.com/y2wx5c4q>  
<http://tinyurl.com/yykrohxo>  
<http://tinyurl.com/y34mbcev>

Even the IEA & EIA are instructing us, as above. To cement in why combustion and subsidized wind/solar interests fear nuclear power, consider direct evidence of their loss as Japan wisely restores their nuclear power to operation: <https://tinyurl.com/y3t9k2vj>  
 Gas and other petroleum use shrinks as nuclear output grows (source: EIA)...



As for investors in subsidized wind/solar power, they know, and some admit, they're doing no service for us or the environment...

Warren Buffet (2014): *"...on wind energy, we get a tax credit if we build a lot of wind farms. That's the only reason to build them. They don't make sense without the tax credit."* <http://tinyurl.com/meule2r>

Further, electricity has a unique property that encourages scams. It's a "fungible" resource. We can't tell, at our electric-utility service point, where the electric energy delivered to us comes from. We can't tell if Buffet's wind or coal or both generate what we receive. Coal/gas/oil power can be "greenwashed" with a bit of wind/solar. Without extensive audits of their contracted sources, electricity aggregators (CCAs in Calif.) cannot know if their customers are indeed getting the clean electricity they pay for.

In contrast, when we think what "utility" service means, we see that services of water/sewer/police/fire... are each identifiable by source, via test, piping, uniforms... Our incoming electric energy isn't – it's scammable. The GND must grasp this reality.

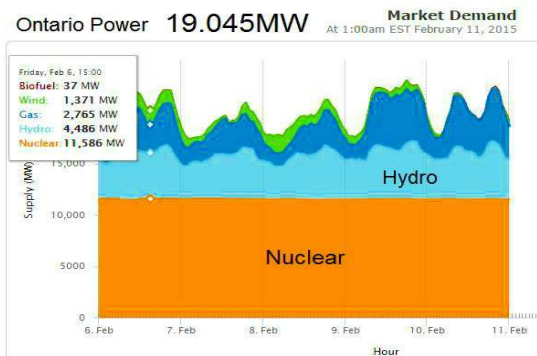
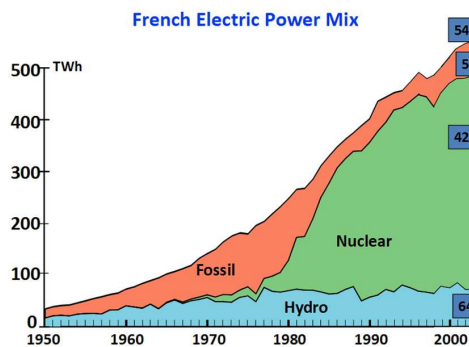
Many of the problems we have with power generation and distribution come from the bad decision Congress made in 2005 to repeal the Public Utilities Holding Company Act of 1935, which protected Americans (via the SEC) from exploitive utility holding-company practices. Before the repeal, ENRON was created by an exception to the PUHCA. We all know how well that went. But President G. W. Bush signed the repeal anyway. Now the SEC doesn't oversee how holding companies manipulate those they hold and the money generated from American utility customers.

If the GND does nothing else on energy, it must restore the PUHCA.

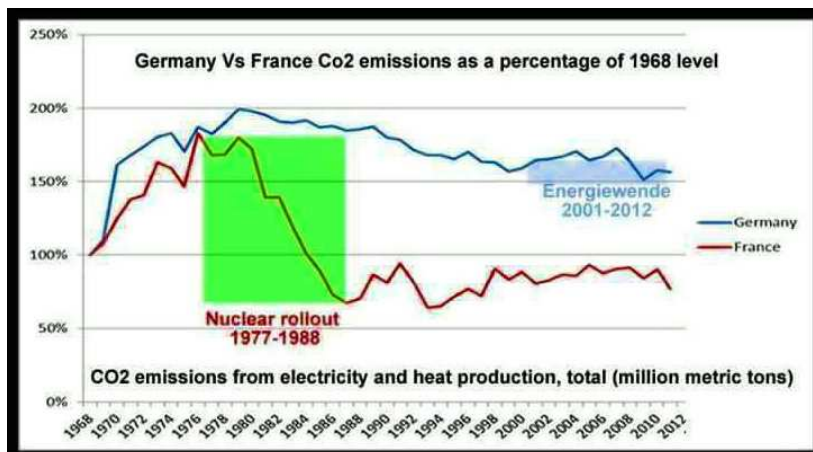
In the House, Rep. Ocasio-Cortez recently labelled "climate change" as "a national emergency". Indeed, it is in fact an international emergency, because of decades of governmental laxity to respond to decades of scientific facts. Today, the GND must be driven by the same and new facts, or it will fail our descendants and species around the world.

An example of what we GND advocates must grasp is that "climate change" is an amelioration created during the Bush-Cheney administration by lobbying interests such as The Heartland Institute – it sounded less threatening than "global warming", etc. The actual threat created by about 200 years of unfettered combustion power is, factually, global warming, ocean acidification and species extinctions. The 5 links on the first page here cover much of that sad reality – a reality we were on track to attenuate by about 2000, had JFK's 1962 energy choice been followed to completion and not sidetracked by 1970s politics and lobbied combustion interests.

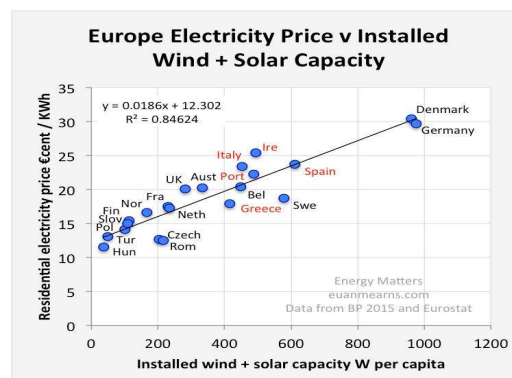
Fortunately, the French were stalwart, under OPEC stimulation, eliminating most combustion power before about 2000. Later, thankfully, Canada, Japan, Russia, S. Korea, Sweden, and, now China, have followed suit. As James Lovelock said in 2013 -- "We need nuclear power soon."...



Sadly, Germany has shown us all what not do – increase emissions by reducing reliable nuclear power while increasing both unreliable wind/solar and combustion. German politics eclipsed facts, despite Germany’s Prime Minister calling nuclear reduction “a mistake”. The mistake is now visible worldwide: <https://tinyurl.com/y775byum> & <http://tinyurl.com/y2vb7y3q> The GND cannot make similar mistakes. Our descendants are watching from the future.

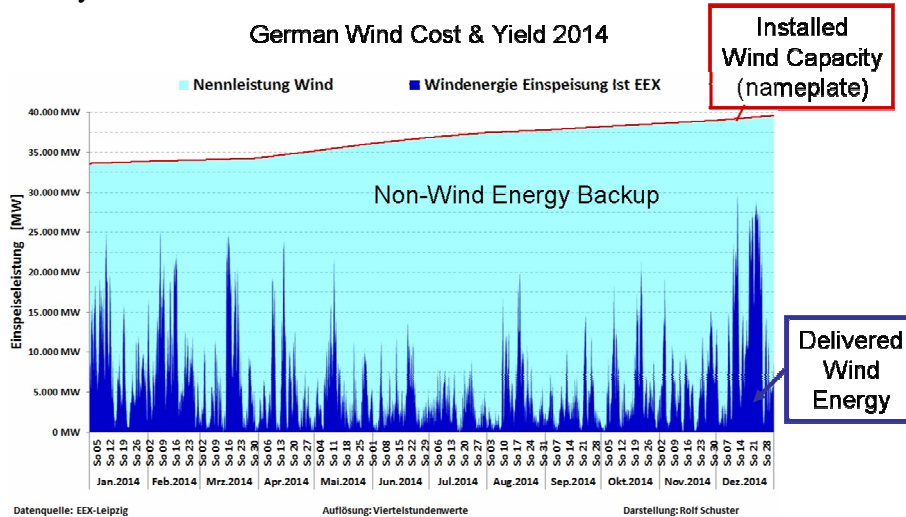


Specific to its unwise deployments of wind/solar power, Germany forced its citizens to pay more for less reliable electricity, while suffering higher pollution, even for those outside German borders...





The German yield (blue spikes below) on its huge wind investments (red line) is a cautionary tale...



German solar yield is worse. The reason is simple: political avoidance of scientific/engineering facts. Again, a factual warning for GND policy.

This DoE table (for 2011-2014) shows how poorly our own wind/solar investments perform (a new DoE quadrennial report will be out this year)...

**Capacity:** Fig. 4.1, DoE 2015 Quadrennial Review: <https://tinyurl.com/y8xecbz2>

	Generation capacity 2010 (GW)	2014 Capacity GW	Power production 2010 (TWh)	2014 Delivery TeraWattHrs	CF=
Coal	316.8	300.4	1,847	1,586	
Gas	409.7	430.3	999	1,122	3769 0.30
Nuclear	101.2	99.2	807	795	869 0.91
Hydropower	78.8	79.2	260	258	
Wind	39.1	66	95	182	596 0.31
Biopower	11.4	13.4	53	64	
Solar	0.86	9.3	1.2	18.3	81.5 0.22
Geothermal	2.4	2.6	15	17	
Fuel cell	0.06	0.2	0.3	1	

The rightmost column shows the fractional energy yield (Capacity Factor, CF) of each equipment investment (Capacity) in the 3<sup>rd</sup> column. Thus all our wind investments only returned 31% of what our deployed wind generators were capable of – winds are not reliable and are even subject to climate. Similarly poor return occurred for solar generation. Both are “intermittent” energy sources that yield useful output for less than half of any day/week/month/year. Yet they consume more of Nature and resources than do more reliable, higher CF sources – the reason? Anti-science politics.

Much as newly minted doctors swear to “do no harm”, ethical engineering graduates can grasp why ‘renewables’ are not suitable for utility-grade power generation, and so eschew them.

In contrast, reliable sources like nuclear power yield a high percentage of return (e.g., 91%) on their Capacity investment. That Capacity is directly fed by materials extracted from the environment and then processed by energy-intense industry. Not surprisingly then, the consumption of raw materials, manufacturing pollution production and environmental impacts are far lower for energy sources that make the most effective use of material/energy inputs per kilo-Watt Hour that they produce. For instance, building a wind generator of about 2MW Capacity consumes about 2000 tons of raw materials, all of which are processed via fossil fuels. Yet, on a yearly average, that wind machine only delivers about 600kW.

This DoE table exposes overall materials-consumption for each energy source...

**Materials:** Fig. 10.4, DoE 2015 Quadrennial Review: <https://tinyurl.com/y8xecbz2>

**Table 10.4** Range of materials requirements (fuel excluded) for various electricity generation technologies<sup>50</sup> **Tons/TWhr?**

Materials (ton/TWh)	Generator only				Upstream energy supply and generator			
	Coal	NGCC	Nuclear PWR	Biomass	Hydro	Wind	Solar PV (silicon)	Geothermal HT binary
Aluminum	3	1	0	6	0	35	680	100
Cement	0	0	0	0	0	0	3,700	750
Concrete	870	400	760	760	14,000	8,000	350	1,100
Copper	1	0	3	0	1	23	850	2
Glass	0	0	0	0	0	92	2,700	0
Iron	1	1	5	4	0	120	0	9
Lead	0	0	2	0	0	0	0	0
Plastic	0	0	0	0	0	190	210	0
Silicon	0	0	0	0	0	0	57	0
Steel	310	170	160	310	67	1,800	7,900	3,300

Key: NGCC = natural gas combined cycle; PWR = pressurized water reactor; PV = photovoltaic; HT = high temperature

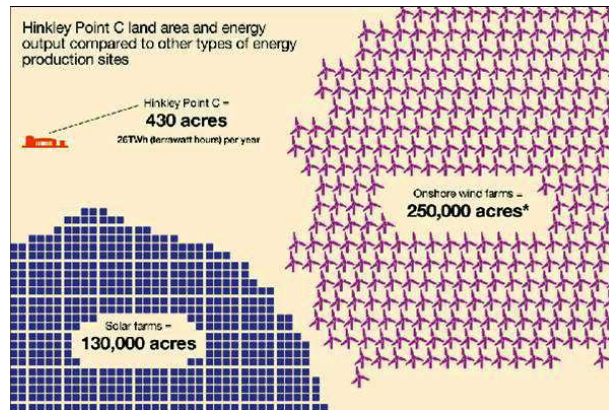
**930** **10,260** **16,447**

The total tonnage required to build-out each type of generation that can deliver a trillion Watt-Hours (TWHrs) over a year appears in the lower red numbers. Wind consumes over 10 times what an ‘equal’ nuclear plant does. Solar demands over 16 times nuclear’s needs. Entities like the World Bank estimate that building out wind/solar instead of nuclear/geothermal would triple worldwide mining and processing, with concomitant environmental damage, pollution increases\*, even social damage, such as child labor.

Yet, those totals don’t even include the additional demands to create complex systems that yield reliability from unreliable wind/solar deployments. Nor do they include all transportation electrification.



The environmental impacts we do well to consider are directly responsive to the energy density of each energy source we might choose. The London Telegraph provided a simple illustration...



Another visual: <https://www.TinyURL.com/WindOrNuc>

The fundamental reason why nuclear power is the least wasteful of materials and the environment is indeed its unmatched power density – a palm-sized piece of Uranium yields enough energy to power any OECD person’s entire life – all energy needs for all purposes, for life. And, the leftovers (waste) from splitting those atoms in two fits in two palms. There’s no “nuclear waste” problem. Facts about nuclear waste and alternative nuclear fuels appear here... <http://tinyurl.com/ydx7cs7x>

GND should not fall into the combustion-wind/solar trap that folks like BP, Exxon & Shell have set. A good description is here: <http://tinyurl.com/y24sq6mp> The typical BP media ad (e.g., in The Economist) illustrates their studied manipulation of us who are environmentally concerned, especially where gas is promoted\*\*...

	1990	2030
Renewables*	0.4	6.3
Nuclear	5.6	6.0
Hydroelectric	6.0	6.8
Coal	27.3	27.7
Natural gas	21.8	25.9
Oil	38.9	27.2

\*Renewable energy includes biofuels

Gas Publicity

The Economist 2/23/19

We see possibilities everywhere. From renewable energy and cleaner-burning natural gas to advanced fuels and new low carbon businesses, BP is working to make energy cleaner and better.

\*\*\* keep advancing

Natural gas burns 50% cleaner than coal in power generation.

Note BP’s inclusion of biofuels with ‘renewables’. BP thus suggests that far less than 6.3% of 2030 power will derive from wind/solar -- far more will derive from combustion, as today. And, BP’s fear of nuclear’s environmental economics is exposed by the 6% BP

desperately hopes we'll be misled to accept – the IEA's new report, Fig. 3, shows exactly what BP et al hope will be our growing US energy source: <http://tinyurl.com/y3uggvpo>

And investors in 'renewables' hope we'll not ever eliminate their Production Tax Credit (PTC) because they know they can profit even if they must pay some entities to take their power when it's not needed – amazing economics! We all pay taxes to support the PTC -- a subsidy from the many to the few -- while those few take that subsidy and often produce power at a loss, yet profit because the PTC (production, not use) more than covers that loss. Some billionaires, as mentioned earlier, even admit to this scam...

Warren Buffet (2014). "...on wind energy, we get a tax credit if we build a lot of wind farms. That's the only reason to build them. They don't make sense without the tax credit." <http://tinyurl.com/meule2r>

Buffet's Berkshire Hathaway Energy (BHE) also owns PacifiCorp, which has 6GWe of coal power to sell wherever it can. So, for instance, midday California solar power is often far more than we can use, so we pay other states' utilities to take it as legally clean power, allowing PacifiCorp to sell its dirty coal power wherever it's accepted. Then, BHE's wind get's top dollar in a "clean-only" region, or at least gets dumped profitably due to its PTC subsidy. The existence of subsidies for some clean power and not for all (e.g., not for nuclear) amounts to a tax on all citizens to benefit a few, while cheating the environment. Subsidizing "production" rather than beneficial "use" makes for an economic travesty and eventually an environmental tragedy...

**Table ES4. Fiscal Year 2013 electricity production subsidies and support**  
million 2013 dollars, unless otherwise specified

**Reality**

Management Information Services, May 2017

Beneficiary	Direct Expenditures	Tax Expenditures	Research and Development	DOE Loan Guarantee Program	Federal and RUS Electricity*	Total	Share of Total Subsidies and Support
Coal	61	642	167	-	30	901	6%
Natural Gas and Petroleum Liquids	18	662	10	-	-	690	4%
Nuclear	37	1,109	406	-	109	1,660	10%
Renewables	7,408	3,373	722	-	176	11,678	72%
Biomass	62	9	47	-	-	118	1%
Geothermal	221	22	2	-	-	245	2%
Hydropower	194	17	10	-	171	392	2%
Solar	2,448	1,712	234	-	-	4,393	27%
Wind	4,274	1,614	49	-	-	5,936	37%
Other	209	-	380	-	5	594	4%
Subtotal Renewables Electric	7,408	3,373	722	-	176	11,678	72%
Biofuels	-	-	-	-	-	-	-
Electricity - Smart Grid and Transmission	8	211	831	-	134	1,184	7%
Total	7,532	5,996	2,136	-	449	16,112	100%

Example: If I want to run a home and small business on solar energy, and my premises are in a sunny clime, I can check my average daily loads and buy several solar panels for my roofs – about 2kW (at noon) total for my home and about 12kW for my business. I have those two sources installed, being sure no trees/structures block their sun.

Immediately, I notice that I'm still buying utility-sourced power most of every day – I've learned firsthand what Capacity Factor means: the sun is out full at most 1/3 of any day. Ok, so I buy a large battery whose Capacity is enough to run my home for 2/3 day and a much larger battery that can do same for my business. I must also buy properly-sized inverters for both batteries so my home/business wiring can receive alternating current from the batteries' stored charge when needed. These inverters are not cheap and must have certifications, just as my solar panels' inverters must. I'll ignore other legal costs.

The batteries, however, made little difference, because I'd sized my solar PV installations to meet just my two daytime loads. There's little/no leftover solar energy to charge the batteries. I buy more solar panels, double what I already have, so now, when the sun is up, the low Capacity Factor of solar will be masked by two extra sets of panels whose energy can go through the inverters into the batteries.

Now, my home and business power appears to be fully solar. Of course, I've installed triple the solar panels and double the batteries I started with – and little roof left. Now can I disconnect from the utility lines?

What happens when my business uses more power to meet an orders rush? What happens when it's cloudy for a week? Maybe I should buy more panels, batteries and inverters? How many? Do I have roof space? How reliable are the components I've already bought? Will I ever have a 'clean', reliable solar-powered system?

Now multiply my situation above by 140,000. A 1GW utility-scale powerplant can serve about 140,000 home+business customers like me. If that plant is nuclear/hydro/geothermal, its output is clean. Its Capacity Factor is ~90% as well—higher than that of my complex, expensive home/business solar installation.

And, the owners of that 1GW plant keep it running for decades, with costs amortized over 140,000 customers. How long will my panels/batteries/inverters last? What's my real cost of building a complex system to avoid most, but not all, dependence on utility power? What's my environmental footprint, as related to all the complex, often polluting in manufacture, devices I've bought? And, for PV, touch a panel in the sun – hot? Commercial PV wastes ~80% of incoming solar energy as heat and infrared. PV for military/space use is very expensive, but superior. Our PV is an unregulated, inefficient product. Its waste adversely affects climate (e.g., Akbari, Menon & Rosenfeld, 2008).

So, perhaps we should all be thinking carefully about why utility-scale clean power generation is the key, not complex assemblages of 'renewables' that force us to create even more complex assemblages of devices and algorithms to cover the low reliability and low efficiency of 'renewables'? My expensive, complex home/business system has many points of failure – a real 'no-no' in reliable engineering design. And, I still need a utility ('grid') connection for long-term survival. This is the factual burden of "distributed generation".

Oh yeah, my spouse just bought an EV! The average commute needs a 20kWhr charge. Time to double my PV + battery system again, so one of us can get usually to work.

As the example indicates, “storage” is what some rely on to save ‘renewables’. But not only is there no “renewable energy” there’s no cheap, reliable storage, save for three sources: hydro, nuclear and geothermal power (geothermal is actually nuclear heat, as from the decay of radioactive isotopes stored in the Earth). Hydro is unfortunately dependent on climate (precipitation), while nuclear fission is not. Nuclear reactors simply tap the fusion energy stored in the heavy Actinide elements (like Uranium, Thorium...) fused by huge, ancient stellar explosions and mergers. Nuclear reactors are energy storage, and are easily exploited for that service: <http://tinyurl.com/zha8dba> ...

9 Sep. 2015: “*Planned Maintenance at Diablo Canyon Unit 2 Delayed to Meet State Energy Needs During Heat Wave*” CAISO: “*Requests Both Units Operate at Full Power*”.

No wind/solar generation can even begin to do that. And this is done on short notice to support clean-power reliability for the 6<sup>th</sup> largest economy in the world.

The ‘grid’ is often used to describe our AC electric-power distribution system. It is not a “grid”, in the sense that a window screen is a grid of crossing wires. We haven’t enough wire in the world to make a power ‘grid’ like that – every electrical load or source sitting at a crossing point of wires. Wasteful.

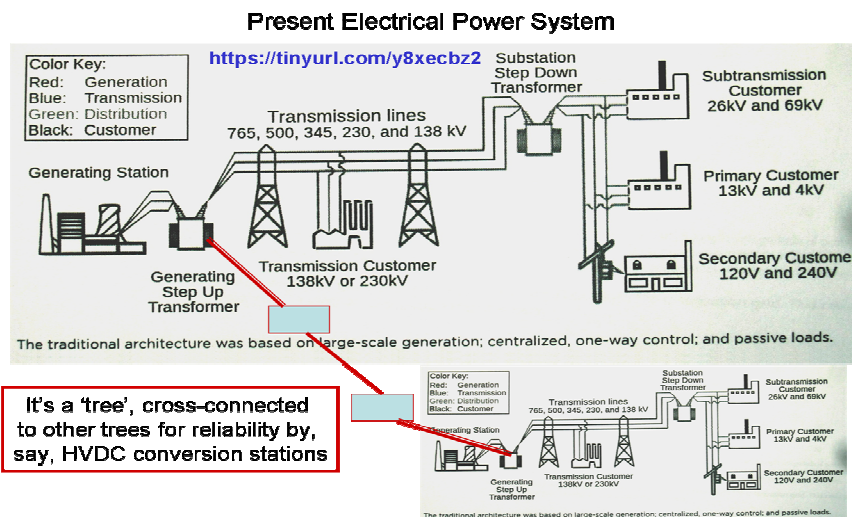
Power is distributed by wiring ‘trees’, whose ‘branches’ serve loads and whose ‘trunks’ end at power plants. Branches from different trees may be connected to share power, so loads that change in one tree can gain or yield power from or to another. These connections are typically called “interconnects” and may cover long distances, using DC power lines for efficiency and AC/DC convertors at their connection ends. In this way, regional power systems can survive under generation failures and/or surprise load increases (as CAISO asked Diablo Canyon to help with). This forms a reliable, regulated, economical power system.

The typical end of a power tree is the power transformer on a pole, or underground, outside customer premises. The transformer has wires to one or several homes/businesses. The transformer’s input is connected to a higher power branch that serves other transformers in the neighborhood. That branch stems from an even higher-power branch that serves multiple transformer branches for the town. And so on, all the way back to the tree’s trunk coming out of the power plant.

An industrial customer, say with a 100MW electric furnace, may be served by an exclusive branch emanating from the trunk/powerplant. And, from the powerplant outward, there are switchyards/substations that allow branches to be disconnected if they experience a failure. That disconnect can be automatic. In any case, it protects customers from widespread loss of power when just a portion of the power tree has trouble. It protects the power company from unnecessary litigation or loss of equipment and revenue. It’s reliable – a utility-grade social service.

One engineering feature of this tree-like power-distribution structure is that valuable energy and materials are saved by increasing the voltage from end customer back toward the powerplant at each branch. Since a neighborhood pole transformer may only be rated at 10kW per home (100 Ampere service), the branch feeding a neighborhood must handle 100 or more such transformers' loads – or 1MW. Moving back to the plant, its trunk to the first branches may be delivering a billion Watts (about 1 million homes).

Metal wires (hanging overhead or inside a transformer/generator) have a maximum current capacity based on their metal and the wire diameter – a higher current (or smaller diameter) and they melt. Before that, however, wire heating just wastes power that could have been sold. Salable power is the instantaneous product of a customer's current load in Amperes times the Voltage at the customer's meter. If many customers are on one branch wire and it's getting hot, we're wasting billable power. So, install a transformer to raise the voltage and reduce current for that branch. That's done at a substation, with large transformers and long, high-voltage insulators. Repeat as needed all the way back to the powerplant's switchyard – the voltage there is often 500,000 Volts. And the current in the outgoing wires serving, say, a million homes, is 2000 Amperes or so. This power origination and distribution design is simple and robust...



Our electrical distribution system is like a giant, flexible dome overhead that must stay inflated to the right extent for us to benefit from the electric energy it represents. The regulated utility managing a dome keeps it properly inflated. New loads draw energy out and tend to deflate the dome, so more generation must quickly be brought on line, perhaps from an interconnection to another, independent utility-grade power tree. 24/7 management keeps the dome up and our electricity “utility grade”.

“Distributed generation” is what we have already, but not much from customer sites. Solar PV on roofs is suddenly considered as a possible power source to feed back into its local power-tree branch, perhaps even with storage at the customer or at the local substation, as So. Calif. Edison is now testing. Is this wise? It seems to violate a basic



engineering tenet: “keep it simple, stupid” (KISS). Adding complexity ruins operating statistics and costs.

All the power-delivery management and controls will have to function in both directions, and each individual load that could also be a power source must have all the connect/disconnect smarts that the overall power provider has long built and maintained. Distributed generation means added equipment and expense for every customer load. Should the 100MW electric-furnace customer now create and manage its own PV installation?

In addition, each power source at a load of any size must meet various standards, especially for safety, such as “islanding” -- implemented by each PV installation’s inverter to protect power-line workers from all local PV sources during a neighborhood outage. Every inverter on the local tree branch must work properly. The reliability of each inverter itself must thus be very high, simply because some folks want to implement local generation which necessarily creates a host of distinct PV systems and inverters not managed by the power company.

And, surprise, each neighborhood transformer must be replaced with one that can handle a multiple of PV inverters sending power outbound when the sun is up. Midday is normally a low load time for homes. Not so with local PV generation. Obviously, this escalates transformer upgrading backwards through more than one distribution-tree branch.

Then there’s “Demand-Response” (DR), which, largely because of the forced incorporation of unreliable wind/solar into our fantasy future electric system, makes loads, even to the household level, variable on command, not by customer choice. For example, SoCal Edison’s experiments with substation storage and rooftop PV must discover realities: both cloudy days and batteries running low. To survive, their system must acquire more input power from upstream sources or ask local loads to back off – demand less power. This must be automated and act quickly. It may even happen on a good ‘renewables’ day. It must propagate backward toward generation and forward to local loads. The DR system may even request load reduction from other branches that demand power from generation farther upstream.

DR not only adds equipment and software into a formerly unidirectional power system, it must be stable under all conditions, including equipment failures anywhere in the system, even outside a DR realm. This, plus normal billing and branch controls, creates a massive feedback-control system. Interconnecting multiple DR realms adds yet another source of instabilities. In engineering, there’s something called: “inappropriate technology”. Our purpose is to distribute clean electrical generation. We know how to do that, as in the diagram above, where generators are emissions-free. Appropriate to our environmental purpose?

All this costs \$\$\$. It adds considerable complexity to sensing and protection systems. It violates a fundamental principle of system design. And, local generation/storage causes

an even greater conscription of raw materials to support its implementation. It does, of course, open myriad business opportunities that again benefit the few at the expense of the many – just attend a Calif. PUC hearing on the latest IRP (integrated resources plan) to see how many hands want into our pockets. Sounds opposite to a GND goal or two.

Then there's the law. Who's responsible to install/maintain all the new gear? If there's a failure that causes physical/financial damage, whose insurers cover whose liability? If DR and my PV left my EV uncharged in the am, when I'm heading off to work, who pays or gets me to work? Even simpler, imagine a service event quietly changed my DR profile – who does what and how quickly, including proper refunds? On the generation side, depending on state regulator, there may even be a “revenue requirement” – my company needs to get paid this much regardless of how much energy is saved by each customer and all the control technology those customers must have installed. Sounds opposite to a GND goal or two.

The SoCal Edison implementations should be watched closely -- remember, they are a held company (by Sempra and Edison International) and not covered by the PUHCA since 2005. Edison and Sempra sell gas.

Our descendants rightly expect that we study facts and not fall into the ‘renewables’ trap while we borrow the environment from them. This is one reason why so many scientists advise us\*\*\*\* all to get back on the nuclear-power track JFK started us on. It's even a national security issue, as he believed.

Any discussion of nuclear energy must swerve into the topic of safety\*\*\*. It's an odd topic, because regulated nuclear power around the world has a better safety record than does any other energy source – even PV panels cause injuries/deaths, not just pollution.

Further, even atomic accidents demonstrate regulated nuclear power's safety: a) Chernobyl's RBMK reactors were/are illegal outside the old USSR; b) Fukushima was caused by specific regulatory violations; and c) Three Mile Island hurt no one and Stimulated industry-wide training and safety improvements that raised nuclear's Capacity Factor to today's ~90%. That alone eliminated vast combustion emissions and concomitant health detriments around the world. And, of course, no one affected by b) or c) became victims of radiation. If only regulation of other industries was as good as that of nuclear power.

Finally, why JFK determined that US national and economic security can depend on nuclear power and why scientists\*\*\*\*\* agree that nuclear power is our best hope to thwart the worst of climate/ocean change can be summarized in the following graphic...





Above: the largest source of clean energy in the 6<sup>th</sup> largest economy in the world. It serves well over 1 million homes and businesses with reliable, clean power, cheaper than any in-state source, even without carbon credits.

And, for GND’s employment goals, it delivers high-paying clean jobs dependent on good education, all while delivering ~\$1 billion/year in taxes and fees to the local economy, schools and jurisdictions. No ‘renewables’-based economics matches that. Similar is true for any US nuclear plant. Denying nuclear power a place at the clean-energy table is unscientific and unethical.

### Summary of Recommendations for HR109

For social legislation, the GND’s goals are good. I suggest adding some specifics:

- every worker above minimal hours is a stockholder.
- internet media require ads/content attribution, as for print/broadcast... media.
- restore the “equal time” fairness rule for all political media communications.
- software vendors accept liability – no disclaimers on “merchantability”.

For clean energy, GND must specifically add nuclear power to its “clean-energy” sources and emphasize its implementation in proportion to its ability to displace unreliable or polluting sources. In particular, GND goals must require that:

- VC Summer be finished and operated.
- San Onofre be repaired and operated.
- VT Yankee be refurbished and operated.
- Kewanee (and any other shutdowns) be restarted under NRC approval.
- Bellefonte be brought to operation.
- Indian Point, Diablo Canyon and any other plants facing shutdown be maintained in operation.
- Shoreham be returned to nuclear operation from gas.
- All reactors, when operating, be provided Carbon- or Zero-emissions credits.

- i) The Production portion of the PTC should be changed to emissions “Displacement” (DTC) and applied to all zero-emissions sources, including nuclear, or the PTC should be completely eliminated.
- j) Add an emissions tax on ‘renweables’ for combustion-backup sources.
- k) Require methane emissions detection and regulation from sources to users.
- l) Regulate photovoltaic products for albedo and efficiency.
- m) Restore the 1935 PUHCA repealed in 2005.

Yes, Rep, Ocasio-Cortez, (and all addressed here) this is a national emergency.

--

Dr. A. Cannara

**Copied officials and press...**

Speaker Pelosi, 1236 Longworth HOB Washington, DC 20515

Sen. Booker, 717 Hart Senate Building, Washington, DC 20510

Sen. Feinstein, 331 Hart Senate Building, Washington DC 20510

Sen. Klobuchar, 425 Dirksen Senate Building, Washington, DC 20510

Sen. Sanders, 332 Dirksen Senate Building; Washington, D.C. 20510;

Sen. Warren, 309 Hart Senate Office Building Washington, DC 20510

Sen. Whitehouse, 350 Hart Senate Building, Washington, DC 20510

News Directors: CNN, CBS, MSNBC, PBS...

Editors: NY Times, LA Times, Washington Post...

## Footnotes:

\* 'Renewables' deployment pollution...

Solar/Wind/Battery Materials

<https://tinyurl.com/n3frxms>

<https://tinyurl.com/ybwpgzvu>

<https://tinyurl.com/z97vxqc>

<https://tinyurl.com/y9p45ujn>

<http://tinyurl.com/ycg32mbt>

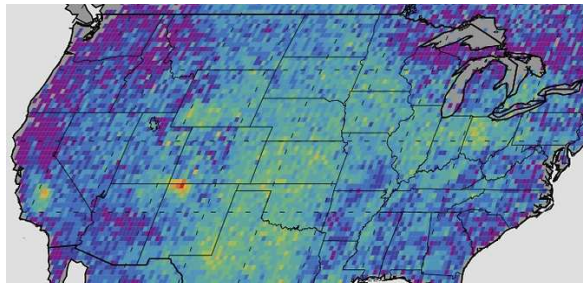
<https://tinyurl.com/j38as7g>

<https://tinyurl.com/yb2ewy74>

<https://tinyurl.com/y7byyqmt>

<https://tinyurl.com/ydgg3rp>

\*\* Satellite measured methane leakage from natural-gas extraction and storage...



Methane is ~83 times worse a GHG as is CO<sub>2</sub> when emitted. It gradually oxidizes in air to average about 20 times worse a GHG over 100 years. Above about 3% leakage, methane is as environmentally bad a fuel as coal: <http://tinyurl.com/z58hwxl>

\*\*\* Energy safety & waste...

### Comparative Power Source Safety



Severe accidents with at least 5 fatalities (1970-2005)

Energy chain	OECD		EU 27		non-OECD	
	Accidents	Fatalities	Accidents	Fatalities	Accidents	Fatalities
Coal	81	2123	41	942	144	5360
Oil	174	3388	64	1236	308	17 990
Natural Gas	103	1204	33	337	61	1366
LPG	59	1875	20	559	61	2636
Hydro	1	14	1	116 (b)	12	30 007 (c)
Nuclear	—	—	—	—	1	31 (d)

(a) First line: coal non-OECD without China; second line: coal China  
(b) Békó and Romania (1991)  
(c) Bengali and Chinaman dam failures alone caused 20 000 fatalities  
(d) Latent fatalities treated separately

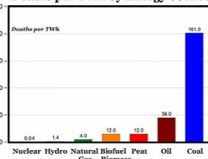
Burgelman & Hirschberg, 2008  
EPRI, 2011-20 August 2008; Davis, Substantiated

US GigaWatt Hours Delivered per Life Lost (2003-2012)

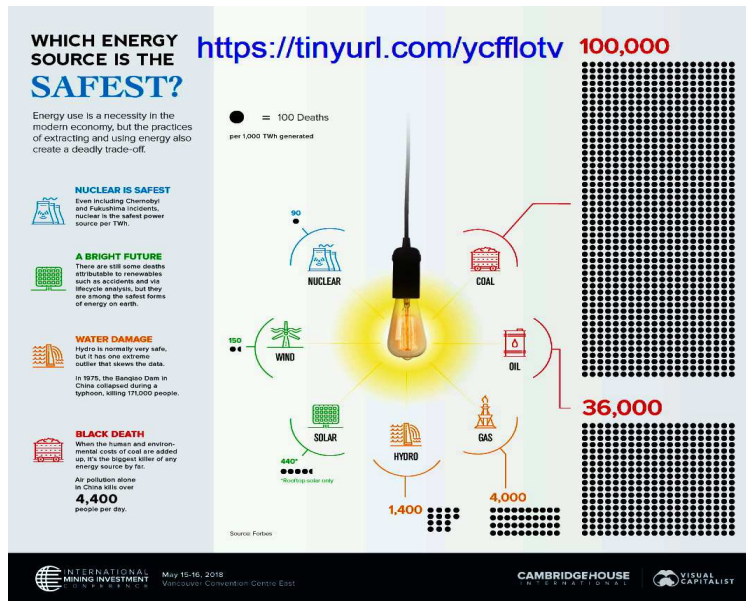
Nuclear  
7,900,000 GWh / life

Gas 51900  
Wind 21600  
Hydroelectric 63,200 GWh / life  
Solar 2500  
Coal 140

Deaths per TWh by Energy Source



Waste – a pinky finger of fissile runs an American’s (OECD citizen’s) life for a couple of years. The size of the ‘waste’ is 2 such pinkies. Coal waste? Duke has ~100 million tons of ash in SE US dumps/lakes, plus more rock waste at mines, plus millions of CO<sub>2</sub> tons emitted yearly. Unlike nuclear waste, chemicals from ash, PV or wind processing don’t decay away. ~95% of ‘spent’ nuclear fuel is fully recyclable, as the French know.



\*\*\*\* Some Readable References & Scientific Support...

“Unintended Consequences”, G. Erickson  
 “Roadmap to Nowhere”, <https://tinyurl.com/yath8yu8> Conley & Maloney  
 “The Non-Solutions Project”, T. Beckers  
 “Dumb Energy”,  
 “Energy: a Human History”, Rhodes  
 “Climate Zero Hour”,  
 “Silver Buckshot or Bullet: Is a Future ‘Energy Mix’ Necessary?”,  
 “Burden of proof: A comprehensive review of the feasibility of 100% renewable-electricity systems”.

Scientists advocating nuclear-power expansion...  
<https://www.youtube.com/watch?v=IW2PNbFGJW4>  
<http://tinyurl.com/y5blckdv> (Brook & Bradshaw)  
<https://e360.yale.edu/features/why-nuclear-power-must-be-part-of-the-energy-solution-environmentalists-climate> (Rhodes)  
<https://en.tempo.co/read/news/2017/02/08/055844486/Nobel-Laureate-Underlines-Importance-of-Nuclear-Energy>

<http://english.yonhapnews.co.kr/news/2017/11/23/0200000000AEN20171123007100320.html> (Chu)

<https://itunes.apple.com/ca/podcast/ecomodernist-podcast/id1187756406> (Allison)

<http://www.nytimes.com/2016/12/21/opinion/to-slow-global-warming-we-need-nuclear-power.html>

<http://climatechange.environment.harvard.edu/joseph-lassiter>

<http://www.nci.org/conf/rhodes/index.htm>

<https://tinyurl.com/y8d2hjqe> (Lovelock 2013 -- "We need nuclear power soon")

<https://www.telegraph.co.uk/news/uknews/1520658/Greens-guru-offers-to-bury-nuclear-waste-in-his-garden.html>

[https://www.youtube.com/watch?v=M\\_IY6qgerY&feature=youtu.be](https://www.youtube.com/watch?v=M_IY6qgerY&feature=youtu.be)

<https://www.nytimes.com/video/science/earth/1194817109084/making-a-case-for-nuclear-power.html> (2006)

<http://tinyurl.com/kn22qcn> (Hansen, Caldeira, Emanuel, Wigley)

<http://www.dailymail.co.uk/news/article-2486894/Scientists-urge-climate-groups-nuclear-power-warn-wind-solar-fulfil-worlds-energy-needs.html>

<http://decarbonisesa.com/2014/06/30/another-climate-scientist-joins-calls-for-nuclear/>

<http://www.sunshinecoastdaily.com.au/news/scientists-tell-greenies-embrace-nuclear-save-plan/2502717/>

<https://www.youtube.com/watch?v=IXTPKGuQhzQ&feature=youtu.be>

[http://www.science20.com/news\\_articles/james\\_hansen\\_to\\_mitigate\\_climate\\_change\\_nuclear\\_energy\\_should\\_be\\_included-154923](http://www.science20.com/news_articles/james_hansen_to_mitigate_climate_change_nuclear_energy_should_be_included-154923)

<http://tinyurl.com/m5qp8vf>

<http://tinyurl.com/necct2l>

<http://seekerblog.com/2015/03/10/james-hansen-calls-out-big-green-part-2/>

<http://tinyurl.com/nh3bsh6> (Hansen vs Big Green)

*"I also recommend that the public stop providing funds to anti nuke environmental groups. Send a letter saying why you are withdrawing your support. Their position is based partly on fear of losing support from anti-nuke donors, and they are not likely to listen to anything other than financial pressure. If they are allowed to continue to spread misinformation about nuclear power, it is unlikely that we can stop expanded hydro-fracking, continued destructive coal mining, and irreversible climate change."*

<https://www.youtube.com/watch?v=rNnaTKfUQ3Y> (2017)

<http://tinyurl.com/y5qsvm8p> (2018, Hansen & Shellenberger)

<http://tinyurl.com/y2fwwnsd> (Hansen & children's climate lawsuit)

<http://epillinois.org/news/2016/4/6/james-hansen-condemns-bernie-sanders-fear-mongering-against-indian-point>

<http://tinyurl.com/y46rbknm>

<https://www.facebook.com/download/823098194404759/An-Open-Letter-to-Environmentalists.pdf>

<http://tinyurl.com/lb478vk> (Williams)

<https://www.youtube.com/watch?v=IzbiIUPwQHg> (Heard)

<http://tinyurl.com/yy743kvf>

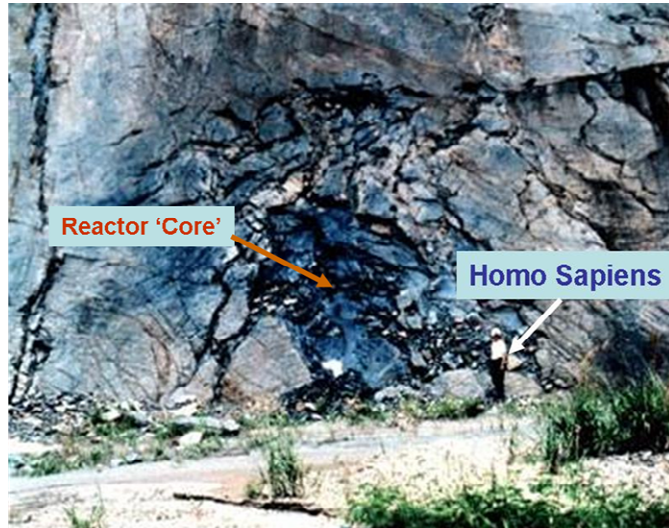
<https://tinyurl.com/y6kkgi79>

<https://tinyurl.com/y2wx5c4q> (Sullivan)



## Mother Nature's fission – Oklo, Gabon...

The mountains in Oklo, south-eastern Gabon are home to several natural  $^{235}\text{U}$  fission reactors. They operated about 2 billion years ago, when the 700-million-year half life of that isotope would have meant it was about 8 times as abundant in typical rock containing Uranium ore. The Earth's growing *atmospheric Oxygen content, water & bacteria concentrated  $\text{UO}_2$  enough that rainfall & groundwater acted as a neutron moderator to enhance fission* by slowing neutrons to 'thermal' speeds, making their capture by  $^{235}\text{U}$  nuclei more probable. When water stopped flowing, the reactors stopped fissioning. When it flowed again, they restarted. The site is now useful to judge stability of fission wastes. Niger & Gabon have very significant U deposits.



<http://www.ans.org/pi/np/oklo/>

<http://www.ans.org/pi/np/oklo/>

[http://en.wikipedia.org/wiki/Natural\\_nuclear\\_fission\\_reactor](http://en.wikipedia.org/wiki/Natural_nuclear_fission_reactor)

[www.physics.isu.edu/radinf/Files/Okloreactor.pdf](http://www.physics.isu.edu/radinf/Files/Okloreactor.pdf)