Climate Change: A Parking Place Model for A Just Global Compact

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1. Introduction

There is a large scientific consensus that the climate change threat is real and we need to act now. Even if the probability is low, precautionary principle suggests that we take action.

At the Copenhagen conference a consensus on an action plan has to be reached if mankind is to deal effectively with the threat of climate change. The delay in taking serious action may have already made attainment of stabilisation at 450 parts per million (PPM) beyond reach. Any further delay would be disastrous for many people.

At the preparatory CoP (Conference of Parties) meeting in Bonn in June 2009, some critical issues are on the table (UNFCCC, 2009). Among these are: What should be the stabilisation level of GHG concentration, 450 PPM or one that limits temperature increase to 2 degrees Celsius above pre-industrial level? Also on the table are issues of per capita accumulative emission convergence and equitable allocation of the global atmospheric resources.

Under the United Nations Framework Convention on Climate Change (UNFCCC) accepted at Rio annex 1 countries (A1Cs) were required to bring their emissions to 1990 level by the year 2000. This very modest target was not reached. Also there is no enforcement mechanism in the UNFCCC and the rest of the world could do very little but watch helplessly as the rich occupy the global environmental space. At the same time under UNFCCC, the non-annex 1 countries (NACs) were free to increase their emissions and had no incentive to be GHG emission efficient. Some of them have crossed per capita emission levels of some annex 1 countries, but there is no mechanism to make them restrain their GHG emissions.

A1Cs insist that before they act some of the large NACs such as China, India, Brazil, Mexico and South Africa also accept some commitments. The NACs are not uniform and differ widely in their need for development as well as their emission levels. Even when one accepts that some action is called for by NACs, how much of it and by whom among them are issues that need to be examined. By raising this issue of NACs, the annex 1 countries are delaying action. Through delays A1Cs have been free riding on the developing countries (Parikh J. and Parikh K. 1997). The atmosphere is a parking space for GHG emissions. Nobody vacates a parking space unless she has to pay for it. A1Cs have been increasingly occupying this space as they don't have to pay for it.

In the present paper we describe a mechanism that ensures equity and expeditious action on climate change by all.

The paper is organised as follows: In Section 2 we argue that allocation of emission quotas is inescapable. In section 3 we explore some principles of fair and just allocation. Section 4 suggests a just global compact that provides incentives to all including the non-annex 1 countries, to act in a carbon efficient manner. Finally section 5 concludes.

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The views expressed here are the personal views of the authors and do not necessarily reflect those of the organizations to which they belong. We thank Maximiliano Mazza for his help in analysis of SRES scenarios and Nakichenovich for providing us the detailed results of SRES scenarios.

2. Allocation of Emission quotas is implicit in all alternatives

Apart from action by non-annex 1 countries, many ideas have been floated for an agreement to reduce GHG emissions. Among these are: Continue along CDM with much deeper cuts by A1Cs; Get developing countries to take measurable verifiable actions under Nationally Appropriate Mitigation Action (NAMA) with finance and technology provided by A1Cs; Levy a global carbon tax; Have a cap and trade agreement under which countries will be given a cap (an upper limit) on what they can emit and emissions above the cap have to be purchased from a country that emits below its cap. The main problem here is how does one determine caps by countries? A cap is an allocation of emission right to a country.

In fact the Kyoto Protocol also is a cap and trade arrangement, where caps were provided on annex 1 countries and they were permitted to trade among themselves as well as with non-annex 1 countries on whom there were no caps. Thus emission rights were allocated. There was some justification for giving unconstrained emission rights to non-annex 1 countries as more than a billion people were living in poverty [World Bank's latest estimate (2008) shows 1.4 billion living with less than US$1.25 per day] and these countries needed to grow. However, non-annex 1 countries have grown at varied rates and the need to grow to deal with poverty is not pressing for some of them. How should their emission rights be fixed?

In any case, a cap and trade agreement in which emission quota is domestically auctioned is similar to a carbon tax. Carbon tax is simpler to administer [Nordhaus (2000), Shapiro (2009)] than cap and trade which would require setting up elaborate institutional arrangements for trade, certification and verification. On the other hand, short term price elasticity of emissions may be low and the reduction in emissions for a given tax rate may be lower than expected. Keohane (2009) has defended cap and trade. Essentially a cap and trade agreement determines the price of emission which is the same as carbon tax in the market while ensuring quantitative reduction. Such market determined price may show high volatility. Thus for example the EU-ETS price varied between Euro 9 and Euro 24 per tonne of CO_2 over the period October 2008 to February 2009 (Nordhaus; 2009). A system of periodic revision of carbon tax depending on realised emissions reduction, say every 3 years, can provide an easier to implement and a stable regime.

In a system of carbon tax regime what is done with the tax revenue is critical. If the revenue is redistributed on some principle, it would imply some allocation of rights of emission quotas.

Even action by NACs under NAMA requires setting up a baseline for NAC emissions. This is also an allocation of emission rights.

A widely discussed notion of allocating emission quotas is that of contraction and convergence (Meyer, 19--, ----) where eventually all will have the same per capita emission rights. How soon this equality is to be realised has profound implications for rights and obligations of countries. Thus allocation of emission rights (quotas) is implicit in almost all proposals and a critical element of any agreement.

Thus, allocation of emission quotas is unavoidable. It is also important to recognise that the scarce commodity is global atmospheric space that should be allocated.

It is important that this issue of allocation of emission quotas is addressed in a fair and just global compact. Global atmosphere is an open access common property, a parking space where countries park their emissions. It is not possible to fence the global environmental space to restrict emissions by any country. A common property resource can be maintained either by allocation of property rights or by common agreement cooperatively adhered to. An agreement would be adhered to only if it is perceived to be fair and just. It is, therefore, important to understand what would be a fair and just agreement. This is the question we address in this paper and suggest a just global impact.

3. Principles for a Fair and Just Allocation

An agreement acceptable to all must be based on fairness and justice. We look at the literature on the principles relevant to climate change negotiations.

3.1 *The Principles Embodied in UNFCCC*

The UNFCCC (United Nations Framework Convention on Climate Change) clearly acknowledges that "the global nature of climate change calls for the widest possible cooperation by all countries and their participation in an effective and appropriate international response, in accordance with their *common but differentiated responsibilities and respective capabilities and their social and economic conditions* (emphasis added).

The "differentiated responsibilities" reflect different historical emissions and different levels of development of countries. 'Respective capabilities and their social and economic conditions' accepts that rich countries have to do more and the poor have a right to develop and the countries were divided into annex 1 and non-annex 1countries. It could be argued that this division was based on per capita emissions. For example, Belgium and the Netherlands, although small in size and population, are in annex 1, while China and India are not. One could say that consideration was given to poor countries due to their GDP level or standards of living, suggests that per capita emissions are implicit in the UNFCCC (Aldy, 2005).

The UNFCCC also clearly recognised the developing countries' right to development and that it will require increases in their emissions. Thus the non-annex 1 countries (NAC henceforth) were not required to restrict the growth of their emissions. To what level they were free to increase GHG emissions was not specified.

However, the world is not static. Obviously as ability and per capita emissions increase there should be a mechanism for countries to share responsibility.

3.2 *Accounting for Historical Emissions*

Should countries be responsible for their excess emissions that have led to the build up of GHG emissions in the atmosphere since the beginning of the industrial revolution? While it can be argued that historical emissions since 1890 should be counted for allocating responsibilities to countries, this may raise issue of moral responsibility. As Muller et al (2007) point out that according to Aristotle moral responsibility ('blame') can be limited because of ignorance. Recently, managing director of Brookings, Antholis (2009) has argued that " if developed nations are held responsible for emissions thet they historically contributed, oblivious to their impact on climate change, why should not developing nations take responsibility for producing generations of people who will generate emissions in the future?" However, no country can claim ignorance of the impact of their emissions on climate change after 1990 when the negotiations for the UNFCCC started. Thus for arriving at a global consensus we consider that countries should be responsible at least for their emissions since 1990. To be symmetric, in any allocation based on population, the populations of all countries should be frozen at their 1990 levels.

3.3 *Rights to Global Environmental Space*

From the emission made in any year, some get absorbed by the global common, such as the seas, and the remaining stays in the atmosphere for years. Thus we need to distinguish, annual absorption capacity and permissible holding capacity of stock of GHGs of the environmental space. Absorption capacity is available year after year but can change with time and climate change. Permissible stock of GHG in the atmosphere, on the other hand depends on what is considered as the acceptable level of GHG concentration. As argued earlier allocating rights to these atmospheric resources either explicitly or implicitly is unavoidable in any agreement. A strong ethical case can be made for equal per capita allocation of rights to atmospheric resources. All democracies and all religions consider all persons equal. The U.S.A.'s declaration of independence considers "self-evident that all men are created equal".

However, it has been argued (Starkey, 2008) that equality should be in terms of welfare. Posner and Sunstein (2008) argue that costs and benefits of any agreement should be considered in allocating rights. Measuring and comparing costs and benefits across countries also involves comparison of welfare, which poses many difficulties.

Economic theory has used broadly two approaches for comparing situations in which different persons are affected differently, the utilitarian approach and the social welfare approach.

The utilitarian approach (Bentham J., 1822; Mills J.S., 1861) prefers the situation where the sum total of individual utilities is larger. Since to Bentham, utility reflected "pleasure and pain", this amounted to "the greatest happiness principle". Many objections are raised against the utilitarian approach. First, interpersonal comparisons of utility are questioned. In fact, (Arrow K. 1951, 1963) clearly states—

> *"The viewpoint will be taken here that interpersonal comparison of utilities has no meaning and, in fact, there is no meaning relevant to welfare comparisons in the measurability of individual utility".*

These difficulties have led to the welfarist approach in which a social welfare function of individual utilities is maximized. One may note that utilitarianism is a special case of welfarist approach in which the social welfare function is a simple sum of individual utilities. Another example of a social welfare function is the Gandhian principle to judge every action by its impact on the poorest of the poor.

It may be possible in some cases to compare two situations without defining an explicit social welfare function or without an interpersonal comparison of utilities. Using the Pareto principle, which states that a situation is better if at least one person is better without no one else being worse off, cardinal utilities that can be added up across persons, anonymity and aversion to regressive transfers, one can develop (see for example, Willig and Baily, 1981) a partial social preference ordering with which unambiguous comparisons of two situations become possible in some cases but not all.

Aversion to regressive transfer implies that whenever a distribution is obtained by transferring income from a poorer person to a richer one, it is considered less desirable that the original one.

Anonymity means one is indifferent to who the individuals are in the two distributions.

Rothschild and Stiglitz (1973) show that such comparison holds for a one good economy. "If there is more than one good, the implications are substantial". This is of particular significance for international comparison.

Comparisons of interpersonal well-being across nations involve more than one element. The conventional approach of using purchasing power parity (PPP) adjusted GDP is also flawed on many counts.

First, GDP itself is now widely recognized as a poor indictor of well being (UNDP, 1990). This has inspired many attempts to create other measures of well-being or development such as the physical quality of life index (PQLI) by Morris M. (1979) and the various versions of the human development index (HDI) developed by UNDP. The HDI itself has been criticized for its theoretical inadequacy by many (Srinivasan T.N. 1994). The Index of Sustainable Economic Welfare (ISEW) calculations (Daly H.E. and Cob J.B., 1994) have shown that since 1970 ISEW has remained flat or declined even though GDP has continued to grow in the USA. Similar results have also been reported for England (Jackson and Marks, 1994).

Second, the real world of many commodities, services and attributes, poses the index number problem that raise difficulties which have no satisfactory answers.

Third, different societies, cultures, nations have different social structures, mores and public institutions. The public goods, services, social capital and safety nets provided are different. If a person dies, the loss suffered by the family is far greater than what her income may reflect. An emotional and financial safety net is gone for her family the loss of which would have very different impacts on the survivors in different societies.

Fourth, as Sen A.K. (1980) suggests, one should aim at equality of "capabilities" which are determined by a person's income, access to public good and services and social capital and institutions within which she functions. These clearly differ across societies and nations.

Fifth, the principle of "anonymity" used in welfare comparisons within a nation may not be acceptable internationally without a world government which gives the same rights to all human beings. For example, suppose that climate change interchanges the positions of US farmers and Indian farmers. This is not likely to be considered a `no welfare loss' situation by the US. The point is that one cannot be indifferent to who bears the impact.

One comes to a sad conclusion. The economics profession does not have any answers to accounting for inequity across nations. One needs to realize this and rely on ethical principles and enunciate them explicitly. As we have noted equal per capita allocations have a strong ethical appeal.

Should allocations depend on needs? Starkey (2008) also argues that equal allocations are not fair. A person living in cold climate needs energy for heating while a person living in the tropics requires energy for air-conditioning. A rural person may need less energy to go to work compared to an urban person but more energy to access facilities such as hospitals. Also equipment in cold climate such as power plants give higher efficiency of fuel use due to thermodynamic Carnot efficiency compared to tropical locations. Should we account for these?

While one may accept in principle that energy needed to meet certain basic needs can vary from person to person and place to place it would be a complex exercise to work out these needs. In any case equal per capita allocation would surely exceed emissions required to meet basic needs.

It is sometimes argued that "emission rights" should not be given to anyone as no one should have the right to emit. One can call it "emission quotas". Also, if the global community accepts that 450 or 550 PPMV is an acceptable level of GHG concentration, then the corresponding stock of GHGs is considered acceptable and that amount of atmospheric resource has to be allocated either as quotas or as rights.

Should quotas to atmospheric resources be allocated on the basis of efficiency with which countries use energy? This efficient use argument is also false. In the neo-classical world of competitive free trade all producers use their resources efficiently. Energy, capital, labour, materials, all can be substitutes in producing a product. If products sell at the same price, comparing intensity of one particular input makes little sense. Also comparisons of emission efficiency are fought with many pitfalls. Should we consider GHG emission per GDP? These depend on relative prices and the nature of economic organisation of a country. Even adjusting the GDP by using PPP exchange rate also does not solve the problem (see Box).

Box

Pitfalls of Cross Country Comparisons of Energy Efficiency

The relative prices and policies vary. The weights used for purchasing power parity adjustments are usually not appropriate for comparing energy use efficiency. For example, taxi rides from airport to downtown hotel in Mumbai and New York would be of similar length and would consume more or less the same amount of petrol. The value added by that ride in Mumbai will be $2 and in New York $20, whereas the PPP ratio would be around 4.0.

Source: *Parikh Kirit S. (2006)*

With tradable quotas to atmospheric resource global costs will be minimised. Equal per capita rights are fair because the burden of these costs will fall on those who are responsible for the threat of climate change and can afford them whereas benefits will accrue to the poor who need them. As Chancellor Angela Merkel observed at a Potsdam Conference "*if it involves large transfer from USA to India, what is wrong in it?*" The USA has an option to reduce the transfer by reducing its emissions. Not paying for emissions cannot be considered just. That such transfers may not be palatable to rich countries cannot be an argument against the justness of equal per capita allocations of global environmental space.

In general there is a wide consensus across countries (Manne and Richels, 1992; Baer et al, 2000; GCI, 2001) that eventually per capita emissions must be equal. The population for allotment of emission rights can be frozen on the day the global agreement is signed so as not to reward population growth and also to encourage early agreement. Also migrants may be allowed to carry their entitlement with them.

4. Towards Just Global Compacts

While the Kyoto Protocol has stimulated some action in developing countries, the market for certified emission reductions (CERs) is thin and so the price received is also low. Thus the net effect on global emissions is marginal. If the A1Cs accept deep cuts, then CDM can be more effective.

Another expectation from CDM was technology transfer. As per a CDM board report (Seres Stephen, 2007) only 39% of the CDM projects involved technology transfer of which 67% include transfer of knowledge.

A new more effective global compact is needed as there is growing global concern about climate change. The growing emissions of some large NACs is causing concern and is being used as an excuse by some A1Cs to delay action on mitigation. How should we proceed? We suggest below an alternative which is consistent with the UNFCCC principle of common but differentiated responsibility.

3.1 *Rental for Parking Emissions in the Global Environmental Space*

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Considering that global atmosphere is like a parking space for GHG emissions, we propose that rent should be charged annually from all countries for every tonne of atmospheric space occupied by their accumulated GHG emissions. For this purpose all emissions from 1990 onwards should be chargeable, since by 1990 all counties knew that climate change is a possibility. Rent is like a carbon tax that is levied on a country's cumulative emissions from a given date. It will encourage countries to delay occupying the permissible atmospheric GHG holding space. Rent by itself is independent of allocation of rights, which come into play when we distribute the proceeds from the rent. The rent collected should be distributed on some principle of justice, which we suggest to be equal distribution on a per capita basis to all nations of the world based on their 1990 population.

The proposal has a number of advantages.

- Charging rent for the stock of accumulated emissions is rational as it is the stock of GHGs that causes climate change/global warming.
- All countries are involved and no distinction between annex 1 and non-annex 1 is needed.
- It will provide appropriate incentives to all countries to be carbon efficient as they all face the same opportunity cost of emissions.
- It also rewards countries for their negative emissions, which play a very important role in many long term global scenarios. For example Riahi et al (2007) show considerable negative emissions from carbon capture and sequestration, bio fuels and afforestation to reach and maintain GHG concentration of 520 PPM.
- It provides a simple mechanism to transfer resources across countries with very little transaction cost and minimal bureaucracy.

- By increasing the rental rate with a cess, compensation for adaptation can also be factored in. The cess collection can be distributed to countries as per their population and in inverse proportion to their per capita emissions with a minimum amount given to all countries with small populations.

This to us is a just compact consistent with UNFCCC where all participate as per their common but differentiated responsibility and capacity.

To illustrate what this scheme involves, we consider SRES scenario B1-520, which stabilises GHG concentration to 520 PPMV. The scenario provides emissions from 2000 upto 2100 by 10 year intervals for 11 regions of the world which are further aggravated into 4 regions, Asia; Latin America, Africa and Middle East Asia (LAFM); OECD and Region of Countries undergoing Economic Transition and Former Soviet Union (REFS). For ease of presentation we consider emissions upto 2050 only. Two types of regional breakups are given, 4 large regions and 11 smaller constituents of the regions. Numbers for each break up add up to the global total.

Table 1 gives projected GHG emissions including land use change up to 2050 for the 520 PPM scenario..

Table 1

GHG Emissions in Billion Tonnes of CO_2 equivalent/yr SRES B1_520 Scenario

Regions	2000	2010	2020	2030	2040	2050
	2000	2010	2020	2030	2040	2050
GLOBE	40.12	41.22	45.72	45.15	41.33	33.46
ASIA	11.47	12.11	14.40	14.41	13.30	11.48
LAFM	9.29	9.97	12.13	13.86	14.26	11.88
OECD	15.02	15.04	14.97	12.59	9.38	6.37
REFS	4.34	4.10	4.23	4.29	4.39	3.74
CPA	5.71	6.57	8.25	8.40	7.57	6.32
PAS	3.23	3.18	3.74	3.63	3.07	2.06
SAS	2.54	2.36	2.40	2.38	2.66	3.09
AFR	2.64	2.70	2.97	3.17	3.33	3.51
EEU	1.05	0.97	0.91	0.77	0.60	0.41
FSU	3.30	3.13	3.32	3.52	3.79	3.32
LAM	4.59	4.85	5.91	6.24	5.78	4.27
MEA	2.06	2.42	3.25	4.45	5.15	4.10
NAM	7.98	8.12	8.49	7.34	5.81	4.11
PAO	1.98	1.93	1.72	1.32	0.75	0.35

Note:

ASIA:	South Asia, Pacific Asia, Central Asia and China (SAS, PAS, CPA)	LAFM:	Region of Latin American and African Countries (AFR, LAM, MEA)
OECD:	Western Europe, North America, Pacific OECD (WEU, NAM, PAO)	REFS:	Region of Countries Undergoing Economic Reform (EEU, FSU)
AFR:	Sub-Saharan Africa (AFR)	CPA:	Centrally Planned Asia and China (CPA)
PAS:	Other Pacific Asia	SAS:	South Asia
AFR:	Sub-Saharan Africa	FSU:	Newly Independent States of the Former Soviet Union
LAM:	Latin America and the Caribbean	MEA:	Middle East and North America
NAM:	North America	PAO:	Pacific OECD
WEU:	Western Europe		

Source: Updated SRES scenario results provided by IIASA.

It is worth noting here that Asia's emissions exceed OECD's emissions only in 2030, even though Asia's population was 3250 million in 2000 compared to OECD's population of 920 million.

Cumulative GHG emissions from 1990 till 2000 are calculated from data on yearly GHG emissions of 1990 and 2000 obtained from World Resources Institute's website (WRI 2009) and are shown in *Table 2*.

Table 2

Cumulative GHG Emissions (1990-2000)

Regions	Billion CO_2	BtC	% of Global	Population @(Millions) (2000)
GLOBE	430.2	117.3	100.0	6055
ASIA	128.6	35.1	29.9	3251
LAFM	102.7	28.0	23.9	1472
OECD	142.6	38.9	33.1	919
REFS	54.9	15.0	12.8	413
CPA	50.7	13.8	11.8	1385
PAS	53.1	14.5	12.3	499
SAS	20.1	5.5	4.7	1367
AFR	27.1	7.4	6.3	611
EEU	11.7	3.2	2.7	121
FSU	43.1	11.8	10.0	292
LAM	58.2	15.9	13.5	515
MEA	17.3	4.7	4.0	345
NAM	73.8	20.1	17.2	314
PAO	24.1	6.6	5.6	150
WEU	49.1	13.4	11.4	456

@from SRES scenarios

Table 3 gives gross cumulative emissions. These are obtained by interpolating yearwise emissions between the years given in *Table 1,* cumulating them and adding the 1990-2000 emissions of *Table 2*.

Table 3

Gross Cumulative Emissions Since 1990 (Billion Tonnes of CO_2)

	2000	2010	2020	2030	2040	2050
GLOBE	430	837	1274	1728	2158	2527
ASIA	129	247	380	524	662	785
LAFM	103	199	311	441	582	711
OECD	143	293	443	579	687	763
REFS	55	97	139	181	225	265
CPA	51	77	106	137	169	204
PAS	53	115	189	273	352	421
SAS	20	30	39	48	55	60
AFR	27	59	92	126	162	198
EEU	12	59	113	174	234	283
FSU	43	66	94	133	181	227
LAM	58	139	222	301	365	414
MEA	17	37	55	70	80	85
NAM	74	106	141	177	211	235
PAO	24	48	72	96	121	150
WEU	49	99	148	191	224	246

In terms of cumulative emissions ASIA exceeds OECD only in 2050.

SAS, South Asian region, with a population of 1367 million in 2000, remains the lowest cumulative emitter, even lower than EEU, the region with the lowest population of 121 million Persons in 2000.

In principle , in order to work out how much global space is occupied in a country, we need to subtract the share of per capita absorptive capacity from each country's emission for each year. Absorptive capacity varies depending on many factors. Would the seas saturate with CO2? How would temperature change, wind velocity etc affect CO2 absorption? Only one thing is somewhat certain that the absorptive capacity will change. Though in principle, a knowledge of global GHG concentrations and annual global emissions one can ex post work out what must have been absorbed. Even here, it will not be possible to differentiate what has been absorbed by national resources and what by global commons. Thus while ideally, rent should be charged on the basis of net accumulated emissions, we will use gross accumulated emissions for illustrating our proposal. **We emphasise however, that as long as the global environmental space and the global absorptive capacity are distributed across countries in the same proportions, the net transfer of resources would remain the same.**

With an annual rental of R US dollars pre tonne of CO_2 a country has to pay R times the gross cumulative emission of *Table 3*. With redistribution of the aggregate rental on a per capita basis, the net payment a region has to make is given by its payment less the share of the population of year 2000 of the region in the total global rent collection. Thus,

Net payment of region *i* =R x Net cumulative emissions of region *i*
- R x Total net cumulative emissions of all countries
x (Population of region *i*/global population)

What should be the annual rental rate? If the price of CO_2 emission traded today is P and if the emissions stay in the atmosphere for *n* years and if the discount rate is *i*, then the annual rental *R* should be as follows:

$$P = R\left(\frac{1+i-\dfrac{1}{(1+i)^n}}{i}\right)$$

With a low discount rate of 1 percent and 100 years CO_2 life time

$i = 0.01$

and $n = 100$

we get $P \simeq R\ (100)$

With CO_2 trading at \$20 per tonne, P = 20 and R = P/100 $\simeq$ 0..20 \$/tonne/year.

With an annual rental R of \$0.20, the net payments payable by each region is shown in *Table 4* and plotted in *Figures 1* and *2*.

Table 4
Net Rent Payable @ US\$ 0.2/Tonne of CO_2 (Billion US\$)

Regions	2000	2010	2020	2030	2040	2050
GLOBE	0.0	0.0	0.0	0.0	0.0	0.0
ASIA	-20.5	-40.6	-60.8	-80.7	-99.3	-114.4
LAFM	-0.4	-0.8	0.2	4.3	11.5	19.5
OECD	15.4	33.1	49.9	63.3	71.7	75.8
REFS	5.1	8.0	10.4	12.7	15.5	18.5
CPA	-9.5	-22.8	-37.1	-51.7	-64.9	-74.9
PAS	3.5	9.2	16.9	26.1	34.9	42.5
SAS	-15.4	-31.8	-49.6	-68.5	-86.5	-102.2
AFR	-3.3	-5.1	-7.4	-9.7	-11.1	-11.5
EEU	0.6	8.5	17.5	27.9	38.1	46.5
FSU	4.5	5.1	6.5	9.9	15.4	21.0
LAM	4.3	13.5	22.7	30.7	36.3	39.7
MEA	-1.4	-2.2	-3.5	-5.7	-8.7	-11.8
NAM	10.3	12.5	14.9	17.6	19.7	20.9
PAO	2.7	5.5	8.1	10.7	13.6	17.6
WEU	3.3	7.2	10.4	12.1	12.2	11.2

Figure 1
Net Rent in Billion US at \$0.2 per Tonne of CO_2

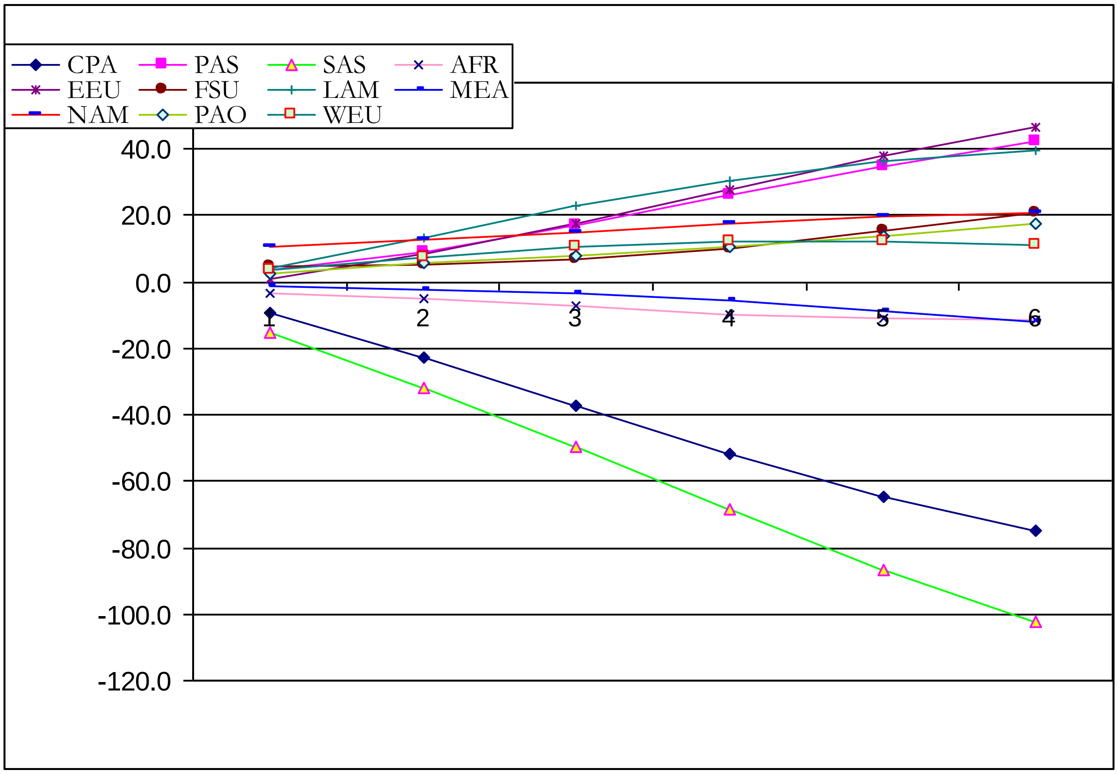
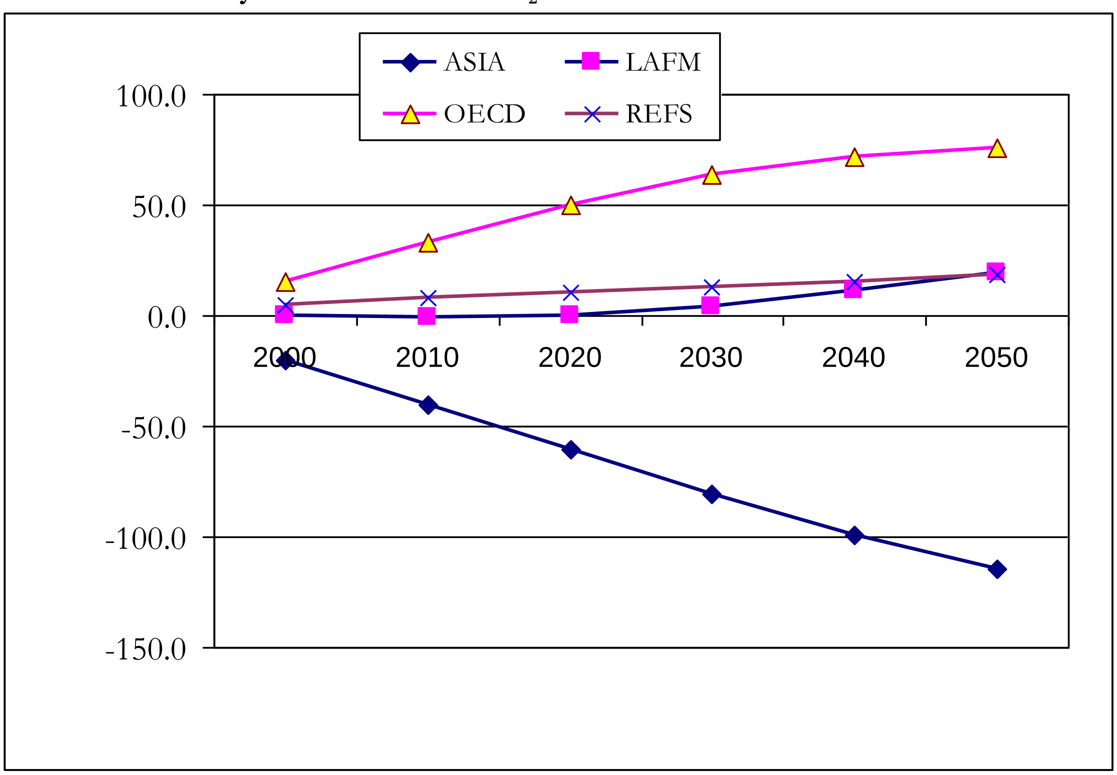


Figure 2
Net Rent Payable for Stock of CO_2 - Billion \$ Per Year at \$0.2 Per Tonne



It is seen that rental payable by OECD countries increases from $13 billion in 2000 to $66 billion by 2050.

The SAS region which includes India is entitled to receive a net payment of $8.9 billion in 2000 which increases to 67 billion in 2050. Even CPA region, which includes China, gets $4 billion in 2000 which increases to $19 billion by 2050. These results show the extent of the occupation of the global environmental parking space by OECD and REFS countries at the cost of countries of Asia and Africa.

3.3 Carbon Tax

If the collection of rents over a long period of time is considered impractical a carbon tax of $20/tonne can be considered as the present discounted value of annual rentals. It can be levied on annual emissions and not accumulated emissions. Again if a carbon tax is imposed from 2010 onwards and proceeds distributed equally as per 2010 population, the projected transfer are shown in Table 5. The transfer are much more than those required under the annual rental scheme and decrease over time as they are front loaded.

Table 5
A Carbon Tax as the Present Discounted Value of Rental

NET Payments with Carbon tax at US$20 per Tonne of CO2 Distributed equally on per capita basis with 2010 population(Billion in US$)

	2010	2020	2030	2040	2050
GLOBE	824.32	914.49	902.95	826.52	669.22
ASIA	-191.05	-192.73	-186.34	-168.45	-122.14
LAFM	-25.07	-6.38	31.28	60.26	55.31
OECD	185.21	171.20	125.34	71.68	33.55
REFS	30.91	27.91	29.73	36.52	33.28
CPA	-44.89	-30.52	-25.13	-25.37	-16.67
PAS	-3.76	0.11	-1.14	-6.11	-13.44
SAS	-142.41	-162.32	-160.08	-136.97	-92.03
AFR	-45.60	-51.08	-45.81	-33.24	-10.72
EEU	4.51	1.61	-0.97	-2.94	-3.85
FSU	26.40	26.30	30.70	39.45	37.13
LAM	26.32	39.83	47.32	44.71	28.04
MEA	-5.79	4.87	29.77	48.79	38.00
NAM	122.17	125.23	102.80	75.81	49.54
PAO	19.97	13.69	5.84	-3.81	-8.11
WEU	43.07	32.27	16.70	-0.32	-7.88

3.4 *Implementation Strategy*

Of course the SRES scenario has built in emission constraints to stabilise GHG concentration at 520 PPMV. Without these constraints countries would have emitted much more. It is not clear if \$20/tonne of CO_2 is an adequate price for countries to follow the emission trajectory of the scenario. The price of CO2 will have to be adjusted and the rental rate correspondingly fixed to see that the global emissions follow the trajectory of the agreed scenario, 520 PPMV in this case. A mechanism for updating rental rate should be decided at the time of the global agreement.

Alternatively, an acceptable stabilisation level of PPMV should be agreed on. This will determine the trajectory of GHGs in the global atmosphere i.e. the total available parking space. This may be allocated to all countries on equal per capita basis. The countries should be free to trade the space. Such a system of allocation of global environmental parking space and trading of it can force the countries to follow the trajectory. Implementation will be no more difficult than that of any cap and trade of emissions scheme. The same mechanism that can enforce a cap and trade agreement can enforce this cap and trade of global carbon space.

If a global agreement is obtained that stabilisation should be at 520 PPMV than the global emission trajectory and the corresponding CO_2 content (row 1 in *Table 3*) in the atmosphere gets fixed. This defines the available atmospheric resource which can be allocated to all countries on equal per capita basis, which they can trade every year. There would be no need to fix any rental price from outside as the market would determine this.

How the entitlements to global carbon space are distributed within the country should be left to the country governments. Country governments may impose a tax or auction the entitlements. In addition a country government may also take other measures such as mandating efficiency standards, to meet its obligations.

As noted earlier a system of periodically adjusted rental rate to track a desired trajectory of global emissions, distributed equally to all is easier to implement than a cap and trade system.

5.4 *Responsibility for Adaptation*

Even equal per capita allocation of global environmental space does not take care of the adaptation burden imposed on people. One should also note that allocation of atmospheric space does not absolve the allottee from the responsibility to compensate those on whom adaptation burden is imposed. Anyone who contributes to the threat of climate change should pay for the adaptation burden imposed on others. A country's liability should be based on the global environmental space occupied by it and for how long it has been occupied by it.

Many developing countries and India in particular, are vulnerable to impacts of climate change. And whether they like it or not will have to adapt to it and bear the burden of adaptation as well as impacts to which no adaptation is possible. This is a burden imposed on them by the cumulated emissions of industrialised countries and must be compensated for. To compensate developing countries for adaptation, a fund was created at Bali Conference. Not only, it is meagre, but it is funded by a cess on CDM transactions of CERs, which is a tax on the developing counties as EU-ETS is outside it.

It would be difficult to assess the additional cost due to adaptation. Also to estimate it a huge bureaucracy may be needed. A much simpler way is to put a cess on carbon emissions and better still, on cumulative carbon emissions and redistribute this to countries on per capita basis in inverse proportion to their per capita GHG emissions. If some small countries with very small population do not get adequate resources with equal per capita allocation
a certain minimum amount may be given to countries with small populations.

4. Conclusions

We have argued that a just global compact would allocate the global environments absorptive capacity and the global atmospheres holding space corresponding to any agreed level of stabilisation, on equal per capita basis. Then either the countries can trade this entitlements on an annual basis or a rental may be charged the receipts from which are distributed equally to all citizens of the earth. A part of the rent collected could be given to small countries on a per country basis. A part can also be set aside for emergency assistance.

This is also a cap and trade scheme or a carbon tax scheme and no more or less difficult to implement it. Only the entitlements are fixed on equal per capita basis.

It may be emphasised that while we have used the B1-520 scenario for illustration, implementation of the scheme does not require any agreement on the scenario to be used as a benchmark scenario. Of course a desired trajectory of global emissions has to be agreed upon if the rental or tax is to be adjusted periodically.

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