COP-15 and the ethics of climate change[1]

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Abstract:

The paper makes an effort to incorporate the sustainability criterion into the UNFCCC *common but differentiated responsibilities* ethical platform. Three fundamental principles of justice arise therein: historical responsibility, present capacity and sustainability. Any attempt to determine responsibility towards climate change mitigation must consider these criteria. In order to operationalize their assessment a synthetic *responsibility index* is calculated for 177 countries. This in a necessary tool for the policy design effort that will be carried out during COP-15 and subsequent Conferences of Parties. It provides an objective method for distributing responsibilities. But the authors see no possibility that an effective agreement can be achieved among almost 200 nations without a previous compromise among the twenty highly responsible parties that accounted for 85,7% of 2004 emissions. Luckily, this group coincides almost perfectly with the existing political group that tends to become the most important locus of world governance, the G20.

Resumo:

O artigo busca incorporar o critério ético da sustentabilidade à premissa de *responsabilidades comuns porém diferenciadas* da UNFCCC. Disso resultam três princípios de justiça: responsabilidade histórica, capacidade presente e sustentabilidade. Qualquer tentativa de determinação da responsabilidade para com a mitigação das mudanças climáticas deve considerar esses critérios. Com vistas a operacionalizar a análise dos citados princípios é calculado um *índice sintético de responsabilidade* para 177 países. Essa é uma ferramenta necessária para o esforço de *design* de políticas públicas que será levado a cabo durante a COP-15 e subsequentes Convenções das Partes, pois provê um método objetivo de distribuição das responsabilidades. Mas os autores não vêem a possibilidade de que um efetivo acordo possa ser realizado entre quase 200 nações se não houver um compromisso prévio entre os vinte países altamente responsáveis (incluída a União Européia) que responderam por 85,7% das emissões de 2004. Afortunadamente, esse grupo coincide quase perfeitamente com o grupo político já existente que tende a se tornar o lócus principal da governança mundial, o G20.

Keywords: COP-15, climate change, ethics.

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1. Introduction

If one lesson has been learned since the third Conference of Parties (COP-3) to the United Nations Framework Convention on Climate Change (UNFCCC), when the Kyoto protocol was designed, it is that no effective commitment can be achieved when a group of nearly two hundred countries negotiates an agreement to which only a much smaller number can actually contribute. That is the basic reason why the success of the post-2012 climate change institutions depends heavily on a common understanding, before December 2009, among the small group of highly responsible countries.

This paper departs from the assumption that any consideration of responsibility should be made on a national rather than on a *per-capita* basis. There are many reason for this. By definition, individual responsibility does not allow one party to be responsible for the actions of another, either from the same or from a past generation. Therefore, a *per-capita* perspective does not allow responsibility to be attributed to the actions of past generations, while a national perspective does. Furthermore, individual based negotiations are not politically executable – the UNFCCC parties are nations, not individuals – nor technically possible – national (let alone international) personal emission distributions are unknown, so any attempt to derive descriptive statistics will be flawed –. A national assessment of responsibility for climate change mitigation is thence the most acceptable approach.

Facing the conflicts of interest that tend to block the international negotiations for an effective agreement on global warming mitigation will require three fundamental ethical issues to be dealt with. They are related to the past, present and future: (1) historical responsibility, (2) present capacity and (3) sustainability (GARVEY, 2008). In case the implications of privileging one of these criteria are not clear enough before COP-15, the risk of repeating what happened in Kyoto will be high: that the common denominator among all the Climate Convention nations' interests hardly fulfills the challenge of sustainability. It is thereby necessary to think about a previous agreement among the “key-nations” that shall be sufficiently persuasive to be accepted by all the others. Hence, one of the basic questions that arise is: which countries are those?

Most of the climate change-related economic literature so far has focused on determining how much, when and how to invest in global warming mitigation and adaptation. While the foundations for the study of these problems are now fairly developed, as can be inferred from the amount of theory that is synthesized in the Stern Review on climate change, the critical debate of who should take the lead in abating greenhouse gas (GHG) emissions down to an ecologically safe level still remains unresolved.

Based on the above stated ethical criteria, this paper tries to point out which nations should be part of a leading climate coalition. Using the most recent data available for all UN countries, historical responsibility is measured by estimates of accumulated emissions, capacity by an indicator of potential for low-carbon technological innovation and sustainability by present CO2 emissions. After that, an attempt is made to synthesize those criteria into a single indicator.

In terms of historical responsibility, a rather small group holds most of the burden for past emissions – only twelve countries are liable for 82,2% of the accumulated emissions before 1990. But their current share (2005) of GHG world emissions is only 65,2%. Shifting to the capacity criterion, twenty-five countries are considered highly prepared to tackle climate change, those developed nations

where there are good conditions for technological advances: specialized human capital, available financial resources and technical dominance. However, even if the group of technological leaders agrees on a strong mitigation strategy, mere 39% of current emissions will be affected, as major emitters such as China and Russia are not part of that group.

Although sustainability of the climate system is the target of the international agreement to be sewn up, for it relates to the future of humankind, and it does point out to a clear group of key-nations, the authors perceive no signal that such a consensus can possibly be constructed before COP-15. Past and present considerations are ethically defendable and will be used by non-historically responsible and less technologically developed countries to restrain commitment. Therefore, because of pure realism, attention is given to the elaboration of a synthetic indicator for the assessment of the three ethical concerns at once, in despite of the many controversies that may arise about the procedures adopted.

The paper contains four sessions after this introduction. Chapter two presents a brief update of the empirical evidence related to the climate challenge, building the case for a much stronger institutional arrangement in the post-Kyoto phase. Chapter three contextualizes the ethical debate that surrounds the issues of climate justice and responsibility, and depicts each of its three fundamental ethical principles. A detailed analysis of the most recent data on emissions is carried out to study the consequences of privileging any single criterion. The fourth session calculates a synthetic responsibility index that operationalizes the ethical assessment of climate change for 177 nations, and compares it to a similar attempt by BAER *et. al.* (2008). Chapter five contains the concluding remarks.

2. The post-Kyoto challenge

The temperature increase deemed acceptable by most scientists, based on potential damages estimates, is of 2 ºC relative to pre-industrial era. This means that the GHG concentration should not overcome the limit of 450 ppm CO2e, as argued by the last IPCC's report. But that concentration was already close to 430 ppm CO2e by 2008, subject to a growth rate of more than 2 ppm per year (STERN, 2008). It then turns out, according to Stern's reading, that remaining below the 450 ppm threshold would require the introduction of expensive technologies before their maturity, so to peak emissions within the next few years, which would be inappropriately expensive. A limit of 500 ppm would then be the correct target, level for which the average temperature may increase from 2.4 to 2.8 ºC, according to IPCC's estimates. Considering that total emissions are currently of the order of 50 Gt CO2e (UNDP, 2007), the achievement of the target proposed by Stern would require emissions to peak in 2012 and to decrease to around 20 Gt CO2e per year by 2050, or less than half today's level.

The analysis of the results obtained by more than ten years of UNFCCC's negotiations may help to comprehend the meaning of that homeric challenge. Comparing the reduction targets established for 2012 by thirty-eight Annex 1 countries to the situation in 2006, it is possible to identify a group of eighteen nations that will almost certainly accomplish or more than accomplish the target, representing 47.8% of the group's total emissions in 2006; five countries responsible for 13.1% of the emissions that will not accomplish the goals and that have emitted, in 2006, an average of 29.4% above their 2012 target; and fifteen countries, responsible for a 39.1% share of emissions, that may accomplish the target, some with serious difficulty such as Italy and Japan.

TABLE 1

Total aggregate anthropogenic emissions of CO2, CH4, N2O, HFCs, PFCs and SF6 excluding emissions / removals from land use, land use change and forestry – Kyoto target, variation from 1990 to 2006, emissions in 2006 relative to 2012 target and share of Kyoto ratifiers' emissions in 2006 – Kyoto ratifiers and non-ratifiers

Countries	Kyoto target 1990 to 2012	Variation 1990 to 2006	Emissions in 2006 relative to 2012 target	Share of Kyoto ratifiers' emissions 2006
Kyoto ratifiers	**-4,3%**	**-15,4%**	**88,5%**	**100,0%**
Countries that will fulfill the target[1]	-2,5%	-31,0%	70,7%	47,8%
Countries that will not fulfill the target[2]	-1,3%	27,8%	129,4%	13,1%
Countries that may fulfill the target[3]	-8,4%	1,4%	110,7%	39,1%
Non-Kyoto ratifiers	_	**16,6%**	_	**68,9%**
Turkey	_	95,1%	_	3,1%
United States	_	14,4%	_	65,8%
TOTAL ANNEX 1	_	**-4,7%**	_	**168,9%**

1 – Russia, United Kingdom, France, Ukraine, Poland, Romania, Czech Republic, Greece, Belarus, Hungary, Bulgaria, Sweden, Slovakia, Croatia, Lithuania, Estonia, Latvia and Monaco.

2 – Canada, Spain, Austria, Denmark and New Zealand.

3 – Japan, Germany, Italy, Australia, Netherlands, Belgium, Portugal, Finland, Ireland, Norway, Switzerland, Slovenia, Luxembourg, Iceland and Liechtenstein.

Source: United Nations Framework Convention on Climate Change (UNFCCC).

Even with a non-negligible number of countries risking to emit more than the target, if the Kyoto Protocol would have ended in 2006, the goals would have been more than accomplished, as there was an average 15.4% reduction in emissions up to that year for the thirty-eight signatories (the global target for 2012 is of 4.3%). Which only allows to conclude that excessively low targets were determined, basically due to (i) having been formulated eighteen years prior to the actual reduction period (base year was 1990, first reduction year was 2008), therefore imposing a high error component to the magnitude of the effort required; and (ii) to having taken part of the negotiations more than a hundred countries that, in practice, could contribute very marginally to the objectives, as they emit irrelevant amounts of GHG. The first difficulty will be minimized in COP-15, as currently data on emissions is made available with a much shorter lag. But the second problem will require that the nations with relevant emissions produce an agreement before the global negotiations in December 2009.

The scenario is very different when the whole of Annex 1 is taken into account, *i.e.*, Turkey and United States included, as only these two countries represent more than two thirds of the total emissions from the Kyoto Protocol signatories. Turkey roughly doubled emissions from 1990 to 2006, while in the U.S. they increased by 14.4%, making the emission reductions for the group as whole to have been of only 4.7% on that period. Once Annex 1 represents 40% of global emissions, that figure represented only a 1.88% decrease in global terms, and was more than toped by the increase in Chinese (78% from 1990 to 2004, for CO2 only) or Indian emissions (59.9%). Total emissions increased by

27% between 1990 and 2004.

Albeit the eight meetings and almost ten years that were consumed by the process that culminated in the Kyoto Protocol, UNFCCC's goal of "to achieve stabilization of greenhouse gas concentrations in the atmosphere at a low enough level to prevent dangerous anthropogenic interference with the climate system" (UN, 1992: 4) remains far from being accomplished. If the agreement that will prevail for the post-Kyoto regime repeats the sequence of shy results that were characteristic of the previous fourteen COP meetings, the risks of human species facing costly socio-environmental catastrophes in the coming decades will be very high.

3. Past, present and future: the ethics of responsibility

The debate unchained by UNFCCC was entirely dominated by two of the three fundamental principles of justice that ought to be respected in the construction of an international regime meant to mitigate global warming (GARVEY, 2008). One was relative to the past and another to the present, but none to the future. According to this, the Kyoto Protocol established that the participation of each country had to correspond to its historical responsibility, and that the national goals were to be proportional to their respective capacities. In other words, the ones who started polluting should start cleaning and those who are more able have to do more. Unfortunately, the third premise remained untouched, that which refers to the unborn generations: sustainability.

The principle of *common responsibility*, a major ethical advance that recognizes the shared heritage of mankind, has pervaded international agreements since the 1950's, when *common concern* started being attributed to matters as different as tuna and other fish, outer space and the moon, natural and cultural heritage and waterfowl. A later development on that recognition was the idea that a *differentiated responsibility* applies to action towards the preservation of the commons, as financial, human and technological capacities vary greatly in accordance with the degree of development of each nation. Such principle was already present at the 1972 Stockholm declaration, which emphasized "the applicability of standards which are valid for the most advanced countries but which may be inappropriate and of unwarranted social costs for the developing countries" (CISDL, 2002), and more explicitly at the London convention on prevention of marine pollution, later that year, which required measures to be adopted by parties "according to scientific, technical and economic capabilities" (idem).

The principles of *common* and *differentiated* responsibilities were put together in different ways in a sequence of international agreements throughout the 1980's (*e.g.*: 1987 Montreal Protocol, 1988 European Community Large Combustion Directive), and were finally stated as *common but differentiated responsibility* at the Rio-92 convention and later on at the UNFCCC. The resulting idea recognizes that despite the common responsibilities, differences in the historical contributions to environmental problems and in economic and technical capacities to tackle these problems should lead to important distinctions in the stated responsibilities of developed and developing countries (idem).

> "1. The Parties should protect the climate system for the benefit of present and future generations of humankind, on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities. Accordingly, the developed country Parties should take

the lead in combating climate change and the adverse effects thereof.

2. The specific needs and special circumstances of developing country Parties, especially those that are particularly vulnerable to the adverse effects of climate change, and of those Parties, especially developing country Parties, that would have to bear a disproportionate or abnormal burden under the Convention, should be given full consideration." (UN, 1992: 4).

The scientific evidence related to climate change was weak enough by 1990 for the first IPCC report to deliver no clear message that global warming could eventually become a drastic constraint to development. Without a strong case for deep emission cuts, it is understandable that the UNFCCC signatories did not bother about assuring a sustainable level of emissions for the coming generations, restraining themselves to the guarantee that no country would be unfairly burdened by too strong mitigation obligations. But this omission will have to be recognized and eliminated from the post-Kyoto regime, as no climate stability shall be achieved without the decisive participation of the group of countries who have negligible historical responsibility, very low technological capacity but a high share of current world GHG emissions. The consequences of failing to make such recognition are studied below by using indicators that allow to evaluate each one of the three ethical criteria – historical CO2 emissions, technological capacity and CO2 emissions in 1990 and 2004. As a final result, a synthetic index is calculated, in chapter three, that helps to assess the three ethical criteria at once.

3.1 Past

The claim that current generations should bear responsibility for the emissions of earlier generations (and the principle underlying the Brazilian Proposal) has been subjected to criticism on the grounds that (a) earlier generations were excusably ignorant of the harmful nature of their emissions (the problem of excusable ignorance), and (b) people should not be held responsible for decisions that others took and hence current generations should not be held liable for the decisions of earlier generations (the problem of past generations) (CANEY, 2005).

It is fair to say that any ethical consideration of long term environmental issues must take sustainability as a primary concern, for nothing can be more important than avoiding unnecessary damages to future generations. Past ecosystem depletion has already been done, and the debate on who should pay the present costs of those damages is important, but secondary to the avoidance of new harm. That is why the solution to *polluters pay* versus *beneficiaries pay* must first be a solution to *future generations don't pay.*

Mitigating global warming down to the 2 Celsius target is therefore the resulting policy objective of the most important ethical consideration. But who will pay for the costs of bringing emissions down to a safe level? Someone will have to, and it would be unfair to make those who have polluted less pay the most. Gases currently in the atmosphere have been emitted by the most industrialized nations (*i.e.*, United Kingdom, USA, Germany, etc), and they have derived a good standard of living out of that. The *non-identity problem* stated by Derek PARFIT (1986, *apud* CANEY, 2005) sounds very odd, as it basically states that no one is responsible for the CO2 emissions done by past generations, because the imaginative world in which they would have avoided emitting wouldn't have given birth to the actual present generations, but to some other imaginative present generation. In that case, it should be asked,

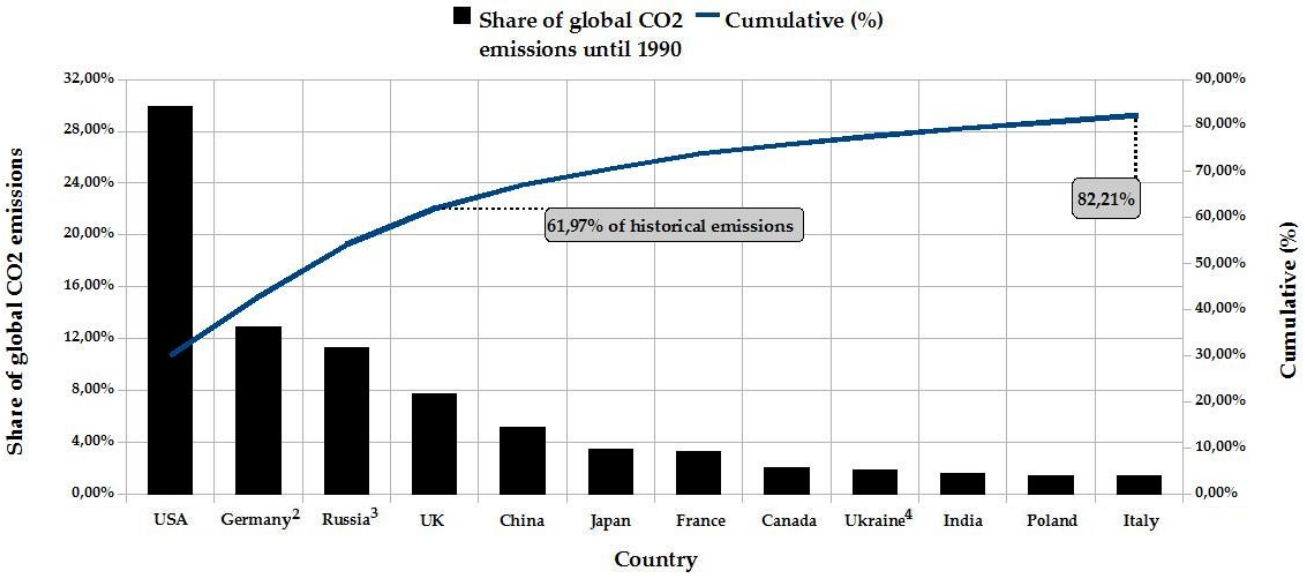
who would bear the costs of the necessary mitigation of CO2 emissions if every present generation, be it from Britain or from Bolivia, is different from that other imaginative present generation?

The fact that there was ignorance about the effects of polluting the atmosphere doesn't indulge humanity from cutting emissions. And thus the question remains the same: who should bear the costs? Think about an industry that uses some new type of chemical and disposes it into a river. The contaminated water generates cancer, but nobody knows it, even scientists. Once information about those damages slowly becomes available, who is responsible for paying the costs of clearing the river? The most acceptable response is that, if anyone, the company who has made profits out of the disposal should be burdened, even if it did not know and the managers and shareholders who took the decision are already dead. Otherwise someone else would have to pay, and that would be totally unfair.

FIGURE 1

Estimates of historical responsibility for CO2 emissions

Fussil-fuel burning, cement manufacture and gas flaring - 12 biggest historical[1] emitters



1 – Starting dates are based on the period when coal started being used in large scale: USA (1800), Germany (1792), Russia (1830), UK (1750), China (1899), Japan (1868), France (1802), Canada (1785), Ukraine (1830), India (1858), Poland (1800) and Italy (1860).
2 – Includes former German Democratic Republic and Federal Republic of Germany.
3 – Includes a 85,74% share of USSR emissions (equal to the 2004 share of all the former Soviet States but Ukraine in CIS – Commonwealth of Independent States – emissions).
4 – Includes a 14,26% share of USSR emissions (equal to the 2004 share in CIS – Commonwealth of Independent States – emissions).
Source: Carbon Information Analysis Center (CDIAC).

In order to assess historical responsibility, cumulative emissions have been estimated until 1990 for the group of countries that, following historical records, had a relevant contribution, since the late 18th Century, for the accumulation of anthropogenic CO2 in the atmosphere. These estimates, although

inaccurate, don't leave doubts about the applicability of the ethical principle of responsibility for the past. But they are not sufficient to determine who should take action, as the distribution of emissions changed a lot in the last two decades. From the process of ascension of the semi-periphery, since the 1970's, and from the elevated amount of emissions due to forest clearing and burning in some countries, resulted the incorporation of countries such as Indonesia, Brazil, Mexico and South Africa to the group of big emitters.

FIGURE 1 shows the percentage of historical CO2 emissions estimated by the Carbon Information Analysis Center (CDIAC) for the twelve biggest emitters until 1990. If just the criterion of historical responsibility were to be taken into account, no more than twelve countries should commit to global warming mitigation, as they where responsible for around 82,21% of emissions up to 1990. But such an arrangement would reach less than two thirds of current emissions, which would make it totally ineffective. Furthermore, a much higher number of countries has the technological capacity to lead the effort of transition to a low carbon economy.

3.2 Present

The country distribution of the capacity to create, diffuse and apply technology is highly concentrated, reason why only a selected group of nations can be called developed. The dominance of this valuable asset relies basically on three factors: (a) technology creation, which is directly related to the existence of a *national innovation system* capable of articulating high level scientific production with the development of new products and processes; (b) adequate technological infra-structures; and (c) human capital (ARCHIBUGI & COCO, 2004). Those countries that managed to build, along the 20th Century, institutions able to supply an elevated level of these three factors are currently much more prepared for the effort of global warming mitigation.

Many metrics have been adopted for measuring the level of technological capacity. The most important ones are the Technological Achievement Index (TAI), from UNDP (2007), the Industrial Development Scoreboard, from United Nations Industrial Development Organization (UNIDO, 2009) and the Technological Index from World Economic Forum (WEF, 2006). The best indicator of technological capacity currently available merges TAI and the Industrial Development Scoreboard and adapts them for maximum coverage (pool of 162 countries) and for the possibility of inter-temporal comparisons. It is called ArCo index (ARCHIBUGI & COCO, 2004) and uses eight indicators that are grouped as follows:

(a) **technology creation.** Indicators: patents and scientific articles.
(b) **Technological infra-structure.** Indicators: internet penetration, telephone penetration and electricity consumption.
(c) **Human capital**. Indicators: tertiary science and engineering enrollment, mean years of schooling and literacy rate.

The ArCo index is calculated as a simple average of the indexes of each one of the three categories (Ia, Ib e Ic), which are, by their turn, obtained through the simple average of the indicators that compose them. The first twenty-five countries were categorized by the authors as *technological leaders* (Finland, USA, Germany, New Zealand and others), the next twenty-five as *potential leaders*

(Russia, Portugal, Argentina and others), the following sixty-one *latecomers* (Brazil, China, India, Iran, Indonesia and others) and the last fifty-one *marginalized* (Nigeria, Pakistan and others). In a more recent paper, CASTELLACCI & ARCHIBUGI (2008) applied cluster analysis techniques to determine the *technology clubs* existing in the world, and based on the ArCo index, they arrived to only three groups: *advanced*, *followers* and *marginalized*. The first of them being composed of twenty-one countries.

Independently of being twenty-one or twenty-five the technological leaders, they are responsible for slightly more than one third of world emissions, a percentage that tends to decrease in the coming years. When those twelve countries that concentrate nearly all the historical responsibility are added, a still low (and rapidly declining) percentage of 71,8% is obtained (GHG emissions in 2005), as big emitters such as Brazil, Indonesia, Nigeria and others continue outside the list. Which leads to the conclusion that the two ethical criteria accepted so far at UNFCCC negotiations are insufficient for the ethical principle of sustainability, the most important of the relevant justice criteria, to be respected.

3.3 Future

In the analysis of chapter 2 the six so called Kyoto gases (CO2, methane, nitrous oxide, PFCs, SF6 and HFCs) were considered, for which there is information available in what regards Annex 1 countries, for the year 2006. As for all the other countries, there are data relative to the emissions of those gases for 1994, produced by each member of UNFCCC for a report, and for 2005, from estimates made by the Environmental Protection Agency (EPA – USA) and put together by the World Resources Institute (CAIT, 2009). Emissions from CO2 only are estimated more systematically and were made available by CDIAC for 2004 (UNDP, 2007).

In average, CO2 emissions represented, in 2004, 77% of total anthropic GHG emissions (IPCC, 2007: 3), with the percentage varying for each country according to its economic structure. At the broad level, given the similarity of the distributions[2] and the fact that CO2 has been practically the only responsible for the growth in emissions, there are not big problems in using CO2 as a proxy for GHG emissions. This is an advantageous procedure because it allows for comparisons with the estimates by CDIAC (only CO2) of the accumulated historical emissions.

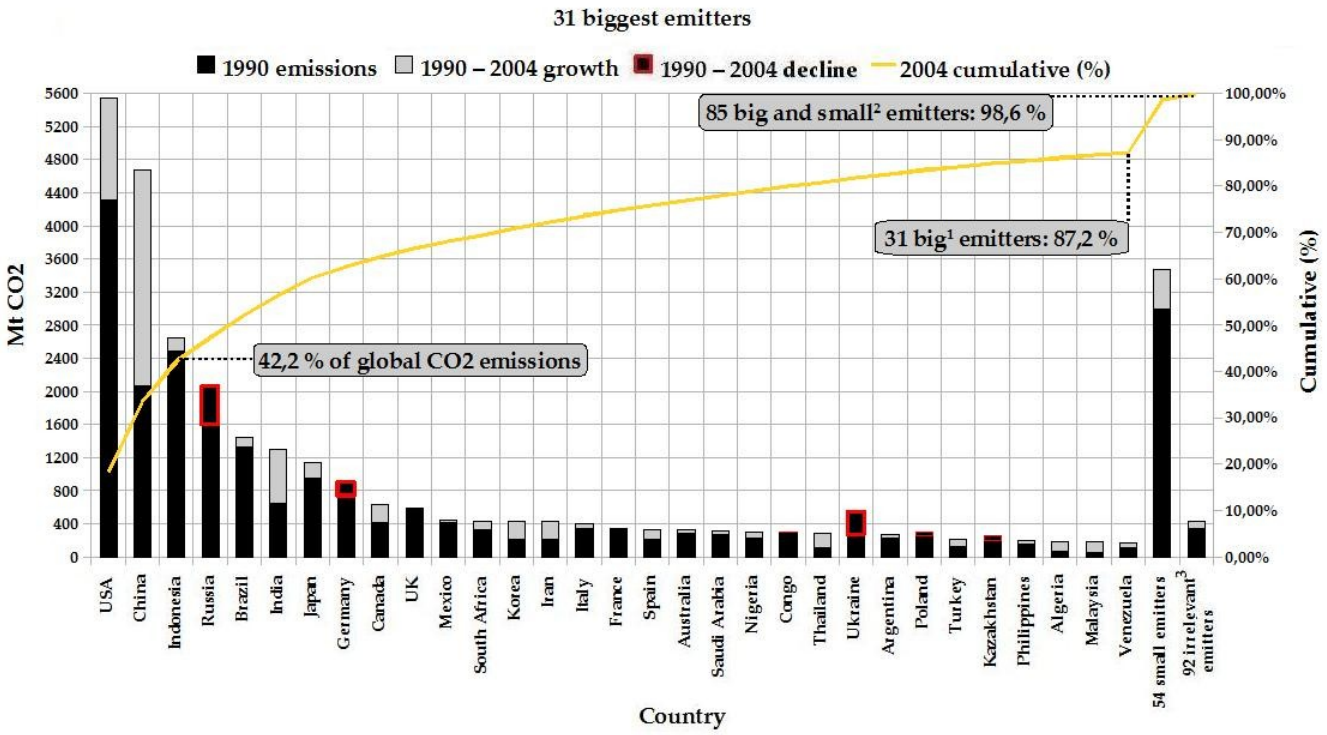
As can be observed in FIGURE 2, the distribution of CO2 emissions per country became less concentrated in the last two decades, as many were incorporated into what can be called the group of big emitters. In 2004, thirty-one nations emitted more than the average of the 177 considered by UNDP (172 Mt CO2). Germany and the United Kingdom, third and fourth biggest historical emitters, were only the eighth and tenth biggest emitters in 2004, while Indonesia, Brazil and India were already part of the six biggest emitters.

The reordaining of countries in terms of CO2 emissions was directly related to the process of historical dissemination of the second industrial revolution's technological pattern, which incorporated millions of individuals into consumption based in fossil energy (*e.g.*, automobiles) and consequently, induced many nations to develop a very carbon-intense productive structure. The list of those who should take action in mitigating global warming is therefore considerably different if only the ethical criterion of sustainability is considered. For in that case, those emitting more in the present and those

2 The difference between the percentage of emissions for any group of countries is not higher than 1.5 points.

with the higher perspectives of increasing future emissions will have to lead action.

FIGURE 2
CO2 emissions per country (1990 and 2004) and cumulative (2004)



1 – Emitted more than the average of the complete series (172 Mt).
2 – Countries who emitted less than the average of the complete series (172 Mt), except for the inferior outliers.
3 – Countries whose emissions lie bellow the median of the distribution (22 Mt). As a group, they represent 1.4% of total emissions.
Source: UNDP (2007).

Such reality fits very well into a three party distribution, in which big emitters are distinguished from small and irrelevant ones. The curve of accumulated emissions confirms this logic: the first group controls 87.2% of the CO2 discharge into the atmosphere; the following fifty-two low emitting nations respond for only 11.4%; and the last ninety-two countries emit the irrelevant amount of 1.4%.

Six high emitting countries actually diminished emissions from 1990 to 2004 (five are former soviet republics). They are an absolute minority in the group of big emitters, which had an average 27% increase in fourteen years, but also in the other two groups of nations. Thirty-one big emitters were responsible for a very similar share of total emissions in 1990 and in 2004, of around 87%. As the other 146 low and irrelevant emitting nations also roughly maintained the same share of global emissions in the period (of around 13%), they had to increase emissions in a very similar rate (23.2%) to the big emitters. Which produced a global 27% increase in emissions, albeit the efforts from UNFCCC.

It is easy to conclude that the very weak performance obtained so far by the attempts to control GHG emissions cannot be repeated if climate stability is to be achieved. With emissions at the level of 50 Gt CO2e, a 27% growth in fourteen years would mean something like 63.5 Gt CO2e being released into the atmosphere every year by 2023, the very contrary of the proposal currently acceptable, of a peak in 2012 and 20 Gt CO2e by 2050. For such a dangerous scenario to be avoided, the ethical premise of diachronic responsibility towards future generations should be at the center of the debate. And that will require participation from those twelve countries[3] that have little historical responsibility and low technological capacity but are responsible for nearly one fourth of current CO2 emissions.

4. Who should take action?

For the primacy of sustainability to be synchronized to the necessary consideration of the other two ethical criteria, a synthetic index has been calculated that hierarchizes countries in terms of responsibility toward the next climate agreement. The *responsibility index* of country *i* is given by equations (1) and (2), where a simple average is obtained from the percentages of total historical emissions and of total 2004 emissions, which is then multiplied by the ArCo index (giving *R(i)*), normalized and multiplied by 100 (giving *RI(i)*). What is obtained is and index whose sum for the 177 countries equals 100 and that consequently can be interpreted as a percentage of responsibility.

(1) $$R(i)=\left(\frac{\frac{Emissions\ until\ 1990_i}{Total\ Emissions\ until\ 1990}+\frac{Emissions\ 2004_i}{Total\ Emissions\ 2004}}{2}\right)\times ArCo_i$$

(2) $$RI(i)=\frac{R(i)}{\sum_1^{177} R_{(i)}}\times 100$$

Albeit the well known deficiencies of such a synthesis procedure, there is no simpler way of concretely expressing, at once, the three fundamental requisites for a climate agreement. The final result, presented in TABLE 1 for the twenty parties with highest indexes (including the European Union), gives hints of the magnitude of the responsibility that should be attributed to each nation. It is notorious that the United States and the European Union alone are supposed to accept a level of compromise much superior to all the rest of the world together, as their indexes amount to 61% of the responsibility. The other eighteen countries that belong to the G20 compose a second group of highly responsibly countries, while all the rest of the world is liable for only 5% of the responsibility for climate change mitigation[4].

3 Indonesia, Brazil, South Africa, Mexico, Iran, Argentina, Saudi Arabia, Thailand, Venezuela, Turkey, Romania and Czech Republic.

4 An important development to be made out of this work is a projection of the responsibility index into the future. It is expected that the developed world (United States, European Union, Japan, Canada and others) will have a sharp decrease in responsibility, as their shares of current emissions are replaced by the semi-periphery (BRICs and others), who by their turn will face rapid increasing responsibility. The assessment of the expected evolution of the responsibility

TABLE 2

Calculated responsibility index (RI), cumulative 2004 emissions and G20 participation – 20 highest ranked*

	Country	Responsibility Index (RI)	Cumulative RI	Cumulative 2004 emissions	G20?
1	**United States**	34,01	34,01	18,20%	Yes
2	**European Union[1] (27)**	27,07	61,07	29,88%	Yes
3	**Russia[2]**	7,50	68,57	35,12%	Yes
4	**China**	5,92	74,50	50,45%	Yes
5	**Japan**	4,94	79,43	54,18%	Yes
6	**Canada**	2,91	82,34	56,28%	Yes
7	**Indonesia**	2,26	84,60	64,97%	Yes
8	**Brazil**	1,65	86,26	69,71%	Yes
9	**Australia**	1,30	87,56	70,78%	Yes
10	**India**	1,24	88,80	75,05%	Yes
11	**Ukraine[3]**	1,09	89,88	75,93%	Yes
12	**South Korea[4]**	1,03	90,92	77,35%	No
13	**South Africa**	0,88	91,79	78,79%	Yes
14	**Mexico**	0,76	92,56	80,22%	Yes
15	**Iran**	0,56	93,12	81,64%	No
16	**Argentina**	0,53	93,64	82,50%	Yes
17	**Saudi Arabia**	0,44	94,08	83,55%	Yes
18	**Thailand**	0,34	94,42	84,48%	No
19	**Venezuela**	0,33	94,75	85,05%	No
20	**Turkey**	0,32	95,07	85,73%	Yes
21	**Others**	4,93	100,00	100,00%	No

* Complete dataset in TABLE A-1.
1 – Includes former German Democratic Republic, Federal Republic of Germany and Czechoslovakia.
2 – Includes a 85,74% share of USSR emissions (equal to the 2004 share of all the former Soviet States but Ukraine in CIS – Commonwealth of Independent States – emissions).
3 – Includes a 14,26% share of USSR emissions (equal to the 2004 share in CIS – Commonwealth of Independent States – emissions).
4 – Includes a 94% share of United Korean emissions (equal to the 2004 share in South Korean + North Korean emissions).

4.1 – The Greenhouse Gas Development Rights Framework (GDRs)

An earlier attempt to develop a responsibility index has been made by BAER *et. al.* (2008), who

index should be an important tool for decision-makers who will establish mitigation goals for the coming decades.

intended to operationalize the UNFCCC's mandate for *common but differentiated responsibilities*. Two principles were assessed: responsibility and capacity. Based on the idea that the funds needed for investment in mitigation and adaptation will have to be made available by countries according to their financial possibilities, they defined capacity as income above a *development threshold*.

The capacity of a country was therefore assumed to be proportional to the sum of all individual incomes that exceed a minimum level, equal to a figure modestly higher than a global poverty line ($ 7.500,00 per person per year - PPP). The responsibility criterion was likewise set to be equal to the sum of individual emissions from 1990 onwards above a *development threshold*. Because the national emissions distributions are not available, they had to assume them to be exactly equivalent to the income distribution, but no further explanation was provided as to how it was implemented and how much was the individual emissions threshold.

The responsibility index was then calculated as a simple average between the share of emissions from 1990 onwards and the share of global financial capacity. Results were projected for 2010, 2020 and 2030, and lead to the conclusion that responsibility will rapidly migrate from the USA (whose index decreases from 33,1% in 2010 to 25,4% in 2030), and the European Union (25,7% to 19,6%) to China (from 5,5% to 15,3%) and India (0,48% to 2,34%). For a few important countries the responsibility figures estimated by BAER *et. al.* (2008) for 2010 were very similar to the index obtained by us. This is true for the USA, China, Brazil and the European Union, who accounted for 50% of 2004's emissions. So it is fair to say that the GDRs framework arrives to roughly the same conclusions (although for the wrong reasons) as when the three fundamental ethical criteria are considered. For most of the other nations, however, the GDRs approach underestimated the responsibility of high emitting countries: Russia, India, Indonesia and Ukraine, who together emitted 19% of the total in 2004, were attributed only a 4,77% responsibility (our figure is instead of 12,1%), which was estimated to increase to bare 6,18% by 2030.

The reason for these results is that poor countries with an unequal income distribution tend to score very low both in capacity and responsibility, as most of their population have incomes below the development threshold. Such a procedure is subject to an important shortcoming. The fact that a high emitting poor country (India, for instance) will discharge a large amount of extra emissions into the atmosphere in the coming decades will not proportionally increase its responsibility, because the emissions distribution is assumed to be fixed at the 2007 level. At the same time, countries with decreasing emissions and a less concentrated income distribution (USA, for example) will be penalized in both criteria.

The consideration of a development threshold is a valuable achievement of BAER *et. al.* (2008), yet they failed both in accounting for technological capacity, which is arguably a better indicator of capacity for climate action than available income, and in considering the principle of responsibility towards future generations. As discussed in chapter three, no effective climate policy shall be achieved if sustainability is not explicitly accounted for.

4.2 – Policy and political implications of the responsibility assessment

A responsibility index is a necessary and objective tool to guide climate policy design (BAER *et. al.,* 2008). Suppose that a cap-and-auction system be implemented worldwide after 2012. How would the national caps be determined? First a global emission trajectory would have to be set, according to

the estimates presented in chapter 2. The difference between the business-as-usual scenario and the agreed-upon trajectory (actual reduction) would have to be distributed in line with each country's percentage of responsibility. According to TABLE 1, the USA alone would have to generate 34,01% of the global emission reduction, Japan 4,94% and so forth. Of course the parameters of the responsibility index – base year for the responsibility criterion, weighting of each criterion in formula (1), inclusion of different greenhouse gases and others – would be subject to political negotiations, but under an objective responsibility assessment framework.

There exist no significant differences, however, between the composition of the list obtained by means of the synthetic indicator and the already effective political group that tends to become the main locus of world governance: the G20. The nineteen nations that compose it are responsible for 77% of current emissions, so an agreement among them would do most of the job, especially because the 20th participant is the European Union. Nonetheless, the commitment of another four mostly semi-peripheric nations will be necessary, as these are medium emitters who are not part of the G20: South Korea, Iran, Thailand and Venezuela. 85,7% of 2004 emissions originated from this "G20+four" group. And it will be responsible for nearly all the emissions when the post-Kyoto phase starts. The synthetic index thence points to the clear need for a climate alliance among central countries and part of the semi-periphery.

A week before the April 2009 London Summit two European climate change think-tanks produced a report that was delivered to the delegates by the German Foreign Office, which emphasized the complementary role of a green fiscal stimulus package and of a more stringent post-Kyoto agreement (BAUER *et. al.*, 2009). The study advocated a task division: the G20 would be responsible for greening the fiscal package that would inevitably come out to deal with the crisis, and the Copenhagen Summit would have to take care of the climate deal negotiations. The report seems to have caused good impression to the leaders, for despite the large predominance of financial issues that surrounded the meeting and the fact that the G20 never had a mandate for environmental negotiations, they assured awareness of the imperative role to be played by the G20 in the construction of a low-carbon economy.

5. Conclusions

Once the primacy of sustainability is accepted, and considering the ethical criteria of historical responsibility and capacity of action, it is possible to determine a rather clear role for those countries that have a high responsibility index and possess political viability for the rapid formation of a climate coalition. The other hundred and thirty nations with nearly irrelevant emissions will not be able to directly contribute to the mitigation effort, but will be the most burdened by a possible lack of success of the negotiations at COP-15, because they are geographically situated in regions of much higher risk of big damages from large temperature increases and because they have less adapting capacity (particularly small islands such as Samoa, Solomon, Seychelles and others). Hence it is fundamental that their power for making pressure and for demanding better results be preserved, without allowing this to block the negotiations and to prevent the achievement of effective results by the nations with real possibility of action.

In the group of forty-six countries ("G20 + four") that must produce an agreement for immediate

emission reductions that limit the atmospheric concentration to 500 ppm, twenty-one with insufficient technological capacity would have to make serious improvements in that area. The best proposal for the semi-periphery is a technological alliance, understood as a mutual effort of exchange and cooperation. But it will not conciliate development and sustainability if the idea of transfer is not replaced by a technological autonomy project. Such idea was put forward by a report edited by the German Federal Environmental Agency, entitled "proposal for contributions of emerging economies to the climate regime under the UNFCCC post 2012" (UMWELTBUNDESAMT, 2008). And it reinforced China's proposal at COP-14.

That is why the best scenario for the months that will precede COP-15, in Copenhagen, will be the possibility of emergency of two parallel dynamics. First, the construction of a coalition able to guarantee that the proceedings of the G20 conclave do put a green fiscal stimulus package in place, so that carbon pricing instruments start becoming a reality in the world economy, and that the G20 leaders manage to lead an agreement during the Copenhagen Summit. Second, the beginning of the articulation among the twenty-one dirty economies with which the technological leaders will have to build unprecedented cooperation in science, technology and innovation (ST&I).

Such a scenario may be considered excessively optimistic in times of an economic recession provoked by one of the worst financial crises ever seen. However, a big part of the ruling elites of the most burdened countries is rapidly realizing that there are multiple benefits from an intense change in the energy matrix, because it will stimulate a new innovation cycle capable of giving birth to the next phase of capitalist global expansion. But investment will have to be strategically allocated into research on low-carbon technological solutions, not only on short term economic recovery. Especially for a global security reason, as the geopolitical distribution of the many energy sources makes the multiplication of bellicose conflicts almost unavoidable.

There is plenty of reasons, therefore, to believe that the Kyoto Protocol will be replaced by a much better regime. And an important role in that evolution could be played by BRIC countries (Brazil, Russia, India and China). Once their ruling elites start orienting ST&I systems to make a low-carbon economy viable. In sum: when they stop prioritizing the rear view mirror to search for the path that will turn the fossil troika obsolete sometime along Century.

TABLE A-1

Average emissions (historical and 2004), Arco Index (1997 - 2000), responsibility index (RI) and cumulative 2004 emissions – 177 countries.

	Country	Average emissions (historical and 2004)	ArCo index (1997 – 2000)	Responsibility Index (RI)	Cumulative	Cumulative 2004 emissions
1	**United States**	24,07%	0,747	34,01	34,0	18,20%
2	**Germany**[1]	7,68%	0,682	9,90	43,9	20,60%
3	**Russia**[2]	8,26%	0,480	7,50	51,4	25,84%
4	**United Kingdom**	4,84%	0,673	6,17	57,6	27,75%
5	**China**	10,23%	0,306	5,92	63,5	43,08%
6	**Japan**	3,62%	0,721	4,94	68,4	46,82%
7	**Canada**	2,07%	0,742	2,91	71,3	48,91%
8	**France**	2,20%	0,604	2,52	73,9	50,06%
9	**Indonesia**	4,51%	0,265	2,26	76,1	58,75%
10	**Brazil**	2,65%	0,330	1,65	77,8	63,49%
11	**Italy**	1,36%	0,526	1,35	79,1	64,79%
12	**Australia**	1,00%	0,684	1,30	80,4	65,86%
13	**India**	2,91%	0,225	1,24	81,7	70,13%
14	**Ukraine**[4]	1,38%	0,417	1,09	82,8	71,02%
15	**South Korea**[3]	0,90%	0,607	1,03	83,8	72,44%
16	**Poland**	1,14%	0,465	1,01	84,8	73,30%
17	**Spain**	0,91%	0,516	0,89	85,7	74,38%
18	**South Africa**	1,25%	0,372	0,88	86,6	75,81%
19	**Belgium**	0,71%	0,642	0,86	87,4	76,13%
20	**Netherlands**	0,61%	0,683	0,79	88,2	76,59%
21	**Mexico**	1,13%	0,358	0,76	89,0	78,03%
22	**Czech Republic**[5]	0,69%	0,475	0,62	89,6	78,37%
23	**Iran**	0,94%	0,313	0,56	90,1	79,79%
24	**Argentina**	0,65%	0,426	0,53	90,7	80,65%
25	**Saudi-Arabia**	0,71%	0,326	0,44	91,1	81,69%
26	**Sweden**	0,25%	0,867	0,41	91,5	81,77%
27	**Austria**	0,33%	0,619	0,38	91,9	82,00%
28	**Romania**	0,47%	0,393	0,35	92,2	82,30%
29	**Thailand**	0,53%	0,342	0,34	92,6	83,23%
30	**Venezuela**	0,47%	0,369	0,33	92,9	83,80%
31	**Turkey**	0,49%	0,347	0,32	93,2	84,48%
32	**Norway**	0,20%	0,724	0,27	93,5	84,72%
33	**Denmark**	0,20%	0,704	0,27	93,8	84,80%
34	**Hungary**	0,28%	0,469	0,25	94,0	84,97%
35	**Switzerland**	0,16%	0,799	0,25	94,3	85,08%
36	**Kazakhstan****	0,33%	0,381	0,24	94,5	85,74%
37	**Malaysia**	0,34%	0,369	0,24	94,8	86,33%
38	**Philippines**	0,37%	0,322	0,23	95,0	86,96%
39	**Israel**	0,16%	0,751	0,22	95,2	87,19%
40	**United Arab Emirates**	0,29%	0,394	0,22	95,4	87,68%
41	**Greece**	0,24%	0,489	0,22	95,6	87,99%
42	**Algeria**	0,38%	0,277	0,20	95,8	88,61%
43	**Finland**	0,13%	0,831	0,20	96,0	88,68%
44	**Slovenia**	0,20%	0,507	0,19	96,2	88,70%
45	**Slovakia**[6]	0,20%	0,481	0,18	96,4	88,79%

	Country	Average emissions (historical and 2004)	ArCo index (1997 – 2000)	Responsibility Index (RI)	Cumulative	Cumulative 2004 emissions
46	**Egypt**	0,34%	0,269	0,17	96,6	89,31%
47	**Kuwait**	0,21%	0,405	0,16	96,7	89,63%
48	**Bulgaria**	0,18%	0,449	0,15	96,9	89,71%
49	**Nigeria**	0,56%	0,141	0,15	97,1	90,68%
50	**Ireland**	0,13%	0,567	0,14	97,2	90,82%
51	**Singapore**	0,12%	0,573	0,14	97,3	90,99%
52	**Uzbekistan****	0,22%	0,319	0,13	97,5	91,43%
53	**Colombia**	0,21%	0,331	0,13	97,6	91,69%
54	**New Zealand**	0,10%	0,645	0,13	97,7	91,79%
55	**Portugal**	0,14%	0,450	0,12	97,8	91,96%
56	**Congo (DRC)**	0,49%	0,125	0,12	98,0	92,92%
57	**Pakistan**	0,31%	0,191	0,11	98,1	93,41%
58	**Myanmar**	0,28%	0,179	0,10	98,2	93,95%
59	**Bolivia**	0,17%	0,305	0,10	98,3	94,27%
60	**Hong Kong**	0,09%	0,569	0,09	98,3	94,39%
61	**Tanzania**	0,28%	0,155	0,08	98,4	94,96%
62	**Libyan Arab Jamahiriya**	0,14%	0,312	0,08	98,5	95,15%
63	**Syrian Arab Republic**	0,14%	0,282	0,08	98,6	95,38%
64	**Qatar**	0,10%	0,380	0,08	98,7	95,55%
65	**Peru**	0,09%	0,345	0,06	98,7	95,65%
66	**Trinidad and Tobago**	0,08%	0,380	0,06	98,8	95,76%
67	**Belarus****	0,07%	0,431	0,06	98,8	95,91%
68	**Croatia**	0,07%	0,414	0,06	98,9	95,95%
69	**Zimbabwe**	0,10%	0,279	0,05	99,0	96,10%
70	**Cameroon**	0,13%	0,192	0,05	99,0	96,35%
71	**Luxembourg**	0,04%	0,486	0,04	99,0	96,38%
72	**Ecuador**	0,07%	0,319	0,04	99,1	96,48%
73	**Viet Nam**	0,09%	0,239	0,04	99,1	96,56%
74	**Nicaragua**	0,08%	0,238	0,04	99,2	96,73%
75	**Zambia**	0,08%	0,240	0,04	99,2	96,88%
76	**Turkmenistan****	0,07%	0,289	0,04	99,2	97,02%
77	**Oman**	0,06%	0,300	0,03	99,3	97,12%
78	**Bahrain**	0,04%	0,410	0,03	99,3	97,17%
79	**Azerbaijan****	0,05%	0,337	0,03	99,3	97,27%
80	**Ghana**	0,08%	0,203	0,03	99,4	97,43%
81	**Morocco**	0,08%	0,217	0,03	99,4	97,54%
82	**Guatemala**	0,07%	0,234	0,03	99,4	97,66%
83	**Lithuania**	0,04%	0,408	0,03	99,5	97,68%
84	**Estonia**	0,03%	0,472	0,03	99,5	97,74%
85	**Sudan**	0,10%	0,140	0,03	99,5	97,94%
86	**Tunisia**	0,05%	0,288	0,03	99,5	98,01%
87	**Lebanon**	0,04%	0,370	0,03	99,6	98,06%
88	**Dominican Republic**	0,04%	0,308	0,02	99,6	98,13%
89	**Cambodia**	0,13%	0,096	0,02	99,6	98,39%
90	**Cuba**	0,04%	0,322	0,02	99,6	98,36%
91	**Jordan**	0,04%	0,341	0,02	99,7	98,42%
92	**Honduras**	0,04%	0,258	0,02	99,7	98,50%
93	**Madagascar**	0,09%	0,116	0,02	99,7	98,67%
94	**Jamaica**	0,03%	0,346	0,02	99,7	98,71%
95	**Bangladesh**	0,07%	0,123	0,02	99,7	98,83%
96	**Sri Lanka**	0,03%	0,280	0,02	99,8	98,88%
97	**Angola**	0,08%	0,107	0,02	99,8	99,03%
98	**Uruguay**	0,02%	0,417	0,02	99,8	99,05%
99	**Kenya**	0,04%	0,204	0,01	99,8	99,10%
100	**Costa Rica**	0,02%	0,361	0,01	99,8	99,13%

	Country	Average emissions (historical and 2004)	ArCo index (1997 – 2000)	Responsibility Index (RI)	Cumulative	Cumulative 2004 emissions
101	**Cyprus**	0,02%	0,440	0,01	99,8	99,16%
102	**Moldova**	0,02%	0,395	0,01	99,8	99,18%
103	**Congo**	0,03%	0,207	0,01	99,8	99,24%
104	**Yemen**	0,04%	0,140	0,01	99,9	99,31%
105	**Panama**	0,02%	0,382	0,01	99,9	99,32%
106	**Macedonia**	0,02%	0,300	0,01	99,9	99,36%
107	**Iceland**	0,01%	0,666	0,01	99,9	99,37%
108	**Mongolia**	0,02%	0,197	0,01	99,9	99,39%
109	**Gabon**	0,02%	0,231	0,01	99,9	99,42%
110	**Lao**	0,05%	0,098	0,01	99,9	99,51%
111	**El Salvador**	0,01%	0,311	0,01	99,9	99,53%
112	**Albania**	0,02%	0,251	0,01	99,9	99,54%
113	**Namibia**	0,02%	0,217	0,01	99,9	99,57%
114	**Senegal**	0,02%	0,151	0,01	99,9	99,61%
115	**Tajikistan**	0,01%	0,356	0,01	100,0	99,63%
116	**Uganda**	0,02%	0,133	0,01	100,0	99,67%
117	**Paraguay**	0,01%	0,323	0,01	100,0	99,69%
118	**Kyrgyzstan**	0,01%	0,306	0,00	100,0	99,70%
119	**Central African Republic**	0,02%	0,110	0,00	100,0	99,75%
120	**Ethiopia**	0,04%	0,067	0,00	100,0	99,82%
121	**Guinea**	0,03%	0,079	0,00	100,0	99,88%
122	**Malta**	0,01%	0,361	0,00	100,0	99,88%
123	**Armenia****	0,01%	0,326	0,00	100,0	99,90%
124	**Botswana**	0,01%	0,255	0,00	100,0	99,91%
125	**Mauritius**	0,01%	0,285	0,00	100,0	99,92%
126	**Suriname**	0,01%	0,264	0,00	100,0	99,93%
127	**Mozambique**	0,02%	0,098	0,00	100,0	99,96%
128	**Burkina Faso**	0,03%	0,050	0,00	100,0	100,02%
129	**Malawi**	0,01%	0,134	0,00	100,0	100,04%
130	**Guyana**	0,01%	0,271	0,00	100,0	100,05%
131	**Papua New Guinea**	0,01%	0,146	0,00	100,0	100,06%
132	**Fiji**	0,00%	0,304	0,00	100,0	100,06%
133	**Mali**	0,01%	0,066	0,00	100,0	100,09%
134	**Mauritania**	0,01%	0,111	0,00	100,0	100,10%
135	**Chad**	0,01%	0,071	0,00	100,0	100,12%
136	**Togo**	0,00%	0,145	0,00	100,0	100,12%
137	**Haiti**	0,00%	0,129	0,00	100,0	100,13%
138	**Swaziland**	0,00%	0,222	0,00	100,0	100,13%
139	**Benin**	0,00%	0,114	0,00	100,0	100,14%
140	**Guinea-Bissau**	0,00%	0,076	0,00	100,0	100,15%
141	**Sierra Leone**	0,00%	0,075	0,00	100,0	100,15%
142	**Djibouti**	0,00%	0,122	0,00	100,0	100,15%
143	**Eritrea**	0,00%	0,093	0,00	100,0	100,16%
144	**Niger**	0,00%	0,031	0,00	100,0	100,16%
145	**Côte d'Ivoire**	0,00%	0,136	0,00	100,0	100,15%
146	**Burundi**	0,00%	0,078	0,00	100,0	100,15%
147	**Saint Vincent and the Grenadines**	0,00%	*	0,00	100,0	100,15%
148	**Sao Tome and Principe**	0,01%	*	0,00	100,0	100,17%
149	**Bosnia and Herzegovina**	0,01%	*	0,00	100,0	100,18%
150	**Solomon Islands**	0,00%	*	0,00	100,0	100,18%

	Country	Average emissions (historical and 2004)	ArCo index (1997 – 2000)	Responsibility Index (RI)	Cumulative	Cumulative 2004 emissions
151	**Samoa**	0,00%	*	0,00	100,0	100,18%
152	**Grenada**	0,00%	*	0,00	100,0	100,18%
153	**Equatorial Guinea**	0,02%	*	0,00	100,0	100,21%
154	**Bahamas**	0,01%	*	0,00	100,0	100,22%
155	**Belize**	0,00%	*	0,00	100,0	100,22%
156	**Brunei Darussalam**	0,16%	*	0,00	100,0	100,26%
157	**Occupied Palestinian Territories**	0,01%	*	0,00	100,0	100,26%
158	**Barbados**	0,00%	*	0,00	100,0	100,26%
159	**Lesotho**	0,00%	0,178	0,00	100,0	100,26%
160	**Comoros**	0,00%	*	0,00	100,0	100,26%
161	**Saint Lucia**	0,00%	*	0,00	100,0	100,27%
162	**Antigua and Barbuda**	0,00%	*	0,00	100,0	100,27%
163	**Cape Verde**	0,00%	*	0,00	100,0	100,27%
164	**Maldives**	0,00%	*	0,00	100,0	100,27%
165	**Saint Kitts and Nevis**	0,00%	*	0,00	100,0	100,27%
166	**Tonga**	0,00%	*	0,00	100,0	100,27%
167	**Dominica**	0,00%	*	0,00	100,0	100,27%
168	**Timor-Leste**	0,00%	*	0,00	100,0	100,27%
169	**Vanuatu**	0,00%	*	0,00	100,0	100,27%
170	**Seychelles**	0,00%	*	0,00	100,0	100,27%
171	**Gambia**	0,00%	0,123	0,00	100,0	100,27%
172	**Rwanda**	0,00%	0,113	0,00	100,0	100,27%
173	**Georgia****	0,00%	0,379	0,00	100,0	100,27%
174	**Bhutan**	-0,01%	0,103	0,00	100,0	100,24%
175	**Chile**	-0,01%	0,424	-0,01	100,0	100,10%
176	**Nepal**	-0,04%	0,121	-0,01	100,0	100,02%
177	**Latvia**	-0,01%	0,439	-0,01	100,0	100,00%

1 – Includes Former German Democratic Republic and Federal Republic of Germany.
2 – Includes a 85,74% share of USSR emissions (equal to the 2004 share of all the former Soviet States but Ukraine in CIS – Commonwealth of Independent States – emissions).
3 – Includes a 94% share of United Korea's emissions (equal to the 2004 share in South Korean + North Korean emissions).
4 – Includes a 14,26% share of USSR emissions (equal to the 2004 share in CIS – Commonwealth of Independent States – emissions).
5 – Includes a 76,6% share of Czechoslovakian emissions (equal to the 2004 share in Czech + Slovakian emissions).
6 – Includes a 23,4% share of Czechoslovakian emissions (equal to the 2004 share in Czech + Slovakian emssions).
* Data not available.
** Former Soviet States – assumed not to have responsibility over USSR emissions.
Sources: UNDP (2007), Carbon Information Analysis Center (CDIAC), ARCHIBUGI & COCO (2004: 637-640).

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