

Super Models, Old King Coal II, & Civil Disobedience

Model:

For fellow technocrats: “Climate simulations for 1880-2003 with GISS modelE”, to appear soon in *Clim. Dyn.*, is available at http://pubs.giss.nasa.gov/abstracts/inpress/Hansen_etal_1.html (Note that there are two versions of the paper available, differing in figure quality and filesize.) The paper documents how well the model simulates past climate. Simulations with this model are extended to 2300 in the paper “Dangerous human-made interference with climate: a GISS modelE study” (http://pubs.giss.nasa.gov/docs/2007/2007_Hansen_etal_1.pdf). The model runs had coarse spatial resolution, as climate models go, but results in the period with observations are reasonable, as climate models go. A merit of our simulations is that they were run for each of 10 individual forcings (greenhouse gases, land use changes, volcanic aerosols, solar irradiance, etc.) as well as for all forcings acting at once. Many climate diagnostics for the runs in both papers are available on our web site, the runs organized as described in the tables in the papers.

Simulations in “Climate simulations for 1880-2003...” are at: <http://data.giss.nasa.gov/modelE/climsim/>

Simulations in “Dangerous human-made...” are at: <http://data.giss.nasa.gov/modelE/dangerous/>

The website provides the ability to easily make plots of various diagnostics for arbitrary periods.

“Super Models” was a guise, using prurient interest to gain attention. Sorry! “Old King Coal II” and “Civil Disobedience” are accurate headings.

Old King Coal II:

Thanks for comments/suggestions re my “Old King Coal” e-mail. Main issues raised:

1. Coal-CO₂ versus Oil-CO₂

My statement that releasing a coal-CO₂ molecule into the air is more harmful than setting free an oil-CO₂ molecule caused puzzlement. Of course the molecules are identical. What I want people to recognize is a way of framing the climate problem that makes clear what action is required to avert disaster. Only two aspects of the physics must be understood:

(1) **CO₂ “lifetime”**. A substantial fraction of the CO₂ released to the air in burning fossil fuels will stay there for a very long time (about one-quarter is still there after 500 years).

(2) **Fossil fuel reservoir sizes**. There is enough CO₂ in readily accessible oil and gas reserves to take atmospheric CO₂ close to, and probably somewhat beyond, the “dangerous” level. The coal reservoir, not to mention unconventional fossil fuels such as tar shale, can take CO₂ far beyond the dangerous level, producing, indeed, “a different planet”.

One other reality, albeit not physics, must be recognized: we can not (successfully) demand that countries such as Saudi Arabia and Russia not mine and sell their oil. And it hardly matters how fast they mine it. We can conserve energy and oil to beat the band, but the readily available oil is still going to be mined in coming decades, not 500 years from now. So, there is just one way we can keep CO₂ within, or at least within hailing distance of, the dangerous limit. Indeed, it is a sensible, doable proposition: we must agree to use coal only in (truly) clean-coal power plants at which the CO₂ is captured and sequestered. By phasing out existing old-

fashioned dirty coal plants over the next few decades, we can keep CO₂ below 450 ppm, cf. our “peak oil” paper: http://pubs.giss.nasa.gov/abstracts/submitted/Kharecha_Hansen.html

Would other countries agree to this? It is the only way to avoid mutual self destruction. Developing countries have the most to lose by failing to halt coal pollution and the most to gain by succeeding. Present dirty-coal uses are, among other things, polluting world oceans with mercury and other bad stuff, making the air in some countries almost unbreathable (killing more than one million people per year), and damaging crops (reducing agricultural productivity in India and China by about 30%). Surely developing countries can be convinced to phase out dirty-coal power, but not while the West is still building dirty-coal plants. And developed countries will need to help developing countries with the technology for carbon sequestration.

Is this “no-CO₂-from-coal” strategy (phase out of coal use, except at power plants that capture CO₂) so difficult to accomplish? Compare it to the effort and cost that went into World War II. Yet this simple “coal” strategy is the primary action needed to solve the purportedly “unsolvable” global warming problem. As described below (“Two Plus Two Solution”), only one other significant action is needed, plus two rather easy “tweaks”.

In summary, there is a difference between coal-CO₂ molecules and oil-CO₂ molecules. The oil-CO₂ molecules, at least those in large readily extractable deposits, will get into the air anyhow. The coal-CO₂ molecules need not get into the air. Once CO₂ molecules get into the air, they are practically beyond our reach; they will stay there “an eternity”. It is a tragedy if we continue to release coal-CO₂ molecules prior to development of capture and sequestration technology, because these CO₂ molecules are the ones that will push climate change into the “dangerous” range. [Refinements to this overview, discussed below, e.g., actions to “draw down” atmospheric CO₂ and the effects of a rising carbon price on the economics of mining fossil fuels in remote locations or extreme environments, do not alter the essence of this story.]

2. Live Earth

I was invited to go on stage at “Live Earth” at the Meadowlands, between Jon Bon Jovi and Smashing Pumpkins performances. I agreed to this, on the condition that I could bring my grandchildren, Sophie and Connor. I assumed it would be like last year when I appeared with Al Gore before a young audience, with a rather impromptu discussion of global warming. Bad assumption. When I asked “Where’s Al?”, I was told that I would be going out alone, and didn’t I have something to put on the teleprompter? Hmm.

Well, with someone standing beside me, I wrote something, but I had a hard time reading the teleprompter. I had told Sophie the day before that I may ask her about saving animals from global warming (see “Trains of Death”). But we couldn’t all fit in one car, so no chance to talk with her on the way to the concert. Once there, the volume was too deafening. But Sophie said we should save “all of them” and 3-year old Connor concurred with her assessment (“me too”). I didn’t realize Sophie was nervous – she did great – but it was clearly draining; she slept till 11:30 the next morning, which she had never done. Now she is very happy about the experience and has something to talk about in 3rd grade “show & tell” this fall.

The point I made with the audience is the overwhelming importance of a moratorium on new coal-fired power plants. Without that, the “101 things” that citizens can do to reduce their emissions do not amount to a hill of beans; all savings of emissions would be blown away by a utility building a new coal-fired power plant. Conversely, a successful moratorium is the main action needed to achieve a stabilization of climate.

A fundamental issue arose, because the “Live Earth” pledge had a waffle-worded statement about coal plants, which implied new coal-fired power plants were o.k. if it was claimed that sometime in the future they would be fitted out for carbon capture and sequestration. Gore’s people confirmed that this was the intended statement of their “energy experts”. When I explained the distinction to Al Gore, he immediately agreed that, by a moratorium on new coal-fired power plants, he meant the same thing that I did: a real moratorium. This is a case where such leadership is essential.

“Energy experts” are just like those who caved in to the automobile manufacturers a decade ago (see “Who Killed the Electric Car”), destroying the chances to slow vehicle emissions. Now the planet is at a far more critical point, and, for reasons explained above, coal is the central issue. Leadership is essential, but it can only lead in a direction that it is being pushed. Young people, who will be affected most, must provide most of that push.

3. Trains of Death

Ed Wilson explains that the 21st century is a “bottleneck” for species, because of extreme stresses they will experience, most of all from climate change. He foresees a potentially brighter future beyond the fossil fuel era, beyond the peak human population that will occur if developing countries follow the path of the developed world to lower fertility rates. Air and water can be clean and we will learn to live with other species in a sustainable way, using renewable energy. The question he asks is: “how many species will survive the tremendous pressure of the 21st century bottleneck?” It is the question that I asked Sophie: “how many of the animals?”

We have had only three decades of rapid global warming so far, but animals are already on the run. If we continue down the “business-as-usual” path, the cumulative shifting of climate zones will become the major factor in species extinctions. Global warming before the end of the century already would be at least half as large as global warmings that caused mass extinctions earlier in the Earth’s history. Human-made warming, if we continue to put in the air fossil fuels stored in the ground over many millions of years, will be far more rapid than the earlier events. And it occurs at a time of other human-induced stresses on species. Interdependencies among species, some less mobile than others, can lead to collapse of ecosystems and rapid nonlinear loss of species, if climate change continues to increase.

Coal will determine whether we continue to increase climate change or slow the human impact. Increased fossil fuel CO₂ in the air today, compared to the pre-industrial atmosphere, is due 50% to coal, 35% to oil and 15% to gas. As oil resources peak, coal will determine future CO₂ levels. Recently, after giving a high school commencement talk in my hometown, Denison, Iowa, I drove from Denison to Dunlap, where my parents are buried. For most of 20 miles there were trains parked, engine to caboose, half of the cars being filled with coal.

If we cannot stop the building of more coal-fired power plants, those coal trains will be death trains – no less gruesome than if they were boxcars headed to crematoria, loaded with uncountable irreplaceable species.

4. Who Killed the Electric Car?

California had a regulation that would have required automobile manufacturers to produce a small percentage of cars without emissions by such-and-such date, and a larger percentage later. Automakers despised this rule, and decided that they had enough clout to ignore it, arguing that it was impractical. Environmentalists seemed to conclude that they were overmatched. Rather than go to the mat, they decided to play ball with the automakers, to try to

work with them, accepting promises that the automakers would do everything that they could to improve vehicle efficiencies and reduce emissions.

The glee with which the automakers tracked down the trial electric cars that they had produced, and crushed the cars into small cubes, must have been palpable. Profit margins on large SUVs were much bigger. Automakers soon forgot their promises about better gas mileage, instead using technical efficiency improvements to make vehicles bigger and accelerate faster.

So who killed the electric car? The automakers? Government officials? All of us who let them get away with it? That vehicle story continues, as plug-in hybrid-electric cars are perhaps the best bet for a path toward a vehicle fleet with sustainable fuel requirements.

However, my reason for bringing up the electric car story is some similarities to the coal story, which is even much more important.

Coal interests are at least as powerful as the automakers. If coal interests have their way, the damage to the planet from coal will greatly exceed that caused by automakers. Their approach is similar to that of the automakers. They have bought influence with law-makers in Washington. They have convinced energy experts, even those with an environmental bent, that they, the coal interests, will win if the parties “go to the mat”.

Specifically, they want to continue to make more coal-fired power plants, claiming that the technology to capture and store CO₂ will be ready in a decade or so, and promising that when it is ready they will convert the power plants to capture and sequester CO₂. This would require not only technology to capture this enormous stream of CO₂, but also a pipeline carrying the CO₂ to a place where it is safely stored. If you are willing to accept their promise to do that, I have a bridge connecting Manhattan and Brooklyn that I will sell to you for a very good price. Even if you believed them, in the meantime, for a decade or likely longer they would be pouring out CO₂ into the air at a rate that would destroy the effect of other efforts to slow climate change.

If we want to save the planet, creation, with all of its creatures, somebody is going to have to go to the mat with the coal interests.

Do not let anyone tell you that there is no viable alternative to increased coal use. If the rules for utilities were changed such that they made bigger profits by selling us less energy by helping users improve efficiencies, rather than bigger profits by selling us more energy, that alone could avoid need for more power plants for the time needed to develop CO₂ sequestration technology. Not to mention the potential for renewable energies to contribute, or the potential via changed building codes, lighting and appliance standards, etc.

Of course it is sensible to allow a trial power plant to be built of the sort intended to eventually include carbon capture and sequestration. But there is no way that anything more than a trial should be allowed. These plants are gargantuan. There is no guarantee that they will even make sense, once carbon is properly priced. Scandinavia provides a good example (B.E. Johansen, *The Progressive*, July 2007): Denmark, e.g., has remade its energy infrastructure. While in the 1980s it had 15 large power plants, it now has several hundred smaller ones, thus closer to homes and offices with reduced power loss during transmission. Much of the energy is renewable. Energy efficiency has been promoted, so the average Dane uses less than half the electricity used in the U.S. In the process, their economy has become stronger.

5. Two Plus Two Solution

When you are given a list of 101 things that you should do to save the planet, it is easy to get discouraged. Well, that way of looking at the problem, without some overall understanding, is discouraging! Moreover, you would need to convince everyone else to do all those things!

Fat chance of that. Even if you convinced a very large number of people, the net effect would be to reduce the cost of oil (and other fossil fuels). With dirt cheap fossil fuels (they are already cheap) do you think that there is not someone in the world who will burn them?

I am not discouraging you from individual good deeds. Those will be a part of the solution, and they will be helpful in the upcoming critical battle with special interests, if we succeed in finding a leader with the guts to “go to the mat”. However, the deeds should be recognized as part of a workable strategy, a strategy that gets everyone to participate, not simply a drop in the bucket.

The solution is two plus two: two important actions and two “tweaks”. By far the most important action is the “coal” solution, specifically an immediate moratorium in the West (developed countries) on new coal-fired power plants without CO₂-capture, and phase-out of such existing power plants (or installation of carbon capture) over the next several decades. Within a decade or less a similar moratorium will be needed in developing countries.

The moratorium cannot wait until agreement is achieved for actions by developing countries, and there is neither moral nor practical justification for waiting. Climate change is determined by cumulative emissions. The United States, for example, is responsible for more than three times more global climate change than is China. On per capita basis, U.S. responsibility exceeds that of China by an order of magnitude. And the total responsibility of Europe exceeds that of the United States. Future economic benefits of prompt technology development and reduced fossil fuel use vitiate any arguments for delaying action.

Once the West stops building additional old-fashioned coal plants that do not capture CO₂, it will be possible to negotiate a halt in such plant building in developing countries. Cooperation of developing countries is likely because they would suffer more from large global climate change, and their regional environment has the most to gain from reduced pollution. Also their economic incentive to construct old-style dirty coal plants will decrease as they realize that these plants must be “bulldozed” within the next few decades.

The second important action required is a gradually rising price on carbon emissions, in the form of a tax, cap-and-trade, or some combination. Why is a rising price necessary, why not just burn oil and gas quickly? It is important to “stretch” oil and gas supplies because energy transitions take time. An increasing carbon price is needed to wean us off fossil fuels, to break the oil-addiction, to develop technology for a clean-planet future, to push us to higher energy efficiencies. Improved efficiencies will be essential in the “beyond petroleum” era. If we do not get on such a course, when “peak-oil” is reached we will be driven to planet-destroying actions such as squeezing oil out of coal, cooking the Rocky Mountains to drip oil out of tar-shale, or other brainless actions of a staggering, dangerous addict. Even a moderate carbon price, but one that businesses realize will be rising, will discourage going to the ends of the world (Antarctica, deepest ocean, Arctic National Wildlife Refuge, etc.) to squeeze out every last drop of oil. Given that we must eventually find a brighter future, with clean energy, high efficiency, and pollution-free air and water, why not get there sooner, rather than later?

In addition to “dirty-coal phase-out” and a carbon price, only two “tweaks” are needed to stabilize climate. The “tweaks” are easier actions that are not as likely to encounter resistance from special interests. The tweaks are needed, because readily available oil and gas will probably push CO₂ somewhat beyond the “dangerous” level. Tweak 1: reduce non-CO₂ forcings (methane, tropospheric ozone, and black soot); reducing these forcings can have a significant impact on the “permissible” CO₂ amount, as quantified in “Greenhouse gas growth rates” http://pubs.giss.nasa.gov/docs/2004/2004_Hansen_Sato.pdf Tweak 2: it may prove necessary to

draw some CO₂ out of the atmosphere; this will be feasible by burning biofuels in power-plants with sequestration, provided that we only slightly overshoot the “permissible” CO₂ level.

This four-point strategy to stabilize climate is described further in Congressional testimony and a paper (How Can We Avoid Dangerous Human-Made Interference with Climate) published at <http://arxiv.org/abs/0706.3720>

6. A Brighter Future

Actions needed to avert dangerous climate change are difficult mainly because of resistance from special interests. The special interests pretend that they are speaking for the good of the public. Horse manure. Overall the world “beyond petroleum” with stabilized climate will be a healthier world. Of course, moving to the next phase of the industrial revolution will require changes, dislocations, sacrifices and hard work. But these provide no reason for inaction. Indeed, moving forward will result in economic benefits from extensive technology development, with many good high-tech high-pay jobs.

Prompt action that minimizes climate change will also allow most of the creatures of creation to survive, to continue to live on a planet resembling the one that has existed during the interglacial period covering the past several thousand years, the period of civilization. Most of the species now on the planet would be able to pass through the “bottleneck”, the period in which the explosion of human population and associated pollution is stressing the ability of the planet to sustain all living things. By dealing with pollution, we can create a brighter future for the planet and all of life.

7. Fossil Fuel Subsidies

Given the damage that fossil fuels cause to the climate, human health, wildlife, forests, lakes, ocean fish, etc., you may think that we place a very high tax on fossil fuels, right? Umm, well, not exactly. On the contrary, our government, egged on by special interests, chooses to subsidize them, or, more accurately, they volunteer YOU to subsidize fossil fuels.

Being from Iowa, I point out an example on the farms, pointed out to me by Bruce Johansen, who found it in an article by Steve Mufson. Franklin Roosevelt granted subsidies for coal-fired power plants to bring electricity to farms in the 1930s. Although this goal has long since been achieved, rural electric cooperatives continue to rake in billions of dollars to build conventional coal-fired power plants. These subsidies remove any pressure for the rural co-ops to promote energy efficiency or aggressively tap renewable resources. As a result, rural co-ops rely on coal for 80 percent of their electricity, compared with 50 percent for the rest of the country, and electricity demand at rural co-ops is growing at twice the national rate.

This is an example showing that fuel use does depend upon pricing, in this case a negative tax (a subsidy). As Amory Lovins has shown, there is enormous untapped potential in energy efficiency and energy sources that produce less or no CO₂. However, to fully tap that potential we need to eliminate perverse disincentives such as fossil fuel subsidies, and we need to institute a moderate price on CO₂ emissions. It does not need to be large, but businesses and consumers need to be aware that a gradually rising carbon price is certain. This provides time for technology development and for the phasing in of new practices and economic replacement of aging infrastructure

Civil Disobedience:

My statement “It seems to me that young people, especially, should be doing whatever is necessary to block construction of dirty (no CCS) coal-fired power plants” raised a concern (of someone in Ireland) that “such a call amounts to incitement to civil disobedience”.

My “Old King Coal” write-up originated from a brief presentation at a dinner in London on July 4. It was noted that it was ironic that I was speaking on our “4th of July holiday” (I thought it impolite to note that we usually call it “Independence Day”). However, in considering what warrants civil disobedience, it is interesting to consider words from a certain “Declaration”.

“...We hold these truths to be self-evident, that all men are created equal, that they are endowed by their Creator with certain unalienable Rights, that among these are Life, Liberty and the pursuit of Happiness. – That to secure these rights, Governments are instituted among Men, deriving their just powers from the consent of the governed. – That whenever any Form of Government becomes destructive of these ends, it is the Right of the People to alter or abolish it... Prudence, indeed, will dictate that Governments long established should not be changed for light and transient causes... But when a long train of abuses and usurpations, pursuing invariably the same Object evinces a design to reduce them under absolute Despotism, it is their right, it is their duty, to throw off such Government...” It then elaborates the tyranny of one King George (no relation to George Polk).

Another document warranting consultation is our Constitution.

It seems to me that, as yet, it is difficult to use actions of our government as grounds for civil disobedience, however egregiously stupid those actions are. (BTW, would dumping coal dust on someone’s desk or white shirt be civil disobedience? Just kidding.) After all, we elected the government and are free to replace it with another.

However, it is not quite so simple as that. We must also ask whether the nature of our government has remained true to that established by the Founders of our country. As discussed elsewhere (Swift Boating, Stealth Budgeting & Unitary Executives, see http://www.columbia.edu/~jeh1/worldwatch_nov2006.pdf), the American Revolution launched the radical proposition that the commonest of men should have a vote equal in weight to that of the richest, most powerful citizen. Our forefathers devised a remarkable Constitution, with checks and balances, to guard against the return of despotic governance and subversion of the democratic principle for the sake of the powerful few with special interests. They were well aware of the difficulties that would be faced, however, placing their hopes in the presumption of an educated informed citizenry, an honestly informed public.

Franklin, Jefferson, and the other revolutionaries would surely be distraught by recent tendencies in America, specifically increasing power of special interests in our government, concerted efforts to deceive the public, and arbitrary actions of government executives that arise from increasing concentration of authority in a unitary executive, in defiance of the aims of our Constitution’s framers.

Do these developments constitute a basis for civil disobedience? What other recourses are available? What is the specific relevance of these developments to climate change?

Congressional action to deal, effectively, with climate change is practically impossible now because of the huge, undue sway that special interests have over our law-makers. An extreme example is the almost comical well-oiled Senator who describes global warming as “the greatest hoax ever perpetrated on the American people”. He has criticized me for taking a \$250,000 “grant” from a left wing organization, referring to what was in fact an environmental award established to honor former Republican Senator John Heinz of Pennsylvania, who died in

plane accident in the 1990s. Although I have corrected the well-oiled Senator's statement, it continues to be repeated by his organization, apparently with the belief that if you repeat a statement often enough it will be accepted as true, especially if coming from a high office.

The problem, however, is not the comical extremist. It is the fact that a huge number of our legislators are under the influence of special interests. Americans recognize this. It is one of the main reasons that voters are fed up with Washington. As yet there has been no effective campaign finance reform and "campaign" finances are financing more than campaigns.

All that being said, it is hard to make the case that the avenues for citizens to affect policy have been exhausted. When I was a 5-year-old my mother would often give me a nickel when I went to school. On the way home my 5-year-old friend and I would stop at Denison Drug and get a drink (root beer or cherry coke) which we would both put our straws in. Now, as 66-year-old geezers we debate with his son generational responsibilities, one input being:

A question for Jim might be: Why are not more scientists involved in and working inside social movements instead of carping about them? If Jim wants more young people involved then he should go out and try to organize them or be part of a movement and network of organizations that is doing so. But then he would have to sacrifice time from his professional career to do this and he probably doesn't like the idea of that. Granted it takes a very well-organized and driven person to be able to do both - Noam Chomsky is the most obvious example of someone who does both solid scientific research (in linguistics) and also participates actively in building social movements for the issue that he is passionate about - foreign policy. In contrast to Jim you rarely hear Chomsky crying about the lack of citizen involvement because he is directly involved in making it happen rather than seeing it as something that his life and work is separate from, and hence is out of his control. So there! You now have five minutes to make your rebuttal. Of course, I just like being a contrarian so don't take my argumentativeness personally. It must be genetic!

It is worth thinking about. Of course, we also have to recognize where our talents lie, and where they do not. It does seem to me that what happens in 2008 is terribly important. The gleam of a new presidency, by itself, is probably fool's gold. It will take an enormous turnover in all the states to get people really committed to needed actions. And it is not enough to ask candidates what they think or will do about global warming (as by the cute little snowman on CNN). It is easy for a candidate to say soothing words (as per the candidate in 2000, who declared CO₂ a pollutant and then reversed himself as soon as in office).

Here is a suggestion. Some organization (I still think young people should be taking the lead) should concoct a Declaration of Responsible Stewardship (surely a better name exists; it might involve the word Earth and/or Creation and/or Climate). Each and every candidate should be asked if they endorse the Declaration. The Declaration should include some very specific statements, e.g.:

1. Will you support a moratorium on new coal-fired power plants that do not capture and sequester CO₂?
2. Will you support legislation to transform utility rewards so as to encourage increased profitability as they help achieve improved user energy efficiencies?
3. Will you support imposition of a fair and gradually rising price on carbon emissions, so as to encourage a reduction in greenhouse gas emissions, with the price determined by apolitical authority based on combined economic and environmental considerations?

The questions need to be worked on, but they should be small in number. It would also be possible for candidates to endorse some of the specific statements without endorsing the declaration in toto.

Of course, these are just personal opinions.

Jim