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Towards a "Houston Protocol": Or how to allocate CO2 emissions reductions between North and South

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Towards a "Houston Protocol"
or
How to Allocate CO₂ Emissions Reductions
between North and South

by
Udo E. Simonis

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papers

Forschungsschwerpunkt
Technik
Arbeit
Umwelt

"The major problems in the world today are the result of the difference between the way nature works and the way man thinks."

Gregory Bateson

Introduction

In June 1992, some 154 countries signed the United Nations Framework Convention on Climate Change (Climate Convention), a centerpiece of the Earth Summit in Rio de Janeiro. The required 50 signatories had ratified the treaty before the end of 1993, and so it became legally binding on March 21, 1994. The first Conference of the Parties will take place from March 28 to April 4, 1995 in Berlin. Thereafter the treaty will move from general principles to specific requirements that signatories will have to obey to avoid penalty. In this way, the Climate Convention may become what the 1985 Vienna Convention was to the 1987 "Montreal Protocol", the widely respected law on ozone-depleting substances.

One of the specific tasks in the coming negotiations on implementing the Convention is how to share the duties of reducing climate relevant gases, particularly carbon dioxide (CO₂), between and among the industrial and the developing countries. The respective proposals could be the most far-reaching ever for socio-economic development; they could lead to fundamental changes in energy, forestry, transport, and technology policies. Some of the aspects of a respective CO₂ agreement - the "*Houston Protocol*" - are addressed in this paper.¹

1. Preliminary assessment

In the future, economists, development planners, diplomats, and politicians will not only have to deal with growth and development processes, but also have to pay increasingly more attention to reduction and redistribution processes. This is particularly true with regard to the most important global environmental problem so far, climate change. Up until now, this problem

¹ I have chosen Houston, Texas as a symbol of a most wasteful use of energy and, at the same time, a most innovative place of technology development.

has been mainly created by the industrial countries, and the debate is about how much the North should give up in climate relevant emissions. The developing countries will, however, follow suit if they keep to the "standard development path". Ecologically, it will be the developing countries that will suffer most from the effects of climate change. Economically, costs incidence will depend on the kind of preventive or adaptive measures taken, the institutional arrangements made, and the wisdom of global environmental diplomacy.

2. Greenhouse gas emissions

In analyzing global climate change and in formulating a corresponding policy (*global climate policy*), two categories of emissions are particularly important: current absolute emissions and relative per capita emissions, and emissions per unit of gross domestic national product.

Although the basic statistical data on the emissions of carbon dioxide (CO₂), methane (CH₄), and chlorofluorocarbons (CFCs), the major greenhouse gas emissions, are few and still weak, it quickly becomes clear what a formidable task the reduction of, or adaptation to, climate change will present to the world in general, and to industrial and developing countries, respectively. Negotiations on this task are presently under way; they center around a new equity problem, the solution of which will be extremely difficult.

Table 1 gives the national rank and percent share of the increase in the estimated atmosphere's warming potential attributable to countries that in 1991 emitted the largest amounts of CO₂, CH₄, and CFCs. The countries are ranked by their Greenhouse Index developed by IPCC, whereby global warming potentials account for the atmospheric lifetime of each gas and its relative efficiency in absorbing infrared radiation (IPCC, 1992). The table shows that the United States and the former Soviet Union together contribute 32.8 percent to the current global emissions, 19.1 and 13.6 percent respectively. If taken as a single unit the European Community would rank third at 12.4 percent. The top six emitters, two of which are developing countries, contribute 55.8 percent of current global emissions.

Table 1. Greenhouse index ranking and percent share of global emissions, 1991

Rank	Country	Percent	Rank	Country	Percent
1.	United States	19.14	26.	Czechoslovakia	0.70
2.	Former Soviet Union	13.63	27.	Malaysia	0.61
3.	China	9.92	28.	Colombia	0.61
4.	Japan	5.05	29.	Netherlands	0.59
5.	Brazil	4.33	30.	Philippines	0.59
6.	Germany	3.75	31.	Myanmar	0.55
7.	India	3.68	32.	Argentina	0.54
8.	United Kingdom	2.37	33.	Turkey	0.53
9.	Indonesia	1.89	34.	Romania	0.52
10.	Italy	1.72	35.	Bulgaria	0.51
11.	Iraq	1.71	36.	Bolivia	0.48
12.	France	1.63	37.	Pakistan	0.46
13.	Canada	1.62	38.	Belgium	0.40
14.	Mexico	1.43	39.	Peru	0.39
15.	Poland	1.16	40.	Yugoslavia	0.36
16.	Australia	1.13	41.	Nigeria	0.35
17.	South Africa	1.12	42.	Egypt	0.34
18.	Spain	1.01	43.	Viet Nam	0.32
19.	Venezuela	1.01	44.	Greece	0.31
20.	South Korea	0.98	45.	Ecuador	0.30
21.	Zaire	0.93	46.	Bangladesh	0.29
22.	Thailand	0.88	47.	Hungary	0.26
23.	North Korea	0.84	48.	Austria	0.25
24.	Iran	0.82	49.	Denmark	0.24
25.	Saudia Arabia	0.78	50.	Algeria	0.23

Source: World Resources 1994-95, p. 201

Table 2 provides the per capita rank and a measure of per capita emissions of CO₂, CH₄, and CFCs for 1991. The measure used is the ratio of a country's per capita emissions to the world median per capita figure, which for 1991 was 2.59 metric tons of CO₂ equivalent per person. Some countries high on the list of total emitters are rather low (Brazil) or not at all on the list of the 50 highest per capita emitters (China and India, for example). The four highest per capita emitters either are large producers of oil (Qatar, the United Arab Emirates and Brunei) or experienced severe deforestation during the 1980s (Gabon). Iraq moved temporarily into sixth place. Among the industrialized countries, Luxembourg, the United States, and Australia rank highest. Per capita emissions in the United States are almost 9 times those of China and almost 18 times those of India, reflecting the generally large disparities in per capita emissions between industrialized and developing countries (see *Figure 1*).

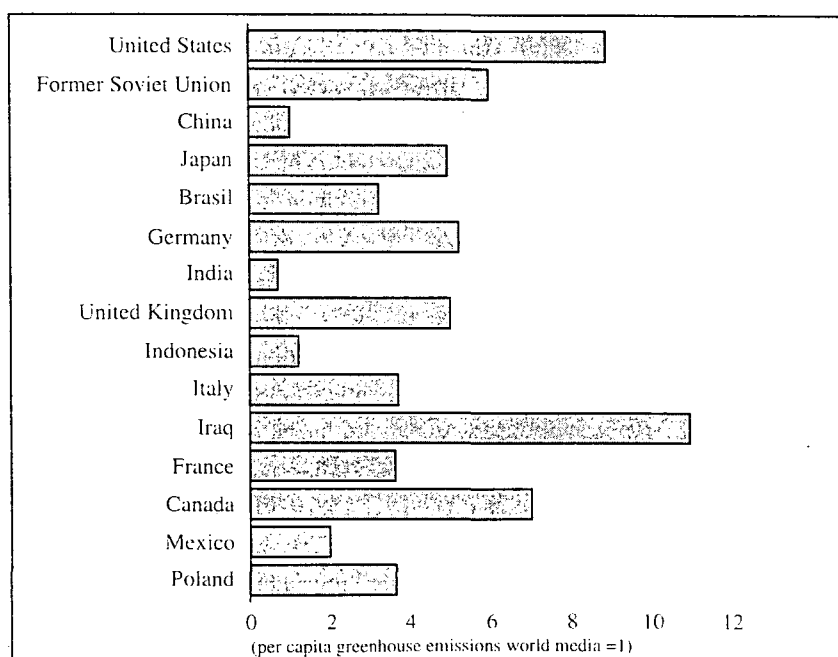
Table 2. Relative per capita greenhouse emissions, 1991

Rank	Country	Per capita measure	Rank	Country	Per capita measure
1.	Qatar	18.63	26.	Belgium	4.76
2.	Gabon	17.03	27.	Netherlands	4.66
3.	United Arab Emirates	16.15	28.	Finland	4.60
4.	Brunei	11.51	29.	North Korea	4.48
5.	Luxembourg	11.41	30.	New Zealand	4.42
6.	Iraq	10.84	31.	Panama	4.13
7.	United States	8.95	32.	Bahamas	4.00
8.	Bahrain	8.43	33.	Malaysia	3.93
9.	Australia	7.70	34.	Israel	3.90
10.	Bolivia	7.68	35.	Austria	3.88
11.	Canada	7.10	36.	Libya	3.68
12.	Bulgaria	6.74	37.	Guyana	3.67
13.	Suriname	6.63	38.	Nicaragua	3.64
14.	Trinidad and Tobago	6.53	39.	Greece	3.61
15.	Singapore	6.33	40.	Poland	3.56
16.	Venezuela	6.01	41.	Italy	3.53
17.	Saudia Arabia	5.95	42.	South Africa	3.39
18.	Former Soviet Union	5.68	43.	France	3.39
19.	Norway	5.68	44.	Brazil	3.37
20.	Denmark	5.61	45.	Iceland	3.32
21.	Germany	5.54	46.	Ecuador	3.23
22.	Czechoslovakia	5.30	47.	Cyprus	3.15
23.	United Kingdom	4.87	48.	Switzerland	3.09
24.	Japan	4.81	49.	Spain	3.05
25.	Ireland	4.80	50.	Paraguay	3.04

Note: world median = 1

Source: World Resources 1994-95, p. 202

Figure 1. Per capita greenhouse gas emissions of the 15 countries with the highest total emissions, 1991



Source: World Resources 1994-5, p. 203

Industrial processes that generate CO₂, like the burning of fossil fuel and the production of cement, constitute the dominant anthropogenic sources of greenhouse gases. Thus these activities represent the greatest opportunity for emissions reductions. Major industrial and large developing countries such as China and India rank high on the list of those with the highest emissions of industrial CO₂ (see *Table 3*). On a per capita basis, however, China and India rank relatively low (see *Figure 2*).

Table 3. Fifty countries with the highest industrial emissions of carbon dioxide (CO₂), 1991 (in million metric tons)

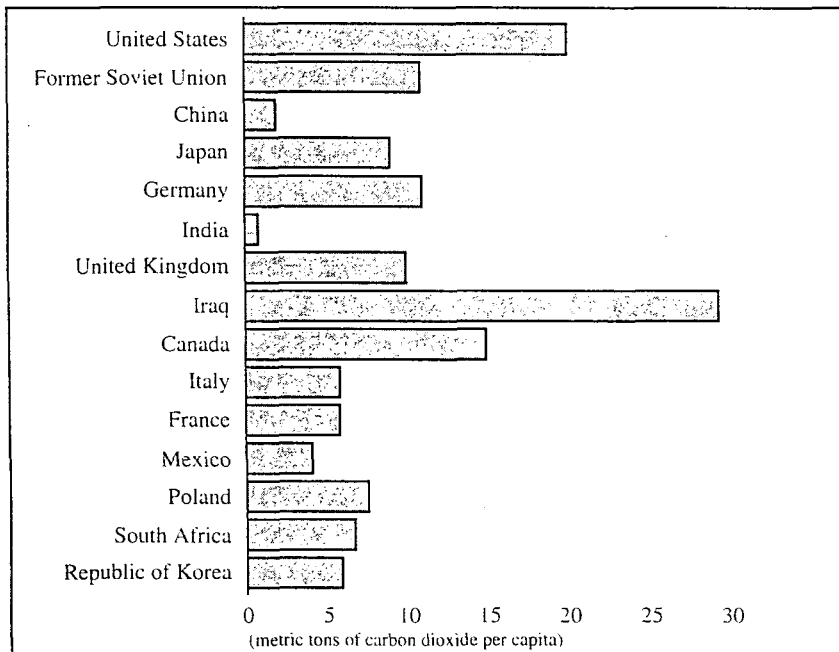
Rank	Country	Total CO ₂ emissions	Rank	Country	Total CO ₂ emissions
1.	United States	4,931,630	26.	Romania	138,027
2.	Former Soviet Union	3,581,179	27.	Venezuela	121,604
3.	China	2,543,380	28.	Argentina	115,848
4.	Japan	1,091,147	29.	Belgium	102,079
5.	Germany	969,630	30.	Thailand	100,896
6.	India	703,550	31.	Nigeria	91,930
7.	United Kingdom	577,157	32.	Yugoslavia	87,225
8.	Iraq	520,281	33.	Egypt	81,667
9.	Canada	410,628	34.	Greece	72,866
10.	Italy	402,516	35.	Pakistan	68,487
11.	France	374,113	36.	Hungary	63,574
12.	Mexico	339,873	37.	Denmark	63,504
13.	Poland	308,164	38.	Malaysia	61,196
14.	South Africa	278,695	39.	Austria	60,331
15.	South Korea	264,647	40.	United Arab Emirates	59,459
16.	Australia	261,818	41.	Norway	58,672
17.	North Korea	243,235	42.	Colombia	57,503
18.	Iran	222,361	43.	Bulgaria	56,675
19.	Spain	219,877	44.	Algeria	55,194
20.	Brazil	215,601	45.	Sweden	53,498
21.	Saudia Arabia	214,919	46.	Finland	52,047
22.	Czechoslovakia	191,356	47.	Philippines	44,587
23.	Indonesia	170,468	48.	Libya	43,008
24.	Turkey	142,555	49.	Switzerland	41,843
25.	Netherlands	138,990	50.	Portugal	41,792

Source: World Resources 1994-5, p. 202

In Article 2 of the Climate Convention its objective is defined in a demanding manner: "The ultimate objective of this Convention and any related legal instruments ... is to achieve ... stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate systems.

Such a level should be achieved within a time frame sufficient

Figure 2. Per capita carbon dioxide (CO₂) releases for the 15 countries with the highest total emissions by industrial sources, 1991



Source: Carbon Dioxide Information Analysis Center (CDIAC), Oak Ridge National Laboratory, unpublished data, August 1993

- to allow *ecosystems* to adapt naturally to climate change,
- to ensure that *food production* is not threatened and
- to enable *economic development* to proceed in a sustainable manner."

To implement this objective and its three stringent conditions, ideally *all* greenhouse gases should be addressed by respective protocols. For the time being, however, this seems rather unrealistic. Technical, economic, social, and political aspects of emissions reductions for the individual gases differ greatly from country to country, region to region, North to South. Specifying targets and measures for the reduction of the respective greenhouse gas emissions, therefore is bound to lead to confrontation as regards distribution of costs and benefits, finance and technology transfer, and the employment of suitable economic and regulatory instruments, like charges and taxes, or norms and standards.

3. Global environmental policy: experiences so far

What can the implementation of the climate convention and the corresponding protocols build on? What experiences have been made with regard to agreements on environmental protection involving both industrial and developing countries?

The number of effective international agreements on environmental protection comprising more than a single region (for example, river basins), involving more than individual projects (like debt-for-nature swaps or the tropical forest action plan), and having been signed both by industrial and developing countries, is rather limited. Volkmar Hartje, who has worked on this question, names only four (Hartje 1989): the London Dumping Convention (1972), the Convention for the Prevention of Sea Pollution by Ships (1973 and 1978), the United Nations Conference on the Law of the Sea (1973-1982), and the Vienna Convention (1985) together with the Montreal Protocol on the Protection of the Ozone Layer (1987).

These agreements contain quite different regulations and instruments, including not only technical provisions but also fiscal incentives and quota systems. The Montreal Protocol (with the respective revisions) is even considered a model blueprint regarding international environmental regimes (Gehring 1990), an example of intelligent "ozone diplomacy" (Benedick 1991).

Up to the present, however, these agreements were only of minor significance for the developing countries, in that they hardly had to fulfill any emission reduction requirements. In this respect as well the Montreal Protocol is new, though modified by a ten-year grace period and provisions for information and technology transfer. The global climate convention, in contrast, will mean significant economic adjustments also for the developing countries with regard to products as well as to production technology.

Theoretically speaking, a relative or an absolute reduction of all the greenhouse gases seems necessary. And basically, all conceivable mechanisms and instruments could be used: *negative lists* (London Dumping Convention), *technical provisions* (Marpol agreement), *property rights* (the Law of the Sea Conference), or *rates of reductions* and *phasing out of productions* (Montreal Protocol). With continuing high population growth in the developing countries on the one hand, and necessary increase of income on the other hand, *relative* limitations (with regard to population or gross domestic product) or *absolute* limitations of greenhouse gases would generate quite dif-

ferent consequences. These consequences will influence the readiness of countries to cooperate or to oppose in the process of negotiating the climate convention and the respective protocols.

Taking into account only the major greenhouse gases, these are probably the most important measures to be considered:

- relative *or* absolute limitation of CO₂ emissions resulting from the combustion of fossil fuels;
- conversion of the trends of CO₂ emissions from biotic sources (i.e., reduced deforestation and increased reforestation, respectively);
- phasing out consumption *and/or* production of CFCs;
- relative *or* absolute limitation of CH₄ emissions;
- relative *or* absolute limitation of the use of nitrogen fertilizers.

Taking the formulation of the CFC reduction plan (not its implementation) as solved, further negotiations will have to focus on protocols for CO₂, CH₄ and N₂, or a combination of them, and on a supplementation by other protocols (on reforestation and biodiversity). Apart from CFCs, only CO₂ has been discussed seriously at the international level. In the following, I shall therefore focus only on CO₂, which presently causes more than 50 percent of the anthropogenic greenhouse effect.

4. Emissions reductions and equity: theoretical considerations

In the Montreal process three steps or targets emerged: *freeze*, *reduction*, and *phasing out*. The endeavors centered on rules to reach quantitative restrictions, while a solution via fiscal disincentives (*CFC tax*) was not seriously pursued. The volume of funds made available (*CFC Reduction Fund*) was, and still is, rather modest, sufficient at best to cover search and transaction costs. With regard to CO₂, however, a further growth of emissions is very probable. *Freeze* or *reduction* seem technically possible, *phasing out* impossible.

With regard to global environment policy, solutions via price and quantitative regulations are feasible, as far as mechanisms of stimulation or sanctioning are concerned. At the very start of all environmental policy, the market mechanism has to be changed. Basically, there are two approaches: One is to fix prices for environmental services, while it is left to the market to

decide how many emissions are economical (*price solution*); or a quota is fixed for the quantity of emissions allowed, while the prices for using the environment are left to develop in the market (*quantity solution*). These two approaches are symmetrical to one another, but they are not equivalent. One parameter, price or quantity, is fixed while the other is left to the market mechanism. The *real* question is which of these parameters should be fixed with regard to *which* environmental problem!

The crucial problem with price solutions (*taxes, charges*) is to determine the correct level of the price to be fixed (*shadow price*). The crucial problem with quantity solutions is to determine the appropriate quantitative ceiling (*quota*) of emissions of a certain type to be permitted. In either case, if the determination is wrong, permitted emissions may exceed the absorption capacity of the ecological system (in our case, the climate system). Price as well as quantity solutions may, therefore, miss the actual target (i.e., stabilization or restauration of the climate system).

With regard to a future CO₂ protocol it is to be expected that in the course of the negotiations both types of solutions will be introduced. To date, quantity solutions (*global quota, national quota, per capita quota*) are in the foreground, while the discussion on price solutions (*global resource tax, national CO₂ charge, "climate tax"*) has only just begun. Under equity considerations, however, these different approaches may lead to quite different results.

Moreover, with regard to quantity solutions, legal rules (*reduction duties*) do prevail. However, the use of market-based instruments (*certificates* or *tradeable permits*) seems to be gaining ground; this suggests the implementation of certain parameters (for example, a certain rise in temperature) by emission quotas (see Tietenberg 1985). These systems would have to be transformed into specific certificates which entitle the holder (country, group of countries) to an (annual) emission of a certain amount of CO₂. These certificates (or tradeable permits) could be regionally or globally transferable (*emissions exchange*). They would be exchanged in the market at prices corresponding to their scarcity, and the ensuing revenue might then be used for substituting high-emission products and technologies by low-emission products and technologies. The certificates would add up to the set framework parameters (*global emission limit*). The certificates sold could thus be interpreted as a compensation for partial renunciation of production or use.

A special problem for a CO₂ protocol is the uncertainty regarding emissions and their impacts on climate (rise in temperature, sea level rise, etc.). This problem could be prevented by corresponding (yearly) devaluations of the certificates. This would lead to either reduced emissions or to the need to purchase additional certificates.

It appears then that CO₂ emissions would qualify for a quantity solution, i.e. certificates to be traded at the local, national, regional and even the international level. However, specific conditions would have to be met to implement this theoretical option smoothly in actual practice. There are also alternative instruments of global climate policy to be considered, such as a tax on fossil fuels or a CO₂ charge. The related questions are to a large extent questions of equity.

5. Global CO₂ emissions reductions: two scenarios

In the following, two global emissions scenarios (*Table 4*) for the years 1985 to 2100 and 1975 to 2075, respectively, are compared.

Those scenarios differ quite substantially:

- In the *EPA's* scenario, a reduction of CO₂ emissions from fossil fuels of about 40 percent is expected, and an active reforestation policy (enlargement of CO₂ sinks) is envisaged, leading to negative net emissions.
- In *Mintzer's* scenario, prevention fails, emissions from the burning of fossil fuels double and changes in land use have no relieving effect; far-reaching adaptation becomes necessary.

Of course, it is difficult to predict which of these (or similar) scenarios will be taken as reference point for a CO₂ protocol. But one can say that the implied strategy of precaution (*prevention*) or adaptation (*cure*) will be determined by three major factors: (1) the real or supposed costs and benefits of the corresponding measures, (2) the perception of the irreversibilities induced by climate change, and (3) the institutional and instrumental measures that can be agreed upon in the North-South-context.

Table 4. Two CO₂ emissions scenarios

Scenario A: "Reduction Scenario"; EPA, 1989					
Year	1985	2025	Emissions 2050	2075	2100
CO ₂ (billion tons) from					
- fossil fuels	19.4	20.5	n.a.	n.a.	12.3
- change of land use	3.0	-1.1	n.a.	-0.4	
Total	22.4	19.4	16.0	14.1	11.8
ΔT 2100/1860 = 1.4 to 2.8 degrees Celsius					
Scenario B: "Growth Scenario"; Mintzer, 1987					
Year	1975	Emission 2025	2050	2075	
CO ₂ (billion tons) from					
- fossil fuels	17.1	21.3	28.3	34.6	
- change of land use	3.8	3.0	2.7	2.5	
Total	20.9	24.3	31.0	37.1	
ΔT 2075/1860 = 2.3 to 7 degrees Celsius					

The current discourse over the reduction of CO₂ emissions reflects to some extent an already existing *common interest* in a sustainable future of industrial society. At the same time, it recognizes the need for further economic growth in the developing countries. And there are several interesting and (surprisingly) coinciding plans, summarized in the following section.

6. CO₂ emission reduction plans: three examples

At the Second World Climate Conference in Geneva in 1990, two plans on CO₂ emission reduction for the time until 2050 were presented: the IPCC proposal and the Ministers' proposal. The IPCC called for drastic and rapid reductions of CO₂ emissions in the OECD member countries, whereas global emissions would decrease only after the year 2005, and then fall by 46 per-

cent until 2050, below the level of 1987 (*Table 5*). The Ministers' proposal was less drastic, with some temporary delay (*Table 6*). The ministers, however, followed the scientists' notion that a further increase of CO₂ emissions should be accorded to the developing countries.

The plan of the Enquête Commission of the German Parliament is the third possible reference case (*Table 7*). The proposal differentiates the industrial countries according to their gross domestic product and suggests that reductions of CO₂ emissions be realized more quickly and thoroughly. Once again, a preference is accorded to the developing countries.

Thus, implicit criteria for the allocation of reduction duties, and the related equity issues, between industrial and developing countries, North and South, can be inferred from the three plans. In the following, special features of these sensitive issues for a global CO₂ protocol are addressed more explicitly.

Table 5. CO₂ emissions plan - Second World Climate Conference - IPCC proposal (base year 1987, in percent)

Year	OECD	Industrial countries others	total	Developing countries	World total
1990	+5	+5	+5	+11	+6
1995	+7	+8	+7	+24	+11
2000	-4	+5	-1	+37	+7
2005	-20	-10	-16	+50	-3
2020	-50	-30	-43	+60	-21
2050	-80	-70	-76	+70	-46

Source: WMO/UNEP, 1990

Table 6. CO₂ emissions plan - Second World Climate Conference - The Ministers' proposal (base year 1987, in percent)

Year	Industrial countries	Developing countries	World total
1990	+5	+11	+6
1995	+8	+24	+11
2000	+5	+37	+12
2005	0	+50	+10
2020	-20	+60	-4
2050	-60	+70	-33

Source: WMO/UNEP, 1990

Table 7. CO₂ emissions plan - The German Enquête Commission (base year 1987, in percent)

Year	Industrial countries			Developing countries	World total
	economically strong	economically less strong	economically weak		
1990	+5	+5	+5	+11	+6
1995	+5	+7	+8	+24	+10
2000	-10	-4	+5	+37	+4
2005	-30	-15	-5	+50	-5
2020	-50	-35	-25	+60	-20
2050	-80	-80	-80	+70	-50

Source: Enquête Commission, 1990

7. Possible criteria for the allocation of CO₂ emissions reductions between North and South

The allocation of emissions reductions between industrial and developing countries depends on various factors, especially: to what degree should a certain greenhouse gas be reduced in relation to other gases, and what criteria should be applied for the reduction? A comprehensive strategy for reducing all greenhouse gases would probably focus on their relative importance for climate change, including substitution processes, while a partial strategy for one single greenhouse gas would probably focus on possible costs and benefits and on equity considerations.

Model criteria for CO₂ emissions reductions are to be found international environmental agreements: the ECE Convention on Long-Range Transboundary Air Pollution (1979), and the Montreal Protocol (1987).

With the signing of the ECE convention, a small number of ECE countries joined a "30 Percent Club" with regard to the reduction of sulfur dioxide (SO₂). Other ECE countries subsequently joined the club. Decisive for this success in beginning to control acid rain was not only the pressure from damage to the forest ecosystems, the formation of the electorate, and the generation of technical and financial solutions, but also the consensus achieved by the club over a simple allocation criterion: "Every country shall reduce its SO₂ emissions by the same rate of 30 percent!" (This consensus had been reached after an intense discussion on whether the current or accumulated emissions, the size of the country, or its emissions export/import

situation should be taken into account, etc.). In this way, the given departure point was legitimized; prior accomplishments or geographic and other peculiarities were not considered.

Thus, the ECE case exemplifies Allocation Criterion I:

Allocation Criterion I
Same reduction rate for all countries on same base (year ...)

The Montreal Protocol also requires a proportionally equal reduction rate (50 percent at first, 100 percent later), but permits a temporary limited exemption from this rule for the developing countries. The developing countries were relieved from the reduction duties because they judged this to be unfair: it was the industrial countries that had caused the damage to the ozone layer with their accumulated CFC emissions. Thus, the developing countries could not be expected to assume an equal share of the duties. On this line of argument is founded Allocation Criterion II:

Allocation Criterion II
*Same reduction rate for one group of countries (industrial countries),
but exempting the other group (developing countries)
for a certain period of time*

The Montreal Protocol concedes the developing countries a CFC production of up to 0.3 kilogram per capita for ten years, and then requires a reduction to 50 percent. In comparison with CO₂ emissions, the reduction of CFC emissions needs but slight adjustment measures because of oligopolistic production and low initial production levels; not millions of tons but thousands. By contrast, the adjustments necessary for a CO₂ protocol will be much more extensive, since many technologies, products, and economic branches are at stake. The industrial countries may therefore try to bargain their own absolute reduction duties against the relative reduction duties (rate of growth of CO₂ emissions) of the developing countries. Apart from the disparities in current absolute emissions, the developing countries might also point at the historical emissions accumulated in the Earth's atmosphere and their own relatively low CO₂ emissions per capita. The more such arguments (and others) are brought into the political arena, the higher the probability that no common (mutual) reduction formula can be agreed on. This makes a crite-

tion of equal treatment attractive. One that could be accepted as fair by the developing countries is equal CO₂ emissions per capita of population. This is Allocation Criterion III:

Allocation Criterion III

*Every country gets the same emission rights (permits),
resulting from reduced global per capita emissions multiplied
by the country's population (base year ...)*

According to this equity criterion, countries exceeding the fixed limit of emissions per capita (the industrial countries) would have to reduce emissions drastically; countries falling below this limit (the developing countries) could increase emissions. This criterion is geared to fairness, does not legitimize the present emissions situation, and requires huge distributions in the North-South context.

By establishing this criterion, peculiarities like the geographic situation, size of the country, resource endowment, and differences in costs would not be taken into consideration, which, again, might open up corridors for bargaining in the negotiations of the CO₂ protocol.

Applying the Allocation Criteria I to III on the two emissions scenarios presented in Table 4 reveals quite different magnitudes of the reduction duties and, respectively, the resulting redistribution of emission rights between industrial and developing countries (*Table 8*).

Up until now, only CO₂ emissions from *fossil fuels* have been considered in this paper. In their case, *freezing* and *reducing growth rates* seem to be the only issues. However, with CO₂ emissions from *biotic sources*, *phasing out* and a *reversal of trends* (i.e., negative growth rates) come into the picture. To strive for a reduction in emissions only would be too modest in view of a possible net-assimilation of carbon in the biomass. Even the introduction of Allocation Criterion III, mentioned above, does not make sense here, as positive emissions fall very much behind the possibility of negative per capita emissions by enlarging the existing carbon-sinks.

An *additional* criterion might therefore consist in linking the obligation to stop deforestation in the developing countries with the obligation of reforestation in the developing countries. Another possibility consists in a striking direct link with the right to CO₂ emissions from fossil sources: *biotic* emissions (resulting from slash-and burn agriculture, deforestation,

changes in land use) reduce the right to per capita emissions of CO₂ from fossil sources, and *vice versa*; reforestation increases it.

Table 8. Allocation of CO₂ emissions reductions: fossil fuels, industrial and developing countries: two scenarios, three allocation criteria

	Global emissions bn tons	Industrial countries bn tons	percent	Developing countries bn tons	percent
Scenario A: "Reduction Scenario"; EPA, 1989					
Departure year 1982	17.4	12.6	72.4	4.8	27.6
Target 2100	12.2				
Allocation according to					
- Criterion I		8.8	72.4	3.4	27.6
- Criterion II		6.9	56.5	5.3	43.5
- Criterion III		3.1	25.3	9.1	74.7
Scenario B: "Growth Scenario"; Mintzer, 1987					
Departure year 1982	17.4	12.6	72.4	4.8	27.6
Target 2100	34.6				
Allocation according to					
- Criterion I		25.1	72.4	9.5	27.6
- Criterion II		19.0	54.9	15.6	45.1
- Criterion III		8.7	25.3	25.9	74.7

There is yet *another* allocation criterion which might come into prominence in the process of negotiating the CO₂ protocol, i.e., an *age criterion* (see Grubb 1989). As the population structure of the developing countries differs widely from that of the industrial countries, an equal per capita emission right might prove ecologically counterproductive, i.e., giving an incentive to keep a high rate of population growth. Therefore, the industrial countries might tend to introduce a minimum age criterion, with which their CO₂ reduction duties could be reduced or their per capita emissions be increased. However, if age were to be considered in a CO₂ protocol between North and South, there would be dramatic consequences for all concerned. When fewer people are counted, per capita emissions will be higher. For nations with a comparatively high ratio of adults, such an allocation would provide a significant advantage over nations with a larger proportion of children who would not count, etc.

To summarize, questions of equity are questions of power. The problem of climate change is so complex that debates on allocation may be perpetuated. Therefore, it seems to me that a guiding criterion has to be postulated which should be as simple as possible and, at the same time, fair and generally convincing. The respective options have been presented above. Some of them seem easier to implement than others. But how do we get from here to there?

8. From here to there: confrontation or cooperation?

With regard to global environmental problems, Peter M. Haas formulated a theory of "epistemic consensus" (Haas 1990). According to his (and my) view, substantial changes have occurred in the process of negotiating international agreements. This evolution of competence in environmental policy can be understood as a collective learning process, an evolution that might refute Hardin's thesis of the "*tragedy of the commons*" (Hardin 1968).

Within this process, *epistemic communities* have formed transnational networks that are politically relevant because of their authoritative knowledge. If such networks develop, and if they acquire and maintain access to policy makers, global conventions and protocols might have an "efficiency guarantee". *Common interests* per se (upon which the Brandt report [1980] was based), the notion of *sustainable development* (Brundtland Report 1987), or *responsibility for the future* (Nyerere Report 1990) alone may not sufficiently enlarge the chances for international cooperation. Cooperation depends also upon the consensus within the epistemic community and that consensus can be strengthened through improved and intensified cooperation among the community members.

This theory, it seems, has been verified by the Montreal process: political action was prompted by an ecological crisis (damage to the ozone layer); international experts established the scope of political alternatives, then negotiated by diplomats; and when the members of this *community* had consolidated their position with the national governments, the latter supported the agreements.

Whether this theory will hold true for the anthropogenic greenhouse effect, and can be verified by the formulation and implementation of a CO₂ agreement - the "*Houston Protocol*" - remains to be seen. While a loosely

cohering *epistemic community* does exist, the internal consensus is not (at least not yet) as strong as in the ozone case. There is even a rift within the *climate change community*: there are *preventionists*, pleading for precaution and immediate action in order to avoid or at least confine climate change, and there are the *adaptationists*, arguing for slow and gradual adaptation to a climate change which cannot be avoided anyway.

There is also a basic rift between ethics and praxis. From an ideal ethical perspective, each person on Earth should have equal emission rights. But this would be revolutionary! It would imply that the industrial North would have to reduce its excessive consumption in favor of the poor South. How likely is it, in such a case, that such radical principles and norms would be established as international law? How many conferences, how many books on ethics and environmental policy will be needed to get that message over - and widely accepted? Only a professional optimist could answer such questions without hesitation. But the issues are too urgent, and history too unpredictable, to warrant despair. We need not be shallow optimists to continue, within the crucial *epistemic community and beyond*, to speak out on behalf of wider popular understanding and a more virtuous public will. It is in this way that a "CO₂ protocol" may become reality - be it in Houston or elsewhere.

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