Central Coast Climate Science Education
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Why Should California Bother: A Response to Carly Fiorina

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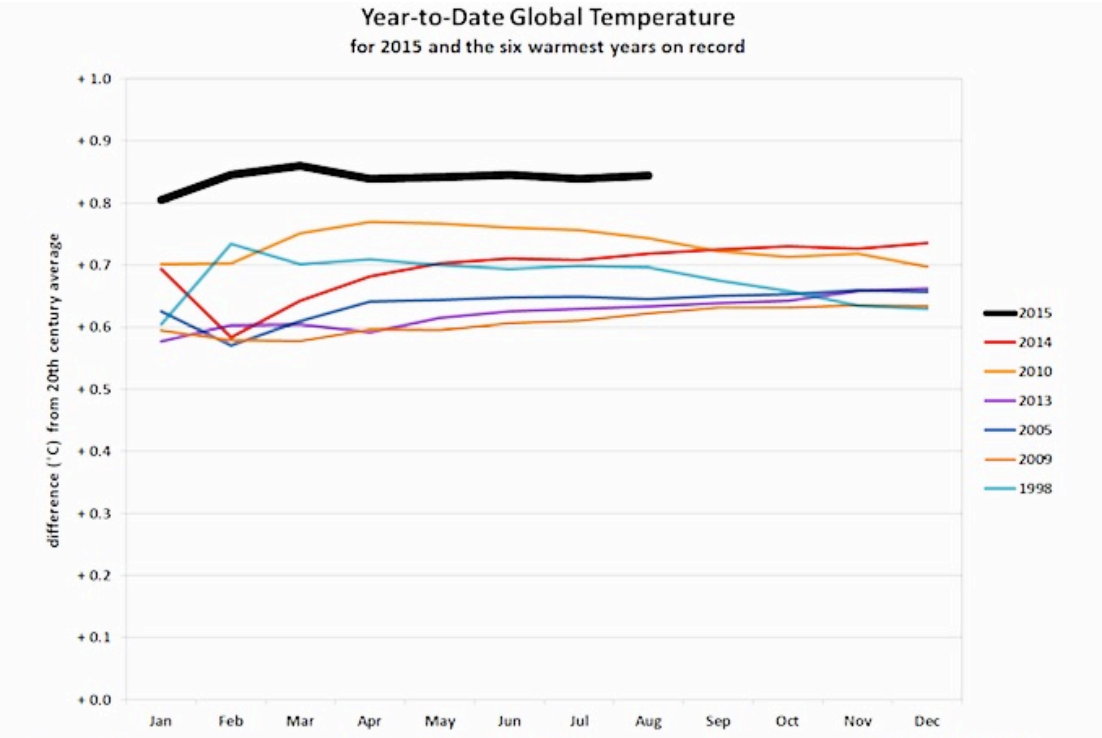
(This essay is a greatly expanded version of a commentary appearing in the October 9, 2015 edition of the Atascadero News.)

After a mild slowdown in global surface temperatures in the early years of this century (*not* a "pause" or "hiatus," and in no way unusual in terms of normal natural variability) http://link.springer.com/article/10.1007/s10584-015-1495-y global surface temperatures are again rapidly rising. 2014 was the warmest year since global temperature records began (in the late 1800s), July 2015 was the warmest month ever recorded, and 2015 is virtually certain to break the 2014 record:



Year-to-date temperature anomalies for 2015 (black line) to the six warmest years on record: 2014, 2010, 2013, 2005, 2009, and 1998 (via NOAA). Each month along each trace represents the year-to-date average temperature: The January value is the January anomaly (departure from the 20th century average temperature), the February value is the average of both January and February, and so on.

http://www.ncdc.noaa.gov/sotc/global/2015/8/supplemental/page-3

In addition, accelerating loss of ice from the huge sheets in Antarctica and Greenland continues, as does sea level rise.

http://america.aljazeera.com/articles/2015/8/26/sea-level-rise-accelerating-nasa-says.html

Thus, denial of a changing climate caused predominantly by fossil fuel emissions is getting increasingly implausible, though there are still some die-hard deniers, including most of the Republican Presidential Candidates.

Instead, another rationalization for the U.S., and in particular, California, not to cut emissions is becoming more common than outright denial of human-caused climate change. This was recently exemplified in a recent TV interview by Presidential aspirant Carly Fiorina.

http://louderwithcrowder.com/carly-fiorina-pwns-katie-couric-on-climate-change/

Fiorina's argument is that reduction of greenhouse gases by the U.S. acting alone would "do no good whatsoever" and would ruin the economy. She repeats this same argument specifically for California. (During this interview she made several outlandish statements, but I want to focus first on why California should adopt these goals. (See the section below: "Further Comments on Carly Fiorina's Interview" regarding some of these statements.)

So, why should California bother, since it indeed contributes only 1% to 1.5% of the world's greenhouse gas emissions?

First, its not true that California is the only Government entity in the world that is reducing emissions and planning to reduce them further--the European Union has similarly ambitious goals.

Secondly, there is no evidence that switching to a low-carbon economy over the next few decades will "ruin the economy". In fact, the renewable energy sector is one of the fastest growing in the State. In cutting emissions "the state has attracted over $27 billion in private investment, and now more than 400,000 Californians work for clean energy businesses."

http://focus.senate.ca.gov/climate

Third, California plays a leading role, by example as well as by organizing global actions, to reduce emissions. Recently, Los Angeles hosted a two-day summit of municipal and regional Government leaders from China and the U.S. that "committed mayors and governors from US and Chinese cities, states and provinces to work together… setting ambitious targets to cut [emissions]."

http://www.dpa-international.com/news/asia/us-china-local-leaders-set-climate-targets-a-46635684.html

This is significant: China and the U.S. contribute 40% of global emissions, most being generated in cities. Even more recently, President Obama and China's President Xi jointly announced further steps to reduce emissions, including China's implementation of a cap and trade policy by 2017.

http://thinkprogress.org/climate/2015/09/25/3705464/us-china-climate-visit-pledges/?utm_source=newsletter&utm_medium=email&utm_campaign=cptop3

Fourth, and in my opinion most compelling, California's action creates a tremendous economic market for innovators of renewable energy technology. SB350 calls for 50% of electricity to be generated by renewables by 2030. California will demonstrate the feasibility of a low-carbon energy economy cost-competitive with fossil fuels. U.S., and especially California-based enterprises, will be world leaders in meeting the inevitable global demand for zero-emitting technologies. Referring to California's mandate for utilities to acquire electricity storage facilities, PG&E CEO Tony Earley put it nicely: "if we buy it, others will find a way to build it."

Here are just three examples of such innovations: Right in our County, a Cal Poly group has been collaborating with an Australian enterprise to generate electricity from wave energy. See http://waveenergyprize.org/teams/cal-poly-protean-wave-energy-inc
and
http://www.proteanwaveenergy.com/wave-energy

In Santa Barbara, a novel approach to storing electrical energy has been developed. http://www.aresnorthamerica.com/ Electricity is stored as gravitational potential energy, but instead of pumping water uphill, electric engines on tracks haul cars with cement blocks. To store electricity, the trains run uphill; they run downhill to produce it.

A portion of the ARES demonstration project near Bakersfield. An electric motor draws power from the grid to haul concrete uphill, and runs in reverse downhill to supply power to the grid.

The system can respond to demands on the grid very rapidly. Since no water is required, such facilities can be located in arid, sunny or windy places adjacent to solar or wind generation, cutting down on transmission losses. A large (50 MW) facility is under construction in Nevada.

Over in Tucson, Arizona, a novel approach to solar energy is under development. http://www.rehnu.com/ Inexpensive steerable mirrors focus sunlight on a small array of highly sensitive photocells. Because the devices always point towards the sun and because these small photocells are much more sensitive then conventional large panels, the overall efficiency of the system is very high.

Two of the sun-tracking 8-mirror modules of the REhnu technology. Sunlight is uniformly distributed over a very small array of highly efficient photovoltaic cells. The system also produces hot water with the heat removed from the system.

At utility-scale deployment, the cost per kWh is projected to be competitive with the cheapest fossil fuel—without subsidies.

There are many more such innovative ideas being developed, including new nuclear reactor designs. These are less expensive then the current "Gen III" reactors and have several features that I believe will overcome much of the opposition to nuclear energy on the part of some of the general public. One such design has been developed by two nuclear scientists while they were MIT graduates. Their design can use the spent fuel rods from the Gen III reactors producing only 5% of the amount of radioactive products, as well as much shorter lifetimes of these radioactive products, compared to the Gen III reactors.

PDF file, 58 pages
http://www.transatomicpower.com/wp-content/uploads/2015/04/transatomic-white-paper.pdf

To bring all of these innovative ideas to large scale, low-cost deployment requires investors. But investors need to know that a market for these products will exist. California's policies ensure this will be the case.

Further Comments on Carly Fiorina's Interview

Fiorina advocates continued generation of energy from coal with intensive development of carbon capture and sequestration. She believes that this is a viable technology, and asserts that China is making major strides in this area while the U.S. does nothing. In fact, according to the Carbon Capture and Sequestration Technologies database maintained at MIT, http://sequestration.mit.edu there is only one large-scale (> 60 MW) coal generation station currently in operation (the Boundary Dam plant in Saskatchewan, Canada) that utilizes carbon capture. Actually, the U.S. *is* working in this area and has some pilot plants in operation while China has several in the "planning stage". Thus, it hardly seems accurate to state that the U.S. has neglected this technology while China has not.

Moreover, the prospects of deploying carbon sequestration associated with coal plants at an economical cost and on a time scale that will avoid very high concentrations of atmospheric CO2 may be beyond reach.

http://pubs.acs.org/doi/pdf/10.1021/acs.est.5b00839

So, arguing that coal should continue to be a major source of energy for electricity seems highly questionable, quite aside from its serious environmental impacts.

But her arguments against wind and solar energy are especially misleading. (And they are repeated by many others, including one by Mr. Lee Pitts in an especially inane column appearing in the June 26th issue of the Atascadero News.).

She opposes deployment of wind for two reasons:

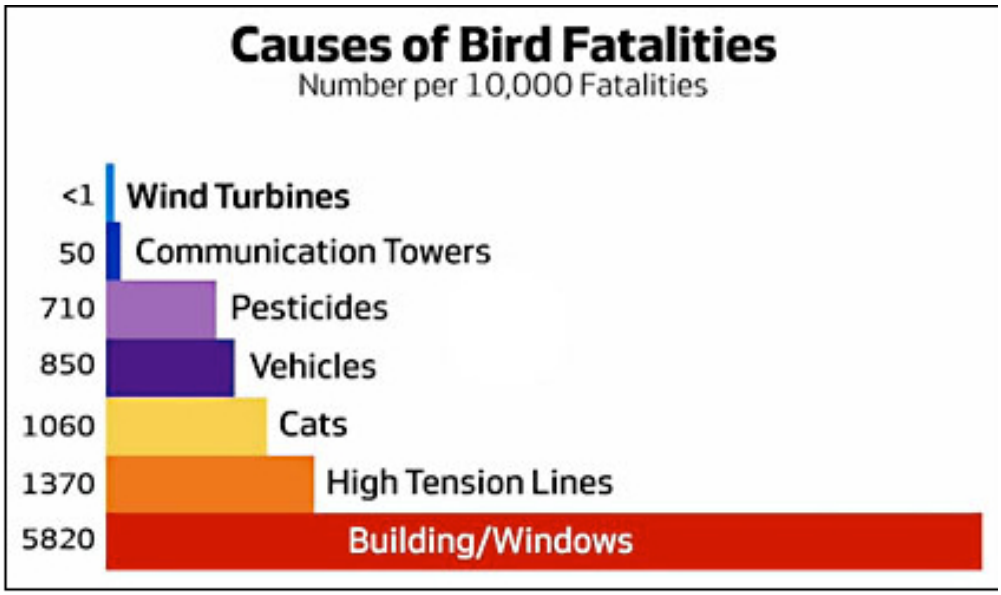
First: "It kills millions of birds". Wind turbines do indeed kill birds, (and bats) but the best estimates I could find was between 148,000 and 328,000 birds annually

http://www.smithsonianmag.com/smart-news/how-many-birds-do-wind-turbines-really-kill-180948154/?no-ist

And, there are several mitigation measures that can reduce these numbers.

But what other things kill birds? Lots of things, and in hugely larger numbers, including cats, high voltage lines and windows, none of which anyone proposes to eliminate.

http://www.motherjones.com/kevin-drum/2014/04?page=4



Moreover, there are serious threats of bird species extinction from loss of habitat and climate change itself: http://climate.audubon.org/

Fiorina's second objection to wind: "Wind farms are unsightly". And coal mines are beautiful? Seriously? Here are two images: one of a wind farm and one of a coal strip mine. You be the judge.

And finally, Fiorina's objection to solar energy is that it uses too much water. Water consumption is significant for a specific kind of solar energy, namely concentrated solar thermal, which heats water to produce steam. As in any steam-powered electrical generation system, whether coal-fired, gas-fired or solar, the steam must be condensed back into water for reuse. This requires cooling, and the most common and efficient form of cooling is "wet cooling", which requires water, though some solar thermal plants use dry cooling. Water usage for wet cooled solar thermal is comparable to that for coal fired plants. However for photovoltaic systems, the only water usage involves occasional washing of the surfaces and this uses far less water per kWh of electricity produced than coal fired plants.

http://www.seia.org/policy/power-plant-development/utility-scale-solar-power/water-use-management

In fact the large Topaz solar farm in the Carrisa Plains uses no water at all. And, the photovoltaic systems currently installed generate about eight times as much electricity as do the solar thermal systems.

http://www.seia.org/research-resources/solar-market-insight-report-2014-q4

Coal mining and coal washing also uses additional water, not to mention the negative impact on streams and water quality of coal. Given the nearly zero greenhouse gas emission from solar energy compared to coal, to argue that solar energy should not be vigorously pursued because of it water consumption is a very flimsy and misleading argument.

In summary, Ms. Fiorina's objection to an ambitious effort for the U.S., and in particular California, to strongly reduce fossil fuel emissions simply does not stand up to rational analysis.