Equal per Capita Emissions - A Fair Model to avert dangerous Climate Change

By Harley J Wright[1]

The 1992 Rio United Nations Framework Convention on Climate Change was inspiring. The world as a whole agreed "to stabilize greenhouse gas (GHG) concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system." The atmospheric concentration was 300 ppm CO2 at that time, already a slight increase from around 280 ppm prevailing from the last ice age to the start of the industrial era. The Framework Convention contains no enforcement mechanisms.

Consequently 28 years later, annual global *emissions* are still increasing – from 24 Gt CO2 in 1992 to ~35 Gt CO2 in 2017. And so are atmospheric *concentrations* from around 280 ppm CO2 preindustrial level to over 400 ppm CO2 since ca 2015, a rise of over 42% in this critical GHG. Despite continuing efforts over 28 years we have failed seriously to reduce GHG emissions, atmospheric concentrations and avoid dangerous climate change in the future.

The '**carbon budget**' is a measure of aggregate CO2 emissions, from eg, 2010 to 2100, that specifies the temperature increase that results with this CO2 addition to the atmosphere. The Emissions Gap Report 2017 by the UN Environment Panel shows the correlation of carbon budgets with associated temperature increases.

Under the 2015 Paris Agreement countries submit Nationally Determined Contributions (NDCs) with plans to reduce their emissions. The 2018 UNEP Gap Report estimates a global mean temperature rise of 3.2°C this century[2], with increases continuing thereafter, with all of the conditional NDCs and existing climate action. Current commitments are seriously inadequate.

A Fair Model to Negotiate Legal Quotas to Limit Climate Change

The basic concept in this paper is for national governments to introduce 'equal per capita carbon emissions entitlements' with international trading in the entitlements/credits/permits. Using per capita emissions is an eminentally fair basis for regulatory action that has never been attempted. This is cap and trade based on national per capita emisions with a contracting cap. Periodic emission caps contract over time so the aggregate emissions do not exceed a carbon budget. This requires formal agreements to manage the allocations, actual emissions, reconciliation with trade and verification. This is an enormous challenge – but it can meet targets to avert dangerous climate change.

High-carbon countries will continue to have real emissions in excess of their allocated credits, eg Australia emits around 18 t CO2 annually per person (a very high-carbon country). In the first year of operation, credits issued would be a little less than the current world average per capita rate, around 5 t CO2 per year. So Australia would need to buy around 13 t CO2 credits per person in trading year one (18 t – 5 t).

And low carbon countries like India would be issued the same 5 t CO2 credits per person. As India emits less than 2 t CO2 per person annually it could sell 3 t CO2 credits per person (no compulsion but a sovereign choice). The price for these credits would be set by free trade in international markets.

At a **hypothetical price of $20/t CO2 Australia would pay $260 per person** annually (say around **0.4% of GDP)** while **India would earn around $60 per person annually (around 3.9% GDP)**[3]

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[2] UNEP Gap Report 2018, p21

[3] Table in Appendix A

The scheme relies on an equal sharing of the limited amount of carbon credits – set scientifically to avoid dangerous global warming. The allocated quotas to countries are unambiguous and avoid the arbitrary and contentious nature of grants to the Green Climate Fund. This Fund is currently mooted to raise $100 billion from developed countries to give to developing countries, annually from 2020 - but the rules or criteria for raising funds from developed countries and allocating them to developing countries are subjective and contestable.

International trade in the rationed issue of carbon credits would create significant trade flows with repercussions for balance of payments and exchange rates. The high income to developing countries would dramatically boost the speed and extent of achieving sustainable development. But there could be a significant cost to some developed countries and a likely basis for opposition within them.

Whatever we do, now or later, there will be some costs and changes to how all countries, 'do things'. The aim should be to reduce GHG emissions fast, fairly, efficiently and accepting necessary changes to achieve a low-carbon and sustainable climate and associated economies. The longer we defer difficult action now the greater and less controllable the problems become for future generations. Changes made now will foster innovation, opportunities and growth.

The proposalessentially a return to the Cap and Trade model which started with Kyoto in 1997 – plus reliable and accelerated funding for Sustainable Development. Regrettably, the focus on cap and trade as a solution has waned over 20 years. But with politically astute promotion in developing and developed countries it can restart and meet agreed targets. What other effective alternative is there than to agree on, and commit to, distribution of the limited and shrinking carbon budget to avert dangerous climate change?

Urgency – The Paris Agreement Not Sufficient

Notwithstanding the best outcome, the Paris agreement is most unlikely to achieve the agreed targets of +2°C let alone +1.5°C.[4] Much more needs to be done now to avoid dangerous climate change.

The UN *"Emissions Gap Report, 2017"* [5] soberingly showed, pp 16 - 18:

> The **global emissions CO_2 budget, starting from 2010, is 1,000 $GtCO_2$** (range: 770-1,380) for limiting global warming **to below 2.0°C** with more than 66 percent probability; and
>
> **less than 565 GtCO2** (range: 550-580) global carbon budget for **1.5°C** warming with around 50-66 percent probability[6].

Alarmingly, the Gap Report shows we emitted around 156 Gt CO2 in 5 years from 2010 to 2015.

In just 5 years we emitted 16% of the 2.0°C maximum global budget and 28% of the 1.5°C budget – for all time – to avoid dangerous climate change!

These global carbon budgets are the estimated maximum CO2 emissions the world can emit from 2010 without exceeding the respective temperature limits; 1.5°C desirably and 2°C unreservedly. Above these limits, the world faces further increasing frequency and severity of climate events: hurricanes and damaging storms, floods, droughts and wildfires. Rising ocean levels will displace millions from their traditional homes. Increasing ocean temperatures and increasing acidity (lower pH values) will likely cause profound ecological changes. We are messing with the world's total ecological fabric with little idea of the changes. Frequent coral bleaching events, with death of much of

[4] Note that the Paris Agreement, 2015 required countries to "put their best efforts" and commit to "Nationally Determined Contributions (NDCs)"

[5] Fig 3.2 from UN Emissions Gap Report, 2017, p17

[6] Personal communication from authors of Emissions Gap Report, 2017

it, on Australia's Great Barrier Reef are serious – but greater damage is virtually certain. The ocean holds most of the extra heat absorbed by the higher GHG concentrations. The ocean is a giant heat buffer that drives the climate.

The climate changes are irreversible in centuries. Non-linear 'tipping points' become increasing possible, ie, major and abrupt changes to climate like methane releases or large ice melts in Greenland and Antarctica, which cannot be reversed.

But we can achieve the temperature targets if we agree now how to share a limited carbon budget.

Options to reduce emissions

There are various proposals of how abatement could be effected. Like this submission itself, proposals are commonly of a single approach. In contrast, Prof Ross Garnaut wrote a Review for the Australian Government in 2008[7]. Chapter 9, *"Towards global agreement"*, provides an excellent review of various options and methods which the world could use to reduce emissions. Methods reviewed include carbon taxes and tradeable emissions entitlements:

From this insightful analysis of alternatives Garnaut concludes:

> ***"The only realistic chance of achieving the depth, speed and breadth of action now required from all major emitters is allocation of internationally tradable emissions rights across countries.***

He notes also:

> ***"The contraction and convergence approach addresses the central international equity issue simply and transparently."***

I know of no better appraisal of plausible methods of abatement wshich has the breadth and depth of Garnaut's Chapter 9, His careful and objective analysis confirmed my own intuitive view of our best option. Hence this submission is based on equal per capita emissions. What plan or methodology is COP following?

Equal per capita emissions entitlements

The world agreed in 1992 in the United Nations Framework Convention on Climate Change to avoid dangerous climate change. At Kyoto in 1997, ~37 countries in Annex B agreed to constrain their emissions to specified targets. They accepted a small challenge to their economies for the necessary global benefit to limit emissions. Each country's target was set at a fraction of its recent (historic) emissions, but not a formally shared part of an overall emissions budget.

The 37 Annex B countries have high per capita emissions. Their targets at Kyoto in 1997 represented small changes from their 1990 emissions and were politically acceptable – it was not a scientific basis. Article 17 of the Kyoto Protocol set up a framework for emissions trading, which could supplement domestic actions to allow countries to meet *"quantified emission limitation and reduction commitments"*. Importantly, countries not in Annex B, with low per capita emissions, did not agree at Kyoto to quantitative emissions constraints but wished to observe international trading schemes developed by the Annex B participants – before they would later join the intended international cap and trade scheme.

Unfortunately, subsequent international emissions trading under Kyoto's first commitment period was weakened by an excess of permits and the collapse of the USSR, which resulted in a surfeit of permits[8] because of high emissions in the Soviet era. The resultant permit price did not reflect the realistic constraint needed - it was too low.

In 2009, at Copenhagen it was hoped that the second commitment period of the Kyoto Protocol would include many other countries, potentially low-carbon countries that would sell excess carbon credits (emissions entitlements) to the high-carbon Annex B countries. This would allow strong participation in an international cap and trade scheme. The

[7] *Garnaut Climate Change Review*, Australian Government, 2008

[8] http://ceag.org/marrakech-slow-train/

Guardian reported that[9], *"developed countries tried to inject long-term emission-reduction goals of 50% for the world and 80% for themselves, by 2050 compared to 1990."* This may sound good but it meant that *"by 2050, developed countries with high per capita emissions – such as the US – would be allowed to have two to five times higher per capita emission levels than developing countries. The latter would have to severely curb not only their emissions but also their economic growth". "The developed countries were attempting to fix a global carbon budget distribution that enables them to get away with the hijacking of atmospheric space, a resource worth many trillions of dollars".*

Understandably, low-carbon countries rejected this proposal and Copenhagen failed because of the unfair 50 year convergence period being proposed – and the international cap and trade model subsequently waned.

An equal-per-capita allocation of the limited carbon budget is clearly fair. If implemented immediately, the subsequent trading in emission credits would provide large incomes to sellers of emissions credits/permits and incur high costs for high-carbon countries.

Aubrey Meyer proposed Contraction and Convergence (C & C, Global Commons Institute[10]), ca 1990, which allows high-carbon countries time to reduce emissions to the global norm. This reduces the high costs of permits if equal shares had been issued initially. C & C was supported over the years and was a key focus at Copenhagen in 2009. However global abatement policies at the COPs have now moved to less definite and less reliable abatement processes.

The world now, more than ever, has an urgent need for strong and reliable emission reductions. It is 20 years since the principle of quantitative emissions constraints with international trading was accepted at Kyoto in 1997. The developed world has had 20 years to reduce emissions. Current global emissions may have stabilised but no significant reduction seems apparent or likely. The Emissions Gap Report 2017 Fig 3.2 shows that starting from end 2020 the world can emit:

- only 207 Gt CO2 before the 1.5℃ threshold, or
- 642 Gt CO2 before the 2.0 ℃ threshold.

At current world emissions rates of ~36 Gt/year the world has only 6 years before the 1.5℃ budget is met or 18 years for the 2.0℃ budget. The remaining global carbon budget is too small to allow emissions quotas to high carbon countries to converge to the global average. Swift action is needed. I**mmediate per capita allocations of the carbon budget can speed up reductions, avoid exceeding a budget for 2.0℃ and possibly reduce global warming from more severe damage**.

When an equal per capita allocation occurs there would be an immediate realisation amongst high-carbon countries of the seriousness of the situation. With a price on emission those can foretell future liabilities and hence the incentives to reduce carbon emissions. All countries would benefit from reductions in CO2 emissons but process changes and reductions in other greenhouse gases would become apparent as other means of reducing their permit buying costs.

If a group with international financial standing could develop and promote a suitable scheme it might be agreed to by the COP in 2020. If the scheme was clear and popular, COP, or some other suitable international body, eg, the World Bank Group, might allocate emission entitlements/permits in 2021 and manage international trade. This is the basis for calculations provided here, assuming trade commences in 2021.

The **global carbon budget would be shared on an equal per capita basis**, allocated to each country according to their present population level. This budget could be a whole of life value, e.g. the budget to 2100 years. Or the budget for shorter, fixed time frames, e.g. five years used for the Kyoto Protocol, could be suitable, or one year as used here for convenience. These mini-budgets would be reviewed and reissued at the frequency of the budget period. Garnaut in 2008, 2011[11] supports per capita allocations of emissions, including Contraction and Convergence, which has all

[9] https://www.theguardian.com/commentisfree/cif-green/2009/dec/28/copenhagen-denmark-china

[10] www.gci.org.uk

[11] *The Garnaut Climate Change Review*, 2008; *The Garnaut Review* 2011, Commonwealth of Australia

countries' per capita quotas converge in an agreed period. In my Global Sustainability framework there is no Convergence period (it is zero) because of the current urgency for reductions.
Monitoring and verification of emissions is relatively straightforward, noting the value of the Marrakesh Accords, which resolved many technical issues. However, the question of enforcement is vexed.

Participation: There are likely to be abstentions from such a scheme initially and the means of coercion or penalties would be strained, some may think insurmountable. But this model is the most basic and simple in concept with a likely high level of acceptance in principle.

Sadly the USA is an unlikely participant at present. China is an indispensable participant. It is the world's largest CO2 emitter. The data in Attachment A show that China's estimated CO2 per capita emissions (7.58 t)would be above the world target (5.2 t) in 2021, the first trading year. China is estimated to pay 0.35% of its GDP for emissions permits. This could create a quandary. China would be encouraged to participate even though the USA maintains its opposition to Paris. And if China participates the USA may feel obligated to join.

It would seem that some critical mass of participation will be required to ensure its success. This model provides a quantitative way of achieving suitable abatement with, arguably, a low level of contestability. When this option is proposed, any who doubt it can be asked for a better proposal to which countries will agree and which assures suitable emission targets are met to avoid dangerous climate change. Doubters can also be asked for their response to their descendants, who will question their ancestors' opposition, **"Why didn't you take proven action to avoid the warnings of deleterious and dangerous climate events and costs?"** In 2019, Greta Thunberg told the UN,

"For more than 30 years, the science has been crystal clear. How dare you come here saying that you're doing enough when the politics and the solutions needed are still nowhere in sight!"

Using old data, calculating indicative results, not forecasts

I made the calculation's in 2018 using data from 2015 to 2017. The results from those early calculations are presented now with a hope for discussion to promote international trading in 2021. I may update the model later with up to-date emissions data.

Rates of contraction, starting from 2021

The calculations determine the rate of reduction required starting in 2011 to meet the respective carbon budgets of **207 Gt CO2 for 1.5°C** temperature increase or **642 Gt CO2 for 2.0°C** temperature increase. Figure 3.2 of the Emissions Gap Report, 2017 uses its estimates for projections from 2011. For the present calculations, an aggregate emission of 358 Gt CO2 from 2010 to end 2020 was used based on actual emissions to end 2015 and extrapolations to end 2020[12].

Actual global emisions after the 2017 Emissions Gap report, make the 358 Gt CO2 value too low. So the results shown probably overestimate the time to reach the temperature targets and underestimate the necessary speeds of reduction.

Calculations here assume that the global emissions budgets remaining at start 2021 are met ('filled') by 2050. This seems a suitable target as emissions have to be close to the budget by 2050 if we wish to limit dangerous temperatures and risks. The most natural contraction path is a constant rate of contraction. Ie, each year's contraction *rate* is the same as the previous year's *rate* of contraction. The relative change and difficulty of adaptation remains constant year to year.

The contraction rates, year-on-year, that achive a suitable cumulative total to meet the threshholds, were 14% for 1.5°C and 4% for 2.0°C. The key parameters are;

Table 1 Constant rates of contraction, year-on-year model estimates

EDGARv4.3.2

	Budget remaining end 2020 (358 Gt emitted 2010 - 2020) *Gt CO2*	Years	Contraction Rate, year on year	Cumulative Emissions 2021 - 2050, *Gt CO2*	Annual emissions in 2050, *Gt CO2*
< 2.0C	1000 – 358 = **642**	To 2050	**4%**	**621**	10.2
<1.5C	565 – 358 = **207**	To 2050	**14%**	**220**	0.3

The 14% year-on-year reductions needed to keep the temperature increase to 1.5°C is unrealistic and sadly unachievable in my view. This is an alarming indication of how ineffective current emissions abatement is. Rather than drift for years more, urgent, strong and effective reductions are needed now.

No time for Convergence – equal per capita entitlements at the start

The need for strong and quantitative reductions means there is no time left for high-carbon emitters to converge to the global target in later years under the Global Sustainability proposal here. The model uses an equal population-based allocation of entitlements for the defined period. The organising authority would need to post potential longterm contraction trajectories for guidance and to aid market pricing.

Trading demonstrated in a trial

As a prelude to the 'real thing' the scheme could run on a trial basis, eg, in 2020. A managing organisation, the 'carbon permit banker', could issue on paper hypothetical emissions permits on a time trajectory to satisfy a global carbon budget. The banker could make trades to balance these against countries' actual emissions. Without real sales of permits, the shadow market would likely need to issue more permits than meets the global budget and it would generate an accumulating carbon debt. The banker would post the annual permit trade. The trade in permits by buyers and sellers could be valued using a current, plausible carbon price.

Value of international trade in emissions permits – implications for countries

The limited range of values still provide a semi-quantitative and illustrative picture. The greatest variation in the models comes from key parameters; eg, carbon price, rate of contraction, is the contraction linear or proportional? Etc. So the particular model is less important than the exact historical emissions being used for a reasonable representation.

I believe people shy away from the concept of equal per capita emissions because they are afraid of the perceived costs and lifestyle changes in western, high-carbon countries – which they assume are high. Accordingly, I have estimated some quantitative costs of emissions trading using the following assumptions. If readers prefer other assumptions the results here might be adjusted appropriately for a semi-quantitative appraisal:

- The **base year** for calculation is **2020**
- **Trading commences in 2021**
- The maximum budgets for emissions is;
    - **207 Gt CO2** from 2020 for **1.5°C** to 2050 and
    - **642 Gt CO2** from 2020 for **2.0°C** to 2050
- The annual **emissions rate reduces at 14%/year**– so that by 2050 the carbon budget of **207 Gt CO2** for **1.5°C** is fully emitted: and **4%/year** for a budget of **642 Gt CO2**.
- **$20/t CO2** is the (assumed) market price of emissions permits
- **Low carbon countries**, i.e. below the global average per capita level (5.4 t CO2/year), **do not increase their emissions in the early years and sell their excess permits on the market to high carbon countries.**
- High carbon countries will emit more than their per capita allocations. They purchase permits on the open market for balance and reconciliation.
- The model applies to the top 49 emitting countries and excludes international air and sea transport. By end 2020 the annual carbon emissions of 49 countries is estimated to be 30.2 Gt CO2

- In 2021 with 4% annual reduction the annual carbon quota is 29.0 Gt CO2, which the model allocates to the 49 countries as follows:
- **Low-carbon countries**, with emissions in 2020 below the global average, emit the same amount as 2020 and are allocated the same quantity in permits in 2021 (5.42 Gt C02)
- The **abstaining countries** also are issued with the same number of permits as they emitted in 2020.
- This leaves 16.5 Gt CO2 of permits which are distributed to the leaders in proportion to their emissions the previous year.This represents a drop of 6.9% from their actual emissions the previous year.
- There are infinite combinations to reconcile actual emissions (physical) with the fixed number of tradeable permits. The model assumes that the leaders buy permits for their 6.9% shortfall. The carbon price is assumed to be $20/t CO2. This is an estimate and would very depending how effectively the countries could reduce their emissions – both buyers and sellers.

International trade – winners and supporters[1314] - see Attachment A

Attachment A shows the first year of international trade by the top 21 emitting countries with a permit price of $20/t CO2 and annual global emissions reducing so the sum of emissions to 2050 meets the threshold global budget, for 1.5°C and 2.0°C.

The trade in permits is expressed as a percentage of each country's GDP. The results would vary with the prevailing carbon price that would probably be set by a free, international market. Note that the total annual trade in 2021 would be ca $160 billion for 91% of global emissions at an assumed cost of $20/t CO2.

Scalable: These order of magnitude costs and benefits in different countries can be scaled for different base assumptions of 1) carbon permit prices and 2) global emissions budgets.

The results show that **low-carbon countries** would **gain significant trade income** from the sale of the emission permits, values given as percentage of GDP:

India 3.9%, Indonesia 2.0%, Mexico 0.35%, Brazil 0.7%, Pakistan 6.6%, Philippines 1.9%, Egypt 1.9%

Conversely, countries with above average carbon emissions would **pay significant amounts** for their permits. The table shows:

China 0.4%, USA 0.3%, Russia 1.3%, Japan 0.16%, Germany 0.18%, Iran 1.11%, South Korea 0.44%, Saudi Arabia 0.86%, South Africa 0.49%, Australia and Canada,0.43 & 0.45% respectively and Poland 0.25%.

These 49 countries account for 91% of global emissions (EDGAR CO2 2015).

The high carbon countries who buy permits might see themselves as 'losers' in this scheme. This is a narrow view whereas it can be seen as necessary to avoid catastrophic global heating. In many countries, their real GDP increases at an average rate of 2% to 3% annually, but can be higher in many other countries[15]. This gives a small improvement in living standards which people expect. So reductions in GDP of more than 1% would be obvious and discomforting for many – both the citizens but also countries' ruling bodies applying these carbon costs to their populace to pay for their above average emissions. Of course such costs will drive innovation to lower the carbon footprint.

There are obviously serious difficulties in getting agreement to equal per capita allocations from countries with high estimated costs of emissions permit trade., E.g. China, Russia, Iran, Saudi Arabia and South Africa. And yes, the USA is problematic politically.

[15] https://en.wikipedia.org/wiki/List_of_countries_by_real_GDP_growth_rate

China, could be problematic with the estimated cost of their purchase of emissions permits at 0.35% of the GDP is large and it might be chary of signing now. China has to be in"Equitable access to sustainable development"[16]) and might provide a view on the South African position.

volved as they are the world's largest emitter, ~30% of global emissions. It is working hard to rein in emissions and is implementing cap and trade schemes. Perhaps the Learned Leaders group [Kofi Annan et al] have a view on how China might be approached on this?

South Africa, requiring 0.5% of GDP in its first year of permit purchases, might also be problematic. Professor Harald Winkler from South Africa has played a leading role in the BASIC countries and writing on this issue. ("Equitable access to sustainable development")

It is surprising that low-carbon countries have not pushed for equal per capita allocations. Contraction and Convergence (C&C)[17] had long been supported at the COPs. Apparently at Copenhagen some high-carbon countries promoted C&C with *a 50 year convergence period*. The 50 year convergence period is seriously unfavourable to low-carbon countries and likely why they have not pursued 'equal per capita' permits more generally, conflating it with convergence in 2050. Surely if the equal per capita model is explained well to low-carbon countries now – it is a zero convergence period! - they would leap at it?

Environmental Marshall Plan [Kofi Annan Plan?]– exchange cash for development

Note the estimated emissions permit trade [at $20/t] involves annual trade of ca $160 billion! for 91% of global emissions if all 49 countries joined the scheme. The Green Climate Fund aims to provide $100 billion per year. Its contributions and allocations are poorly defined, certainly not formulaic or market based like equal per capita. Serious uncertainties abound around its eventual success.

The quantitative trade in carbon emission permits under equal per capita could be partlly substituted by agreements to exchange emission permits for specified aid. Note that the Marshall Plan, paid by the USA, provided ca $130 billion in today's values (less than 3% combined national income of the recipient countries between 1948 and 1951) to aid development after WW II.

Emissions trading overcomes arbitrary nature and uncertainties of the Green Climate Fund.

The unusually high income going to low-carbon countries from emissions trading would create major structural changes and likely consumption of more goods and services from developing countries. There would be a major increase in international trade. The trade in emission permits can be seen as a virtuous process – the developing countries develop rapidly in ways to meet the Sustainable Development Goals (SDG) and the developed countries have greater trade with the developing countries, stimulating their economies and helping compensate for the large trade expense of permits.

The benefits of development projects in developing countries [think education, health, water, power, communications and IT and infrastructure] could be strongly supported by exports of technological expertise and specialist hardware from the rich countries. This production boost in high-carbon countries can reduce concerns at hefty carbon expenses.

Free-Loaders – seem inevitable in initial efforts

At present the US seems unlikely to join such a scheme and being a major emitter could create a startup problem. More generally, Garnaut said, *"Deep trade among a set of countries which includes major sellers and buyers of entitlements is enough to secure these benefits, not all countries need to participate in trade"*[18]. The top twenty one emitters account for three quarters of global emissions, see attached table; and three of these would be major sellers of entitlements, India, Pakistan and Indonesia while Brazil and Mexico would also participate initially. With a suitable critical mass in the start up, there can be many pressures applied to major free-loaders to join. These include trade barriers (eg, Border Adjustment Measures) and legal challenges to nations and carbon supplying corporations. There

[16] http://gdrights.org/wp-content/uploads/2011/12/EASD-final.pdf

[17] Contraction and Convergence proposed by Aubrey Meyer at www.gci.org.uk

[18] Ross Garnaut, *The Garnaut Review 2011*, page 45

is also public and diplomatic pressure about the ethics of neglected responsibilities. This may not affect recalcitrant leaders but it can affect the general public with potential political pressures and outcomes. This would be strengthened by a strong, concordant global voice noting this equitable and necessary action can avert the otherwise inevitable dangerous climate change. There are no other alternative, likely means to avert this. This is a fair and equitable process. With reasonable support this cap and trade scheme can meet the tough challenge we now have due to insufficient commitment over 20 years. If this fails, the longer term view is really frightening. Lord Stern's Review[19], estimated that without action, the overall costs of climate change will be equivalent to losing at least 5% of global gross domestic product (GDP) each year, now and forever. Including a wider range of risks and impacts could increase this to 20% of GDP or more, also indefinitely. These are frightening costs and would be a dreadful legacy to leave later generations.

Emissions trade – potentially cannibalises other aid

Developed countries already provide support to developing countries facilitated by the SDG and other aid schemes. Scandinavian countries stand out (around 1% of GNI) followed by the UK and other European countries[20]. It would be important for developing countries that emissions trade did not totally supplant other aid programs.

The basis of contributions to, and sharing from, the Green Climate Fund appear arbitrary. Conversely, an agreed framework for trade in emissions permits provides a robust and quantitative basis for funding development projects. The Green Climate Fund could be supplanted with grace – with equitable, defined and larger development support.

Virtues of rapid, global development and SDGs

Emissions trade would be a significant change to trade dynamics. The overall 'cost' to high-carbon countries can be viewed as other aid programs, a major altruistic measure. The USA is acknowledged as the most generous in internal charitable contributions[21], though low in international aid. The US might be encouraged to join emissions trade to lift its international aid. Overall, countries in the developed world should seem able to forego some small percentage of GDP growth (probably less than 1%/year) to achieve two worthy goals; 1) emissions abatement likely to avoid dangerous climate change and 2) an economic impetus, likely to readily achieve the Sustainable Development Goals.

We could dream that in a few decades most countries would be at a reasonable level of development. Importantly too, this would likely lead to population stabilisation. Development brings the demographic transition – population stability – through education, health and women's fertility management.

Future Legal Liabilities and public standing – governments and firms

James Hansen is involved in suing the US President for lack of environmental care – due to climate change. In the UK, the Plan B group is similarly suing the UK government for similar dereliction of duty, which I think may include false or misleading information on the UK's proposed abatement and effects on mitigating global warming. I expect the book by Dr Peter Carter, *Unprecedented Crime: Climate Science Denial and Game Changers for Survival* (2018) will heighten awareness of the risks to all those involved in decisions involving carbon emissions, eg, promoters of Australia's huge Ardani coal mine. While parliamentary law makers may have some *ex officio* protection against negligence by parliamentary decisions they still have to face family, friends and the public for their roles in climate crime. This could be a useful argument to present to waverers to encourage stronger mitigation.

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[19] Nicholas Stern, *"Stern Review on the Economics of Climate Change",* https://en.wikipedia.org/wiki/Stern_Review, Oct 2006

[20] https://en.wikipedia.org/wiki/List_of_development_aid_country_donors

[21] http://www.independent.co.uk/news/world/americas/america-new-zealand-and-canada-top-list-of-world-s-most-generous-nations-a6849221.html

GLOSSARY

C & C	Contraction and Convergence
CO2, CO2e, Carbon	carbon dioxide, carbon dioxide equivalent, carbon
COP	Conference of Parties (to the UNFCCC)
Copenhagen	COP 11 2009 in Copenhagen
Emissions Entitlements, Carbon Credits, Permits	Allocations of a right to emit 1 tonne CO2, eg, ERU and CER
Emissions Trading	Trade in emissions entitlements / carbon credits
GDP	Gross Domestic Product
Greenhouse Gases, GHGs	Any of the 6 gases in Annex A, Kyoto Protocol
Paris	COP 21 2015 in Paris
SDG	UN Sustainable Development Goals
UNFCCC	United Nations Framework Convention on Climate Change

A. Value of trade in emissions permits in 2021,

Equal per capita emissions allocations – decrease 4% y/y

Income from sale of, or cost to buy, emissions permits as a percentage of each country's GDP first trading year, 2021.

Ideal model: 48 countries alll of which agree to work with the ideal model, viz, ie, accept equal per capita emissions permits (entitlements) and to trade. Total value = $167 billion.

Politically realistic model: 49 countries (includes the Philippines a larger market), has same conditions as in ideal model except 6 countries abstain but maintain Paris commitment. The six abstainers are; USA, Russia, Iran, Kazakhastan, United Arab Republic and Venezuala.[22] Total value = $164 billion.

Key to table **Kyoto countries** **Abstaining countries**

CREDITORS: Low carbon countries can maintain static emissions and sell excess entitlements to high emitters

			Ideal model All countries (48) Reduce; 2021		Politically realistic model 43 countries Reduce, 6 'abstainers' stabilise; 2021	
Country	CO2 Emissions 2015, % World total	Per capita CO2 emissions, 2015-2020, t	INCOME or (COST), %GDP	INCOME / COST (@ $20/t CO_2), $M	INCOME or (COST), %GDP	INCOME / COST (@ $20/t CO_2), $M
USA	14.3%	16.05	-0.34%	(63,615)		-
Germany	2.2%	9.50	-0.16%	(5,703)	-0.17%	(5,259)
Japan	3.5%	9.81	-0.20%	(9,668)	-0.20%	(8,887)
UK	1.1%	6.06	-0.01%	(170)	-0.02%	(318)
France	0.9%	5.06	0.04%	919	0.01%	-
Canada	1.5%	15.30	-0.43%	(6,635)	0.43%	(5,968)
Italy	1.0%	5.94	0.00%	(15)	--0.02%	(164)
Australia	1.2%	18.50	-0.45%	(5,914)	-0.45%	(5,299)
Spain	0.7%	5.67	0.01%	99	-0.01%	88
Belgium	0.3%	8.54	-0.11%	(579)	-0.12%	(542)
Netherlands	0.5%	9.73	-0.17%	(1,261)	-0.17%	(1,160)
Sweden	0.1%	4.32	0.05%	286	0.03%	131

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			Ideal model All countries (48) Reduce; 2021		Politically realistic model 43 countries Reduce, 6 'abstainers' stabilise; 2021	
Country	CO2 Emissions 2015, % World total	Per capita CO2 emissions, 2015-2020, t	INCOME or (COST), %GDP	INCOME / COST (@ $20/t CO_2), $M	INCOME or (COST), %GDP	INCOME / COST (@ $20/t CO_2), $M
Denmark	0.1%	6.46	-0.02%	(60)	-0.03%	(67)
Austria	0.2%	8.52	-0.10%	(441)	-0.11%	(413)
Turkey	1.0%	4.49	0.28%	2,040	0.16%	788
Finland	0.1%	8.81	-0.11%	(310)	-0.12%	(288)
Switzerland	0.1%	4.79	0.02%	165	0.01%	32
Norway	0.1%	8.20	-0.05%	(233)	-0.05%	(220)
Greece	0.2%	6.11	-0.02%	(40)	-0.05%	(63)
Ireland	0.1%	7.75	-0.07%	(168)	-0.08%	(161)
Luxembourg	0.0%	17.78	-0.21%	(133)	-0.20%	(119)
Portugal	0.1%	4.90	0.08%	182	0.03%	19
New Zealand	0.1%	7.22	-0.06%	(118)	-0.07%	(116)
Iceland	0.0%	11.65	-0.22%	(37)	-0.22%	(34)
China	29.5%	7.58	-0.40%	(45,342)	-0.47%	(43,720)
India	6.8%	1.85	4.60%	103,839	3.93%	82,986
Russia	4.9%	12.23	-1.42%	(17,698)	Paris - static	-
Iran	1.8%	7.89	-0.72%	(3,082)	Paris - static	8,008
Korea	1.7%	12.15	-0.44%	(6,167)	-0.44%	(5,590)
Saudi Arabia	1.4%	15.66	-0.94%	(6,127)	-0.93%	(5,509)
Indonesia	1.4%	1.93	2.33%	20,099	1.99%	15,987
Brazil	1.3%	2.34	0.79%	14,259	0.66%	10,989
Mexico	1.3%	3.70	0.49%	5,290	0.36%	3,282
South Africa	1.2%	7.45	-0.48%	(1,662)	-0.56%	(1,614)

			Ideal model All countries (48) Reduce; 2021		Politically realistic model 43 countries Reduce, 6 'abstainers' stabilise; 2021	
Country	CO2 Emissions 2015, % World total	Per capita CO2 emissions, 2015-2020, t	INCOME or (COST), %GDP	INCOME / COST (@ $20/t CO_2), $M	INCOME or (COST), %GDP	INCOME / COST (@ $20/t CO_2), $M
Poland	0.8%	7.71	-0.24%	(1,333)	-0.28%	(1,278)
Thailand	0.8%	4.06	0.59%	2,368	0.39%	1,284
Taiwan (China)	0.8%	11.85	-0.51%	(2,721)	-0.52%	(2,470)
Kazakhstan	0.7%	14.90	-1.46%	(3,146)	Paris - static	-
Malaysia	0.7%	7.87	-0.36%	(1,181)	-0.41%	(1,125)
Ukraine	0.6%	5.15	0.42%	559	0.04%	-
Egypt	0.6%	2.37	2.31%	6,512	1.92%	5,005
Viet Nam	0.6%	2.18	3.65%	6,802	3.07%	5,313
United Arab Emirates	0.6%	21.50	-0.70%	(2,813)	Paris - static	-
Argentina	0.5%	4.36	0.23%	1,240	0.14%	550
Venezuela	0.5%	5.66	0.01%	75	Paris - static	3,149
Pakistan	0.5%	0.90	7.49%	18,818	6.6%	15,775
Iraq	0.4%	4.32	0.48%	1,084	0.29%?	498
Algeria	0.4%	3.64	0.81%	1,736	0.60%	1,097
Philippines					2.92%	8,045
W51 incl Kyoto	**89.4%**		**0.27%**	**166,647**	**0.23%**	**163,749**

- IPCC gives global Carbon Budget from 2010. Hence need to estimate here the emissions total to 2020 for model estimates commencing in 2021. The estimate for 2010 through 2020 is 358 Gt.
- Carbon Price = $20/t CO2
- Annual per capita emissions drop 4% from 5.42 t in 2020 to 5.20 t CO2 in 2021
- Annual per capita emissions continue to decrease by 4% each year

Basic Model Assumptions – Trade emissions permits in first year, 2021

These estimates were developed before the 2020 corona virus pandemic and subsequent economic disruption. Although GHG emissions, particularly CO2, will be lower in 2020 than I had estimated before the disruption, this is not significant for the purpose of modelling the exchange of funds, or possibly SDG benefits.

Base year data for 2020

The Carbon Budgets are estimated from the UNs values for 2010.

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Many people have made contributions to my ideas here. Their contributions have each been invaluable and I thank you all warmly. I give special thanks to Dr Gavan Mc Donell for his strong support.

Dr Harley Wright, Climate Consultant

[redacted]

26 Nov 2020

*About the author, see end page

* About the Author;

Harley J Wright, [redacted]

I have been an environmental scientist and manager for 30 years, coming from a training in physical chemistry and later Environmental Studies. I have had frequent, detailed engagements on climate change policy from national and corporate executive positions. I provided detailed expert commentary on the penultimate draft of the IPCC's Synthesis Report and Summary for Policy Makers 3AR. Now retired, I work on policy aspects of climate change and having no commercial or government affiliations, I act on my own account. I am an Australian citizen who is deeply concerned that the world is not acting firmly enough to deal with the increasing threats from global warming. I hope this helps.

Following the COP's Durban Platform request for "views on options and ways for further increasing the level of ambition …" I submitted my Sydney Bridge "Framework to share carbon space to 'increase ambition' and 'ensure highest possible mitigation" to the UNFCCC/COP in 2012; see;
http://www.gci.org.uk/Documents/Sydney_Bridge.pdf

[redacted]

Equal per capita emissions entitlements can avoid dangerous climate change if commenced now.

Unbridled emissions of greenhouse gases (GHGs) is now established beyond all reasonable doubt to have warmed the earth by around 1°C above preindustrial temperatures and is already heading to dangerous climate change. Our GHG emissions are now beyond the assimilable capacity of the environment.

Equal per capita emissions entitlements is equitable. Every person on the planet gets an equal entitlement to the limited amount of GHG that can be emitted to avoid dangerous climate change. People in high carbon countries can no longer emit GHGs without constraint as they have done historically. This model distributes the limited carbon budget remaining equally amongst all. International trade in carbon entitlements (= permits) allows high emitters to pay for their emissions. Low emitters earn income from selling their excess permits. Everyone is subject to the same cost pressures to reduce their emissions.

It requires small economic concessions by the high-carbon, generally well off, countries

- **To limit further global warming, and**
- **Decisively provide transformative, sustainable development to developing countries**

At Kyoto, 20 years ago, we had an agreed commitment to international trading with cap and trade. So far, we have failed but this model can work with swift action.