MuseLetter

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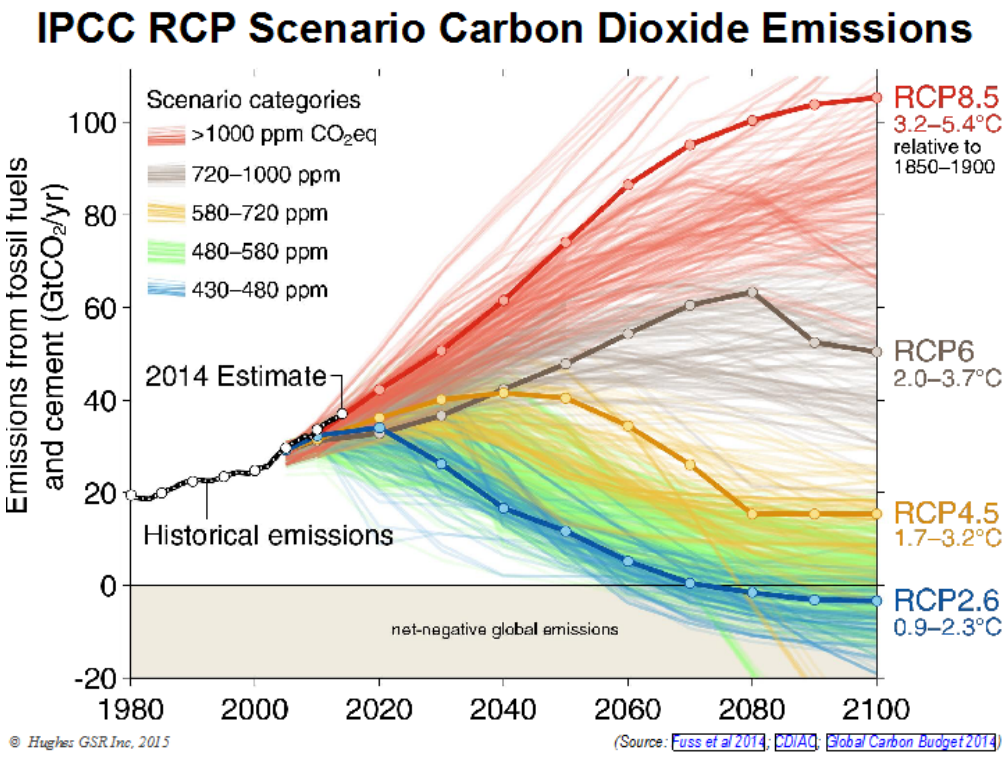
In the Museletter this month, two essays. First: Might peak coal improve our chances of avoiding the worst climate change impacts? And what are the implications for economic growth? Second: What are the implications of Donald Trump's announcement that he'll renege on the U.S. commitment to the Paris climate agreement?

Coal Is a Dinosaur and so is the growth economy

In a recent paper, Justin Ritchie, a Ph.D. candidate in resources and the environment at the University of British Columbia, and his co-author, UBC professor Hadi Dowlatabadi, pointed out that global estimates of the amounts of coal that are economically and technologically recoverable have fallen by two-thirds since the 1990s. This observation also formed the substance of my 2009 book, *Blackout: Coal, Climate and the Last Energy Crisis*, so it's nice to see the point taken up by others. However, Ritchie and Dowlatabadi go a step further and think through the implications of the ongoing coal reserves downgrades for climate modeling.

The Intergovernmental Panel on Climate Change (IPCC) has for years produced computer-generated models of several possible trajectories for future greenhouse gas emissions through the remainder of the century. These "representative concentration pathways," or RCPs, include an extreme high emissions case, RCP 8.5, that is commonly referred to as "business as usual." In this scenario, "coal use in particular increases almost 10 fold by 2100" according to IPCC authors.



At the 2015 American Geophysical Union meeting in San Francisco, at a session co-organized by Post Carbon Institute and other organizations, PCI Fellow David Hughes gave a presentation in which he showed that actual recoverable fossil fuel reserves are consistent only with low-emissions RCP scenarios. The new paper from Ritchie and Dowlatabadi reaffirms much of Hughes's argument (though Hughes looked more broadly at reserves of all fossil fuels, plus uranium).

What does this downgrading of likely carbon emissions mean for climate change modelers, climate activists, policy makers, and concerned citizens? According to Ritchie, the implication is clearly not as simple as "don't worry, fossil fuel depletion will solve climate change for us." Instead, "The same finding that shrinks CO2 emissions may also lower the cost of dealing with global warming, making the Paris Agreement that addresses climate change easier to achieve," as a *Bloomberg article* on Ritchie's paper puts it. That's because costs of climate action are typically measured against the economic growth presumed to occur if the world continues burning coal and other fossil fuels at ever-increasing rates extrapolated from recent decades. If those extrapolations are unrealistic (too high), then keeping emissions within a two-degree Celsius limit will be easier and cheaper.

Ironically, Ritchie's and Hughes's questioning of likely future carbon emissions (no official change has filtered through the IPCC apparatus as of yet) occurs just as Donald Trump undertakes telegenic coal advocacy and abandons the Paris climate accord. In view of the reality that America's best coal has already been dug and burned, the notion that the industry can somehow be revived at our president's whim would be laughable—except that the sad joke is on the hundreds of thousands of coal country voters who fell for Trump's fake promises.

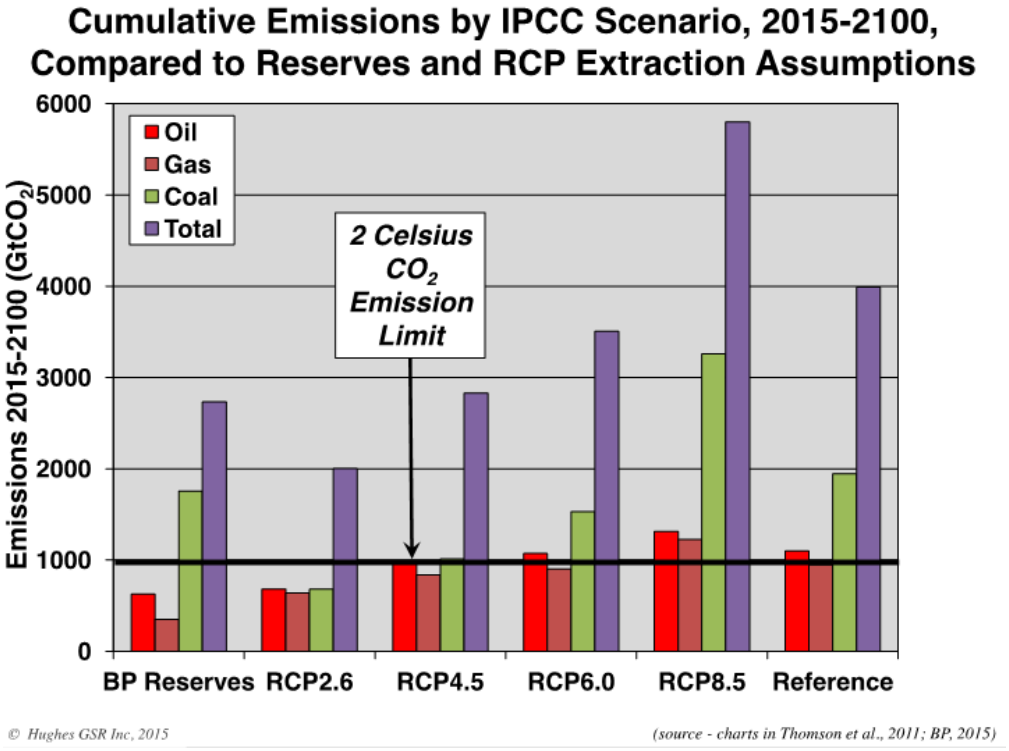
Why has the world dragged its feet in adopting more realistic fossil fuel resource estimates? Pushback from the fossil fuel industry is certainly understandable: coal, oil, and gas companies—whether traded on stock markets or government owned—derive market value from their assets, which consist of future production potentials. Lower reserves estimates translate to lower asset valuations. The motives of climate scientists and activists in overestimating burnable carbon reserves are harder to divine; one can only guess that they accept at face value the numbers from the fossil fuel industries, and then pad those numbers further out of caution (more on this in a moment). In any case, more realistic fossil fuel reserves estimates should help us come to terms with reality in several ways—not only with regard to climate modeling, but economic expectations and political prospects as well.

Every few years, the IPCC issues a major new "assessment" crammed with data and models, aimed at informing policy makers. Unfortunately, these assessments are also filled with what Oliver Gedens has called "magical thinking." For example, the most recent IPCC assessment (its fifth, released in 2014) described a series of computer-generated models of energy and emissions pathways that would keep the world below two degrees C. Eighty percent of these rely on negative emissions technologies, of which the primary one is Bio Energy with Carbon Capture and Sequestration (BECCS). The idea with BECCS is to grow enormous amounts of biomass, burn it, then capture the carbon and bury it. In order to capture and bury enough carbon to make enough of a difference, lots of biomass would be needed; by Gedens's calculations an area larger than the size of India would have to be planted in fast-growing crops destined to be combusted. The carbon dioxide that's captured would have to be compressed and moved through thousands of miles of pipelines to old, depleted oil and gas wells to be buried forever, requiring an infrastructure comparable to that of the current global oil industry. The costs would be enormous, as would be the risks.

Again, unrealistic assumptions about fossil fuel reserves, and therefore emissions, lead to unrealistic (i.e., implausibly expensive and risky) methods for keeping those emissions down. The only realistic solution to our climate crisis is not to put so much carbon in the atmosphere in the first place. But that path runs counter to expectations about economic growth—which requires energy. And that is almost surely at the root of the IPCC's assumptions about future fossil fuel consumption (regardless of whether those fossil fuels are actually available to be consumed).

So far humanity has increased the global atmospheric CO2 concentration from 280 parts per million to over 400 ppm—an already dangerous level. David Hughes figures burning our remaining realistic reserves of coal, oil, and natural gas would send us to about 550 ppm. There's an easy way of *not* getting to 550 ppm: leave most of those fossil fuel reserves in the ground. But that would sink the economy, unless we very rapidly develop alternative energy sources (nuclear, which is expensive and risky; or solar and wind, which are more realistic alternatives). Is it even possible to make the energy switch so quickly and completely as to avoid major bumps along the road? Building alternative energy infrastructure will itself require energy, and during the crucial early stages of the transition most of

that energy will have to come from fossil fuels. There's no way to bootstrap the energy transition process with energy from, say solar panels and wind turbines, because wind, and especially solar, technologies take years to energetically pay for their own manufacture and installation. So to avert burning even more fossil fuels than we otherwise would (in order to build all those solar panels, wind turbines, electric cars, heat pumps, and so on), resulting in a big pulse of carbon emissions, we would have to severely curtail the use of fossil fuels for current purposes—the maintenance of business as usual. That would also imperil economic growth. And we are talking about a remarkably small time window available for the shift, compared with the decades required for past energy transitions. It's all so complicated that one can get a headache just thinking about it.



The main stumbling block that leads policy makers to twist their logic into pretzels is economic growth. Remove the requirement for growth, and it's barely possible (not easy, but possible) to reconcile carbon reserves, emissions, energy sources, and warming targets—*if* governments somehow dedicate enough money and policy effort to the job. However, with further economic growth as an absolute requirement, the resulting climate models fester with internal contradictions and with assumptions about speculative technologies that very few people believe can be scaled up sufficiently, and that may have economic, environmental, and political repercussions that no one is prepared to deal with.

We cannot afford to hide the implications of realistic fossil fuels reserves estimates behind magical thinking. Perhaps the most important of those implications is that the world is probably just about at peak energy right now, give or take a decade. If we act immediately and strongly to rein in climate change, then a peak in world energy usage will likely occur more or less immediately. If we don't act, then we may have another decade before fossil fuel

depletion results in peak energy anyway. Our energy mix will shift: in the case of strong climate policy, oil will start to decline first (due to depletion), probably before 2020, and coal as well (due to policy), with natural gas growing until roughly 2020-2050, when it peaks globally from depletion. Without strong climate policy, coal peaks anyway (due to depletion) around 2025 (Chinese coal consumption appears to have peaked in 2013-2014). The amount of energy we get from nuclear power probably won't change much over this time period. Renewables will contribute a larger share, depending on investment levels and policy supports, but cannot realistically expand far enough, fast enough, to maintain energy growth and therefore economic growth.

So overall, one way or the other, we have just about hit the maximum burn rate our civilization is likely to achieve, and it's mostly downhill from here. That has implications for robust economic growth (it's essentially over), and hence for war and peace, inequality, political stability, and further population expansion. Dealing with the end of energy growth, and therefore economic growth, is the biggest political and social challenge of our time—though it's unlikely to be recognized as such. (Our biggest ecological challenges consist of climate change, species extinctions, and ocean acidification.) The impacts of the end of growth will likely be masked by financial crashes and socio-political stresses that will rivet everyone's attention while a quiet trend churns away in the background, undoing all our assumptions and expectations about the world we humans have constructed over the past couple of centuries.

If we're smart, we will recognize that deeper trend and adapt to it in ways that preserve the best of what we have accomplished, and make life as fulfilling as it can be for as many people as possible, even while the amount of energy available to us ratchets downward. We'll act to rein in population growth and aim for a gradual overall population decline, so that *per capita* energy use does not have to decline as fast as total use. We'll act to minimize ecological disruption by protecting habitat and species. We'll make happiness, not consumption, the centerpiece of economic policy.

If we're not so smart, we'll join the dinosaurs.

Failing President Spites Climate

There are a lot of things that make protecting Earth's climate really hard. Like the fact that fossil fuels are so deeply embedded in our economy and way of life. Or the fact that all policy makers, in every country and at every level of government, demand more economic growth (even though increasing the size of an economy leads to more energy and materials usage, and hence more carbon emissions). Or the scary prospect of planetary feedbacks that might increase the scale of climate impacts far beyond scientists' forecasts.

Add to that list one Donald J. Trump, the likely soon-to-be-indicted president of a nation that's rapidly careening toward the fracturing of its financial system, the collapse of its geopolitical influence, and the evaporation of whatever ethical basis for world leadership it may ever have claimed.

It's easy to be cynically dismissive of Trump's just-announced exit from the 2015 Paris climate accord: the agreement wasn't strong enough to actually achieve its goals, and Trump will likely be booted from office one way or another before the agreement withdrawal can take practical effect. However, the symbolism is damning not just of him but of a huge swath of American political culture. Sad.

The one good thing that might emerge from this dreary development is a reinvigorated effort on the part of other nations—plus U.S. state and local governments—to engage in the necessary and inevitable transition away from fossil fuels. Just as Donald Trump often makes policy decisions simply by noting what Barack Obama did, and then doing the opposite, untold millions worldwide are increasingly adopting a similar attitude toward Trump and his merry band of co-conspirators. If Trump hates climate action so much, there must be something good about it.

The best success stories about climate action never emerged from Washington; they came instead from places like northern California, where citizens are creating their own nonprofit electric utility companies committed to expanding renewable energy; from Amsterdam and Copenhagen, which have spent decades minimizing the role of the automobile; and from countless villages throughout the Global South where cheap solar cells and LEDs are reducing the burning of biomass for light.

Read between the lines. "Make America Great Again" roughly translates to: "Don't look to Washington for examples, guidance, inspiration, or help—especially now. It's up to you. Get to work!" Thanks for upping our dedication and zeal, Mr. President.