

Chapter 45. Energy and World Peace

Presidents Truman and Eisenhower were realists, but also firm believers in the democratic ideals on which America was founded, as expressed in the Declaration of Independence and the Constitution. World War II revealed that the United States could not continue to pursue “a more perfect union” in isolation from the rest of the world.

Even before the war was over – while Franklin Roosevelt was President – it was clear that global cooperation was needed for mutual survival and prosperity. Unlike the end of World War I, when the United States shunned the League of Nations, the United States led the formation of the United Nations, adoption of the Universal Declaration of Human Rights, and formation of organizations such as the World Bank that promoted global cooperation and prosperity. There was bipartisan recognition of the need for and the value of global cooperation.

President Eisenhower, in his “Atoms for Peace” speech at the United Nations on 03 December 1953, said: “I know that the American people share my deep belief that if a danger exists in the world, it is a danger shared by all; and equally, that if hope exists in the minds of one nation, that hope should be shared by all.” Eisenhower’s words, appropriate then, would prove prophetic in ways that then could be only dimly imagined.

Eisenhower had witnessed the human degradation and destruction from great wars and atomic weapons. “Occasional pages of history do record the faces of the ‘great destroyers,’ but the whole book of history reveals mankind’s never-ending quest for peace and mankind’s God-given capacity to build. It is with the book of history, and not with isolated pages, that the United States will ever wish to be identified. My country wants to be constructive, not destructive.”

Eisenhower looked forward to a time when the enormous nuclear arsenals of the West, mainly in the United States and the Soviet Union, would be scaled back, and the nuclear fear that gripped the public in the 1950s would subside. “To hasten the day when fear of the atom will begin to disappear from the minds of the people and the governments of the East and West, there are certain steps that can be taken now. I therefore make the following proposal. The governments principally involved...should...make joint contributions from their stockpiles of normal uranium and fissionable materials to an international atomic energy agency...under the aegis of the United Nations. The atomic energy agency could be made responsible for the impounding, storage and protection of the contributed fissionable and other materials. The ingenuity of our scientists will provide special safe conditions under which such a bank of fissionable material can be made essentially immune to surprise seizure.”

“The most important responsibility of this atomic energy agency would be to devise methods whereby this fissionable material would be allocated to serve the peaceful pursuits of mankind. A special purpose would be to provide abundant electrical energy in the power-starved areas of the world. Thus the contributing Powers would be dedicating some of their strength to serve the needs rather than the fears of mankind.”

Eisenhower ended his speech with “...the United States pledges...to devote its entire heart and mind to finding the way by which the miraculous inventiveness of man shall not be dedicated to his death, but consecrated to his life. I again thank representatives for the great honor they have done me in inviting me to appear before them and in listening to me so graciously.”

Eisenhower's dream of beating swords into plowshares was on the minds of the nuclear engineers at Argonne National Laboratory. They aimed to develop nuclear reactors optimized for civilian use. Commercial nuclear power plants built in the second half of the 20th century are called 2nd generation nuclear reactors (1st generation being earlier test reactors). These reactors are based on technology that was developed for military purposes.

There are almost 100 2nd generation nuclear power plants in the United States today, generating about 20 percent of U.S. electricity. These power plants use light-water reactors. They operate under high pressure, with ordinary water being a moderator that slows the neutrons so that they are more effective at generating fission of the nuclear fuel. But these reactors “burn” less than one percent of the nuclear fuel, the rest being left as nuclear “waste.” Light-water reactors were developed to power the first nuclear submarines. They were well-suited for that, as they consumed no air and produced no emissions. A small amount of uranium was sufficient to power a submarine for long periods, even though less than a percent of the fuel was utilized.

The goal of civilian scientists and engineers now is a suite of reactors with these characteristics: (1) they should be passively safe – they should shut down in the event of an anomaly and keep the nuclear fuel cool without need for external power, (2) they should include modular designs that reduce the time and cost of reactor build, (3) they should include “fast” reactors capable of “burning” nuclear waste to expand the fuel supply and help manage the waste. Today's test reactors are called 3rd generation; they are expected to lead to large-scale commercialization of passively-safe 4th generation reactors.

Argonne scientists and engineers in 1992 had nearly completed a prototype of the Integral Fast Reactor (IFR). As a fast reactor, it let neutrons move at a high speed that caused fission of more of the nuclear fuel. The IFR was to operate with onsite fuel reprocessing that extracts “unburned” nuclear fuel for processing and reinsertion into the reactor. This allows the reactor to utilize nearly 100 percent of the nuclear fuel and “burn” nuclear waste, thus reducing the magnitude of ultimate waste by a large factor. The IFR concept “closes” the fuel cycle, including fuel production, power generation, fuel reprocessing and waste management.

Eisenhower's dream became a nightmare when Bill Clinton was elected President. In his first State of the Union Address, Clinton declared: “We are eliminating programs that are no longer needed, such as nuclear power research and development.” Clinton appointed Hazel O'Leary as Energy Secretary. She terminated the IFR project, ordering that the test reactor (EBR-II, Experimental Breeder Reactor-II) be dismantled. Department of Energy scientists were instructed not to promote the potential merits of that technology.

Clinton was aware of the climate matter and the need for carbon-free energy. Why terminate R&D right when an advance in the technology was in the offing? If nuclear power proved to be unneeded, it did not have to be deployed. But why eliminate next generation nuclear power as an option for the next generation of humanity to consider? Did Clinton think nuclear power would disappear from Earth if the U.S. phased it out? Would not Russia or other nations be glad to assume leadership in the nuclear industry? Would that make the world a safer place? The “atoms for peace” concept assumed that the U.S. would be a technology leader, as required to be a leader in international cooperation and governance of nuclear material.

Imagine the shock that Stanford and many others¹ devoted to the IFR project felt upon learning of Clinton's action. Making it worse, the Clinton administration asserted that this research on improved ways to make electricity from nuclear fuel would make it easier for war-like nations to acquire nuclear weapons. In fact, the Argonne scientists were aiming to close the fuel cycle in ways designed to discourage weapons proliferation as well as enhance global prosperity.

The bogus claim that nuclear power plants beget nuclear weapons is blatantly exposed on the Korean peninsula. South Korea has 24 nuclear power plants, is prosperous, and has no nuclear weapons. North Korea was denied nuclear power and has built nuclear weapons. A nation seeking weapons-grade nuclear material for a bomb does not need to build a nuclear power plant for electricity first; indeed, that would be a tortuous, expensive way to get there. A small research reactor and a centrifuge suffice. No nation can be denied the right to carry out nuclear research – nuclear radiation is proving more and more useful for medical purposes.

Nuclear weapons are a big problem, but not one caused by power plants. Eisenhower saw the need for global cooperation against a rogue nation that may build nuclear weapons. Intelligence gathering capability today makes it impossible for a nation to construct a nuclear weapon and the ability to deliver it without the world being aware of their activity. The world needs to be united, through the United Nations, in policies and actions to discourage weapons development.

Nuclear power was a debate topic in March 2010. On a trip to Australia I was asked to participate in a debate in Melbourne on the pro-nuclear side. I described the climate threat, the need to phase out coal, and the potential of nuclear power to help supplant fossil fuels. We lost the debate, as judged by an audience poll. The “winning” arguments included the claim that nuclear radiation was having severe health effects on people around the world and the claim that nuclear power increased the chance of nuclear war.

There was a picket line outside the Sydney University building a few days later, when I gave a talk there. They handed out material criticizing my pro-nuclear remarks, which had been picked up by Australian media. I stopped to talk with a few of the picketers. Discussion was friendly. Their source of information was Helen Caldicott, a physician who asserted that millions of people were dying or being maimed by nuclear radiation. I don't think that I persuaded them otherwise – after all, who should they believe: a physicist or a physician?

When I got back to the United States, I sought advice of George Stanford. George was a nuclear reactor physicist – retired from Argonne – where his career was devoted to nuclear reactor safety. How could I do a better job of helping the public understand the truth? George gave me a 1-page summary he had written for a high school debating team preparing to argue the case for nuclear power and a longer article that he wrote in a simple Q&A format.² The latter article described how the fast reactor that Argonne scientists had developed (the IFR) was an advance in reactor safety and would help reduce the risk of weapons proliferation. Tom Blees' book³ describes the politics that led to the extermination of the IFR project.

What I was seeking was a more general explanation of why the public was so poorly informed about the potential of modern nuclear power to contribute to a healthier and safer world. Historian Spencer Weart provides an excellent scholarly discussion, *The Rise of Nuclear Fear*,⁴ but I was hoping for a simple explanation appropriate for public discussion.

It's not so simple, though. It required a series of factors, piled one atop another. Here is my opinion based on discussion with George and other scientists and on publications.

First, Hermann Muller, in his lecture in 1946 upon receiving the Nobel prize in physiology or medicine declared that his experiments on mutations in fruit flies showed that even the tiniest amount of radiation causes mutations and thus a cancer risk, with harm proportional to radiation amount. In fact, he never presented data from experiments with low levels of radiation.⁵ Linus Pauling invoked presumed great harm from low levels of radiation to pressure political leaders into termination of atmospheric testing of nuclear weapons, a good deed for which he received the Nobel Peace Prize. These concerns did not lead to adequate scientific study of the effects of low-level radiation, but they did lead to a strong desire of the public and regulatory agencies to prevent exposure to any level of radiation, without comparison to other risks.

Second, Hollywood entered as a powerful force on the anti-nuclear side. The *China Syndrome* film, describing the fanciful threat of a nuclear core meltdown that might burrow its way all the way to China, coincided with the worst nuclear accident in the United States: the Three Mile Island partial core meltdown and radiation release in Pennsylvania.

Third, most environmental organizations adopted anti-nuclear positions and some politicians echoed their anti-nuclear stance. Bill Clinton repaid electoral support of environmentalists by reducing nuclear R&D. He terminated and attempted to bury years of work by scientists and engineers to develop a new generation of passively-safe nuclear reactors for civilian use.

Fourth, Democratic Presidents sometimes chose people for the Nuclear Regulatory Commission (NRC) who are anti-nuclear, according to Stanford. I had queried Stanford after receiving an Environment America press release with a quote from an ex-Commissioner (Peter Bradford) that “nuclear power investments would actually worsen climate change.” Stanford said that Bradford was a lawyer who knew little about nuclear or climate science but was regularly “trotted out” by environmental groups to make anti-nuclear statements backed by his NRC credentials.

Fifth, the media tend to reflect the position of the big environmental organizations. The media do not give the public a good objective comparison of the pros and cons of alternative energies.

Environmental groups have influenced energy policies. The most consequential energy policy in recent decades has been Renewable Portfolio Standards imposed on utilities, which are required to generate some rising percentage of their electricity from renewable energy sources. Total subsidies of wind and solar power – in the U.S. and globally – exceed subsidies of nuclear power, even though nuclear power has generated more carbon-free energy. Why are Renewable Portfolio Standards not Clean Energy Portfolio Standards, which would allow utilities to find an optimum complement of carbon-free energies?

I got an insider perspective on this topic in 2010 when I received the Sophie Prize and a share of the Blue Planet Award. The financial awards were enough to not only invest in college savings plans for our grandchildren but also to put solar panels on our barn and our children's houses. Our barn is large with the roof well-oriented to catch sunlight. Solar panels and installation on the barn cost just over \$75,000, but the government provided renewable energy incentives. Pennsylvania sent us a check for \$17,000 and we got a \$23,000 deduction in our federal taxes spread over two years. Thus the government (taxpayers) paid more than half the cost.

Also, the utility must use net metering: when we generate more energy than we use, we pay nothing and the utility owes us for the excess electricity that we generate. We also get renewable energy credits to sell. Ponzi schemes like this appear to work until there are too many ponzi players and the taxpayers rebel.

Our pride in going solar was deflated when a California colleague informed us that net metering is unethical. It subsidizes upper income homeowners and creates regressive taxes on poor and lower middle-class communities. Net metering means that solar power created at a time of day when electricity has negative price (utilities must dump excess electricity) is converted into free electricity for us, which we can extract at the time of day when electricity price is highest.⁶

People who don't have solar panels must pay electricity rates sufficient to cover fossil fuel power generation when the sun isn't shining, while we extract our free electricity. Yup, electricity is given free to people whose situation allows them to install solar panels. Net metering costs are picked up by the other customers. Now you know why your electric rate is going up.

What's a scientist to do? Most scientists realize that nuclear power is needed if we are to phase off fossil fuels in the next few decades. We will need much more electricity generation by carbon-free fuels, especially in countries such as China and India. But the main complement to intermittent renewables, if not nuclear, will be fossil fuels.

This message did not seem to be reaching the public and policymakers. Pushker Kharecha and I thought that our workshop on the eve of Obama's election – with inputs from a range of scientists – had objectively set priorities: efficiency, renewables, electric grid, nuclear, carbon capture. However, we were unable to reach decisionmakers. Environmental groups continued to call the tune in the Obama administration, as they had with Clinton and Gore.

Shortly after the March 2011 earthquake-tsunami devastated Japan, we decided to write a [paper](#) with⁷ an objective analysis of the deaths and CO₂ emissions avoided by nuclear power worldwide. We were motivated by the backlash against nuclear power in the aftermath of the Fukushima accident, which in our opinion was irrational.

The Fukushima power plant had 2nd generation nuclear reactors, which required external power to cool the nuclear fuel in case of such an accident. The external power was located in the (flooded) lower floor and the spent nuclear fuel cooling pool in the upper floor. For a region subject to flooding, the building was designed upside-down.

Human error and unforeseen situations will occur. That's why passively-safe shutdown is included in 4th generation nuclear reactors. The Argonne experimental fast reactor – which Clinton closed and dismantled – was put through the accident sequences of Chernobyl and Three Mile Island. In both cases it shut down quietly – as it would have under Fukushima conditions.

Gregory Jaczko was chairman of the NRC at the time of the Fukushima accident. Jaczko earlier served as appropriations director for U.S. Senator Harry Reid and as the Senator's science policy adviser.⁸ Jaczko was appointed as an NRC commissioner by President George W. Bush in a deal to get Reid to stop blocking 175 of Bush's appointees; Reid then lobbied heavily to get Jaczko placed as chairman of the NRC by President Obama.⁹

Jaczko was highly visible after the tsunami hit Japan in 2011 and caused meltdowns of three of the nuclear reactors at Fukushima. He issued a 50-mile evacuation warning for any Americans in the area, a response that some found extreme.¹⁰ The Japanese government evacuated a smaller area, yet this still required relocation of several hundred thousand people. Relocation stress is reported to have caused 3,700 deaths.¹¹ A subsequent study¹² questions the value of large-scale evacuations, stating: “The overall conclusion is that relocation should be used sparingly if at all after any major nuclear accident.”

As serious as the Fukushima accident was, one had to wonder whether reaction to the accident was not dramatized by Jaczko and others opposed to nuclear power. George Stanford, however, wanted the focus to be on the need for passively-safe design of 4th generation nuclear power, which would have prevented core meltdown and radiation release.

George – who died in 2013 – was right. When an aircraft disaster occurs, we don’t terminate aircraft construction. Instead, we investigate and improve the design of aircraft. The result is that aviation now provides our safest long-distance travel. Nuclear power has potential to have the smallest environmental footprint and least fatalities per unit energy, if it doesn’t already.¹³

Helen Caldicott’s assertions were fictions. George Monbiot, a respected British journalist, explored the sources of Caldicott’s assertions. He writes: “Over the past fortnight I’ve made a deeply troubling discovery. The anti-nuclear movement to which I once belonged has misled the world about the impacts of radiation on human health. The claims we made are ungrounded in science, unsupportable when challenged and wildly wrong. We have done other people, and ourselves, a terrible disservice.” Monbiot’s article, [Evidence Meltdown](#),¹⁴ is illuminating and worth reading today. The extent to which the public has been misled is, indeed, troubling.

So – again – what’s a scientist to do? The situation is complicated, as noted above, but environmental organizations are central as they school a large block of voters. If we hope to change things, we had better persuade the leaders of those organizations.

Ken Caldeira, Kerry Emanuel, Tom Wigley and I wrote an [open letter](#)¹⁵ to environmental leaders on 3 November 2013, explaining that “...there is no credible path to climate stabilization that does not include a substantial role for nuclear power” and asking for their support.

The ringleader, NRDC (Natural Resources Defense Council) President Frances Beinecke, responded on the same day: “The better path is to clean up our power plants and invest in efficiency and renewable energy.” She pointed out that waste storage and security of nuclear material were important issues. The irony – that their support caused Harry Reid to stand like a wooden soldier blocking the entrance to safe geologic storage of waste in Yucca Mountain and that their support egged Bill Clinton to terminate and dismantle serious R&D aimed at safely closing the fuel cycle – was ignored.

Bill McKibben called, encouraging me to meet with Frances Beinecke, who he praised highly. I had a better idea. Steve Kirsch, an entrepreneur and philanthropist located in Silicon Valley, would be more persuasive. Steve read my book and communications, and he had become an ardent supporter of modern, safe nuclear power as an essential tool to minimize climate change. Steve is passionate, articulate and pulls no punches – if anyone could wake up enviros, he could.

Steve reported back – dejectedly – after having lunch with Beinecke: NRDC could not change its position about nuclear power for three reasons: the first two were forgettable and forgotten, the third was that they would lose a big chunk of the donations that cover their annual costs of more than \$100M per year. I’m not usually cynical, but to me it seemed like that joke concerning something obvious: “you get three guesses and the first two don’t count.”

NRDC depicts themselves as authoritative sources of scientific information and legal strategy. They have leveraged their collaborations with well-endowed corporate interests to develop an image of effectiveness. They promote as big successes ineffectual climate agreements such as those at the United Nations COP meetings in Copenhagen and Paris, while in fact these were business-almost-as-usual. They exhibit no understanding of policies that would actually alter the global carbon emissions trajectory. Instead, they bask in photos of NRDC lawyers sitting in the White House helping to concoct Obama’s Clean Power Plan, which helps replace coal CO₂ emissions in part with gas CO₂ emissions while locking in long-term fracking, methane emissions, and groundwater pollution.

It’s impossible not to love the Obamas. Nevertheless, we must admit that Barack not only threw in with the big banks – as his way to address the global financial crisis – but also with “big green.” Big green is composed of environmental organizations with annual budgets of order \$100M; they’re in bed with corporate America and advocate business-almost-as-usual. NRDC and EDF (Environmental Defense Fund) are prime examples.

One reason that these organizations can’t see much beyond the end of their nose is because that’s far enough to see the money. There’s plenty of work for them (they’re mostly lawyers) in cap-and-trade and the clean-power-plan. Never mind that 200 national caps is not a workable strategy for global climate – it works for big green. For some insight, check the footnote in the prior chapter -- an economist’s analogy to Colonel Nicholson in *Bridge on the River Kwai*.

Big green got huffy when I [recommended](#)¹⁶ that the public withhold their annual contributions to big green and instead send a note that they would begin making donations again after the environmental organization announced support for nuclear power, as well as for renewables. The problem is that your donations are likely small compared to those of their big-time donors. Don’t give up. Your note would help. We can still make our democracy work. I will get to that topic and provide a number of suggestions, but first let’s finish with big green and the Obamas.

I am not criticizing individuals. Bill McKibben is right that Frances Beinecke is a good person and an effective leader. America’s respect and love of the Obamas, already high, will only grow over time. But big green and Barack need an ice-cold shower to wake them up to the fact that – as long as they continue to support business-almost-as-usual – they are part of the problem.

Steve Kirsch got a date with Obama in 2015. The way it works in America today is that if you are wealthy enough and give a big enough donation, you can get a date with almost anyone. It would be a brief audience, so a week before their meeting Steve carefully prepared two questions that he would ask: one of them on health care, the other on global warming.

The latter question was: “Global warming is the most important issue of our lifetimes. James Hansen is arguably the world’s expert on this topic. He was the one who first alerted Congress to the problem, well before anyone else. He’s been absolutely right on what has transpired and

he has some viable ways to fix the problem that he would love to discuss with you. Would you be willing to meet with him?”

Early the next morning (I suppose that the meeting was an evening social function) Steve sent a message from his iPhone: “Call me and I’ll tell you what Obama said about you.”

To the best of my recollection, Steve’s oral message was: Obama said that he reads your writings. He would like to (or perhaps it was: is willing to) meet with you, if the topic is policy.

Wow. Policy is what I would like to talk with Obama about. I told Steve that I was locked in my study trying to finish the most important paper¹⁷ of my career ([*Ice Melt, Sea Level Rise, and Superstorms*](#)). As soon as it was finished, we should find out whether the invitation was real.

After the paper was submitted for publication, Steve tried to contact Obama, but he could not get through. So, I sent an e-mail to John Holdren (Obama’s Science Adviser) and Steve, attaching a copy of the “Ice Melt” paper. I told John about Steve’s meeting with Obama, Obama’s response, and that I would like to pursue a meeting with the President.

Holdren’s reply was a long rambling paragraph about the climate threat, saying that he was already persuaded that IPCC understated the danger, and that the President was fully informed on the matter. He concluded “keep up the good work.” Not a word about meeting with Obama.

Several months later I wrote *Isolation of 1600 Pennsylvania Avenue* for my e-mail distribution because I felt that the President was not getting good policy advice. Advice seemed to be from the business-almost-as-usual, Ivy League, Wall Street crowd. I concluded that their advice might work for old people, but it’s a betrayal of young people and future generations. At least I got the attention of John Holdren, who sent me a note to put me in my place.¹⁸

Holdren was right, of course. Obama must already have decided what he could do regarding climate change in his last years. As a lame duck, he was handicapped. On the other hand, freedom from reelection concern might allow actions that are otherwise politically difficult.

I’m one of 22 plaintiffs in a lawsuit filed against the U.S. government. The other 21 are young people and I’m “guardian of future generations.” We say that the government is violating the Constitutional right of young people to life, liberty and property. We ask the government to have a plan to phase out fossil fuel emissions. A plaintiff and defendant can have private discussions, with or without their lawyers being present. It would’ve been interesting to outline a plan for the government and settle the case. I’m sure the other plaintiffs would’ve been happy to agree to it.

Another potential Presidential initiative would be analogous to the national science education support provided under President Kennedy. Instead of space, the focus would be energy. In the 1960s the federal government supported graduate school traineeships. At the University of Iowa, for example, there were 30 NASA graduate school space science traineeships at any given time – which is how I managed to go to graduate school. There should also be post-doc support for up to three years, with the post-doc allowed to choose his location of work, which might be at a university or within the private sector. Given our first-rate universities and entrepreneurial potential, we would see rapid progress, especially in a neglected area such as nuclear science.



Fig. 45.1. Grandsons Connor and Jake, ages 7 and 4, get urgent Indiana Jones message.

It's been almost three decades since big green pulled Clinton's strings. Think where we would be today if – rather than following big green directives – we had instead invested in such open educational opportunities and provided growing support for unfettered clean energy R&D.

Final years of a Presidency provide a chance to do things that initially may seem unpopular. Political machinations today paint China as an enemy and pretend that China is responsible for climate change, but it is easy to show that U.S. historical emissions are more responsible. We need a President with the courage to tell the public the truth and take steps to work with China. Emissions from China have shot past those of the U.S. and India's population will soon pass China's. Priority of those nations is rightly raising their living standards. They will do that as we did – by burning fossil fuels – unless there is a better alternative for dispatchable power. Straightforward analysis shows that the one technology capable of producing dispatchable power cheaper than fossil fuels is modular 4th generation nuclear power. With cooperation, modular safe reactors could become reality rapidly. With that in the offing, agreement on a rising carbon fee would be possible. Surely it will dawn on us that we work together or sink together.

If working together to advance energy technology – with its mutual benefits – is too hard a step, we should begin by cooperating on science. We have outstanding former students and colleagues living in China who would be happy to work together on difficult problems such as measuring the global climate forcing by aerosols, a task that the U.S. abandoned (Chapter 33).

President Obama might also aid communication of policy to young people. Connor, our oldest grandson, at age 10 made an astute observation: “If we keep doing what we are doing now then the environment will be ruined when the people who are kids now are grownups. And unless we can figure out how to make a time machine that actually works, there will be no way to go back in time to fix it. It's not fair that the grownups now are ruining the atmosphere for the grownup in the future. Grownups now are scared of nuclear power but they should be scared of what will happen if they keep doing what they're doing now because we know the ways to use nuclear power safe and we know that using fossil fuels is not safe. It's very dangerous.”

Connor deserves an “A” for that analysis. Sophie, his older sister, thinks that the government deserves an “F.” Our government in Washington wades in a deep mire of special interests. Yet our Constitution stands as a bulwark that protects all people. Young people believe that they are people and deserve equal protection of the laws. Let us see now if their trust is warranted.

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- ¹ Till, C.E. and Y. Chang, *Plentiful Energy: The Story of the Integral Fast Reactor*, CreateSpace, 392 pp., 2011.
- ² Stanford, G.S., 2001 <http://www.columbia.edu/~jeh1/Documents/Stanford.2001+2010.IntegralFastReactors.pdf>
- ³ Blee, T., *Prescription for the Planet*, Create Space, 375 pp., 2008. Free pdf at <http://thesciencecouncil.com/>
- ⁴ Weart, S.R., *The Rise of Nuclear Fear*, Harvard University Press, ISBN 978-0-674-05233-8, 2012.
- ⁵ Calabrese, E.J., [The linear no-threshold \(LNT\) dose response model](#), *Chemico-Biological Inter.* 301, 6-25, 2019.
- ⁶ Negative electricity prices occur frequently in places, such as Germany and California, that have a substantial amount of intermittent renewable energy. Even in places where the renewable energy amount is too small to cause negative prices, the costs associated with intermittency increase electricity costs for other ratepayers.
- ⁷ Kharecha, P.A., and J.E. Hansen: [Prevented mortality and greenhouse gas emissions from historical and projected nuclear power](#). *Environ. Sci. Technol.*, **47**, 4889-4895, 2013.
- ⁸ Reid opposed completion of the Yucca Mountain repository for nuclear waste, despite assurance of scientists that geological storage of the waste was safe and desirable so that it would be available for possible use in future 4th generation fast reactors. Absence of a nuclear waste depository has hindered expansion of nuclear power in the U.S.
- ⁹ Campbell, H., [Former NRC head Gregory Jaczko says the Union of Concerned Scientists is wrong on nuclear](#), *Science 2.0*, 10 November 2018. Retrieved 9 January 2021
- ¹⁰ Kageyama, Y., US ex-nuclear chief: [Fukushima lesson is phase-out](#), Tokyo Associated Press, 13 March 2014.
- ¹¹ Denver, S., Eight years after Fukushima's meltdown, the land is recovering, but public trust is not, Washington Post, 20 February 2019.
- ¹² Waddington, I., P.J. Thomas, R.H. Taylor and G.J. Vaughan, [J-value assessment of relocation measures following the nuclear power plant accidents at Chernobyl and Fukushima Daiichi](#), *Process Safety Environ. Protec.* 112, 16-49, 2017.
- ¹³ Markandya, A. and P. Wilkinson, [Electricity generation and health](#), *Lancet* 370, 979-990, 2007.
- ¹⁴ Monbiot, G. <http://www.columbia.edu/~jeh1/Documents/Monbiot.2011.DebateWithCaldicott.05+13April.pdf>
- ¹⁵ Letter: <http://www.columbia.edu/~jeh1/Documents/LetterToEnvironmentalLeaders.CNN+AP.2013.pdf>
- ¹⁶ Hansen, J., [Renewable Energy, Nuclear Power and Galileo](#), http://www.columbia.edu/~jeh1/mailings/2014/20140221_DraftOpinion.pdf
- ¹⁷ Hansen, J., M. Sato, P. Hearty, R. Ruedy, M. Kelley, V. Masson-Delmotte, G. Russell, G. Tselioudis, J. Cao, E. Rignot, I. Velicogna, B. Tormey, B. Donovan, E. Kandiano, K. von Schuckmann, P. Kharecha, A.N. Legrande, M. Bauer, and K.-W. Lo: [Ice melt, sea level rise and superstorms: evidence from paleoclimate data, climate modeling, and modern observations that 2 C global warming could be dangerous](#) *Atmos. Chem. Phys.*, **16**, 3761-3812, 2016.
- ¹⁸ I am dismayed at the attack you are propagating on the President's stance on climate change and on the advice he is getting on the topic, above all from me. This is dismaying not only because you did not have the professional courtesy to share this rant with me directly, even though I am the main target of it, but also because it is a shame to see one of the leading climate scientists of all time besmirch his own reputation by so energetically displaying his policy ignorance and, in so doing, allowing his ego to take control of his judgment.
- Be assured of this: there is nothing in your writing, either published in the peer-reviewed literature or propagated on your website, of which the President is not already aware. That's because I brief him regularly on these matters, covering everything of possible consequence. No president of the United States has ever received, or ever wanted, anything like detail I provide to President Obama.
- Your view that he has been "isolated" is evidently the result of my reluctance to propose a meeting with you for the President's schedule. As you surely must understand, the President's time is the most precious commodity in government. None of us here wants to use it for briefings that would convey nothing that the President doesn't already know.
- I reiterate my respect for you as one of the world's greatest climate scientists. But please do not imagine that this makes you an expert on climate policy or politics, never mind on what the President of the United States does or does not understand. You are not. You embarrass yourself when you suggest otherwise.