Rolling Stones

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I do few interviews because of the time required and my difficulty in making things clear orally. The Rolling Stone interview by Jeff Goodell was an exception, a testimony to his abilities.

An important number in the story was not right, but is being corrected. It made me wonder how to make that number simple enough for people (including ourselves) to remember easily.

The number is the amount of carbon that we must somehow suck out of the air, if we want to get back to 350 ppm CO_2 in the air by the end of the century, which is a first approximation, a first target, for what must be done to keep climate close to the Holocene range, the relatively stable climate of the past 11,700 years during which civilization developed.

[You may say, well that's a stiff requirement, so let's just allow climate to be hotter. But that would mean you are willing to accept a continually receding shoreline, with eventual loss of all coastal cities. When that would happen is debatable – an inherently difficult nonlinear problem – but each new piece of evidence is pushing it sooner than the experts had been estimating. And remember that coastal cities include more than half of the world's large cities, likely many of the cities you love, with lots of history. Consider the implied humanitarian and economic debacles, with hundreds of millions of refugees.]

Back to the number: we showed in a 2013 paper that we would need to extract 100 GtC[1] to get back to 350 ppm by 2100, if we began reducing emissions in 2013 at the (optimistic) rate of 6%/year. 100 GtC is almost as large as the net historical emissions from deforestation, so it is about as much as we could hope to extract via improved agricultural and forestry practices.

However, emissions did not begin to decline in 2013. Emission growth slowed down from about 3%/year in the preceding two decades to an average 0.6%/year in 2012-2015. Because of the time it takes to move politics and to change energy infrastructure, in our newest paper (now under review) we assume that global emissions will change little in the next four years.

If we further assume the same 6%/year emission reduction rate beginning in 2021 relative to 2020, the extraction from the air required to get to 350 ppm by 2100 is ~150 GtC.

So, the bottom line is that the 8-year period (2013-2020) of continued high emissions changes the required CO_2 extraction from 100 GtC to 150 GtC – another easy # to remember.

Is it possible to store 150 GtC in the biosphere and soil? Say, even if we make all plausible efforts to employ biochar where it has other benefits and apply rock dust in conjunction with reforestation and agricultural processes where it has other benefits? We will discuss that in a later message. Here I only want to note that the 8-year delay has made the task much more difficult, increasing the magnitude of carbon extraction from 100 GtC to 150 GtC.

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[1] 1 GtC = 1 gigaton carbon = 1 billion tons carbon = 10^{15} grams carbon = 1 petagram C = 1 PgC; so a GtC is exactly the same as a PgC. Much of the community seems to be switching to PgC, but here I still use GtC. Also note that we give the mass of carbon, not the mass of CO_2. Because the atomic mass of C = 12 and O = 16, the CO_2 mass exceeds C mass by a factor 44/12 (~3.67). Fossil fuel emissions today are ~10 GtC, easy to remember.

Let me also comment on the realism or lack of realism of the 6%/year rate of reduction for CO_2 emissions. Some people say that is implausible, and then, out of the other side of their mouths, they say that we need a plan to reduce emissions by 80% by 2050. I've got news for them. An 80% reduction by 2050 implies ~5%/year reduction, for the common assumption of exponential reduction, i.e., the percent applies to the fossil fuel emissions still remaining, a reasonable assumption, because you take the low-hanging fruit first.

An alternative scheme to get 80% reduction would be linear reduction of emissions, so 80/30, i.e., ~2.7%/year, if reductions start in 2020. In this linear case the percent reduction is relative to 2020 emissions, not relative to the prior year's emissions. The truth may be between these (exponential and linear) cases. There is some truth to the low-hanging fruit concept and the fact that some emissions may be recalcitrant, which favors the exponential approximation. However, if a carbon fee rises gradually over time, the linear case might be a better approximation.

The important point is that the reduction rate to achieve 80% reduction by 2050 is conceivable. However, it will not happen unless the world comes to its senses in the next few years and agrees that it is necessary to have an across-the-board (oil, gas, coal) rising carbon fee collected at domestic mines and ports of entry, thus making the price of fossil fuels more honest by including their costs to society. This would make economies more efficient and spur economic growth.[2]

Finally, I note that even my colleagues did not "get it", that in the (true) Holiday Tale, I was the Mad Hatter[3]. Oh, well, no more poetry for me.

[2] It takes two to dance. I have always said that it requires an agreement between either U.S. + China, Europe + U.S. or Europe + China to be made near-global via border duties on products from non-participating countries and rebates to manufacturers for products shipped to non-participating countries. I had thought that either pair involving Europe was unlikely, because, as the Science Adviser to the European Commissioner said, pointing to a building of EU bureaucrats, "you need to persuade them." However, recently there are some murmurs in the EU about the carbon fee concept, albeit not yet by the major parties, so, given other political developments, maybe it is possible for Europe to play a leading role, despite its current struggles.

[3] During the Victorian age, it is said, hatters (not, in that case, the wearers, but rather the hat makers) were prone to be mad, because mercury was used in the manufacture of felt hats, leading to a high rate of mercury poisoning. Resulting speech, memory and other neurological problems tended to make hatters appear quite mad, whether at tea parties or not.