SUBMISSION TO THE SENATE SELECT COMMITTEE ON CLIMATE POLICY

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Introduction

I write as a scientifically literate member of the public who has spent many hours pondering a question rather similar to the object of this committee's inquiry, namely, what should be done about climate change. Unfortunately I have been unable to arrive at a stable and rational answer to that question. Were it not for one consideration, I would almost certainly be in the camp of those who say we must as a planet aim for levels of atmospheric carbon dioxide lower than those we have already reached, a point of view which I am sure will be amply and vociferously represented among the submissions you receive. However, there is one consideration which overturns that conclusion (along with many other assumptions of everyday political life). As I said, I have had some difficulty in actually embracing its implications, so this submission will have two parts. In the first part, I will talk briefly about why the most ambitious targets are desirable, and add a few reflections on how they might be achieved. Then, in the second part, I will get to the perspective which potentially overturns the logic of the first part.

Part one: Why to aim for a return to preindustrial atmospheric conditions, and how to get there

To begin with, I want to establish a simple conceptual framework by means of which to describe the situation and humanity's options. These concepts are necessarily simplifications of reality, but so long as they are not actually untrue to reality, they offer a way to think about an otherwise very complex situation.

The key concepts are that *there is a global temperature*, that *its changes are determined by a sum of so-called radiative forcings*, and that *it takes time for a change in forcings to translate into the corresponding change in global temperature*.

The baseline temperature of Earth is determined by our distance from the sun, to which the natural greenhouse effect then adds about fifty degrees Celsius, and from which natural cooling influences (like reflection of sunlight back into space by clouds) subtract about fifteen degrees. When atmospheric composition and surface reflectivity change, they introduce ‘forcings’ which induce a new equilibrium temperature; but since the new equilibrium must include the ocean, it takes decades to fully establish itself.

In the recent geological past, Earth has moved back and forth between two states, one in which continental ice sheets are restricted to the polar regions, and one in which there are also ice sheets covering large areas of Europe and North America. Further back, there was a time when there was no ice anywhere, forests grew in Antarctica, and the ocean was 80 meters higher than it is now. These three states are characterized by different levels of carbon dioxide: in the depths of an ice age, CO_2 is at about 170 parts per million; in a warm ‘interglacial’ period like that in which human civilization developed, CO_2 is around 300 ppm or a little less; and on the ice-free planet, CO_2 was at about 450 ppm.

Transitions between these states are initiated and driven by different forms of forcing. The original transition out of the ice-free state may have been induced by the uplift of the Himalayas, which have served as a very slow carbon sink through the formation of carbonate minerals by weathering. The movement between glacial and interglacial states appears to be initiated by small periodic changes in Earth’s orbit around the sun, and then amplified (in the case of the long slow thaw that ends an ice age) by the retreat of the ice sheets (which reduces the reflectivity of the planet’s surface) and by the uptake of greenhouse gases by natural sinks, above all by the ocean. (During the global cooling that begins an ice age, these processes happen in the other direction, again beginning with the small orbital shift.)

Unchecked, the ultimate consequence of global reliance on fossil fuels would be to take us back to the ice-free state by melting the ice caps, but that is a process requiring centuries to play out. In the short term we would experience the other aspects of global warming, such as shifting climatic zones, increased frequency and intensity of various weather events, and the beginning of sea level rise.

The nature of the human influence on climate is rendered complex by the fact that it is about more than increasing levels of carbon dioxide. That methane and various artificial greenhouse gases also contribute to warming is well-known, but what is less appreciated is that there is also a human-induced global cooling brought about by traditional pollutants. These pollutants have a very short atmospheric lifetime compared to carbon dioxide, and provide a persistent negative forcing (cooling effect) only because we persist in producing them. As the newly industrializing world cleans up the air of its cities, the magnitude of this negative forcing is liable to be reduced, further increasing the net warming effect in a way independent of the increase due to the accumulation of carbon dioxide.

I think that rounds out the picture of the present. We emit carbon dioxide; it accumulates and drives the global temperature higher, but we don't get there right away because the ocean is such a big heat sink; and we also emit other, particulate pollutants which offer a compensatory cooling effect, but an effect which will disappear the moment we stop producing them. The long-range consequence of all this global warming is a return to the ice-free world, and in the short term we get to experience ever-amplifying weather-induced mayhem.

There is a political consensus that this is a bad path to be on, but we are struggling to commit even to actions that fall short of getting us off that path. The European Union's criterion of how to avoid dangerous climate change – keeping the global temperature within two degrees of the preindustrial temperature – informed the indicative targets in the 2007 Bali roadmap (according to which developed countries should aim for a 25-to-40% reduction in emissions, relative to 1990 levels, by 2020), which were constructed with a CO_2 target of 450 ppm in mind; but more recent work suggests that one is already on the path to the ice-free planet at CO_2 levels above 350 ppm (with various positive feedbacks sufficient to take us the rest of the way thereafter), and we're presently at 385 ppm, and increasing by 2 ppm per year.

Thus increasing numbers of people have concluded that the goal must be a world of zero net emissions, and a period of CO_2 drawdown, continued until CO_2 levels have returned to something like the interglacial norm of 300 ppm. So long as we have positive net emissions of CO_2, the problem will get worse; it will only stop getting worse when we reach zero net emissions; and the situation will only improve once CO_2 starts going down again.

This is clearly a huge change from the world we know, where GNP is pretty much proportional to a country's CO_2 emissions. Nonetheless, I think it is clearly the logical endpoint of the path on which we are now embarked – the development of "zero-emission" models for energy, transport, industry, and agriculture. I trust that this perspective is developed in detail by other submissions and will not say too much about it. Also, unlike most zero-emissions advocates, I cannot be too alarmed about the fact that today's targets fall short of that goal; I trust that the future will bring both ample painful incentives (in the form of weather and climate damage) to go all the way, and new ideas which will ease the transition, which right now looks so expensive to accomplish. I will observe merely that, assuming a long-term goal like 300 ppm, a "fair and equitable contribution" consists of each nation aiming to achieve a zero-emission economy, and then to additionally capture and sequester as much atmospheric carbon as it put up there to begin with. And of course, there is every reason for nations to collaborate in achieving these goals, as they all have an interest in success.

Part two: Why all that effort might be unnecessary after all

If that was the whole story, I would happily spend my life trying to ease and facilitate the inevitable transition to a zero-emissions society, and wrestling with the innumerable issues, small and large, implied by such a transition. However, it is not the whole story. According to the perspective I shall now describe, climate change is only a transitory threat and something of an illusory threat, not because the science is wrong, but because we are on the cusp of a technological revolution which almost in passing renders the climate threat easily remediable, while posing an even greater threat of its own to human survival.

The technology in question is nanotechnology, though it may be best conceived as intrinsically linked to another technology, artificial intelligence, because they are liable to advance together, and the unprecedented situation they will create arises from their conjunction. These names are sometimes used to designate rather humble technological achievements, so I should also be clear that I am talking about advanced nanotechnology and advanced artificial intelligence.

The best description of the emerging situation is still a book that was written over twenty years ago, Eric Drexler's "Engines of Creation", the text of which is available online. Very briefly, advanced nanotechnology – precise control of atomic-scale structures and processes – will enormously expand the range of what is technologically possible, and advanced artificial intelligence will get us to that point with unequalled rapidity, once a certain threshold is crossed. Among the predictable capabilities are an ability to capture and sequester atmospheric CO_2 cheaply, rapidly, and in any desired quantity – thus permitting a rapid return to 300 ppm – and the ability to make free-living microscopic nanomechanisms, a sort of self-reproducing pollutant, which existing life is quite unable to metabolize, and which would therefore accumulate until they had smothered the world in their progeny – thus the extinction threat. The other foreseeable outcomes of nanotechnology may look like the ingredients of a science-fiction utopia (see Drexler's book for details), but the sheer destructive potential is likely to trump all that, and looks incredibly difficult to stop.

In short, this is a view of 21^{st}-century life which is largely in competition with the outlook according to which the struggle to achieve sustainability, and above all to stop climate change, defines the future. If all this was a century or more away, that would leave plenty of time for the fight against climate change to be relevant. But if it's ten to thirty years away, then even the most vigorous effort to decarbonize the economy appears pointless, because it is unable to make enough of a difference to the planet's temperature trajectory on that timescale to significantly affect human welfare. (I recall a figure in one of Ross Garnaut's reports, in which a difference of half a degree was achieved about twenty years from now, by following one global emissions trajectory rather than another. That might barely be enough to count for something.) The implication is that we should be focusing entirely on adaptation, while preparing to meet the nanotechnological challenge.

Certainly the effort to stop climate change and the effort to prepare for nanotechnology can coexist in society, and can even reinforce to a small degree. One can plan to achieve the carbon drawdown part of the goal via carbon-capturing nanotechnology, for example (while making sure that it is not on one of the developmental pathways that leads to weapons of mass destruction). But unless one's strategy for dealing with nanotechnology is to ban it comprehensively and make sure it never happens – and that would probably require, in the long run, the destruction of all microscopes, and anything else which offered a window on the world of the invisibly small – the anticipation of a near-future nanotechnological upheaval has a corrosive effect on one's belief in the need to stage a decarbonising technological revolution in the present, for the sake of the climate. That has been my experience.

Conclusion

In conclusion, I regret that I had nothing to say about the relative merits of emissions trading and a carbon tax, on the place of agriculture in such schemes, the appropriate magnitude of government support for renewable energy and transitional assistance for affected industries, and all those other concrete issues of policy which fall within the remit of this committee. But I hope this brief introduction to an unusual perspective on the problem was diverting and stimulating, and I warn that, regardless of what we do on the climate front, this other situation is approaching, still largely unheralded.

Postscript

I'd like to acknowledge a conversation with Katja Grace which encouraged me to make this last-minute submission, and also the support of UQ Climate for Change in creating an environment in which I could think and learn about the issues surrounding climate change.