12 June 2013

VP Al Gore
The Climate Reality Project
901 E Street NW, Suite 610
Washington, DC 20004
info@climatereality.com Fax: 202-628-1445
Cc: Dr. T. Sanford, Maggie Fox, CEO

Dear Al,

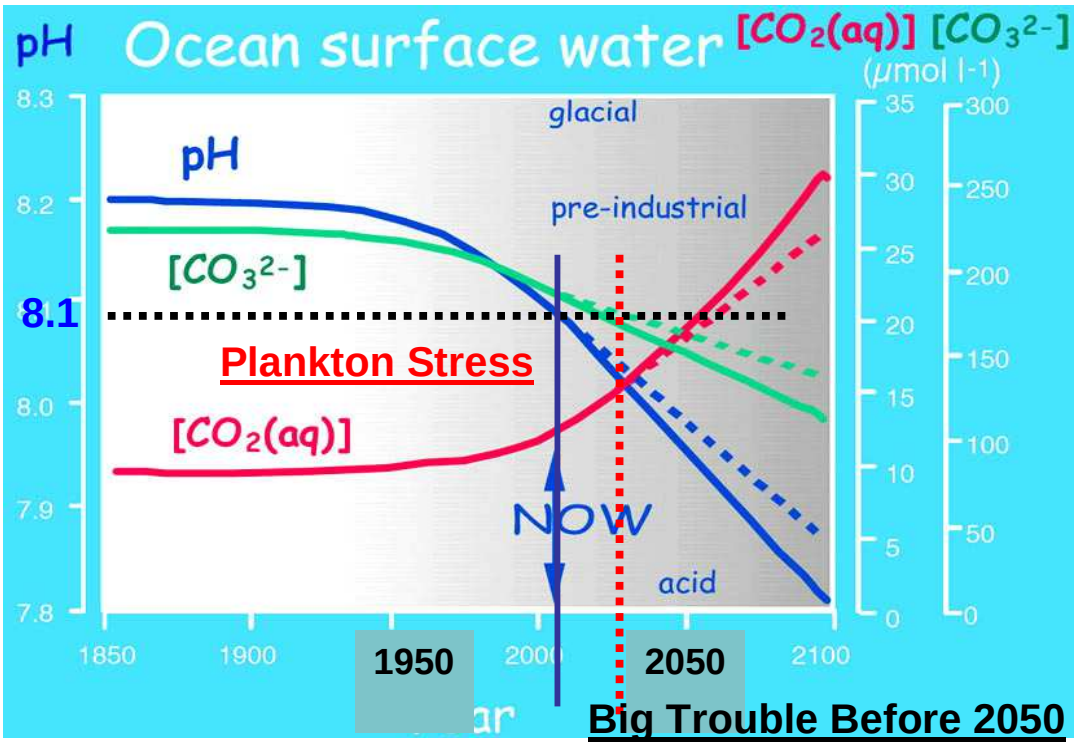
It was a pleasure to participate in the Google discussion yesterday, with Dr. Sanford and you.

A logistics note: it's hard from the website to find a real address for Climate Reality – that's often not a good sign to us ordinary folks, so I hope it gets fixed. I'm mailing this certified to be sure it actually gets to you, since that too is often a problem with some organizations.

As a long-time Sierra Club member, a supporter of EDF and many other environmental groups, and as a scientist & engineer, I wish to raise issues to you that few organizations appreciate as important. I hope you'll agree we have no time to waste, because we've wasted so much. I'll also suggest that your opinions on nuclear power can be improved, which is equally important to any success in dealing with present and future environmental threats. Two points for your consideration…

First, Ma Nature doesn't care how dumb we are. We must wise up, learning what's important to understand before taking on opinions and exerting actions. For example, sadly few media folks and self-labelling environmentalists actually understand that global warming & sea rise are not as immediate and threatening as is ocean acidification. They are real, but 'peanuts' compared to the non-linear (tipping point) in ocean chemistry now fast approaching. That event can not only shut down the natural Carbon Cycle*, but shut down most sea life that forms the base of food chains upon which even we humans depend for about 20% of all our food protein. We've moved ocean pH from 8.2 to 8.1 in just 100 or so years. Below 8.0, carbon fails to be sequestered by most sea life and that sea life fails to support itself and billions of us.

The following figure illustrates the problem we've allowed combustion of fossil hydrocarbons to create:



When the blue curve of average oceanic pH falls much below the present 8.1, calcifying organisms will begin to fail to develop skeletons & shells. Rising sea temperature and local, acidic upwelling worsen the effects. Creatures not only fail to mature and reproduce, they fail to sequester our unnaturally added carbon by living, then dying, falling to sea floors and contributing to seafloor limestone formation. Tectonic subduction normally would complete that sequestration of carbon into Earth's crust, only to reappear via volcanic action millennia later.

The red and blue curves cross at 8.0pH, which indicates almost full shutdown of the natural Carbon Cycle (a small, inadequate sequestration remains via rock-weathering and sediment chemistry**). This will occur well before 2050. We've achieved what no other specie has and ocean pH is now the lowest in about 300,000,000 years. The combination of lowered pH and raised water temperatures has already shown effects, easily seen by fishermen around the world. The next figure shows what some small but

important members of the sea food chain have been experiencing for a few years at least:

Normal Larvae:

Deformed Larvae

Warmer, acidifying North Atlantic

Oyster beds in northern waters have already been showing failures in maturation. Norway is exceedingly concerned with what its fishing industry sees all around waters they harvest.

Despite IEA reports (www.iea.org/), this disaster cannot be forestalled simply by eliminating CO_2 emissions -- not even if all combustion worldwide stopped this instant. Our profligate combustion has allowed >500 billion tons of fossil carbon to be converted to both CO_2 in air & sea and to $ in industry accounts.

Certainly, eliminating combustion power ASAP is essential. We had that opportunity in the Kennedy administration – it was begun then, but foiled by politics in the Nixon administration and beyond. I'll cover this later.

So, our priority beyond combustion-power elimination is to determine how best to protect ocean life and chemistry from this moment on. This too will demand power. And, it must be done quickly and continually, since even building a windmill generates huge amounts of CO_2.

For example, one path is to process billions of tons of dolomite/dolostone (calcium-magnesium carbonate) so that it can be distributed in seas to neutralize the carbonic acid created by our emitted, then dissolved, CO_2 and thus to precipitate that carbon as new seafloor carbonates. Similarly, calcium oxide (quicklime) can be used -- again derived from limestone and

similar rock via large energy input. All remedies have environmental implications on land.

The seriousness of our self-inflicted emissions problem should now be evident – about 1/2 the >500 gigatons of carbon we've emitted is in seawater. To neutralize its effects and precipitate it for sequestration will require that billions of tons of onshore carbonate be thermally processed by energy sources beyond our current system capacity. And, these new sources must not emit CO_2, any GHG, or any other significant pollutant.

Heating dolomite, for example, will release CO_2, allowing the residual material to be added beneficially to sea water – calcium & magnesium themselves are essential to all life. A little ferrous iron can be added for amplified sea-life nutrition.

The evolved CO_2 can then be processed at high temperature, such as provided by DoE's Generation-IV Molten-Salt Reactor (MSR) and Thorium MSR (LFTR) designed in the 1960s, but left unfunded in the '70s. Their ~700^{o}C heat can dissociate CO_2 and water, allowing the oxygen to flow freely into the air and the carbon & hydrogen to be formed into benign compounds for use as chemical-industry feedstocks, carbon storage and truly carbon-neutral fuels. Note that the present combustion-fuels industry is not an "energy" industry, but a purveyor of chemicals for which the customer must provide the oxidizer. Dealing with ocean acidification via nuclear heat allows us to also build truly carbon-neutral fuels, as for aircraft.

Personally, I've been amazed at how few environmentalists have even heard of the issue of ocean acidification, or of how it might be dealt with, despite it reaching tragic proportions in just years, not decades.

Second, many of us have been ambivalent or even hostile to nuclear power. And, unfortunately many organizations, like my own Sierra Club, NRDC, FOE and some others, unwisely have greased the skids for the combustion industry by being naively anti nuclear-power, despite its demonstrated safety.***.

Fortunately, folks like James Hansen have come to see the light of that error and so I hope you will too. We had no extra time, even when JFK determined what to do: http://tinyurl.com/6xgpkfa Now we're on negative time to act – we've laid tracks to trouble for our descendents..

Pres. Kennedy and many scientists and engineers were concerned then with the waste of burning otherwise valuable hydrocarbon materials. They were also concerned with pollution and power reliability/cost. The dangers of CO_2 emissions were recognized then too – one plan given Congress around 1970 suggested planting 1 trillion trees per year (about 6 trees per capita per year). Unfortunately, the Nixon administration narrowed funding choices in the 1970s, so that despite Senator Baker's brief restoration of funds, nuclear power R&D took a wrong turn: http://tinyurl.com/73p7ler (about 8min. in). Perhaps, Al, you remember what Howard Baker tried to do for ORNL?

Our present nuclear-power systems are based on a 1946 patent. Its holder knew that better & safer designs were possible, and with Nobelists Seaborg & Wigner was able to demonstrate that in the 1960s, following one path outlined in the 1962 report to JFK. The Chinese and others around the world are now running with our '60s R&D. We're not – much as we're not effectively addressing emissions.

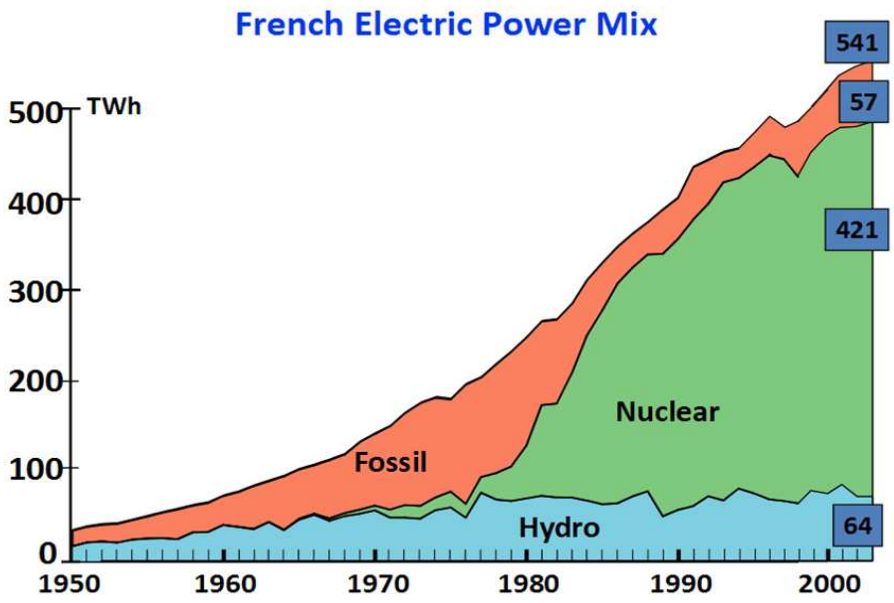
However, despite the improvements Alvin Weinberg achieved in the '60s over his 1946 patent, the nuclear industry in the US is effectively stifled. It's not even an industry, because of various political masters, including uninformed environmental groups, like my own Sierra Club. Fortunately, a few, like EDF & UCS state they're neutral and only concerned with safety – good, since nuclear power worldwide has remained the safest form of generation ever deployed by mankind (windmills kill/injure more).

Shall we honor JFK by thinking accurately? The natural Carbon Cycle, even if we act quickly to preserve it, can only handle 0.3 gigatons of carbon per year. We now emit about 9 gigatons per year. Our >500 gigaton backlog means that there's at least 1500 years of planetary havoc in the cards for our

descendents, even if we cease all emissions today. What do we think they're thinking of us as they look back from the future?

Beginning in 1980, we needed to start about one new, full-sized (1GWe) emissions-free, 24/7 generation station per month to meet the goal of zero CO_2 emissions from power in the US by about 2000. And, we'd have been profitably selling the technology to countries around the world, achieving worldwide zeroing of emissions at about the same time. That could have occurred, if the Seaborg Commission's recommendations had been followed and funded. We'd not be quite so bad off and our descendents might have more respect for us.

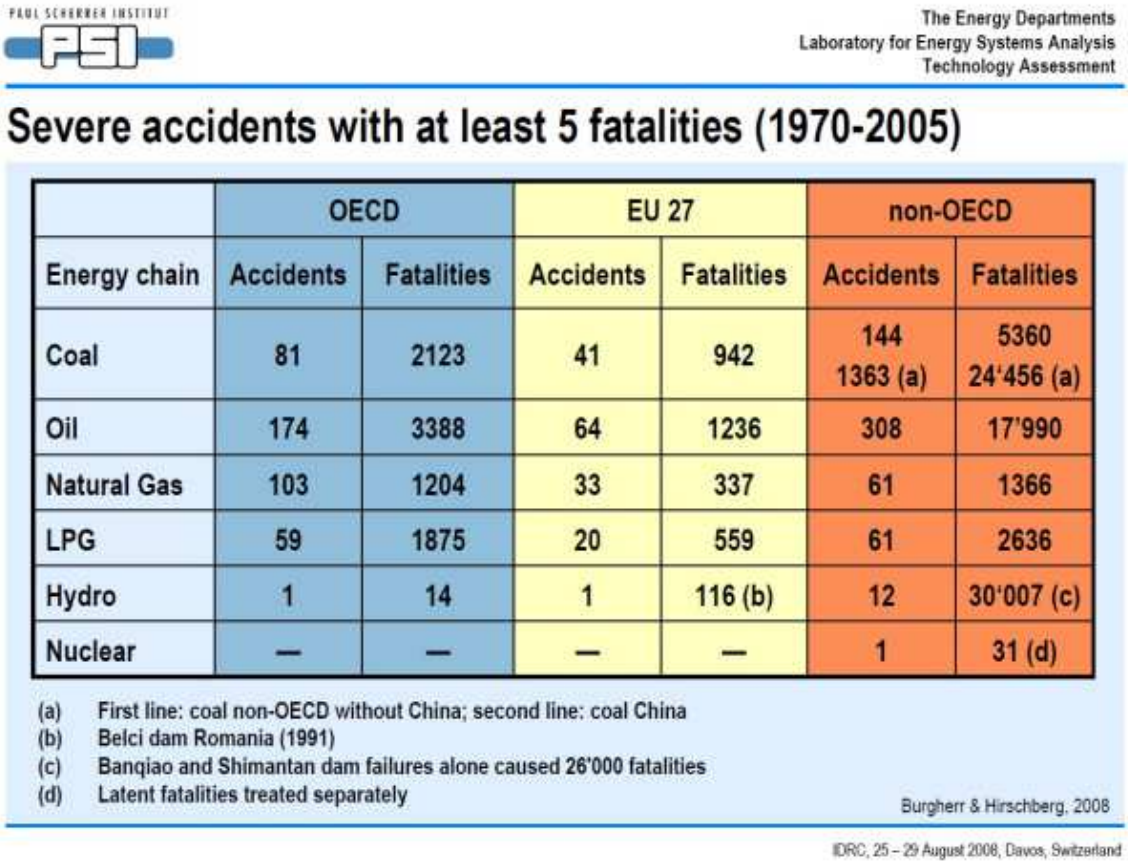
The French effectively did that (with a US, Westinghouse design):



http://ieee4life.org/2013-03-20Meeting/presentation.pdf

They mass-produced and improved our design. They educated their people to understand nuclear power. They recycled their fuel and built a publicly accessible storage site for the little waste they produce. We could have too. Imagine.

The end references speak for themselves on unmatched civilian nuclear safety, but let's examine a figure or two that summarize 50 years of worldwide results in the operation of nuclear power stations (note too the 200+ naval nuclear reactors have operated equally safely for decades):



We can also look at nuclear power another way – <u>avoided deaths/illnesses</u>. Each year the EPA estimates we lose >12.000 Americans to coal emissions – not including mining, etc. China loses the population of San Francisco each year. India loses over 100,000. China spends >3.5% of GDP on emissions-related health effects.

In the US East, about 1/3 of power comes via coal combustion, about 1/3 from nuclear and 1/3 from hydro, gas, etc. Over 40% our population resides east of the Mississippi and in the path of combustion emissions. That means about 4800 eastern Americans die each year from just the 1/3 power mix that's coal fired. Imagine if that 1/3 had been converted to nuclear, as suggested by JFK's request in 1962. How many Americans would still be alive in our East? What should a protester at Shoreham think of his/her act?

Now consider what happens when we substitute nuclear for coal/oil/gas, say in the world, or Japan – consider <u>life years lost from all causes</u> (mining, construction, operation…) related to alternative technologies:

Years of life lost worldwide per TWHr (courtesy of Burton Richter) --

Nuclear:	**25**
Gas:	**42**
Coal:	**140**

Energy & Environmental Science, 2012, DOI: 10.1039/C2EE22658H and
W. Krewitt et al. Risk Analysis, Vol. 18, No. 4, 1998.

Years of life lost had Japanese electricity been generated by nuclear versus combustion --

Source...	*Fukushima Total* 898 Twh	*Japanese Total Nuclear* 6097 Twh
Coal	**124,000**	**840,000**
Gas	**38,000**	**260,000**
Nuclear (normal)	22,000	153,000
Fukushima (est.)	4,800	4,800
Total Nuclear	**26,800**	**157,800**

For Japan, in particular, two facts arise:

- **a)** If all power had been combustion up to 2011, at least 260,000 years of life would have been lost to the Japanese people (gas etc. used), or over 800,000 years if coal had been their main power source,
- **b)** If Fukushima Dai-Ichi had never been operated, the corresponding years of life lost would be about 38,000 & 124,000.

And, no one has died from Fukushima and no one is expected to.**** So the 4800 estimate is nearer 0. Yet, people died from the Chiba coastal LNG terminal's massive explosion soon after the Tohoku quake. Interestingly, one indictment of TEPCO management for the Fukushima disaster is simple – the Onagawa plant, nearer the quake & tsunami, survived and provided refugees with shelter – it was constructed according to proper standards, and not by TEPCO.

As we in the US have fumbled on advanced nuclear power, the Japanese government fumbled even more on regulation and land-use policy – these stone tablets, all over Sendai, carved lovingly by ancestral Japanese, warn: "Do not build here.":

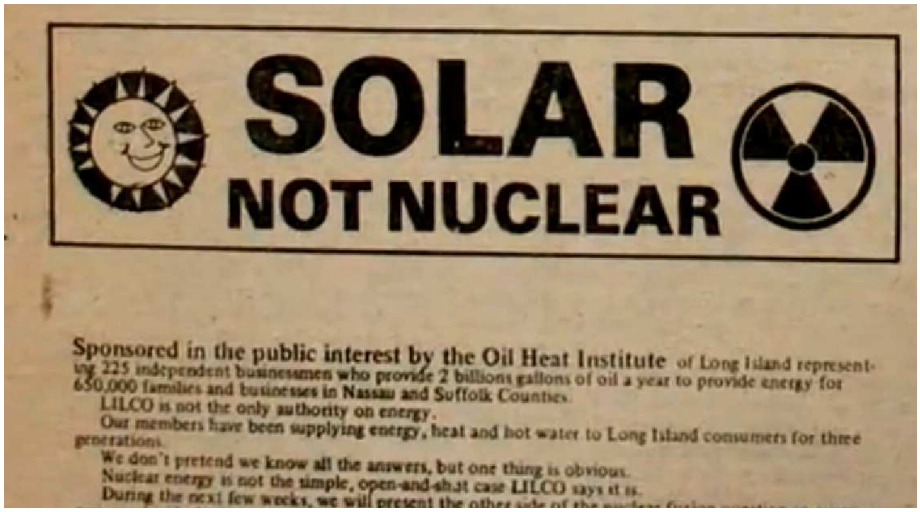
The Fukushima disaster was not nuclear in origin. Nor was Chernobyl. But, even including both those tragic events, nuclear power remains the safest form of generation ever deployed by mankind (PSI ENSAD***). Japan now seems to recognize this and may return many of its plants to operation, as they should.

Part of our problem in the US is our legislation, which has foolishly defined "nuclear waste" as something the French have known for decades (and all world's scientists know) is 95% not waste. JFK knew this. My own Sierra Club, NRDC and some others claiming to be environmentalists don't seem to want to. The new movie "Pandora's Promise" shows sadly many activists acting foolishly about nuclear power.

Some of us, as Sierra members, have been working since last year to move their Board of Directors to correct their erroneous policy. The sad part is that organizations tend toward bureaucracy and self-protection, against the interests for which the groups were originally founded. John Muir would understand the reason nuclear power is an environmental choice – power density & demonstrated safety. The Sierra Club understood this as well, before 1986, but reversed upon Chernobyl without even realizing the Chernobyl event was caused by mismanagement of a safety experiment on a type of reactor illegal everywhere in the world except the former Soviet Union. Some members of Sierra committees now favor nuclear power, but are afraid to speak up – the hallmark of a bureaucracy gone wrong.

This is how grand mistakes are made. What Will Rogers once said about Congress applies within all empowered but bureaucratic organizations that avoid facts: "When I make a joke, a few people laugh. When Congress makes a joke, it's the law".

We have not the right to call ourselves environmentalists and at the same time foolishly oppose demonstrably safe nuclear power. If we do, we become complicit with the combustion industry and its complacency with the environmental and human damage its conversion of fossil carbon to $ creates. We become accessories to those many American, Japanese, Chinese,,, deaths due to combustion power. Protesters of the Shoreham nuclear station on Long Island were both supported and fooled by the Oil Heat Institute into thinking solar power circa 1986 was a viable alternative to nuclear – note the ad sponsor below:


SOLAR
NOT NUCLEAR

Sponsored in the public interest by the Oil Heat Institute of Long Island representing 225 independent businessmen who provide 2 billions gallons of oil a year to provide energy for 650,000 families and businesses in Nassau and Suffolk Counties.

LILCO is not the only authority on energy.

Our members have been supplying energy, heat and hot water to Long Island consumers for three generations.

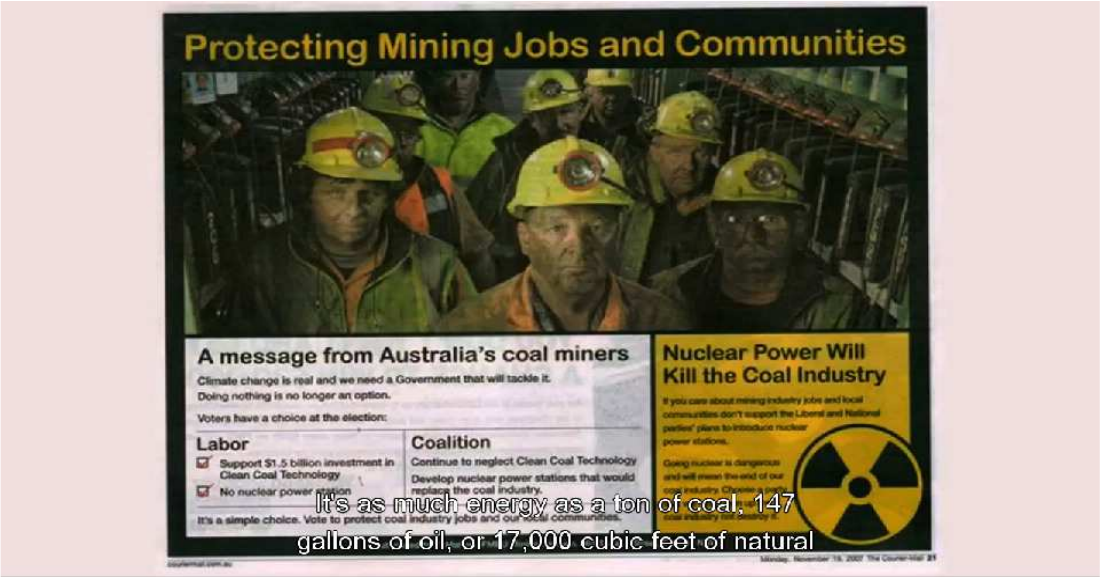
We don't pretend we know all the answers, but one thing is obvious.

Nuclear energy is not the simple, open-and-shut case LILCO says it is.

During the next few weeks, we will present the other side of the nuclear fission question

The combustion industry has always feared nuclear because it has always known nuclear power could easily displace it. And the Japanese have now bid on conversion of Shoreham to burning gas.

Even Australian coal interests have wanted to sacrifice fellow Australians to thwart nuclear power:



This mindset cannot stand. It is unsustainable, especially given our need for vast new power sources to support an effective fight against ocean acidification.

Our descendents are watching. They see us wasting an entire gigawatt on just our mobile devices (even more GW by NSA grabbing our frivolities). They see a German government succumbing to ill-informed groups aiming to shut down their safe nuclear power and impossibly replace it with 'renewables' and coal – even with a new 2.2GWe lignite-burning plant -- flaunting any emissions pledges Germany has made..

This too cannot stand.

As I mentioned at the outset, we're out of time. We've been out of time since we ignored French nuclear wisdom. Now, we've guaranteed worldwide tragedies. Yet, we must proceed as quickly as possible to follow even the Chinese lead on new nuclear power. About 4 nuclear stations in the US are to be shut down soon. Our San Onofre, 2GWe plant in California has been shut down for non-nuclear reasons and may close simply because of repair costs to its steam systems. What's the cost of its planned substitution by gas combustion? How many years of life lost to combustion are worth not repairing such an asset? Each of the nuclear plants closing in the near future is a perfect site for improved nuclear systems – or just call the French (Areva). This is what we should be doing, though we seem not even able to recognize the value of repairing our bridges.

And, we should be re-funding the ORNL work that ceased in the 1970s for no good reason, and which the Chinese have taken up. With the class of reactor successfully designed and operated at ORNL in the 1960s, we'd have no "nuclear waste" to speak of and we'd be able to use our existing "waste" for decades of US power: http://tinyurl.com/7o6cm3u and: http://tinyurl.com/8xmso5v

Fortunately, people like Admiral (former Senator) Joe Sestak understand this. I hope you will too. We must get to work,

Consider the story of the old, retired general asking his gardener to plant one of his favorite trees The gardener brings forth a sapling, but thinks and says: "But sir, you will likely pass before this tree blooms." The general replies: "Then we must not delay. Plant it at once".

Leadership. We desperately need wisdom, attention to facts and that leadership. We're not getting it from our government, our agencies, most of our politicians – not even from many posturing environmental groups. It's up to each of us, including you, Al. Are you with me? One environmentalist in our local group here is just 95. He knows he'll not be around to see solutions in place, but that's not what he thinks important, just like the old general. Are you with us, Al?

Let me know of any questions. I'm ready to help you in any way that advances both points raised above.

Sincerely,

Alex
--
Dr. Alexander Cannara
Menlo Park, Calif.
650-400-3071

PS, It's also worth listening to some young people trying to wake us up…
www.youtube.com/watch?v=TQmz6Rbpnu0 (1992)
www.youtube.com/watch?v=Ko3e6G_7GY4&feature=channel_video_title (Durban South Africa)

References…

* See papers by K. Caldeira of Stanford, D. Depaolo of UC Berkeley Planetary Sciences, etc. http://energyseminar.stanford.edu/node/461 http://tinyurl.com/kobuytd (specific example)

** AAAS Science, p533, I Feb 2013

*** http://tinyurl.com/42wvr9l (PSI ENSAD 1998)
http://cen.acs.org/articles/91/web/2013/04/Nuclear-Power-Prevents-Deaths-Causes.html (averted death)
www.forbes.com/sites/jamesconca/2012/06/10/energys-deathprint-a-price-always-paid/
www.scientificamerican.com/article.cfm?id=the-human-cost-of-energy
www.wano.info//article.cfm?id=the-human-cost-of-energy

**** www.nirs.org/fukushima/naiic_report.pdf (Fukushima Commission report)
www.unis.unvienna.org/unis/en/pressrels/2013/unisinf475.html (UN report)