Cumulative Carbon and Just Allocation of the Global Carbon Commons

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1 Introduction

In the climate problem, there is a clear goal for a theory of justice: to first reduce growth rate of global carbon dioxide emissions, and ultimately to bring them to zero before the carbon emissions have committed the Earth to an unacceptable degree of climate disruption. We are not interested in abstract notions of who may deserve tp be punished. There is a job to be done, and while finding a just solution is only a part of the process, it probably does play some role in persuading all parties to act in their mutual interest. Nations will rarely do anything that goes much against perceived self-interest just because it is the right thing to do, but on the other hand, in the absence of military coercion, nations will mightily avoid agreeing to restrictions they perceive (rightly or wrongly) as unjust.

Finding a solution to the threat of global climate change involves distribution of a valuable and scarce resource, the *global carbon commons*. It engages issues of equity between rich and poor (both within nations and across national boundaries), and between present and future generations. We also need to find principals for dealing with past emissions, in order to determine how much of the commons has been "used up," and how the unused portion of the commons should be allocated. These are quintessentially ethical problem. First, we need to get clear on the nature of the resource being distributed

2 The Global Carbon Commons

When carbon is emitted into the air in the form of carbon dioxide (generally as a result of burning fossil fuels or as a consequence of deforestation) over time it is repartitioned between the atmosphere, the ocean and the near-surface materials of the land. That portion that remains in the atmosphere causes global warming and other forms of climate disruption, while that portion which enters the ocean causes ocean acidification. Allocation of the global carbon commons requires us to know the relation between climate-relevant emissions and climate change.

Other significant greenhouse gases, notably methane, also contribute to global warming, but these do not merit consideration on an equal footing with CO_2 because their persistence in the atmosphere is so short. For example, methane has an atmospheric lifetime of only 12 year, so that we can delay methane controls for two centuries if we wish, and still get the full benefit of reduction of methane emissions within a few decades of implementation of controls. The same cannot be said for CO_2, as we shall see shortly. The commonly used practice of aggregating shortlived and longlived greenhouse gases through their Global Warming Potential leads to highly erroneous policy guidance, and should be abandoned [1].

Recent research has shown that the magnitude of climate change, as measured by global mean warming, is very well characterized by a simple metric known as *cumulative carbon*. Cumulative carbon is simply the net carbon emitted globally over the period of time during which human activities continue to contribute a net input of carbon (as CO_2) to the Earth system – more or less the duration of the fossil fuel era. The key results regarding cumulative carbon are as follows:

- The global mean warming is *linearly proportional* to cumulative carbon.
- The amount of warming at the time emissions cease is nearly independant of the emissions trajectory over which the cumulative carbon is emitted.
- The amount of warming at the time emissions cease persists for about a thousand years, and declines only very gradually over the next ten

[1] Solomon S, Pierrehumbert RT, Matthews D and Daniel JS 2012: Atmospheric composition, irreversible climate change, and mitigation policy. World Climate Research Program Open Science Review, in press.

thousand years, and still more slowly over the following several hundred thousand years.

Cumulative carbon is usually quoted as gigatonnes (billions of metric tonnes) of carbon. The linearity property is very important in thinking about allocation, because the contribution of individual entities to climate damage, be they nations or persons, can be characterized by the amount of cumulative carbon they contribute to the total. To determine the size of the usable carbon commons, we must determine, by a process of negotiation, the maximum allowable warming that can be tolerated, and then translate that into a cumulative carbon number. Because the climate change is nearly independent of emissions trajectory, there is little point in arguing about details of when an entity chooses to emit its fair allocation of carbon.

The fact that it is the *cumulative* amount of carbon that counts for climate derives from the very long lifetime of CO_2 in the atmosphere. It accumulates in the atmosphere, rather like mercury in the fat of a fish, and leads to essentially irreversible changes in the climate [2]. Before proceeding to the question of usage and allocation of the carbon commons, we'll digress to summarize the basic science leading to the connection between climate change and cumulative carbon [3].

During the first 10000 years after emissions, the main sink for anthropogenic CO_2 is uptake by the ocean. In order to store a significant amount of carbon in the ocean, it must be mixed from the surface layers into the deep ocean, and this takes about a thousand years. Moreover, the ocean can only store significant amounts of carbon by converting it from dissolved CO_2 to bicarbonate (the same substance found in baking soda), and this involves some chemistry that has nonlinearities in it. The upshot is that the fraction of emitted carbon that stays in the air as CO_2 once the atmosphere-ocean system has come into chemical equilibrium increases with the cumulative carbon emitted. A calculation of the air fraction, based on the very simple equilibrium carbon model in Pierrehumbert (2010) [4]. is shown in the up-

[2] Archer D. 2008: *The Long Thaw*, Princeton University Press. Solomon, S., G. Kasper Plattner, R. Knutti, and P. Friedlingstein 2009: Irreversible climate change due to carbon dioxide emissions, Proc. Natl. Acad. Sci., 106, 17041709.

[3] For a more complete review of the subject, see National Research Council, Climate Stabilization Targets: Emissions, concentrations and impacts over decades to millennia, The National Academies Press, Washington, D.C., 2011.

[4] Chapter 8, Pierrehumbert RT 2010: *Principles of Planetary Climate*. Cambridge University Press

per panel of Fig. 1, where the amount in the atmosphere is expressed as gigatonnes carbon (GtC); to put this in more familiar units, 100GtC in the atmosphere translates into approximately 46 parts per million CO_2. Hence, the atmospheric CO_2 is concave upward as a function of cumulative carbon. However, the radiative forcing which drives climate change is logarithmic, and hence concave downward, as a function of atmospheric CO_2. These two nonlinearities very nearly cancel, leading to a linear relation between temperature increase and cumulative carbon, as shown in the lower panel of Fig. 1.

The deep ocean warms and approaches thermal equilibrium on the same 1000 year time scale as it draws down CO_2 following the cessation of emissions. The net result is that atmospheric temperature remains fairly flat over the thousand years following the end of emissions. This is illustrated in Fig. 2, where we show the modeled CO_2 and temperature trajectories resulting from releasing 1700GtC cumulative carbon over an emissions trajectory which brings emissions to zero by the year 2250 [5]. The temperature time series would be virtually identical even if all the cumulative carbon is emitted in a pulse over a single year, owing to the thermal smoothing effects of the ocean [6].

Over the next ten thousand years (not shown), carbonate (basically limestone) dissolves from sediments and washes into the ocean in rivers, buffering the oceans acidity and allowing a bit more carbon to be taken up, leading to a modest reduction in temperature. Fig. 3 [7] shows how the future climate looks as a function of global cumulative carbon emitted, based on the median IPCC climate sensitivity; there is a 50-50 chance things would be worse for any given amount of cumulative carbon. If we adopt a 50% chance of global mean warming of 2C or more as our climate target for the sake of discussion, that translates into an allowable total emission of about a trillion tonnes of carbon. This serves as a measure of the size of the carbon commons [8].

[5]The atmospheric CO_2 trajectory is taken from the carbon cycle model of Eby, M., K. Zickfeld, A. Montenegro, D. Archer, K. J. Meissner, and A. J. Weaver 2009: Lifetime of anthropogenic climate change: millennial time scales of potential CO2, and surface temperature perturbations, Journal of Climate 22 (10):2501-2511, DOI: 10.1175/2008JCLI2554.1. The corresponding temperature is computed using the two-box climate model described in Solomon *et al.* 2012 (see footnote 1)

[6]*ibid*

[7]*op. cit.* National Research Council 2011

[8]Allen, M. R., D. J. Frame, C. Huntingford, C. D. Jones, J. A. Lowe, M. Meinshausen, and N. Meinshausen 2009: Warming caused by cumulative carbon emissions towards the

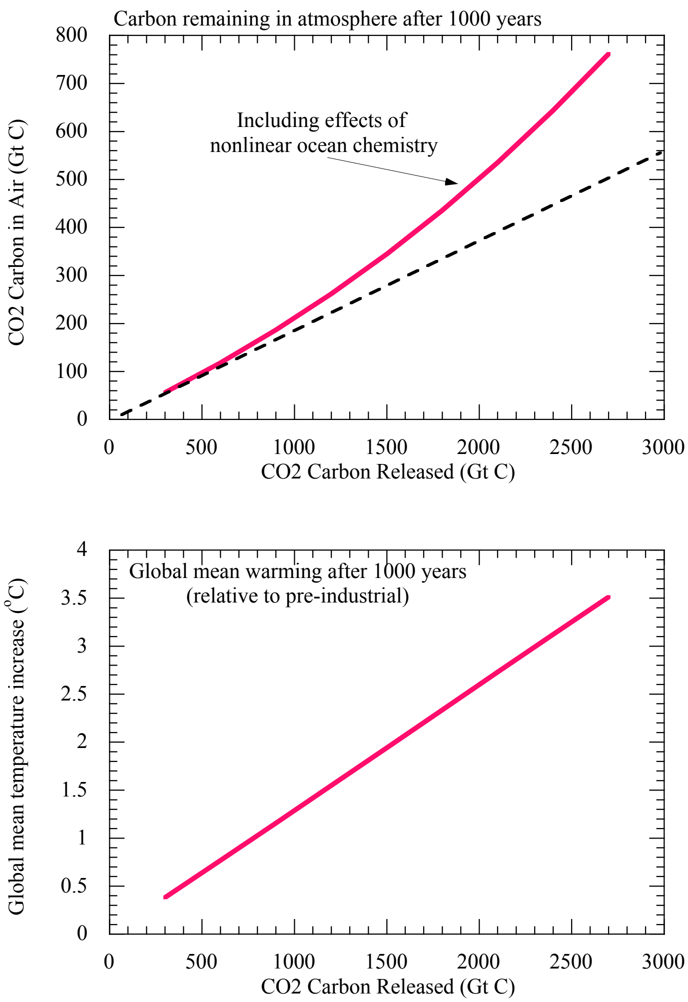

Figure 1: Upper panel: Gigatonnes carbon in air (as CO_2) vs Gigatonnes emitted. Calculation is based on carbon added to a 280ppmv atmospheric pre-industrial baseline, assumed in equilibrium with the ocean. The air fraction represents the amount left in the atmosphere after the ocean and atmosphere have equilibrated, but before ocean acidification has been buffered by dissolution of carbonate (limestone) from land and the sea floor. Lower panel: Corresponding global mean warming based on an equilibrium climate sensitivity of 3 degrees C per doubling, which is approximately the IPCC median value.

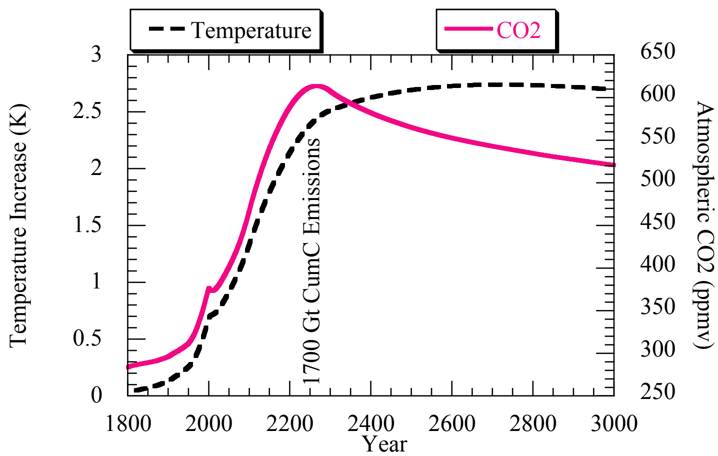

Figure 2: Time series of atmospheric CO_2 concentration and global mean atmospheric temperature resulting from emission of 1700 gigatonnes of carbon up to the year 2250, followed by cessation of emissions.

Our discussion of cumulative carbon so far was based only on uptake of CO_2 by the ocean, but terrestrial ecosystems also intercept some of the emitted carbon and store it in living biomass and near-surface soil carbon – perhaps as much as 2.4 Gt per year at present [**CITE: INSERT FOOTNOTE]. The behavior of this part of the carbon cycle is far less well understood than the oceanic carbon sink, which mostly depends on fairly basic physical and chemical principles. The terrestrial carbon sink is a delicate balance between the increase in carbon uptake by photosynthesis (stimulated by increasing atmospheric CO_2, and by inadvertent and deliberate reforestation or changes in agricultural practices) and a nearly equally large change in the release of CO_2 from decomposition of dead biomass and soil organic carbon. The future of this sink is uncertain, warming tends to enhance decomposition and it takes little change in the balance to turn the net sink into a net source, releasing the carbon we have recently been storing in soils, and perhaps even more than that. The carbon cycle models used in Figs. 2 and 3 do in fact include a terrestrial carbon module which tends to return to the atmosphere the carbon stored in soils in the first century or so. This part of the carbon

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trillionth tonne, Nature, 458 (7242), 11631166, doi:10.1038/nature08019

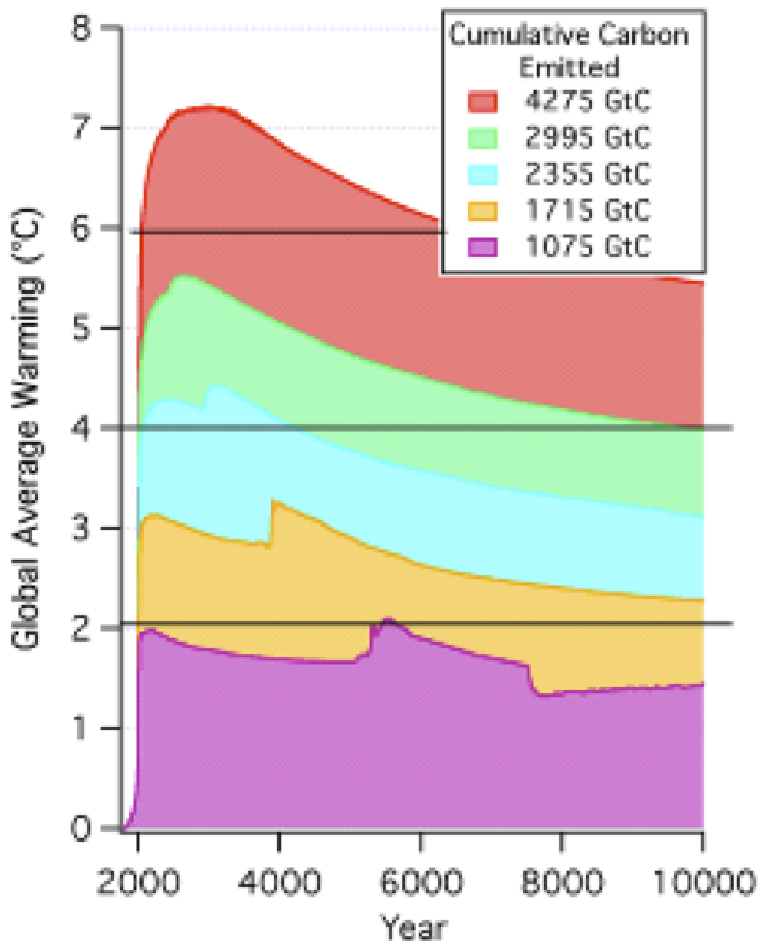

Figure 3: Global mean temperature out to the year 10000, as a function of cumulative carbon emitted during the period of fossil fuel usage.

cycle needs to be relegated to the domain of known unknowns, and apart from saying that it would be hazardous to rely on continued near-surface storage of carbon that is very subject to oxidation by bacteria that have had two billion years to get good at making use of available organic carbon, there is little that can be said with certainty.

How much of the carbon commons has been used up already, and who used it? Fig. 4 shows the cumulative emission for four representative regions (two in the developed world and two in the developing world), together with the net global value. The four regions chosen make up more than half of the world total. Globally, about a third of the trillion-tonne carbon commons has already been used up by fossil fuel burning alone. It is clear that the developed nations (North America and Western Europe plus Germany) have used a far larger share of the carbon commons than the developing world regions (Centrally Planned Asia plus Far East Asia – think China and India). China may have overtaken us as an emitter, with India not far behind, but while the cumulative emissions of both regions are growing rapidly at present rates of growth they will not overtake North America cumulative emissions until roughly 2040.

Land use changes attributable to human activity (mainly deforestation) have also added CO_2 to the atmosphere – approximately 150 Gt carbon as of 2005 – though this source is not growing as fast as the fossil fuel source, and indeed can't grow for much longer before we run out of forests to cut down. Including this source in the regional inventory could somewhat shift the contributions of the various regions to cumulative carbon, but we have left it out of the picture in part because historical land use carbon emissions are subject to considerable uncertainty, especially if one wishes to factor in the large source of carbon due to deforestation during the European colonization of North America. Besides that, deforestation creates opportunities for future carbon sink due to reforestation, provided the land has not become so degraded that it can no longer support forest growth. To the extent that nations avail themselves of this fairly rapid (though limited) carbon sink, the net effects of deforestation are a wash.

The ocean is not a long-term sink of carbon. The carbon added to the system is re-partitioned between an ever-growing air fraction and an oceanic fraction, but so long as emissions exceed the minuscule rate that can be absorbed by the very slow processes which convert CO_2 to limestone on land, the atmospheric carbon dioxide will continue to grow. Thus, to prevent continued warming, everybody's emission of fossil fuel carbon needs to fall

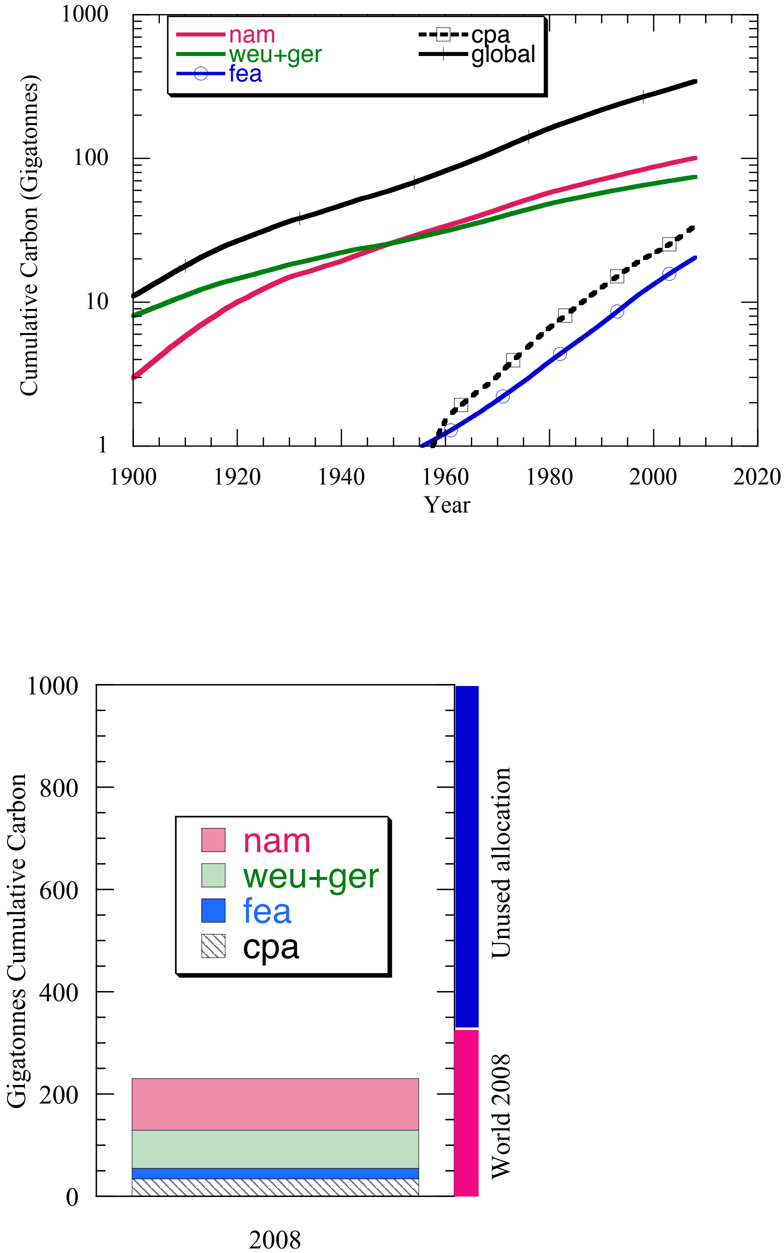

Figure 4: Global and regional cumulative fossil fuel carbon emissions. Regions defined as follows: nam = North America, weu+ger = Western Europe and Germany, fea = Far East Asia (mostly India and Pakistan; doesn't include Japan), cpa = Centrally Planned Asia (mostly China). Bar chart in lower panel shows year 2008 cumulative emissions on a linear scale, compared with the 1000 gigatonne cumulative emissions target

essentially to zero at some point [9], and before an unacceptable value of cumulative carbon has been reached. The Carbon Commons is not a renewable resource. Allocating it is not like divvying up fishing rights in the world ocean. When it comes to carbon, there is no sustainable catch, If fish were like carbon, everybody would need to give up fishing eventually, and those who caught more fish in the past would have fed themselves at the expense of others.

3 Principles for just allocation of the Carbon Carbons

As recounted by Shklar [10] , Aristotle saw greed as the basic driver of injustice, and his theory of distributive or normal justice was largely based on the need for an orderly process to keep greed from running rampant. Subsequent thinking may have broadened our understanding of the wellsprings of injustice, but it seems to me that greed, and the need to keep it in check, serves very nicely as the basis for discussion of just allocation of the Carbon Commons.

The moral philosopher Peter Singer, identified three generally recognized principles of justice that could be applied to the allocation of the carbon commons, and explained them in terms of an analogy with a series of lakeshore villages all of whom dump pollution into a lake they rely on for fish [11]. These principles have a certain affinity with the notion of greed as the root of injustice. I will reformulate them and make them quantitative in terms of cumulative carbon.

The first of the three alternate principles is *Polluter Pays*, which can be paraphrased as "you broke it, you fix it." In the village analogy, it implies that the village that dumped the most sewage bears a proportionate bulk of the responsibility for cleaning up the mess. In the context of the Carbon Commons, there being no practical way to "fix" the climate by removing a significant proportion of past emissions from the atmosphere, fixing the problem largely means accepting a lower allocation of future emissions. By

[9]Matthews, H. D., and K. Caldeira, Stabilizing climate requires near-zero emissions, Geophys. Res. Lett., 35, L04,705, 2008.

[10]Shklar JN 1990 : *The Faces of Injustice*, Yale University Press 144pp.

[11]Singer, Peter 2006: Ethics and Climate Change: A Commentary on MacCracken, Toman and Gardiner Environmental Values 15 (2006): 41522.

this standard, Figure 4 demonstrates that North America has more obligation to reduce its emissions rate than Centrally Planned Asia. In fact, even if North America instantly reduced its emissions to zero, it would not be until 2030 that Centrally Planned Asia caught up to an equal degree of obligation, at its present rate of cumulative emissons growth.

Singer's second principle, which we'll call *Equal Future Shares* is prospective rather than retrospective. Each individual alive in some baseline year is a tabular rasa, free from any responsibility for carbon emitted in the past, and with an equal entitlement to a share of the allowable global future emissions. As Singer notes [12] it is desirable to base per-capita allocations on population in a baseline year, or some other target population, so as to provide an incentive for measures (hopefully benign) that moderate population growth. *Equal Future Shares* is usually thought of as allocating blocks of emissions rights to nations in proportion to their baseline population, but if the right kind of global emissions market could be established, there's no real reason not to issue shares directly to individuals. There's much to be said for that, in terms of increasing flexibility and endowing individuals with more freedom to choose how their personal allocation is used, and how much should be left to descendants.

However it is distributed, making allowance for the portion of the carbon commons used up by past land use changes (basically deforestation), dividing up the roughly 500 Gt remaining over the Year 2012 world population yields an allocation of about 70 tonnes per person, which could be augmented to the extent that an individual participates in successful reforestation projects. At the present rate of North American emission, this would be used up in only 13 years, even without allowing for future growth in emissions rate. Regardless of where the obligations of North Americans stand relative to the developing world, it is clear that we would need to be doing far more than we currently are in order to bear our fair share of the burden of decarbonizing the world economy. Under *Equal Future Shares* Centrally Planned Asia could continue to emit for several decades at their current annual rate, but would still have considerable incentive to reduce their *emissions growth rate* since the current rate of growth in emissions rate would exhaust their allocation in not too long a time (roughly 30 years, given a sustained 5% annual growth rate, vs. 56 years if the emissions rate is frozen at its 2008 value)

Neither of the preceding two principles invoke wealth redistribution as

[12] Singer, Peter 2002: One world. Yale, 235pp.

a justification. Wealth redistribution from richer to poorer may be a side effect insofar as the countries with greater historical cumulative carbon on the whole tend to be richer and less populous, but the principles would yield the same result even if this were not the case. That brings us to Singer's third principle. *Equal Future Shares* treats all individuals equally, but Singer's third principle adopts the premise of Rawls that inequality in treatment of individuals can be accepted to the extent that it benefits the least advantaged individuals. This principle would allocate more emissions rights to poorer individuals, or citizens of poorer nations than would be the case under *Equal Future Shares*, thus further increasing the responsibility of the developed world to act on carbon mitigation relative to the developing world. It may be objected that what Rawls mostly had in mind is something like the reverse – that to a limited extent it may be acceptable to allow the rich to get richer, if their greater productivity or creativity in use of resources winds up, through subsequent distribution of the fruits of their labors, in benefiting the poorest. That objection is neatly taken care of if the carbon allocations are tradable, since the rich would be free to buy emissions rights from the poor at a high price, and still profit from the transaction.

The Rawlsian scheme can also be justified by a *Deepest Pockets* principle – those who can afford to pay for a shared benefit, with the least suffering to their own well being, should do so. This is the same principle that justifies progressive tax codes.

Singer's discussion of *Polluter Pays* does not take cognizance of the relative population of each village. It is useful for showing that, even leaving population aside, North America has a greater obligation to act on carbon mitigation than Centrally Planned Asia, but more broadly considered the neglect of population leads to some obvious anomalies. For example, large nations could farm out their emissions-producing activities to a large number of small states like Andorra and Luxembourg, and thus escape culpabilility. To rectify such anomalies, one needs to take into account the relative populations of countries or regions, but that is not straightforward for *Polluter Pays*, because it requires one to decide how to attribute past emissions amongst the presently living population. Just allocation would dictate doing something of the sort however, if one is to use *Polluter Pays*, since nations do not emit carbon just for the fun of it. To the extent that they are wisely governed, they do it to provide benefits to their people, and the more people that need to be served, the more emissions will be required, all other things being equal.

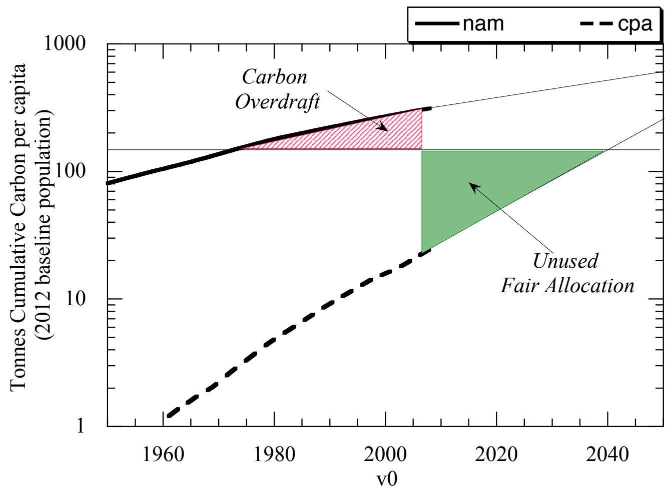

Figure 5: Per capita cumulative carbon for North America and Centrally Planned Asia, based on 2012 baseline populations in each region. The horizontal line represents the per capita fair share of the global Carbon Commons.

In order to address these issues, I propose a hybrid between *Polluter Pays* and *Equal Future Shares*, which I'll call *Equal Total Shares*. This principle is like *Equal Future Shares* in being per-capita based, but attempts to factor in past carbon emissions. Based on 2012 world population, the fair individual share of the Carbon Commons is 143 tonnes, some of which has been already used by our forebears. If past carbon emissions were allocated equally to all people alive in the base year, then *Equal Total Shares* and *Equal Future Shares* would be identical. However, some individuals have benefited more from past emissions than others, so we can get a more just solution by taking that into account. By way of example, let's do a per-capita cumulative carbon accounting in which the historical emissions of North America and Centrally Planned Asia are assigned to the number of individuals in those regions alive in 2012. The results are shown in Fig. 5. By this measure, North Americans used up their fair allocation already in 1970, and were 173 tonnes per person into carbon overdraft by 2005. In contrast Centrally Planned Asia will not have used its just allocation until 2040. Again, we conclude that it would be just for North America to bear more of the burden of reducing emissions than Centrally Planned Asia; indeed it would appear that we owe somebody compensation for our overuse of the Carbon Commons.

The rather extreme principle we have used for attributing past emissions is based on the premise that the prosperity of a nation's citizens today represents the accumulation of the fruits of past energy usage and its associated carbon emissions. It could be argued, with considerable justification, that a person should not be liable for their grandfather's carbon, let alone that of their earlier forebears. Even more so, it could be argued that an immigrant to the United States from China should not be saddled with a full share of the U.S. carbon overdraft. These are serious issues that any allocation of past emissions must confront. Perhaps there should be a statute of limitations for carbon emission. This cannot be justified on the basis of ignorance of consequences of carbon emissions, since that has been known for well over a century, but one could perhaps find justification to write down some of the past carbon debt on the grounds that the benefits accrued from sufficiently early emissions are dispersed. As the cutoff of the statute of limitations for carbon approaches the present, *Equal Total Shares* and *Equal Future Shares* become identical. However, since so much of the carbon has been emitted relatively recently, putting the cutoff date at 1950, which includes the lifetime of the parents of most developed-world persons alive today, would still leave the developed world with a considerable carbon overdraft.

None of the principles we have discussed for just allocation of the Carbon Commons invokes retribution as a guiding principle. The aim is not to cause the guilty parties to suffer, so it is perfectly acceptable if the richer villages take care of the problem by investing in pollution reduction in the poorer villages.

Based on Fig. 5, at a price of $100 per tonne carbon each North American would owe $17,300 for his or her share of the national carbon overdraft. Payment of this debt need not take the form of a direct wealth transfer to nations who have not used their allocation. It could instead be interpreted as the amount we are obligated to invest in developing and implementing technological means to decarbonize our economy, with possible spinoffs to other economies. I have no real expectation that North Americans would agree to taking on an investment of this magnitude any time soon, but one should at least not deceive oneself into thinking that we are declining this responsibility out of any valid sense of injustice, rather than simple unimpeded greed.

It may well be that President George W. Bush was speaking for a majority of the American people when he said, in regard to the Kyoto Protocol, "We will not do anything that harms our economy, because first things first are the people who live in America." [13]. Perhaps the American political consciousness is wired up in such a way that any international agreement perceived as reducing the growth of American prosperity (no matter how rich it still leaves us) automatically triggers a sense of injustice. Shklar distinguishes between the *sense of injustice* and *actual* injustice, but cautions that ""All feelings of injustice have a claim to be examined." [14] I do not propose to fathom the source of the peculiarly American sense of injustice (if that is indeed what it is) when asked to do something about climate change. But we must not accord the American sense of injustice any greater claim to be examined than the Chinese sense of injustice, since after all, the Chinese must also be persuaded to sign on to any global carbon emissions protocol if it is to be useful. Why would the Chinese government, on behalf of its people, agree to such a manifestly unjust treaty as the proposal of Posner and Weisbach [15] would seem to wish on them? Perhaps if the United States plays a game of chicken with climate in which China flinches to avoid the crash we will win. That may be good gamesmanship, but we should not fool ourselves into thinking it has anything to do with justice.

At the same time we acknowledge the essential justice of according more emissions rights to the developing world than to the developed world, we must acknowledge the desirability of avoiding purely quixotic actions. If the industrialized world stops emitting carbon but China and India pick up the slack, that will not serve the purpose of protecting the climate. That would be like rearranging the deck chairs on the Titanic. It may satisfy some sense of justice to give the steerage passengers a chance to lounge on the first class deck before the ship goes down, but it would be better to get everybody into lifeboats. Getting the developed world to agree to just emissions caps is only part of the negotiating strategy needed to bring the rest of the world into a controlled-carbon regime.

4 Conclusions

Our analysis confirms and consolidates Singer's conclusion that no matter what reasonable theory of justice one applies, the first world, and especially North America, has the greatest obligation for aggressively reducing carbon

[13] *op. cit.* Singer 2006

[14] *op. cit.* Shklar

[15] Posner E and Weisbach D 2010: *Climate Justice*, Princeton University Press, 220pp.

emissions. This conclusion applies even if we write-down all carbon emissions before 2008 and even without factoring wealth redistribution into the equation for social justice. But that does not mean the first world can go it alone, since it is global emissions that count, and the problem cannot be solved without a regime that can persuade the developing world – especially India/Pakistan and China – to bring down their carbon emissions as well.

Anyone arguing that some human beings are intrinsically endowed with a right to a greater share of the Carbon Commons (or any other scarce resource) than others should face a high hurdle in justifying this claim. One could counter that life is unfair and it's not our particular oblgation to right all wrongs. After all, investment bankers are paid more than professors and we tolerate that – after all we did choose to be professors. But when women and blacks are paid less than white men for the very same work, that is, in modern society considered rank injustice, though in historical times it might have been considered merely a misfortune (like the Lisbon Earthquake) to have been born a woman or a black – or a slave. Those who argue that the developed world has no particular obligation to take on more share of carbon mitigation efforts than the developing world are in essence arguing that it is just a misfortune that the Chinese were borne into a nation that did not get to the Carbon Commons as soon as we did. Here, we should pay heed to Shklar's admonition that the rich are very prone to finding ways to reclassify injustice as misfortune. It seems to me that much of the abundant cleverness displayed in Posner and Weisbach [16] is deployed to this very end.

Much of my discussion assumed that nations and individuals will have to accept a considerable harm or loss from actions to reduce carbon emissions. This is not actually so certain, even in the short term. In the long term one is going to have to adapt to a world without fossil fuels at some point, since they will surely run out, and probably sooner than we think. Prudent measures to decarbonize before a fossil fuel scarcity crisis is upon us simultaneously with an irretrievably wrecked climate could well leave us more prosperous and secure than business as usual [17]. Nations and individuals currently seem to have more fear of messing with the economy than of messing with the climate. Perhaps the answer is to be found in Shklar's observation that "We get angry at and on behalf of individuals, but are indifferent to wrongs that

[16] *op. cit* Posner an Weisbach

[17] Lovins A and the Rocky Mountain Institute 2011: *Reinventing Fire*, Chelsea Green Publishing:Vermont, 334pp.

seem to affect too many people at large." In contrast to the dispersed and somewhat abstract harms from a changing climate, economic impacts may seem very individual. If this cognitive dissonance can be countered, and it becomes recognized that there is a path forward that makes everybody better off and richer, and provides new business opportunities, then much of our theorizing about justice, based on the premise that avoiding climate change is bitter medicine, will be moot.