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# Possible Criteria for Differentiated Commitments: Fair or Feasible?

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# POSSIBLE CRITERIA FOR DIFFERENTIATED COMMITMENTS: FAIR OR FEASIBLE?\*

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## Abstract

This paper discusses the notion of differentiated commitments or burden sharing in the ongoing negotiations on emissions reductions of greenhouse gases. The negotiations, which takes place in the Ad Hoc Group on the Berlin Mandate (AGBM) under the Framework Convention on Climate Change (FCCC), is leading up to the third Conference of the Parties (COP-3), which is scheduled to take place in Kyoto in December later this year. The paper briefly surveys some of the main issues in the negotiations and argues that the question of differentiated commitments or burden sharing is only one among many difficult topics on the negotiating table. Based on some proposed principles of 'fairness', a few central indicators are identified and we provide data on these for a group of OECD countries. We outline some of the propositions for differentiated commitments in the current negotiations, and concludes that within the framework of the OECD countries, burden sharing is only possible if countries outside of the European Union (EU) can compensate USA for the additional greenhouse gas reductions needed to allow high cost countries to commit to lower abatement than the average reduction level. However, an attractive option, not explored in this paper, is for the group of countries outside EU and USA to make a deal with countries with economies in transition, as these countries generally are expected to have relatively low marginal reduction costs. Further studies of such 'east-west' deals are clearly warranted.

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## 1. Introduction

The current negotiations taking place under the Framework Convention on Climate Change (FCCC) in the Ad Hoc Group on the Berlin Mandate (AGBM) can be viewed as concerning three main questions:

1. How large reductions in greenhouse gas (GHG) emissions should the Annex 1 countries<sup>1</sup> commit to in the medium term?
2. How flexible should the implementation be?
3. How should the costs of the commitments be allocated among the participating countries?

The first question is slightly complicated by some disagreement on exactly which countries should be required to commit themselves to emission reductions. In particular the new OECD member countries not included in Annex 1, Mexico and South Korea, are a concern. The time horizon for binding commitments is also a topic for discussion, although the year 2010 now seems to be in favour among many delegates to the negotiations. Finally, the possibility of 'time flexibility' (i.e., budgeting and borrowing emission quotas over time) has been proposed by the USA in the negotiations.

The second question concerns the problem on whether and how joint implementation and trade in emission quotas should be allowed under a new protocol or a similar instrument. It is recognised that such flexibility would lower the cost of implementation of a given Annex 1 commitment, but at the added cost of making the negotiations and eventual treaty more complex. Thus, the feasibility of reaching an agreement on this issue before the Third meeting of the Conference of the Parties (COP-3) in Kyoto in December 1997 has been questioned. There are also differences in positions on who should be allowed to participate in an eventual flexible implementation. Should it be possible to include parties not required to reduce their own emissions (e.g. the less developed countries) or should the flexibility only cover arrangements between Annex 1 parties?

Finally, the third question is on international burden sharing; not between the 'north' and the 'south', but rather between the industrialised countries. Two main proposals exist on this issue. One, mainly pushed by the USA, is for a 'flat rate' arrangement where all parties to the treaty commit to a common percentage reduction relative to emission levels in a base year (usually 1990). In essence this amounts to an undifferentiated approach. The other proposal is less well defined, but amounts to some sort of differentiated commitments based on characteristics of each country such as gross domestic product (GDP) per capita, population size and GHG emission intensities.

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<sup>1</sup> See Appendix 1 for a list of Annex 1 countries. The Framework Convention on Climate Change (FCCC) also establishes more specific obligations for particular categories of states. Thus, it distinguishes between members of the OECD (as of 1992) (listed in Annex II to the Convention), countries in transition to a market economy (Eastern European countries which, together with the OECD countries, are listed in Annex I), and developing countries. The Convention requires OECD countries to take the strongest measures, while the states in transition to a market economy are allowed a certain flexibility. The Convention recognizes that compliance by developing countries will depend on financial and technical assistance from developed countries; in addition, the needs of least developed countries and those that are particularly vulnerable to climate change for geographical reasons are given special consideration (Article 4, paras. 2-7).

## 2. Differentiated commitments in the climate convention negotiations

Differentiated commitments, in the context of the ongoing climate negotiations, is basically put forward as a negotiating position for two reasons:

- As a way of achieving a cost effective solution.
- As a way to achieve a 'fair' outcome in the negotiations.

Of these, the first is generally considered solvable by the use of appropriate instruments like trade in emission quotas or by allowing for Joint Implementation of emission reduction measures. The second issue of fairness is sometimes regarded as too difficult to handle, involving as it does deep philosophical questions, and it has therefore been suggested to postpone this issue from at least the current negotiating process, even though the principle of differentiated commitments is clearly stated in the Convention and the Berlin Mandate. In this paper I will argue that the fairness issue perhaps is not that much more difficult to handle than other issues one has to face in the negotiations. Let us therefore start with a (non-comprehensive) list of some of the issues facing the negotiators.

- *The timing issue.* When are reductions to take place, should they be relative to a historical base year or period, or should they be related to a baseline projection of emissions? Should one be allowed to borrow or bank emissions across time periods? If yes, when should the emission accounts then be settled?
- *The issue of comprehensiveness;* that is which greenhouse gases (GHGs) should be regulated and how should one calculate a proper 'exchange rate' between the various gases<sup>2</sup>. Also the topic of *sinks* of greenhouse gases belongs to this class of questions.
- *The regional scope of the treaty.* A list of so called Annex I countries was drawn up in Rio in 1992 and the current negotiations take as a starting point that only these countries should at present be directly affected by climate control policies. Basically the Annex 1 countries consists of OECD countries as of 1992 and countries with economies in transition. However, since 1992 new members have joined the OECD and the question as been asked whether in particular Mexico and South Korea should face the same regulations as the older OECD members are likely to face.
- *The issue of flexible instruments.* Should trade in emission quotas and Joint Implementation be allowed? If so, who should be allowed to participate in these schemes; only parties whose emissions are to be regulated by a climate treaty or all parties?
- Finally, *the issue of ambition level;* i.e. what overall reductions in future emission levels should one aim at in the climate treaty.

In view of this list, burden sharing or differentiated commitments only appears as one among several difficult issues that has to be tackled in the negotiations. With this background, let us take a closer look at the two arguments put forward for a solution based on differentiated commitments.

### 2.1 Efficiency concerns

It is well known that a least cost solution to the problem of global reductions in emissions of greenhouse gases (GHGs) is obtained if the net marginal costs of the parties to the treaty are equalised<sup>3</sup>. This can be achieved by assigning differentiated commitments to the participating

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<sup>2</sup> See Fuglestedt and Skodvin (1996) for a detailed discussion of this topic.

<sup>3</sup> At least in an ideal world. If some of the actors have market power it may create problems, see Hagem and Westskog, 1996 and Hagem, 1996.

countries reflecting differences in benefits and costs of emission reductions. It may also be achieved with a common ‘flat rate’ commitment to reductions if this is combined with suitable flexible instruments like GHG quota trade or Joint Implementation (JI). Although in an ideal world this would secure equal marginal costs, the *total* costs to the parties can vary widely under the different schemes.

Some difficulties with the efficiency approach to differentiated commitments should be noted:

- It is at present very difficult to quantify the *benefit* of GHG emission reductions. This is partly due to the inherent complexities of the climate system, but also due to the side effects of GHG reductions such as reduction in local pollution, which in many cases is likely to outweigh the direct benefits of climate control<sup>4</sup>.
- Although perhaps less complex, also the *costs* of GHG emission reductions are difficult to estimate empirically for a number of reasons. Some of the problems are of a conventional kind in the sense that there are uncertainties associated with the relevant elasticities in the economies. This is not, however, the main obstacle to obtaining reliable marginal cost estimates, at least in the industrialised world where economic data are of fairly high quality. Rather the variety of ways to implement a control policy, a carbon tax say, creates large problems in identifying a single cost figure. This is partly the well known problem of identifying a reference or baseline scenario with which to compare the control scenario in order to identify the costs of the control. Thus, whether removal of subsidies for fossil fuels is considered part of the baseline scenario or part of the control scenario obviously will affect the costs of the control to a large degree in many coal producing countries. It also, however, is a problem related to the specific way a policy like a carbon tax is implemented. Such a tax has the potential of generating quite substantial revenues, and different ways of allocating these revenues, e.g. reducing the income tax or reducing tax on investments, may crucially affect the macro economic costs of the control policy.
- Finally, an inherent and important problem associated with all exercises that depends on projecting the future development of the economy, is the forecasting of technological development. This is at present a poorly understood field, and given that a climate treaty has the potential of affecting important international markets like the markets for oil and gas, it is very difficult to foresee how different control options may affect the technological development and hence the cost of the control policies.

These notes are not meant to indicate that the issue of cost effectiveness is unimportant or should be disregarded in the ongoing negotiations. Rather they are meant to highlight that even in the application of ‘pure’ economic arguments for differentiated commitments or use of flexible instruments, a pragmatic approach is needed where rough ‘rules of thumb’ is what one should be looking for. It is sometimes put forward that fairness issues are too difficult to deal with because of problems we will touch upon in the next section. The point then is that these difficulties may not in the end be much more difficult than those associated with ‘costing’ the various control policy options.

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<sup>4</sup> Secondary benefits of climate policy are those not related to mitigation of climate related damage, but following as a by-product of the climate policy. Examples include reduced damage to health, materials and nature due to reduction in the emission of local air pollutants. Other secondary benefits may include those following from a restructuring of the tax system towards greater reliance on green taxes and away from more distortive taxes, e.g. the income tax. For discussions and estimations of secondary benefits related to climate policy, see for instance Alfsen et al. (1992) and Ekin (1996).

## 2.2 Equity/Fairness issues

What constitute a fair treaty is obviously difficult to specify. In fact the question of what constitutes fairness for an individual, and even more so - a nation - is a deep philosophical question without a single answer. Some relevant notions may however be illustrated as in table 1 based on Rose (1992). The table lists 10 criteria one may consider essential for a fair treaty<sup>5</sup>. The criteria are cast in the form of how to distribute emission permits, given that overall emissions are to be stabilised or reduced. Note that the welfare impact of a control policy is interpreted as *net benefits*, i.e. benefits,  $B$ , minus costs,  $C$ , while the general welfare level is supposed to be reflected by the measure GDP per capita. In the table,  $R$  designate emission reductions and  $E$  emission levels.

Table 1. Some equity criteria

	Criterion	General description	Examples of 'operational rule'
1	Horizontal	Persons in the same group are treated equally	$C_i - B_i = \text{equal}$
2	Vertical	Greater concern for the disadvantaged	$C_i - B_i \propto \text{GDP}_i$
3	Ability to pay	Parties pay according to their means	$C_i \propto \text{GDP}_i$
4	Sovereignty	Each nation guaranteed a minimum permit	$R_i/E_i = \text{equal}$
5	Egalitarian	Every human equal	$R_i/E_i \propto \text{population}$
6	Market justice	Free market is a fair means of allocation and distribution	Auction entitlements to highest bidder
7	Consensus	A decision is fair if parties agree to it	Distribute permits so that a majority of nations is satisfied
8	Compensation	Pareto rule: No party should be made worse off	$C_i - B_i < 0$
9	Rawl's maximin	Maximise welfare of the worst off nation	Distribute large proportions of permits to the poorest countries
10	Environmental	Emphasise 'rights' of ecosystem	Max $R_i$

Source: Adapted from Rose, A. (1992): 'Equity considerations of tradeable carbon emission entitlements', in UNCTAD, *Combating global warming. Study on global system of tradeable carbon emission entitlements*, Geneva: UNCTAD, as cited in S. Fankhauser (1995): *Valuing climate change. The economics of the greenhouse*, London: Earthscan Publications Ltd., p. 135

Note that benefits will depend on aggregate emission reductions, i.e.  $B_i = B_i(\sum_j R_j)$ , while costs are mainly determined by own reductions, i.e.  $C_i = C_i(R_i)$ . The problem then is to distribute  $R_i$  in a 'fair' and equitable manner.

In order to illustrate the problem with a flat rate approach, we reproduce a figure from Torvanger et al. (1996) showing one example of a calculation of the costs to some OECD countries under a flat rate agreement of 20 per cent reduction relative to 1993 levels (figure 1).

Although the cost calculations depends on a number of uncertain and perhaps controversial assumptions, it seems obvious that the burdens of emission reductions are very unevenly distributed, with relatively clean countries as the losers. The larger countries in emission terms get a more favourable treatment under this type of protocol.

<sup>5</sup> See also Kverndokk (1995).

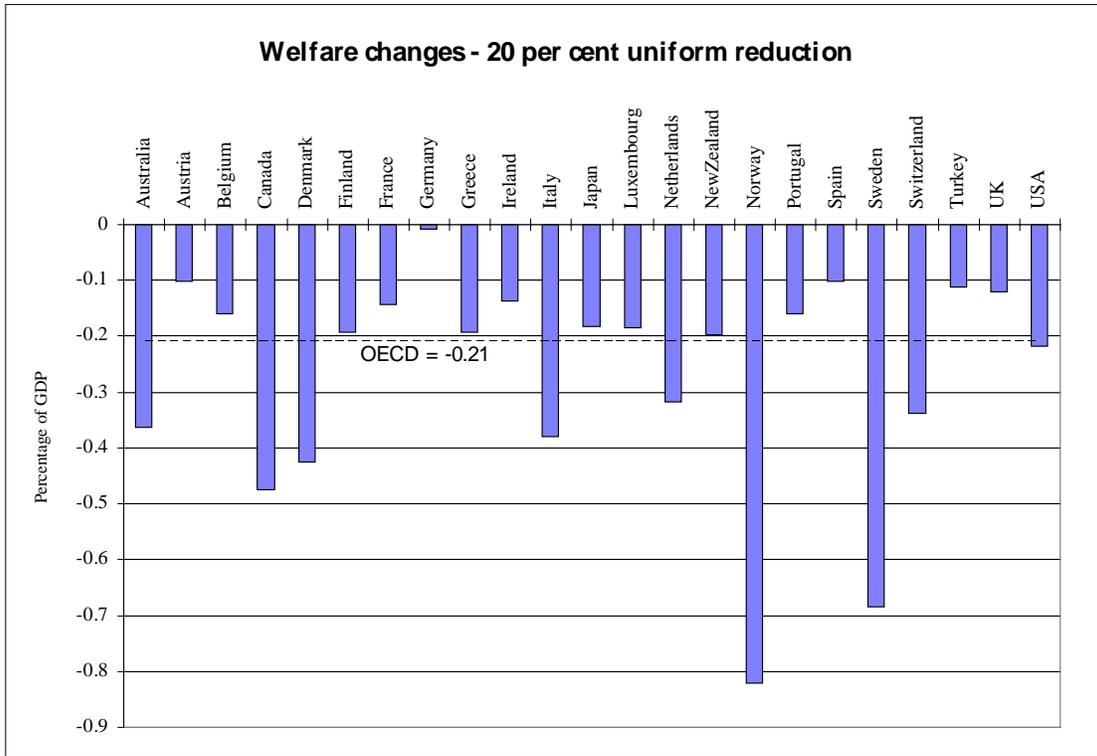


Figure 1. Welfare effects of a uniform 20 per cent reduction in CO<sub>2</sub> emissions.

### 2.2.1 Indicators

We note from the list in table 1 that *three indicators* stand out in the discussion of a fair distribution of commitments. One is related to national wealth and is most often associated with Gross Domestic Product (GDP) per capita. The others are related to GHG emission intensities, namely emissions per capita and emissions per GDP. One can argue for these indicators in terms of fairness along the following line:

- The GDP per capita indicator reflects the ability to pay principle, in that rich countries should reduce more, whatever the costs of reductions.
- Emissions per unit of GDP reflect a right to emit per unit of economic activity in a country. This indicator may therefore be said to some extent to reflect the ability to pay principle in table 1, which stress the equalisation of the abatement costs among groups.
- Emissions per capita reflect the egalitarian principle in table 1, where the right of every human to an equal proportion of total emissions is underlined. Countries with high emission per capita should therefore reduce more than other countries.

Overall, we find these indicators attractive since countries with *high emission intensities* are likely to have many options in reducing emissions. We therefore expect the cost of reduction in countries with high emission intensities to be smaller than in countries with less emission intensive economies. On the other hand, countries with high *GDP per capita* generally have more resources available to meet the reduction costs and the loss of welfare due to emission reductions may therefore be relatively smaller in these countries.

Figure 2 shows population size, emission levels and GDP for a selected number of OECD countries. We see that the USA is dominating in every respect, followed by Japan and the four large countries of the European Union (EU).

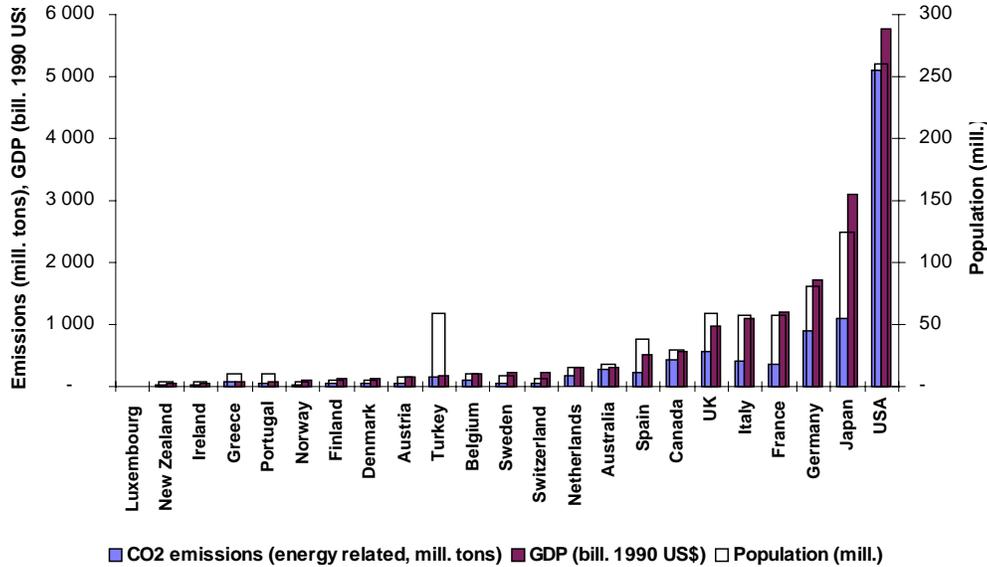


Figure 2. Population, emission levels and GDP for a selected number of OECD countries. 1990.

The next figure (figure 3) transforms these variables into the respective wealth and emission intensity indicators. In this figure we have grouped the countries into USA, EU and the rest of the countries and sorted each group according to their GDP per capita.

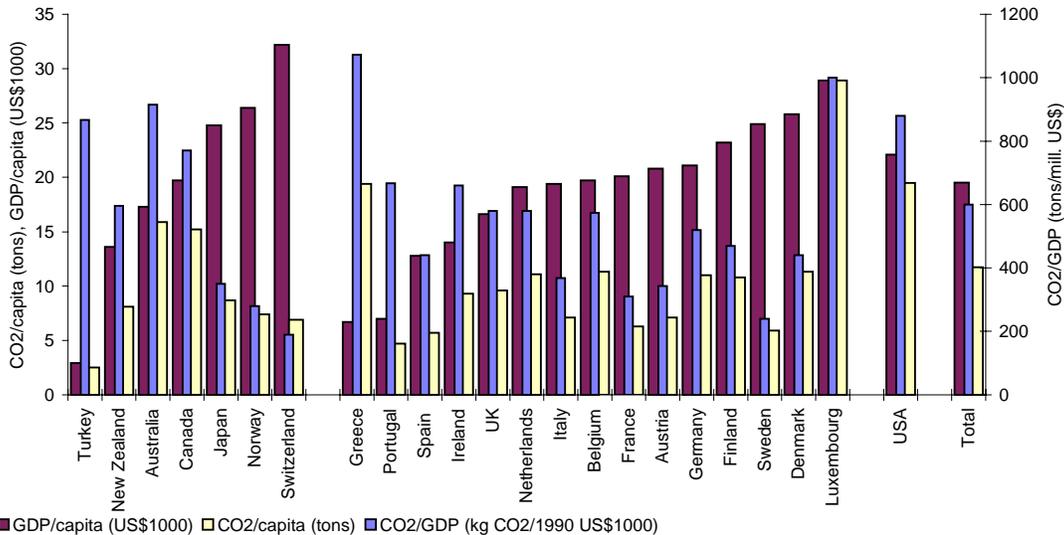


Figure 3. Wealth and emission intensity indicators for some OECD countries. 1990.

Figure 4 shows the wealth and emission indicators in a somewhat different format. The wealth indicator is 1990 GDP per capita measured in 1990 US\$ relative to a population weighted average. Similarly, the CO<sub>2</sub> emissions are calculated relative to a population weighted average for the region. Thus, values above zero indicate that the corresponding country is wealthier (measured as GDP per capita at 1990 exchange rates) and have higher per capita emission than the average value. Thus, the figure divides the countries into “rich” and “poor”, “clean” and “dirty”. Common sense would argue that “rich” and “dirty” countries should commit to larger emission reductions than “poor” and “clean” countries.

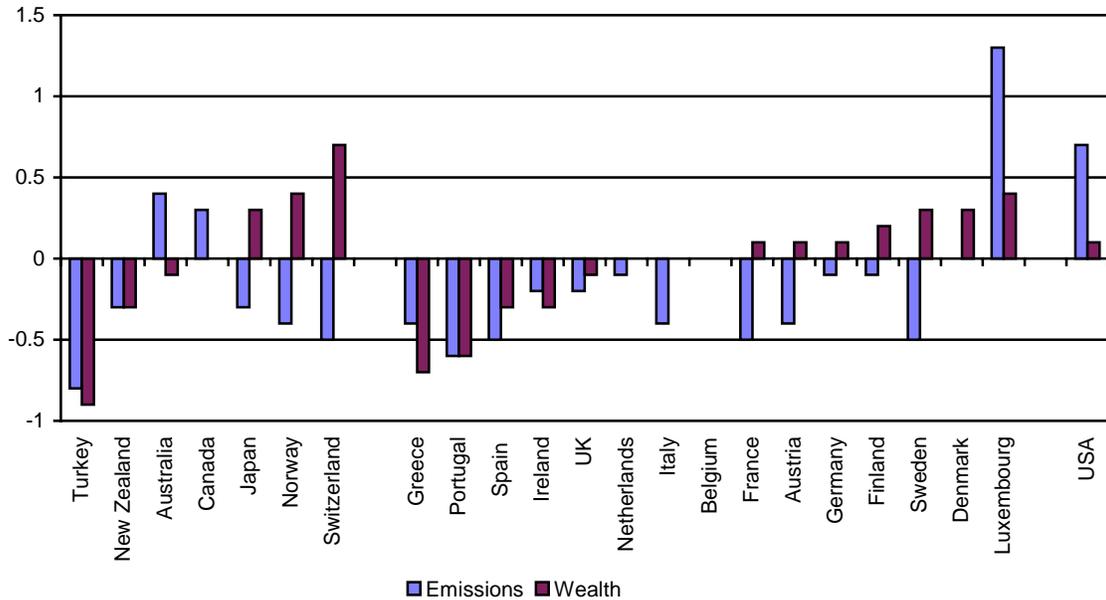


Figure 4. Wealth and emission intensities for some OECD countries. Differences from the respective population weighted averages.

Table 2 gives the data behind figure 4. The table also compares emission and GDP levels with the relative population size of each country and denotes them as dirty/clean and poor/rich if their shares of CO<sub>2</sub> emissions and GDP deviate more than +/-30 percent from their share of the total population. The characterization must of course be understood in a relative sense.

Measuring wealth by GDP per capita must be considered as relatively uncontroversial in this context<sup>6</sup>. It is perhaps more difficult to decide whether emission intensities should be measured relative to population size or the size of the economy. However, in practice, the choice may not matter very much, since there is a high co-linearity between these indicators for a substantial subgroup of countries, see Figure 5. Note that in the figure, Turkey, Portugal and Luxembourg has been kept out of the regression calculation, but are shown as outliers in the figure.

In addition to the indices mentioned above, also other cost related indicators have been suggested in the ongoing negotiations. Thus, an international climate treaty may have large impacts on important world markets, e.g. the markets for fossil fuels. Countries with large trade in these commodities may be expected to be more severely affected than other countries, either positively or negatively. For this reason Australia have proposed to base differentiated commitments also on indicators related to trade in fossil fuels. In our mind, this indicator is more difficult to justify than the indicators discussed above. On the one side, it is true that a country dependent on export of fossil fuels (e.g. Norway) may face considerable costs in a regime with an international climate treaty. On the other side, this export activity usually creates large rents and thus makes the country better off to pay the reduction costs. It may also seem somewhat idiosyncratic to single out trade of fossil fuels for special treatment; why not cars or any other internationally traded good?

<sup>6</sup> Although there is a large literature on the relations between wealth and welfare. See e.g. K. A. Brekke (1997).

Table 2. CO<sub>2</sub> emissions, population and GDP as percentage of OECD totals (except Iceland, Mexico, Czech Republic, South Korea) and deviation of emission and GDP from shares determined by population shares.

	CO <sub>2</sub> emissions	GDP	Population	CO <sub>2</sub> relative to population	GDP relative to population
Australia	2.8	1.8	2.0	dirty	-
Austria	0.6	1.0	0.9	clean	-
Belgium	1.1	1.1	1.1	-	-
Canada	4.3	3.3	3.3	-	-
Denmark	0.6	0.8	0.6	-	rich
Finland	0.5	0.7	0.6	-	-
France	3.6	7.0	6.6	clean	-
Germany	8.7	10.0	9.3	-	-
Greece	0.7	0.4	1.2	clean	poor
Ireland	0.3	0.3	0.4	-	-
Italy	4.0	6.5	6.5	clean	-
Japan	10.6	18.1	14.2	-	-
Luxembourg	0.1	0.1	0.04	dirty	rich
Netherlands	1.7	1.7	1.8	-	-
New Zealand	0.3	0.3	0.4	clean	poor
Norway	0.3	0.7	0.5	clean	rich
Portugal	0.4	0.4	1.1	clean	poor
Spain	2.2	2.9	4.5	clean	poor
Sweden	0.5	1.3	1.0	clean	-
Switzerland	0.4	1.3	0.8	clean	rich
Turkey	1.5	1.0	6.8	clean	poor
UK	5.4	5.7	6.7	-	-
USA	49.5	33.7	29.7	dirty	-

Sources: OECD (1995a); OECD (1995b).

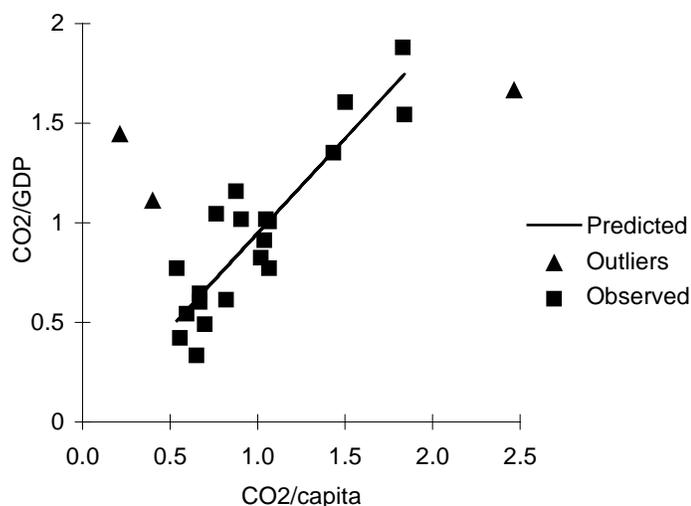


Figure 5. Relation between normalised CO<sub>2</sub> emission per capita and CO<sub>2</sub> emission per GDP.

### 3. The negotiations

#### 3.1 *The proposal of the European Union.*

After a rather chaotic period in the negotiations, positions were made more clear during the sixth session of the Ad Hoc Group on the Berlin Mandate (AGBM) taking place in Bonn in March. Here, the European Union (EU) surprised most delegates by announcing a common negotiating position in the process leading up to the meeting in Kyoto in December later this year. In short, EU specifies *a 15 per cent reduction in year 2010 relative to 1990 of a basket of three greenhouse gases: CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O*<sup>7</sup>. EU also stated the intention of coming up with an interim target for the year 2005.

In addition to specifying an overall reduction target, EU also indicated a burden sharing among the member countries along the lines depicted in table 3 and figure 6, which, however, only sum up to a 10 per cent reduction. Additional reductions are therefore required if the 15 per cent target is to be achieved.

EU stated further that within year 2000, means should be developed to include other greenhouse gases such as HFC, PFC and SF<sub>6</sub> in the basket of gases to be regulated. As a concession, primarily to France, EU also declared that in the longer term more sophisticated methods of burden sharing should be developed securing a convergence of the emission levels of the member countries based on suitable emission indicators. This must be seen on the background that France earlier have stated vigorously that one should aim for equal per capita emission levels.

*Table 3. Differentiated commitments among EU countries*

Member countries	Emission reductions in 2010 of CO <sub>2</sub> , CH <sub>4</sub> og N <sub>2</sub> O (Weighted by GWP <sub>100</sub> ) relative to 1990. Percent
Belgium	-10
Denmark	-25
Germany	-25
Greece	+30
Spain	+17
France	0
Ireland	+15
Italy	-7
Luxembourg	-30
The Netherlands	-10
Austria	-25
Portugal	+40
Finland	0
Sweden	+5
Great Britain	-10

<sup>7</sup> These are to be weighted together by use of their respective greenhouse warming potentials calculated using a 100 year horizon (GWP<sub>100</sub>).

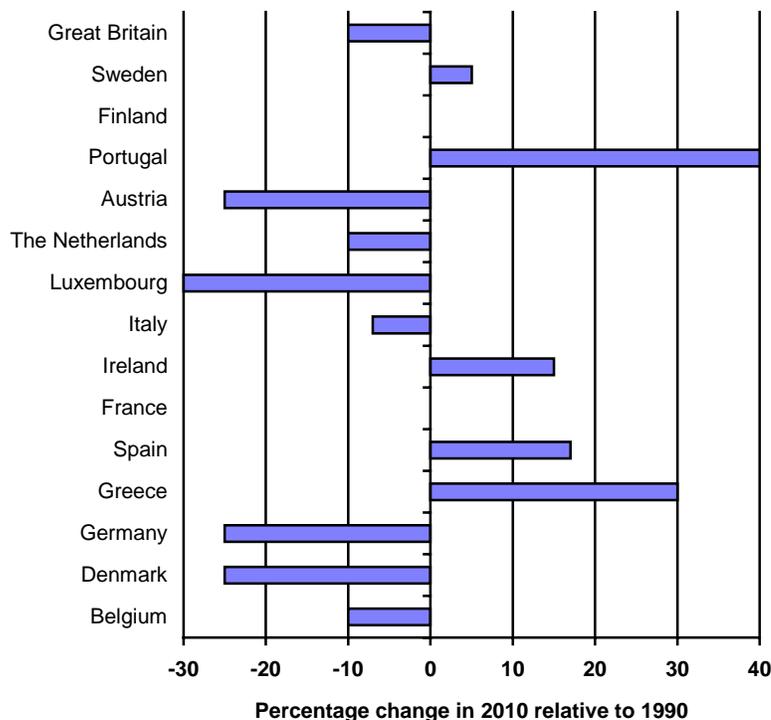


Figure 6. Differentiated commitments in EU.

Two things are noteworthy about the EU proposal. One is the relatively high ambition level of 15 per cent reduction before year 2010 (although this is still far short of what is needed for a stabilisation of greenhouse gas concentration in the atmosphere). As pointed out by the proponents of differentiated commitments (e.g. Norway), this ambition level has only been possible because of the burden sharing envisaged within EU. It has been speculated on how this differentiation was arrived at, but the answer seems to be that it is the result of a political process where also other elements that those directly related to climate change has been under consideration. In any case, EU maintains that no simple formula was employed in the determination of the national commitments.

The other noteworthy feature is of course the wide discrepancy between the national commitments, ranging from an *increase* in emissions of 40 per cent for Portugal (how should this come about?) and somewhat slower growth in Greece and Spain, to 25 per cent reduction in countries like Germany, Austria and Denmark (Luxembourg tops the list with 30 per cent reduction).

In summary, it seems fair to say that the ambitious EU position has been made possible by securing an internal burden sharing, and that this in turn has been possible because of the tight integration of the EU member countries. In this manner different topics and conflicts can be considered simultaneously, thus enlarging the negotiating arena considerably. Unfortunately, a similar technique may be difficult to apply for other small nations.

### 3.2 Three groups

After the common declaration of the EU countries, it is reasonable to view the OECD as consisting of three groups: EU, USA and the rest of the countries (here denoted by RoA I). Population and GDP wise, these three groups are rather similar. However, they differ with respect to their CO<sub>2</sub> emissions, see figure 7.

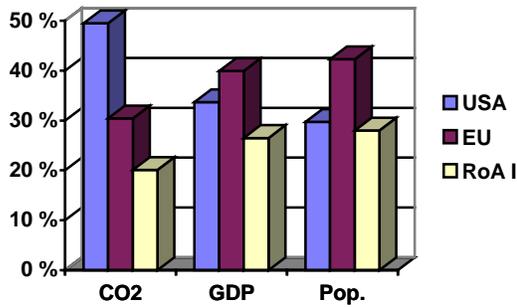


Figure 7. Share of OECD totals for USA, EU and rest of the countries (RoA I). 1993

Transforming these indicators into emission intensities and a wealth indicator reveals that EU and the residual group are almost identical, while USA both have higher emission intensities and higher wealth per capita, see figure 8. Given that EU has settled its need for burden sharing, what is left is for USA and the residual group to agree on a burden sharing. For a fairer distribution of commitments according to the principles and indicators discussed above, USA must take on a larger share of the total burden. The problem is of course what the residual group can offer USA in return for such an arrangement.

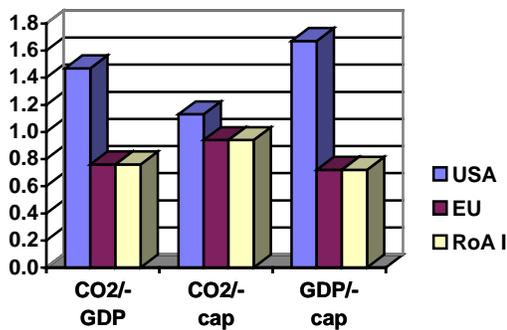


Figure 8. Main indicators for USA, EU and rest of the countries (RoA I). 1993

### 3.3 Differentiated commitments à la Norway

Norway has put forward a proposal for differentiated commitments based on the above indicators and the following formulae<sup>8</sup>

$$Y_i = A \left( \beta \frac{B_i}{B} + \chi \frac{C_i}{C} + \delta \frac{D_i}{D} \right) \quad (1)$$

Here,  $Y_i$  is percentage reduction of emissions in country  $i$  relative to a business-as-usual (BAU) scenario in a future year,  $B$  denotes CO<sub>2</sub>-equivalents per GDP,  $C$  is GDP per capita and  $D$  is CO<sub>2</sub>-equivalents per capita.  $A$  is an overall scaling factor. The indicators enter the formulae in a normalised manner, i.e. country values divided by the respective average values.

The three indicators are meant to capture some essential elements behind the differences in abatement costs among countries, and thus to provide a more 'fair' distribution of the required reductions as discussed in section 2.2.1 above.

<sup>8</sup> The proposal is quite similar to some of the proposals put forward and analysed in detail by Torvanger et al. (1996).

Essential to the proposal is of course that the weights in the formulae are to be determined through negotiations. In effect there are then only two degrees of freedom, since the sum of the weights should be equal to one. It is of course impossible within this restricted room for negotiations to reflect all of the variability between nations. This is both a weakness and strength of the proposition. It is a weakness because the negotiated treaty can not be entirely fair with so crude an instrument for capturing differences between nations. At the same time it is a strength in that the participants are to some extent forced to use arguments of a principal nature in the debate. The simplicity of the scheme may also perhaps enhance the possibility for reaching an agreement within the tight time limits towards the third conference of the parties in Kyoto in December 1997.

In the figure below (figure 9, left hand columns) we have calculated  $Y_i/A$  based on a scheme where each of the three indicators gets equal weights. The countries fall into three broad groups. If we sort the groups according to whether they are more than 10 per cent from the central value (equal to one) we find one group representing the North American countries, Greece, Australia and Luxembourg with high commitments (large reductions), a group of countries with medium reductions, and finally a group of countries with relatively small reductions (Portugal, Turkey, Spain, France, Austria, Italy, Norway, New Zealand and Sweden).

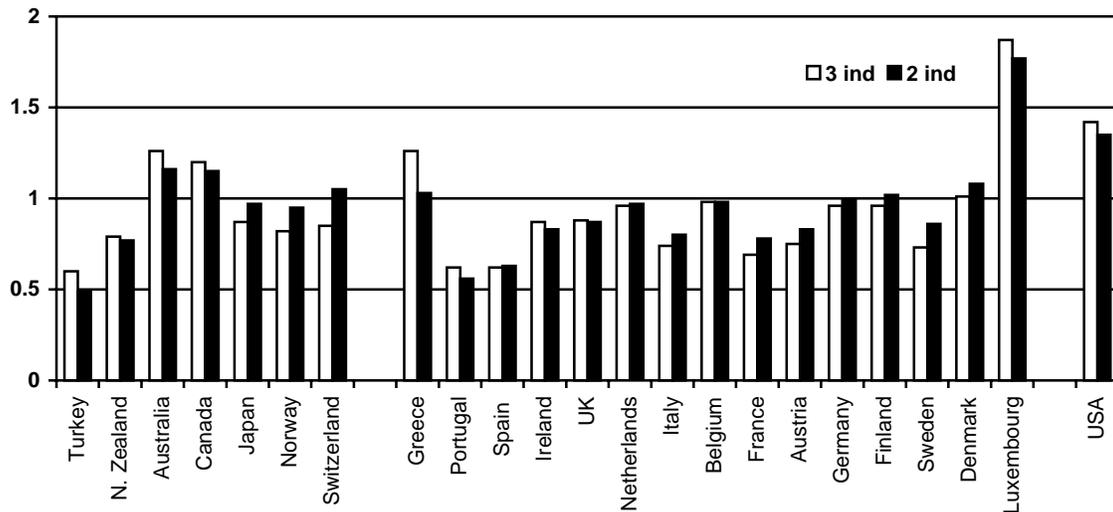


Figure 9. Relative commitments for reductions

As mentioned previously, in the sample used here there is a large degree of co-linearity between two of the terms in the formulae, i.e.  $CO_2/GDP$  and  $CO_2/capita$ . This implies that the formulae can be reduced to containing only one degree of freedom (in addition to the determination of the overall level of emission reduction); namely the weight distribution between a measure of emission intensity ( $CO_2/capita$  or  $CO_2/GDP$ ) and wealth ( $GDP/capita$ ). Figure 9 above also shows calculations based on an equal weighting of these two degrees of freedom (right hand column). Relative to the first calculation, more emphasis is now put on the wealth indicator, thus increasing the obligations of the rich countries and reducing the commitments of the relatively poor nations.

Figure 10 shows that for the three aggregated groups it does not matter very much whether 2 or 3 degrees of freedom are employed in the 'Norwegian' formulae (1) (indicated in the figure by the terms '2 ind.' and '3 ind.' respectively). In both cases, USA is required to reduce more by a factor between 1.4 and 1.5 compared to a flat rate requirement, while EU and the residual

group (RoA I) have equal requirements and only need to carry 80 percent of the flat rate burden.

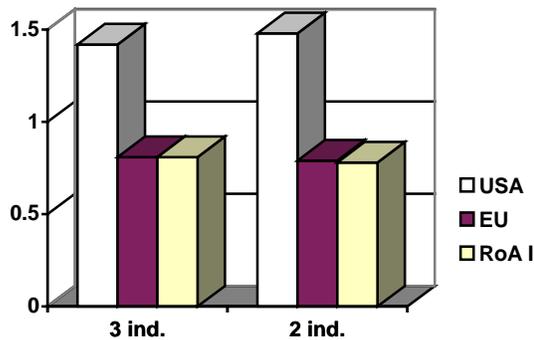


Figure 10. Differentiated commitments à la Norway with 3 and 2 degrees of freedom for aggregated groups of countries

#### 4. Summary and conclusions

As a summary we would state that in negotiating a climate treaty there are no way around the issue of burden sharing. Even within the simplest possible regime, consisting of flat rate reductions in each Annex 1 country, there is an implicit assumption of how the burden of commitments should be allocated. The gross unfairness of this ‘grand-fathering’ rule probably makes it unfeasible as a building block for an international climatic treaty.

In considering other possibilities for burden sharing one comes up against the problem that many of the countries in the residual group (approximately equal to the OECD countries outside EU and the USA) wants differentiated commitments, but also want to reduce *less* than the average commitment. The logical counter weight to this is, as we have seen, that USA, with high emission intensities and probably lower abatement costs than most of the other countries considered here, should reduce more. The question then is what the residual group can offer USA for such a deal. The EU has found an internal solution (with the help of sacrifices from Denmark, Germany and Austria) and will probably not want to participate in this game. It may thus seems that the only way forward is for the residual group to come to terms with USA in order to tap into this relatively large reservoir of cheap abatement, and make the payment in term of other concessions to the USA.

However, there is a possible avenue open that has not been explored in this paper, but that deserves further study. It concerns the position of the economies in transition. Generally, these countries have marginal reduction costs well below both those of the EU and the USA. A sensible approach for the residual group is therefore to explore the possibilities for joint implementation with this group of countries, and Russia in particular. It is still unclear, however, how stringent the commitments of this group of countries will be under a ‘Kyoto protocol’. In short, I propose the thesis that differentiated commitments are necessary to secure both a fair and a feasible outcome of the Kyoto conference, but that the ‘fringe OECD countries’ outside the EU and the USA will have to be more active vis á vis the economies in transition (and Russia in particular) in order to secure such a solution.

## 5. References

- Alfsen, K. H., A. Brendemoen and S. Glomsrød (1992): Benefits of climate policies: Some tentative calculations, Discussion Paper no. 69, Statistics Norway.
- Berg, E., S. Kverndokk and K. E. Rosendahl (1996): Market power, international CO<sub>2</sub> taxation and petroleum wealth, *Discussion Papers* 170, Statistics Norway.
- Brekke, K. A. (1997): *Economic growth and the environment. On the measurement of income and welfare*, Cheltenham: Edward Elgar Publishing Limited.
- Ekin, P. (1996): The secondary benefits of CO<sub>2</sub> abatement: How much emission reduction do they justify?, *Ecological Economics* 16, 13-24.
- European Environment Agency (EEA) (1996): *Climate change in the European Union*, Environmental Issues Series no. 2, Copenhagen.
- Fankhauser, S. (1995): *Valuing climate change. The economics of the greenhouse*, London: Earthscan Publications Ltd., p. 135.
- Fuglestedt, J. and T. Skodvin (1996): A comprehensive approach to climate change: Options and obstacles, Report 1996:4, Oslo: CICERO.
- Hagem, C. (1996): 'The value of information and the design of a climate contract under asymmetric information both before and after the contract is signed', CICERO Working Papers 1996:1.
- Hagem, C. and H. Westskog (1996): 'The design of a tradeable CO<sub>2</sub>-quota system under market imperfections', CICERO Working Papers 1996:2.
- IPCC (1996): Climate change 1995 - The Science of Climate Change, Technical Summary of the Working Group I Report.
- Kverndokk, S. (1995): Tradeable CO<sub>2</sub> emission permits: Initial distribution as a justice problem, *Environmental Values* 4, 129-148.
- Organisation for Economic Co-operation and Development (OECD) (1995a), *OECD Environmental Data Compendium*, OECD, Paris.
- Organisation for Economic Co-operation and Development (OECD) (1995b), *Energy Policies of IEA Countries, 1994 Review*, OECD, Paris.
- Rose, A. (1992): 'Equity considerations of tradeable carbon emission entitlements', in UNCTAD, *Combating global warming. Study on global system of tradeable carbon emission entitlements*, Geneva: UNCTAD.
- Torvanger, A., T. Berntsen, J. Fuglestedt, B. Holtmark, L. Ringius and A. Aaheim (1996): Exploring distribution of commitments. A follow-up to the Berlin Mandate, Report 1996:3, Oslo: CICERO.

## 6. APPENDIX 1: Annex 1 countries

<b>Annex I Countries</b>	<b>Annex I Countries</b>
Australia	Japan
Austria	Latvia a/
Belarus a/	Lithuania a/
Belgium	Luxembourg
Bulgaria a/	Netherlands
Canada	New Zealand
Czechoslovakia a/	Norway
Denmark	Poland a/
European Economic Community	Portugal
Estonia a/	Romania a/
Finland	Russian Federation a/
France	Spain
Germany	Sweden
Greece	Switzerland
Hungary a/	Turkey
Iceland	Ukraine a/
Ireland	United Kingdom of Great Britain and Northern Ireland
Italy	United States of America

a/ Countries that are undergoing the process of transition to a market economy.

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CICERO was established by the Norwegian government in April 1990 as a non-profit organization associated with the University of Oslo.

The research concentrates on:

- International negotiations on climate agreements. The themes of the negotiations are distribution of costs and benefits, information and institutions.
- Global climate and regional environment effects in developing and industrialized countries. Integrated assessments include sustainable energy use and production, and optimal environmental and resource management.
- Indirect effects of emissions and feedback mechanisms in the climate system as a result of chemical processes in the atmosphere.

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