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with contributions from Kathrin Joester

Taking the Lead: Post-2012 Climate Targets for the North

**Towards adequate and equitable
future climate commitments for
industrialised countries**

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Abstract

Any definition of adequacy consistent with the objective of the Climate Convention will require increased mitigation efforts in industrialized countries far beyond those levels agreed in Kyoto. This paper, therefore, focuses on future reduction targets for industrialised (Annex I) countries. It starts with an assessment of mid- and long-term targets already adopted in industrialised countries against the backdrop of required emission cuts to keep climate change within tolerable limits. Taking into account their heterogeneous national circumstances, the main part of the paper presents a method for differentiating Annex I countries with a view to assigning future mitigation and financial transfer commitments. This differentiation exercise is based on an analytical approach that was developed in the project “South-North Dialogue – Equity in the Greenhouse”. Slightly modifying the original approach the level of reduction targets is determined by the two criteria of “responsibility” and “potential” to mitigate. Obligations to provide financial and technological resources to developing countries, on the other hand, are to be assigned according to the “capability” criteria.

Comparing the results of the differentiation exercise reveals that the process of assigning mitigation and financial transfer commitments should be separated. The analysis of the potential and responsibility criteria highlights the need for further differentiation between industrialised countries when it comes to assigning reduction targets. As regards the provision of financial support, however, the analysis according to the capability criteria confirms that the differentiation made by the Climate Convention (Annex I – Annex II) is still valid. Extending the analysis to developing countries furthermore reveals that the differentiation between Annex I and non-Annex I countries is becoming increasingly obsolete.

Although a future climate agreement will not directly correspond to the results of any analytical differentiation exercise, starting from the basis of a rational and transparent approach could facilitate negotiations and, at least, indicate what a fair agreement might look like. This might favour the less powerful countries in negotiations, thereby leading to more equitable results.

1. Introduction

“Il est temps d’agir, car il nous faudrait trois planets pour survivre si tous les habitants du monde consommaient comme ceux des pays industrialisés aujourd’hui ...”
(French “Plan Climat 2004”; France 2004, p.4)

With some delay, the Russian decision to ratify the Kyoto Protocol in November 2004 has completed the era of multilateral environmental negotiations in the Nineties. On 16 February 2005, ninety days after Russia had deposited its ratification document at the United Nations Headquarter in New York, the Kyoto Protocol has entered into force. This was a crucial step for the development of the climate regime (Ott et al. 2005). However, it is also evident that the reduction targets contained in the Kyoto Protocol are only a small step towards achieving the objective of the Climate Convention to avoid “dangerous” anthropogenic climate change – and that many more steps will have to follow.

Any definition of adequacy consistent with the objective of the Climate Convention will require increased mitigation efforts far beyond the levels agreed in Kyoto and from virtually all countries. This means, first of all, further and much deeper emission cuts in industrialized countries. It means, second, the avoidance of emissions (compared to business-as-usual trends) in developing countries, and ultimately emission reductions for some of them. In recent years, most of the policy-oriented research on the design of a post-2012 climate regime has focused on options for the involvement of those countries that are classified as developing countries in the Climate Convention (“non-Annex I countries”) into a future limitation regime (e.g. Baumert 2002; Höhne et al. 2003; Ott et al. 2004).

Although this will certainly be a crucial issue in future negotiations (and crucial for the global emissions path), it sometimes distracts from the requirement for further substantial reductions in Western industrialised countries and in those countries with economies in transition. At least in the short- and mid-term, those developed countries, titled as Annex I countries in the climate regime, must continue to take the lead in combating climate change – both for adequacy and equity reasons. Annex I countries still contribute with more than half to global greenhouse gas emissions and their per capita emission level is, on average, more than four times higher than the average per capita emissions in non-Annex I countries. Besides, due to their technological and financial capability to undertake climate protection measures – but also due to their responsibility for causing climate change – it is up to them to show directional leadership, i.e. to demonstrate developing countries options for stepping into a fossil-fuel-free economy.

This paper, therefore, focuses on future reduction targets for Annex I countries and thereby complements an earlier report on potential ways for setting mitigation commitments for developing countries (Ott et al. 2004). It does so by providing some background information on what “deep cuts in the North” could mean. We will start with the reduction efforts required to keep climate change within tolerable limits. Then we will take stock of mid- and long-term targets that have already been adopted in Annex I countries and provide an assessment in view of the reductions required. The main part of the paper, however, will focus on a method for differentiating Annex I countries with a view to assigning mitigation and financial transfer commitments. The differentiation of targets among industrialised countries contained in the Kyoto Protocol was hardly systematic and much has changed during the last decade in many Annex I (and non-Annex I) countries. In view of the upcoming negotiations we have conducted a differentiation exercise based on the analytical approach that was developed in the project “South-North Dialogue – Equity in the Greenhouse”¹ (see Ott et al. 2004). This approach links the level of mitigation (and financial transfer) commitments to the respective national circumstances of a country. Although a purely analytically-based differentiation is unlikely to be implemented “as it is” in political negotiations, the results of our differentiation exercise reveal some useful lessons for the preparation of a future climate agreement.

¹ Further information on this project is available at <http://www.south-north-dialogue.net>.

2. The challenge: deep emission cuts for industrialised countries

Any future climate agreement should be guided by the overall objective of the Climate Convention (UNFCCC) to stabilize “greenhouse gas concentrations in the atmosphere at a level that would prevent *dangerous* anthropogenic interference with the climate system” (Art. 2 UNFCCC). Although Article 2 UNFCCC does not explicitly mention any concrete figure concerning the required stabilization level, scientific analyses on the impacts of climate change suggest that this should correspond with an increase of global average temperature by not more than 2°C compared to pre-industrial levels (see e.g. Hare 2003). This was also confirmed by the German Advisory Council on Global Change (WBGU) that conducted an extensive evaluation of limits to climate change for ecosystems, food production, water availability, economic development and human health (WBGU 2003a). However, even a temperature rise of 2°C already commits the Earth to significant climate change (IPCC 2001, Leemans/Eickhout 2004, Thomas et al. 2004) and requires adaptation measures starting in the near-term in those regions that are most vulnerable to climate change.

Based on this scientific assessment a number of governmental and non-governmental institutions have proposed that the term “dangerous” in Article 2 of the Convention be defined as a temperature increase above 2°C. The “2°C goal” is included in reports by the Dutch and the French government, it was agreed on in the European Council and is also the official position of the Climate Action Network (CAN 2002, EU 2005a; France 2004; Netherlands 2004).

Aiming at a maximum temperature increase of 2°C would most probably require atmospheric greenhouse gas concentration to stabilize well below 550 ppmv CO₂ equivalent.² This would require global emissions to peak at around 2015-2020³ and a reduction of global energy-related CO₂ emissions by about 45-60 % from

² Recent new findings on climate sensitivity (Schrag/Alley 2004; Stainforth et al. 2005) even suggest the necessity to achieve a lower stabilization level in order to stay within the 2° Celsius corridor (Hare/Meinshausen; 2004; UBA 2005). The Environment Council of the European Union concluded at its meeting in March 2005 that “recent scientific research and work under the IPCC indicate that it is unlikely that stabilisation of concentrations above 550 ppmv CO₂ equivalent would be consistent with meeting the 2°C objective and that in order to have a reasonable chance to limit global warming to no more than 2°C, stabilisation of concentrations well below 550 ppmv CO₂ equivalent may be needed” (EU 2005b, p. 10).

³ According to den Elzen/Meinshausen (2005) a delay in peaking of just five years up to 2020-2025 would imply a doubling of the maximum rates of emission reductions required to meet concentration levels of 450 ppm CO₂ equivalent or lower, thus leading to large costs impacts.

1990 levels by 2050 accompanied by substantial reductions of other greenhouse gases (WBGU 2003a).⁴ This would certainly pose an unprecedented global challenge and would require rather profound infrastructural transitions. However, the “Factor Four”-Scenario produced by the Wuppertal Institute demonstrates that under certain conditions a reduction of global CO₂ emissions by about 50 % by the middle of this century is not only technically feasible, but also economically viable – even if nuclear energy is phased out (Hennicke 2003; Hennicke/Fischedick/Wolters 2000; Hennicke/Müller 2005; see also Pacala/ Socolow 2004). According to this scenario, world primary energy consumption can be kept almost constant despite a gross world product that is three times higher by the year 2050, if priority is given to energy efficiency measures. If this is accompanied by active support to the market introduction of combined heating/cooling and power generation (CHCP) technologies and a broad mix of renewable energy technologies, the global emission reductions needed for an 2°C emission path are technically and economically achievable.

As greenhouse gas emissions in most developing countries will increase in the next decades to fulfil basic development needs, halving global greenhouse gas emissions by mid-century implies much deeper emission cuts for industrialised countries.⁵ According to the recommendations of the WBGU, the industrialised world would need to reduce its greenhouse gas emissions by at least 20 % by 2020 and further up to 80 % until 2050, taking 1990 as base year (WBGU 2003a; 2003b). This would require profound structural changes, but the report of the German study commission on sustainable energy supply has demonstrated for Germany that an 80 % reduction of CO₂ emissions by 2050 is technically and economically feasible (Enquete-Kommission 2002; Hennicke 2004; Hennicke/Müller 2005). For the European Union, a recent study of the Wuppertal Institute also proved the feasibility of a reduction of greenhouse gases by more than 30 % until 2020 (Lechtenböhmer et al. 2005).

This analysis was confirmed by the UK energy white paper which concludes “that the cost impact of effectively tackling climate change would be very small”. According to the British white paper the costs for the required mitigation policies and measures would be equivalent to an average annual reduction of between 0.01-0.02 percentage points from a business as usual GDP growth rate of 2.25 % per year – not taking into account the adaptation and damage costs avoided by

⁴ Den Elzen/Meinshausen (2005) calculate lower greenhouse gas reduction levels (e.g. 40-45 % below 1990 levels for stabilization at 400 ppmv CO₂ equivalent) as they allow for a certain overshooting for the lower concentration targets, i.e. concentrations may first increase to an “overshooting” concentration level and then decrease before stabilizing. However, based on Hare/Meinshausen (2004) they assume lower concentration levels (400/450 ppm CO₂ equiv.) to be required to limit global mean temperature below 2° Celsius.

⁵ Besides, industrialised countries need to provide financial and technological resources for mitigation activities in developing countries thereby enabling them to follow a less greenhouse gas intensive development path than the industrialised world has taken (*see chapter “Assigning the adequate level of transfer obligations”*).

tackling climate change (UK 2003, pp. 27-28). The analysis undertaken by the UK suggests that reaching the same level of GDP as in the business as usual projection for 2050 would only be delayed by a couple of months summing up to less than one year. A similar statement is contained in the Dutch 4th National Environmental Policy Plan: “(If) there is international agreement (...), the transition (*to a sustainable energy system*) is conceivable, feasible and affordable. (...) The estimated costs are of the same scale as the costs of the current energy system.” (Netherlands 2004).

Taking into account the potential impacts of climate change, the historical responsibility of industrialised countries, and the feasibility of a transition to a sustainable energy system, it is obvious that mitigation activities in Annex I countries must be strengthened considerably in the period after 2012. The emission targets set by the Kyoto Protocol were only a first step in inflecting the curve of growing emissions, and next steps must involve much more ambitious targets. The complexity and cost of a transition to a non-carbon economy will grow with each passing year of business-as-usual development, as society continues to invest in capital that embodies a commitment to years or even decades of continued greenhouse gas emissions. Therefore, setting longer-term reduction targets in the near future is required to give investors, business and consumers the right incentives to contribute with their activities to the decarbonisation of the economy.

3. Mid- and long-term targets adopted by industrialised countries

A number of Annex I countries have recognised the urgency of action and have already started thinking about next steps beyond the first commitment period of the Kyoto Protocol. Although the focus of national climate policy in most Annex I countries is on implementing the targets set in the Kyoto Protocol, some countries have realized that (long-term) target-setting could be a policy instrument to support the re-structuring of their fossil-based economies. A few countries have even agreed on mid- and long-term reduction targets for their country and/or suggested targets for Annex I countries as a whole (*see Table 1*).⁶ Although the legal status of those targets show a considerable variety, they document that there is, in some countries, the political will to show leadership and to continue the international struggle to combat climate change in an intensified manner.

Denmark was the first to show directional leadership when the Danish Ministry of Environment and Energy published the report “Climate 2012 – Status and Perspectives for Denmark’s Climate Policy“ in 2000. The report does not include a country specific target for Denmark but suggests a target for the group of industrialised countries. These should halve their greenhouse gas (GHG) emissions by 2030. The relevant section in the report reads as follows:

„The Danish Government would like to establish targets and frameworks for significant long-term reductions of greenhouse gases in keeping with the goal of the Convention. The industrialized countries must assume leadership in reducing greenhouse gas emissions, the development of new technology, and the transfer of this technology to the developing countries. On the basis of IPCC figures, the Government is working for a 50 per cent reduction in greenhouse gas emissions in the industrialized countries by 2030.“ (Denmark 2000, p. 13 ; emphasis added)

Another country from Northern Europe, **Sweden**, was the next country that outlined a long-term reduction target. In line with other proposals, the “Swedish Climate Strategy” that was published in 2001 refers to a stabilization target below 550 ppmv CO₂ equivalents. However, the Swedish emission target differs from

⁶ This chapter is based on results of a survey on existing emission reduction targets beyond 2012 that has been drawn up in two steps: First, documents focusing on mid- and long-term national climate protection strategies that have been published on the internet by ministries and federal agencies were collected and evaluated. The second step consisted of sending a short questionnaire to national focal points for climate policy in Annex I countries asking for mid- and long-term climate strategies/targets/positions.

others as it does not aim at a reduction rate of absolute emissions but focuses on reducing per capita emissions. By mid-century the average annual emissions of every Swedish citizen should not be more than 4.5 tonnes of CO₂ equivalent:

“Sweden shall act internationally to prevent the concentration of greenhouse gases exceeding the equivalent of 550 ppm (parts per million) carbon dioxide equivalents. By 2050, emissions of greenhouse gases in Sweden should total less than 4.5 tonnes of carbon dioxide equivalents per capita per annum and emissions should continue to decrease thereafter.” (Sweden 2001, p. 15; emphasis added)

Compared to emission levels in 2000 (7.9 tonnes CO₂ equiv. per capita) this implies a 43% reduction of absolute emissions assuming constant population figures. Similar to the Swedish approach, the target included in the national climate change programme of the **Czech Republic** – adopted in March 2004 – also focuses on emission levels per inhabitant. Quite ambitiously, the plan includes a 30 % (25 %) reduction target for per capita emissions of CO₂ (GHG) by the year 2020 compared to 2000 emission levels (Czech Republic 2004). Up to now, the Czech Republic is the only country from Eastern Europe that has adopted a national mid-term target. What it makes even more outstanding is the choice of the base year as greenhouse gas emissions in 2000 were already 23.1 % lower than 1990 (UNFCCC 2004).

Another key country, the **United Kingdom**, has underscored its leadership role by setting itself a long-term emission target. The Energy White Paper “Our energy future – creating a low carbon economy” published in 2003 by the British government contains a commitment to a 60 % reduction target by mid-century. The relevant paragraph in the White Paper reads as follows:

“Our ambition is for the world’s developed countries to cut emissions of greenhouse gases by 60% by around 2050. We therefore accept the Royal Commission on Environmental Pollution’s (RCEP’s) recommendation that the UK should put itself on a path towards a reduction in carbon dioxide emissions of some 60% from current levels by about 2050.” (UK 2003, p. 25; emphasis added)

For the mid-term, the White Paper outlines further cuts in CO₂ emissions by 2020 that correspond to a 25-31 % reduction compared to 1990 emission levels (UK 2003, p. 13). This figure is slightly less ambitious than the target the German government has set for 2020. In view of the negotiations on future commitment periods of the Kyoto Protocol, **Germany** aims at a 40 % emission reduction by 2020 compared to 1990 levels. However, this goal was made conditional to the prerequisite that the European Union as a whole commits itself to a minus 30 % target during the same time period. This target was mentioned for the first time in the coalition treaty between the Green and the social-democratic party in 2002

(Germany 2002) and received official status when it was included in the progress report on the National Sustainability Strategy (Germany 2004) and in the National Climate Protection Programme (Germany 2005).

The Dutch government also suggested some numbers for mid- and long-term targets in its “4th National Environmental Policy Plan” that was published in 2004. Concerning global emission levels the report states that “if climate change is to be kept within acceptable limits, global emissions will have to be stabilised at the present level in 2030 and then be halved by the end of century” (Netherlands 2004). Focussing on emissions of Western Europe, the report refers to a RIVM study that recommends a 40 to 60 % reduction of CO₂ emissions by 2030 compared to 1990 levels. Still under discussion is a mid-term target for the Netherlands to reduce greenhouse gas emissions by 30 % in 2020 (Gupta/ Asselt 2004).

Also last year, the French government adopted its “Plan Climat 2004” (France 2004). According to the original schedule the release of the plan was envisaged for 2003 but this date was repeatedly postponed with the effect that the “Plan Climat 2003” has become the “Plan Climat 2004”. Though the announced policies and measures included in the plan were criticized for their shortcomings (RAC-F 2004) it contains the most ambitious long-term target of all Annex I countries. The overall objective is to halve global greenhouse gas emissions by 2050 in order to limit the increase of global average temperature to 2°C above pre-industrial level. To reach this objective the French government aims at a 75-80 % reduction of emissions during the same time period – a target that is also suggested for industrialised countries as a whole.

“Al'échelle mondiale, il nous faut avoir divisé par deux les émissions de gaz à effet de serre à l'horizon 2050. Cela suppose que les pays industrialisés, dont la France, parviennent à les diviser d'ici là par quatre à cinq, c'est-à-dire réduisent leurs émissions d'environ 3% par an sur les 50 prochaines années.” (France 2004, p. 4)

Finally, the **European Union** confirmed in March 2005 its 2°C target already adopted by the Environment Council in 1996 (EU 1996) and recommended mid- and long-term targets required for achieving it. In this context, the Environment Council concluded that “reduction pathways by the group of developed countries in the order of 15-30 % by 2020 and 60-80 % by 2050 compared to the baseline envisaged in the Kyoto Protocol should be considered” (EU 2005b, p. 13). The minus 15-30 % target for 2020 was also confirmed by the subsequent conclusion of the European Council (EU 2005a).

Table 1: Overview on current mid- and long-term quantified mitigation targets in Annex I countries

Country	Reduction target	Green-house gases	Target year/ period	Base year	Year of adoption	Legal status	Other targets / comments
Czech Republic	30% of per capita emissions	CO ₂	2020	2000	2004	National Climate Change Programme	Targets should be aimed at “after the end of the first commitment period of the Kyoto Protocol”.
	25% of per capita emissions	all GHGs	2020				
Denmark	50% (industrialized countries)	all GHGs	2030	1990	2000	Report by the Ministry of the Environment and Energy	Base year not explicitly mentioned.
European Union	15-30% (developed countries)	all GHGs	2020	1990	2005	Conclusion of the Environment Council of the European Union; Conclusion of the Council of the European Union	Council conclusion only contains the 2020 target; global temperature increase $\leq 2^{\circ}\text{C}$; stabilisation of atmospheric GHG concentration <i>well below</i> 550 ppmv CO ₂ equiv.
	60-80% (developed countries)		2050				
France	75(-80)% (France; industrialized countries)	all GHGs	2050	2000	2004	National Climate Policy Programme: “Plan Climat 2004”	Global temperature increase $< 2^{\circ}\text{C}$; atmospheric CO ₂ concentration < 450 ppm; halving global GHG emissions by 2050; base year not explicitly mentioned.
Germany	40% (Germany) 30% (EU)	all GHGs	2020	1990	2004	Progress report on the National Sustainability Strategy	German target conditional on the EU adopting a -30% target; global temperature increase $\leq 2^{\circ}\text{C}$.

Netherlands	40-60% (Western Europe)	CO ₂	2030	1990	2004	4 th National Environmental Policy Plan	Global temperature increase $\leq 2^{\circ}\text{C}$ and $< 0.1^{\circ}\text{C}$ per decade; sea level rise < 50 cm; stabilization of global emissions in 2030 and halving by the end of the century.
Sweden	Per capita emissions $\leq 4.5\text{t}$ CO ₂ equivalent; ➔ ~43 % reduction of 2000 emission level	all GHGs	2050	-	2001	Government Bill: "The Swedish Climate Strategy"	Atmospheric CO ₂ equiv. concentration ≤ 550 ppm.
United Kingdom	60% (UK; developed countries)	CO ₂ (UK) all GHGs (developed countries)	2050	2000	2003	Energy white paper	National goal: 20% reduction in CO ₂ emissions by 2010; reductions of 15-25 MtC below current emission projections (135 MtC) by 2020; base year not explicitly mentioned ("reduction (...) from current levels").

Sources: Czech Republic (2004), Denmark (2000), EU (2005a, 2005b), France (2004), Germany (2004), Netherlands (2004), Sweden (2001), UK (2003).

At a first glance, these mid- and long-term targets are hardly comparable due to varying base/target years and different greenhouse gases/countries included. To facilitate the comparison of the reduction levels proposed, we have indexed targets against 1990 emissions and calculated the required reduction levels for every decade beyond 2010 by linear extrapolation (*see Table 2*).

Table 2: Comparison of mid- and long-term reduction targets in Annex I countries

	Kyoto						
	1990	2000 ²	2010	2020 ³	2030	2040	2050
Annex I - Denmark	100	93.9	94.8	72.4	50.0	-	-
Annex I - EU	100	93.9	94.8	77.5	61.7	45.8	30.0
Annex I - France	100	93.9	94.8	77.0	59.1	41.3	23.5
Annex I - UK	100	93.9	94.8	80.5	66.2	51.9	37.6
EU (15) - Netherlands	100	96.7	92.0	71.0	50.0	-	-
EU (25)¹ - Germany	100	90.7	92.3	70.0	-	-	-
Czech Republic - GHG	100	76.9	92.0	57.7			
Czech Republic - CO₂	100	78.0	92.0	54.6			
France	100	98.8	100.0	81.2	62.4	43.5	24.7
Germany	100	81.3	79.0	60.0	-	-	-
Sweden	100	93.6	104.0	91.3	78.7	66.0	53.3
UK	100	87.2	87.5	72.0	59.6	47.3	34.9
Annex I – 2°C (WBGU)	100	93.9	94.8	80.0	60.0	40.0	20.0

1: Data for Malta and Cyprus were not included in calculations; most recent data for Lithuania from 1998.

2: Emissions according to reported UNFCCC inventory data.

3: The UK and “Annex I - EU” figures are not based on linear extrapolation but on the respective targets for 2020.

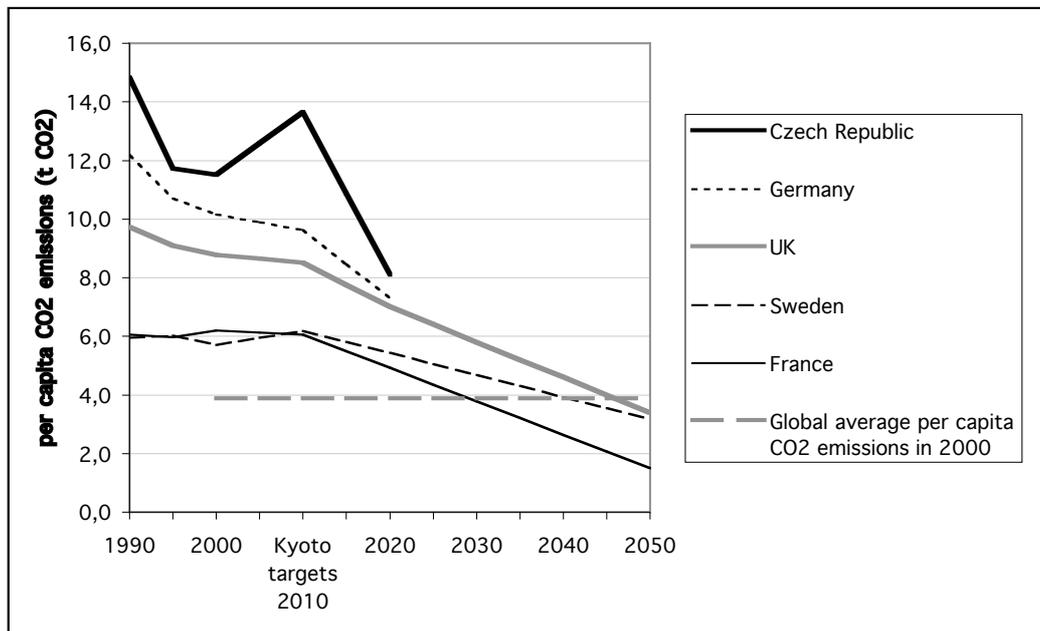
Bold figures are the highest, grey figures are the lowest in the respective year.

Data source: UNFCCC (2004); calculations by authors.

For 2020, almost all targets are in line with or are even more ambitious than the reference 2°C-WBGU-path (at least -20 %). The most ambitious figures are the Czech targets (-45.4 % for CO₂, -42.3 % for GHG) followed by the national targets of Germany (-40.0 %). However, assuming that 2010 levels will be equal to Kyoto targets it becomes clear that the Danish/Annex I target as well as the German/EU-25 and the Dutch target/Western Europe target also require high reduction efforts (> 20 %) from 2010 to 2020.

For 2030, reduction levels are still approximately on a 2°C path. In particular, the Danish/Annex I and the Dutch/Western Europe targets are even below the reference path. Only the Swedish figures are in both periods well above the reference path. This can be explained, however, with the special national circumstances. Due to large contribution of renewable energies to the Swedish energy portfolio its greenhouse gas emissions are already relatively low (on a per capita and per GDP basis) if compared to other Annex I countries so that the emission levels aimed at will still be relatively low despite “less ambitious” reduction targets (see Figure 1).

Figure 1: Country targets on a per capita basis⁷



Data source: IEA (2004); calculations by authors.

Looking at the 2040 and 2050 reduction levels, not only the Swedish but also the UK figures clearly deviate from the 2°C reduction path whereas the French proposal almost demonstrates coherence. Taking into account the special Swedish situation this means that all suggested targets are in line with the EU target of a maximum temperature increase by 2°C with the only exception being the UK.

⁷ Assuming constant population figures. Taking into account population changes according to the projections by the United Nations Population Division (“medium variant”) the per capita targets of the U.K. and France decrease from 3.4 to 3.0 t CO₂ and from 1.5 to 1.4 t CO₂, respectively, while the German target for 2020 would remain at 7.3 t CO₂ (UN Population Division 2005).

4. Differentiating commitments among industrialised countries

Defining the adequate level of overall future emissions in industrialised countries is only the first challenge. Another crucial issue is how to assign mitigation commitments to countries in a way that takes differing national circumstances into account. In doing so, the Convention principle of “common but differentiated responsibilities and respective capabilities” is the most important. This principle already inspired the differentiation between Annex I and non-Annex I countries, a grouping that mirrors to a certain extent the development levels of countries in the late Eighties and the early Nineties when the Convention was negotiated. However, looking today at the mid- and long-term evolution of the climate regime, the wide diversity of national circumstances within these two groups requires further differentiation. Most research done in this field focuses on non-Annex I countries, aiming at identifying those countries that are already industrialising and therefore, more capable to take over mitigation commitments in future commitment periods (see e.g. Bodansky 2004; Höhne et al. 2003; Ott et. al 2004). It is quite obvious, however, that in the short- and mid-term the developed world needs to contribute most to emission reduction efforts. Nevertheless, there is hardly any literature assessing the differences among Annex I countries.

The differentiation among industrialised countries in Annex B of the Kyoto Protocol was hardly systematic. Even Raúl Estrada, chairman at COP 3 and often called the “father” of the Kyoto Protocol, is cited as “still looking for the basis of these figures” (Oberthür/Ott 1999, p.120). However, one of the challenges in defining an adequate and equitable global climate agreement for the future is to deliberate differentiation on the basis of an open, transparent, analytically-based framework. This is not only true for the integration of non-Annex I countries in a commitment regime but also for the differentiation of reduction targets and financial transfer commitments among Annex I countries.

The burden sharing agreement of the European Union indicates how this might work. Internal EU negotiations started on the basis of a systematic assessment of the specific circumstances in different sectors of the economy in each country according to the “Triptych approach” (Blok et al. 1997) and resulted in a broad range of country-specific emission targets (Oberthür/Ott 1999, pp. 141-145). Aiming at a total reduction level of 8 %, the agreement allows some countries to increase their emissions well above 1990 levels (e.g. Portugal +27 %, Greece +25 %) while others have taken on reduction targets much higher than the average EU level (e.g. Luxemburg -28 %, Denmark/Germany -21 %) (UNFCCC 2002).

Broadening this spirit of differentiation and solidarity to the international level is a prerequisite for the success of future climate negotiations.

4.1 Applying a modified “South-North” approach

The analytical approach applied in this section for differentiation among Annex I countries is based on an approach that was developed in the project “South-North Dialogue – Equity in the greenhouse” (for further information see <http://www.south-north-dialogue.net>). This dialogue brought together fourteen researchers from all world regions to discuss building blocks of a future climate agreement and resulted in the joint proposal “Towards an adequate and equitable global climate agreement” (see Ott *et al.* 2004). One of the main elements of this proposal was an approach for differentiation among developing countries. This approach will be applied, in a modified manner, to differentiate Annex I countries.

To be both fair and reflective of national circumstances, the “South-North” differentiation framework is based on the criteria of responsibility, capability and potential to mitigate:

- Responsibility – as a reflection of a Party’s contribution to the climate problem through historic and ongoing greenhouse gas emissions.
- Capability – as a reflection of a Party’s financial and socio-economic means to help overcome the climate problem.
- Potential – as a reflection of the mitigative opportunities within a Party’s economy to reduce greenhouse gas emissions or to pre-empt the growth of greenhouse gas emissions through cleaner development.

For each of these criteria, specific, concrete indicators are considered to quantitatively capture each country’s national situation (*see Table 3*).

Responsibility has been defined in the Brazilian proposal as a country’s contribution to temperature increase (UNFCCC 1997; La Rovere *et al.* 2002). In our analysis, however, the approximation of cumulative emissions of fossil CO₂ over the period 1990 to 2000 will be used. This relatively recent period avoids “punishing” countries for historical emissions, when the consequences were less widely known. At least since the IPCC’s First Assessment Report in 1990, the implications of increasing greenhouse gas concentrations in the atmosphere can be said to be well-known internationally. This indicator is arguably quite generous to countries that started to industrialize early and whose emissions up to 1990 are significant.

Capability as a criterion recognises the fact that a country's capability to reduce emissions might be quite different from its level of responsibility. A country may have relatively high historical emissions and thus high responsibility for contributing to climate change, but nonetheless be too poor to devote resources toward mitigation and/or it might not have access to the needed technologies. As an approximation of (economic) capability the Gross Domestic Product on the basis of purchasing power parities (GDP-PPP) per capita is used.

Potential to mitigate can be related to two indicators – emissions per capita, and emissions intensity ($\text{CO}_2/\text{GDP-PPP}$). A high value for $\text{CO}_2/\text{GDP-PPP}$ would suggest high potential to mitigate.⁸ The more efficient an economy already is (lower CO_2 emissions per unit GDP-PPP), the less potential there is (at a given cost) to mitigate further through efficiency. However, the level of emissions per capita needs to be taken into account as well. High per capita emissions suggest unsustainable consumption patterns, which implies considerable potential to mitigate without endangering a basic level of development, e.g. by life style changes.

Quantitatively assessing the indicators for responsibility, capability and potential for Annex I countries clearly captures the differences among them (*see Table 3*) and suggests the different levels of emission reduction/financial transfer targets to which an equitable regime should oblige them.

Annex I countries cover a wide range of values for each of the three criteria, including very high values and sometimes lower values as well, as shown in Table 3. Responsibility to mitigate is above world average for all Annex I countries except Turkey, but ranging from 29.1 t CO_2 /person (Turkey) up to 240 t CO_2 /person (Luxembourg). Regarding capability as reflected by GDP per capita, Annex I includes the 16 countries with the highest income level but also six countries with values below world average. The emission intensity of the economy as an indicator for the potential to mitigate is rather low for the majority of Annex I countries, but there are also 12 countries included in Annex I that have higher values than world average. In contrast, the other indicator for potential, GHG/capita, is above world average in all Annex I countries with the only exception being Latvia.

This diversity of national circumstances indicates the need for further systematic differentiation among Annex I countries. The purpose for this additional differentiation is two-fold: On the one hand it builds the basis for assigning different levels of reduction targets. On the other hand it serves to identify those

⁸ Emissions intensity ($\text{CO}_2/\text{GDP-PPP}$) was chosen as an indicator of mitigation potential following the "South-North" approach. Arguably, indicating the reduction potential of a country would rather require country specific bottom-up analyses. However, as this complexity could conflict with the requirements of political negotiations we keep using the simpler metric.

countries that should provide the bulk of financial resources to non-Annex I countries with high potential to mitigate, in order to allow those countries to take on demanding emission targets (see Ott et al. 2004).

Analysing further reduction targets for industrialised countries requires a slight deviation from the approach developed in the context of the “South-North” proposal. In contrast to the original “South-North” approach we will not apply an index combining all criteria for differentiating among those countries. Instead, we will assign reduction targets according to an index derived from the “potential” and “responsibility” criteria because this reflects more adequately the real situation of those countries as regards their mitigation potential. In most industrialised countries the capability to realize domestic emissions reductions can be assumed and many studies show that even demanding reduction levels will only imply minor impacts on GDP growth rates (see e.g. Enquete-Kommission 2002, Hennicke 2004, UK 2003). Obligations to provide financial and technological resources to non-Annex I countries, however, will be assigned by purely applying the capability criteria.

Table 3: Criteria for differentiating countries

	Annex I	Annex II	Annex I, but not Annex II	non-Annex 1	World
Potential to mitigate CO₂/GDP, 2000 (in t CO ₂ / Mill. US \$-PPP) - Range - Group average	210 to 1,768 538	210 to 706 476	385 to 1,768 1,090	17 to 2 325 537	16.8 to 2,324 540
GHG/capita, 2000 (in t CO ₂ equiv.) - Range - Group average	4.4 to 24.9 14.6	7.1 to 24.9 15.9	4.4 to 14.0 10.0	0.2 to 67.9 3.3	0.2 to 67.9 5.6
Responsibility to mitigate Cumulative CO₂/capita, 1990-2000 (in t CO ₂) - Range - Group average	29.1 to 240.2 128.1	58.4 to 240.2 134.9	29.1 to 151.2 95.4	0.1 to 521.8 19.2	0.1 to 521.8 40.5
Capability to mitigate GDP/capita, 2000 (in US \$-PPP) - Range - Group Average	3,980 to 53,410 22,062	16,530 to 53,410 27,526	3,980 to 16,530 7,011	450 to 23700 3,686	450 to 53,410 7,316
GHG emissions, 2000 (in Mt CO ₂ equiv.) - Total: - Top five:	17,088 USA: 6,932 Russia: 1,905 Japan: 1 334 Germany: 972 Canada: 714 [EU (15): 3 978]	13,622 USA: 6,932 Japan: 1,334 Germany: 972 Canada: 714 U.K.: 662 [EU (15): 3 978]	3,829 Russia: 1,905 Ukraine: 522 Poland: 375 Turkey: 362 Czech Rep.: 143	15,630 China: 4 967 India: 1 854 Brazil: 841 Korea (South): 526 Mexico: 511	33,621 USA: 6 932 China: 4 967 Russia: 1,905 India: 1 854 Japan: 1 334 [EU (15): 3 978]

Sources: WRI (2003).

4.2 Assigning levels of reduction targets

In this differentiation exercise the “potential to mitigate” together with the responsibility criteria determines the level of the reduction target for a given country. A country with high potential would be obliged to exploit this potential, i.e. to accept high reduction targets to be carried out domestically. This principle seeks to ensure that the climate regime is economically efficient, in the sense of directing mitigation efforts toward those countries in which there is the biggest potential for mitigation. The level of the reduction target is further determined by a country’s responsibility for causing climate change. Those countries with high historical emissions have already used their share of the global common “atmosphere”. They have, therefore, the responsibility to strictly reduce their emissions in order to allow other countries access to this global good for fulfilling their basic development needs.

Due to high per capita emissions and/or a high emission intensity of their economy, almost all Annex I countries have a high potential to mitigate greenhouse gas emissions compared to the majority of non-Annex I countries. All of these countries furthermore are responsible above average for the accumulation of greenhouse gases in the atmosphere. Therefore, an adequate and equitable global climate agreement requires that all Annex I countries retain or, in the case of Australia and the United States of America, take on Kyoto-style commitments, i.e. quantified (absolute) emission reduction obligations. However, the level of reduction efforts needs to be differentiated according to the respective potential and responsibility to mitigate.

The following differentiation exercise seeks to provide an analytical base for determining different levels of reduction targets. Annex I countries were categorized in three groups according to an index equally weighting cumulative per capita CO₂ emissions and a “potential” index derived from CO₂/GDP-PPP and GHG/capita (equally weighted).⁹ The group of “High Emitters” was identified as those countries with an index value one standard deviation above the mean, i.e. those with the highest aggregate score (*see Table 4 for the composition of the groups and Appendix I for values of indicators/indexes*). These countries would have to take on reduction targets that are far more demanding than Kyoto levels in the subsequent commitment periods. Those Annex I countries with a medium index value (mean plus/minus one standard deviation) compose the group of “Elevated Emitters” with lower targets than the former group. Finally, the

⁹ Using the Climate Analysis Indicator Tool (CAIT) the indicators were indexed to a scale of 0 to 100, where 0 represents the minimum value in the data set and 100 represents the maximum value (WRI 2004). The indexing formula is as follows:

$$\text{Index value} = 100 * (\text{actual value} - \text{minimum value}) / (\text{maximum value} - \text{minimum value}).$$

remaining six Annex I countries that are not part of any of these two groups are titled “Moderate Emitters” as they have low index values if compared to Annex I average. Correspondingly, they only need to take on relatively low reduction targets, since their potential/responsibility to reduce emissions is limited.

Table 4: Industrialised countries with different levels of reduction targets

	HIGH EMITTERS	ELEVATED EMITTERS	MODERATE EMITTERS	
	<i>→High reduction targets</i>	<i>→Medium reduction targets</i>	<i>→Low reduction targets</i>	
1	Australia	Austria	Croatia	1
2	Canada	Belarus	Latvia	2
3	Czech Republic	Belgium	Lithuania	3
4	Estonia	Bulgaria	Sweden	4
5	Luxembourg	Denmark	Switzerland	5
6	Russian Federation	Finland	Turkey	6
7	Ukraine	France		7
8	USA	Germany		8
9		Greece		9
10		Hungary		10
11		Iceland		11
12		Ireland		12
13		Italy		13
14		Japan		14
15		Netherlands		15
16		New Zealand		16
17		Norway		17
18		Poland		18
19		Portugal		19
20		Romania		20
21		Slovakia		21
22		Slovenia		22
23		Spain		23
24		United Kingdom		24

This exercise does not aim at assigning concrete, quantitative targets for each individual country, but merely serves to provide a rough indication of the level of commitment that might be expected from each country. Quite obviously, the determination of individual targets will be the result of political and diplomatic negotiations, where the respective negotiation weight and willingness of each country will play an important role. Besides, a “special treatment” of non-Parties

to the Kyoto Protocol and of rather “poor” countries with low ability to pay for mitigation activities¹⁰ might require a deviation from the analytical grouping.

A further analysis of the differentiation results offers some more surprising insights. For example, all countries in the group of “Moderate Emitters” have much lower index values than those non-Annex I countries that were identified in the “South-North” proposal as “Newly Industrialised Countries” (NICs; *see Appendix 2*). Most NICs would even fall into the category of “High Emitters”.

Taking this analysis a bit further we have explored the question: What would the grouping look like if all countries, Annex I and non-Annex I, were included? Applying this differentiation approach to the global level reveals that additional to the eight “industrialised” countries originally included in the group with the highest index values (one standard deviation above mean) 15 more countries in this range are non-Annex I countries (*see Table 5; list of all countries in Appendix 3*).¹¹ On the other hand, the “Moderate Emitters” only occupy a medium-rank, with many non-Annex I countries showing higher values. This points to the fact that, although the first level of differentiation between Annex I and non-Annex I countries will probably remain valid for the next commitment period(s) for political reasons, in the long term any fair and equitable climate agreement will require to treat at least some non-Annex I countries in a similar manner as Annex I countries as far as assigning mitigation obligations is concerned.

Table 5: Differentiation of countries according to potential/responsibility at a global level

HIGH EMITTERS (industrialised and developing countries)			
1	<i>Qatar</i>	13	Estonia
2	<i>United Arab Emirates</i>	14	Canada
3	<i>Kuwait</i>	15	<i>Turkmenistan</i>
4	<i>Bahrain</i>	16	<i>Uzbekistan</i>
5	<i>Nauru</i>	17	<i>Brunei</i>
6	United States of America	18	Czech Republic
7	Luxembourg	19	<i>Mongolia</i>
8	Russian Federation	20	<i>Serbia & Montenegro</i>
9	<i>Trinidad & Tobago</i>	21	<i>Saudi Arabia</i>
10	Ukraine	22	<i>Singapore</i>
11	Australia	23	<i>Suriname</i>
12	<i>Kazakhstan</i>		

¹⁰ The income level of four countries (Bulgaria, Romania, Russia, Ukraine) within the groups of High and Elevated Emitters is below world average.

¹¹ However, the capability to mitigate is quite low in some of these non-Annex I countries such as Suriname, Mongolia and Uzbekistan (*see Appendix 4*).

4.3 Assigning the adequate level of transfer obligations

For obvious reasons of capability and responsibility, but also for political reasons, Annex I countries will have to shoulder their own mitigation activities without financial compensation beyond the use of the Kyoto mechanisms (emission trading, joint implementation and the clean development mechanism).¹² Furthermore, according to the “South-North” proposal, Annex I countries will have to provide financial and technological resources to those groups of developing countries with high potential to mitigate but low to medium ability to pay for the required climate protection efforts. Without financial and technological support of industrialised countries, the economic development of the South along a low-greenhouse gas path is hardly conceivable. This, however, is an intrinsic part of meeting the climate challenge.

The Climate Convention already includes provisions on financial support for mitigation activities in developing countries. In this context, the Convention further differentiates Annex I countries in “Western” industrialised countries, which are listed in Annex II to the Convention, and countries with economies in transition. This further categorization took into account the differing ability to pay, but also the political landscape in the early Nineties. Annex II countries must provide “financial resources, including for the transfer of technologies, needed by the developing country Parties to meet the agreed full incremental costs” for fulfilling their (mitigation) commitments defined by the Convention (Article 4.3 UNFCCC). Those industrialised countries not listed in Annex II shall only assist vulnerable countries in adapting to climate change (Article 4.4 UNFCCC). These provisions can build a suitable legal basis for a transfer provision like that included in the “South-North” approach, but have to be developed further to binding obligations. It needs to be assessed, however, whether the categorization of industrialised countries in Annex I and Annex II is (still) a suitable basis for assigning transfer obligations.

We suggest that the scale of financial and technological resources each Annex I country is required to transfer to developing countries is determined by its (economic) capability. Accordingly, countries with high capability will provide support for mitigation activities in developing countries that have high mitigation potential but comparatively little capability.

As an approximation to a country’s capability we used the per capita income level and categorized Annex I countries in two groups according to their GDP-PPP values. This grouping provides the analytical base for determining different levels

¹² Only a few Annex I countries might need assistance from other Annex I countries to achieve the reduction targets assigned to them. E.g. Russia and Ukraine have a very high potential to mitigate and are therefore categorized as “High Emitters” but may lack the capability to implement required mitigation activities as their income level is below world average.

of transfer obligations. The group of “Affluent Countries” was identified as those countries with GDP figures above Annex I average income level (*see Table 5 for the composition of the groups*). These countries need to provide the highest transfers to developing countries. The second group of “Moderately Wealthy Countries” also have to pay for mitigation activities in developing countries but at a considerably lower level than the first group.

This differentiation reveals that the original categories of the Climate Convention were chosen rather well: The new grouping corresponds to a large extent with the Annex I-Annex II differentiation in the Convention – only four countries (Greece, New Zealand, Portugal, Spain) would fall into another category compared to the Convention. Taking into account that these four countries have the highest values within the group of “Moderately Wealthy Countries” (and that three of them are members of the European Union) one could argue for maintaining the categorization as defined in the Convention for the next round of negotiations.

Table 6: Industrialised countries with different levels of transfer obligations

AFFLUENT COUNTRIES		MODERATELY WEALTHY COUNTRIES	
-> <i>High financial transfers</i>		-> <i>Low financial transfers</i>	
1	Australia	Belarus	1
2	Austria	Bulgaria	2
3	Belgium	Czech Republic	3
4	Canada	Croatia	4
5	Denmark	Estonia	5
6	Finland	<i>Greece</i>	6
7	France	Hungary	7
8	Germany	Latvia	8
9	Iceland	Lithuania	9
10	Ireland	<i>New Zealand</i>	10
11	Italy	Poland	11
12	Japan	<i>Portugal</i>	12
13	Luxembourg	Romania	13
14	Netherlands	Russian Federation	14
15	Norway	Slovakia	15
16	Sweden	Slovenia	16
17	Switzerland	<i>Spain</i>	17
18	United Kingdom	Turkey	18
19	USA	Ukraine	19

Taking this differentiation exercise to the global level, i.e. to including Annex I and non-Annex I countries, yields the following results (*see Appendix 4*). The

group of countries with the highest index values (one standard deviation above the mean) would still consist mainly of Annex II countries. Nine of 33 countries in this top category, however, would come from non-Annex I “developing” countries – mainly oil-producing states (Brunei, Kuwait, Qatar and United Arab Emirates), two Asian newly industrialised countries (Singapore, Taiwan), the new EU member state Cyprus, Israel and Bahamas. Even more remarkable is the fact that six Annex I countries (Bulgaria, Latvia, Romania, Russia, Turkey, Ukraine) do not belong to the group of those 60 countries with an income level above world average.

Even if the result of the global capability differentiation does vary less than the differentiation according to the potential/responsibility criteria, we conclude that not in the next round of negotiations but in the mid- and long-term the differentiation between Annex I and non-Annex I countries will need to be revised due to evolving national circumstances.

5. Conclusions

Our analysis has revealed some valuable insights for the further development of the climate regime. We do hope that it might serve to correct some of the myths regarding potential and capability of industrialised and developing countries to undertake meaningful action to protect the climate. These myths refer partly to the ability of industrialised countries, but also to the differences between industrialised and developing countries.

First, the analysis underlines the need to develop a thorough analytical base for the negotiations of post-2012 commitments in the framework of the Kyoto Protocol. Besides the challenge to integrate developing countries (non-Annex I countries) into a regime of quantified mitigation commitments, the negotiation of further and more substantial reduction targets for industrialised countries (Annex I) presents a major challenge that makes the negotiations for the Kyoto Protocol look easy. Comparable to the “Triptych approach” that was used by the European Union in the early stages of negotiations for its burden-sharing agreement, a thorough analytical base will at least provide a reference for the direction where negotiations should be heading.

Second, the analysis highlights the need for further differentiation between industrialised countries because of their differing level of potential and responsibility to mitigate greenhouse gas emissions. Any future climate agreement that is to be consistent with the ultimate objective of the Climate Convention but also economically efficient would require to direct mitigation efforts toward those countries in which there is the most potential for mitigation. Therefore, the level of reduction targets for countries should be guided by the potential (and responsibility) criteria – irrespective of political willingness and/or advanced negotiation strategies.

Third, regarding the capability of industrialised countries, the analysis confirms that the differentiation made by the Convention regarding the provision of financial support (Annex I-Annex II) is still valid. “Western” industrialised countries are still those most capable to assist developing countries in complying with their mitigation commitments. The capability of the remaining countries listed in Annex I, however, is very heterogeneous and does not justify treating all countries with economies in transition in the same manner. Furthermore, the analysis clearly shows that many developing countries are more capable to provide financial means for poor countries than several industrialised countries not included in Annex II. Regarding financial transfers, the group of Annex II

countries should therefore be enlarged in the mid-term beyond the classification contained in the Convention.

Fourth, comparing the results of the two differentiation exercises reveals that the process of assigning mitigation and financial transfer commitments should be separated. Some countries like Russia and Ukraine have large potentials (and responsibility) to reduce emissions, but their (economic) capability to open up this potential is well below world average. Others like Switzerland and Sweden have relatively low reduction potentials (below world average) but should nevertheless assist other countries in their mitigation activities due to their high capabilities. Therefore, linking both obligations for mitigation and financial transfer as it was done in the Convention violates the principles of effectiveness and equity.

Fifth, although for political reasons the first level of differentiation between Annex I and non-Annex I countries will probably remain valid for the next commitment period(s), our analysis reveals that it is becoming increasingly obsolete. On the one hand, many non-Annex I countries have high values in at least one of the differentiation criteria examined while, on the other hand, some Annex I countries, in particular those with economies in transition, are far from being at the top of the ranking lists.

Finally, future agreements in climate policy will certainly not directly correspond to the results of any analytical differentiation exercise. Negotiations will always be predominantly guided by political factors such as power, diplomatic skills and the linking with processes in other policy arenas. Besides, the enlarged European Union will most probably shift some differentiation needs from the international to the European level. However, starting from the basis of a rational approach could facilitate negotiations and, at least, indicate what a fair agreement would look like. This might favour the less powerful countries in negotiations, thereby leading to more equitable results. Without addressing equity, however, the challenge of climate change may not be resolvable. In the mid- and long-term any climate agreement must be “embedded in a framework that recognizes that issues of justice and equity lie at the heart of the climate change problem” (King 2004, p. 177; see also Wuppertal Institute 2005).

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Appendix 1: Potential and responsibility indicators and indexes of Annex I countries

Annex-I Countries	CO₂/GDP-PPP (t CO ₂ /Mill. US\$, 2000)	GHG/capita (t CO ₂ equiv., 2000)	Potential Index (CO ₂ /GDP and GHG/capita, 1:1) ¹	Cumulative CO₂/capita, 1990-2000	Responsibility Index¹	Aggregate Index¹ (potential and responsibility index, 1:1)
USA	595,2	24,2	29,6	201,9	38,7	34,1
Luxembourg	360,1	21,0	22,1	240,2	46,0	34,0
Russian Federation	1565,6	13,1	42,5	132,1	25,3	33,9
Ukraine	1768,3	10,6	45,1	103,1	19,7	32,4
Australia	705,8	24,9	32,5	167,7	32,1	32,3
Estonia	1146,0	12,9	33,2	151,2	29,0	31,1
Canada	631,4	23,2	29,6	165,2	31,6	30,6
Czech Republic	856,1	14,0	27,7	139,6	26,7	27,2
Belgium	483,4	14,7	20,1	129,1	24,7	22,4
Poland	843,6	9,7	24,2	98,1	18,8	21,5
Finland	453,1	13,2	18,3	123,8	23,7	21,0
New Zealand	477,4	21,4	24,9	81,8	15,6	20,3
Netherlands	408,1	13,7	17,7	117,6	22,5	20,1
Ireland	371,5	17,4	19,6	104,6	20,0	19,8
Germany	405,8	11,8	16,2	120,4	23,1	19,6
Belarus	820,5	9,0	23,1	82,1	15,7	19,4
Denmark	335,1	12,6	15,2	120,9	23,2	19,2
Bulgaria	843,9	9,0	23,7	76,3	14,6	19,2
United Kingdom	403,1	11,3	15,7	105,4	20,2	18,0
Slovakia	591,8	8,3	17,6	89,6	17,2	17,4
Greece	527,8	11,0	18,3	84,9	16,2	17,3
Japan	381,9	10,5	14,7	100,9	19,3	17,0
Slovenia	458,4	10,0	16,0	78,2	15,0	15,5
Romania	735,5	6,0	19,1	60,6	11,6	15,4
Austria	300,5	9,6	12,3	83,1	15,9	14,1
Norway	269,3	11,3	12,8	79,3	15,2	14,0

Annex-I Countries	CO₂/GDP-PPP (t CO ₂ /Mill. US\$, 2000)	GHG/capita (t CO ₂ equiv., 2000)	Potential Index (CO ₂ /GDP and GHG/capita, 1:1) ¹	Cumulative CO₂/capita, (t CO ₂ , 1990-2000)	Responsibility Index¹	Aggregate Index¹ (potential and responsibility index, 1:1)
Italy	318,8	9,3	12,4	81,2	15,5	14,0
Iceland	275,7	10,1	12,0	81,5	15,6	13,8
Hungary	469,5	8,0	14,8	66,6	12,7	13,8
Spain	381,4	9,4	13,9	68,8	13,2	13,5
Portugal	365,6	8,7	13,0	58,4	11,2	12,1
France	262,8	8,5	10,6	68,7	13,1	11,9
Croatia	503,2	6,1	14,0	48,0	9,2	11,6
Lithuania	416,5	6,0	12,1	52,6	10,1	11,1
Switzerland	209,5	7,1	8,4	66,1	12,7	10,5
Sweden	232,5	7,2	9,0	62,5	11,9	10,4
Turkey*	544	5,4	14,4	29,1	5,6	10,0
Latvia	384,8	4,4	10,2	48,2	9,2	9,7
Annex I	538,4	14,6	21,2	128,1	24,5	-

Mean: 19,2

Standard deviation: 7,5

Average plus standard deviation: 26,7

Average minus standard Deviation: 11,7

1: Using the Climate Analysis Indicator Tool (CAIT) the indicators were indexed to a scale of 0 to 100, where 0 represents the minimum value in the data set and 100 represents the maximum value (WRI 2004). The indexing formula is as follows:

Index value = 100 * (actual value – minimum value) / (maximum value – minimum value).

For the potential index and the aggregate index the two underlying indexes were added and divided by two.

Data source: WRI (2003).

Appendix 2: Differentiation of non-Annex I countries according to the “South-North” approach

	“Newly Industrialised Countries” (NIC)	“Rapidly Industrialised Countries” (RIDC)	“Other Developing Countries” (Other DC)	“Least Developed Countries” (LDC)	
1	Bahrain	Algeria	Armenia	Afghanistan	1
2	Brunei	Antigua & Barbuda	Azerbaijan	Angola	2
3	Cuba	Argentina	Bolivia	Bangladesh	3
4	Israel	Bahamas	Cameroon	Benin	4
5	Kazakhstan	Barbados	Congo	Bhutan	5
6	Korea (South)	Belize	Cook Islands	Burkina Faso	6
7	Kuwait	Bosnia & Herzegovina	Côte d'Ivoire	Burundi	7
8	Qatar	Botswana	Dominica	Cambodia	8
9	Saudi Arabia	Brazil	Ecuador	Cape Verde	9
10	Singapore	Chile	Egypt	Central African Republic	10
11	Suriname	China	Gabon	Chad	11
12	Trinidad & Tobago	Colombia	Georgia	Comoros	12
13	Turkmenistan	Costa Rica	Ghana	Congo, Dem. Republic	13
14	United Arab Emirates	Cyprus	Guatemala	Djibouti	14
15	Uzbekistan	Dominican Republic	Honduras	Equatorial Guinea	15
16		El Salvador	India	Eritrea	16
17		Fiji	Indonesia	Ethiopia	17
18		Grenada	Jamaica	Gambia	18
19		Guyana	Kenya	Guinea	19
20		Iran	Kyrgyzstan	Guinea-Bissau	20

21	Jordan	Libya	Haiti	21
22	Lebanon	Macedonia, FYR	Kiribati	22
23	Malaysia	Moldova	Laos	23
24	Malta	Mongolia	Lesotho	24
25	Mauritius	Morocco	Liberia	25
26	Mexico	Namibia	Madagascar	26
27	Oman	Nicaragua	Malawi	27
28	Panama	Nigeria	Maldives	28
29	Peru	Pakistan	Mali	29
30	Philippines	Papua New Guinea	Mauritania	30
31	Saint Kitts & Nevis	Paraguay	Mozambique	31
32	Saint Lucia	Seychelles	Myanmar	32
33	Saint Vincent & Grenadines	Sri Lanka	Nepal	33
34	South Africa	Swaziland	Niger	34
35	Thailand	Syria	Rwanda	35
36	Tunisia	Tajikistan	Samoa	36
37	Uruguay	Venezuela	Sao Tome & Principe	37
38		Vietnam	Senegal	38
39		Zimbabwe	Sierra Leone	39
40			Solomon Islands	40
41			Somalia	41
42			Sudan	42
43			Tanzania	43
44			Togo	44
45			Tuvalu	45
46			Uganda	46
47			Vanuatu	47
48			Yemen	48
49			Zambia	49

Source: Ott et al. 2004.

Appendix 3: Differentiation of countries according to the potential/ responsibility criteria

	Country	27	Finland	55	Austria	82	Equatorial Guinea
1	<i>Qatar</i>	28	Libya	56	Norway	83	Argentina
2	<i>United Arab Emirates</i>	29	Oman	57	Italy	84	Barbados
3	<i>Kuwait</i>	30	New Zealand	58	Iceland	85	Bolivia
4	<i>Bahrain</i>	31	Azerbaijan	59	Macedonia, FYR	86	Chile
5	<i>Nauru</i>	32	Netherlands	60	Hungary	87	Yemen
6	United States of America	33	Ireland	61	Spain	88	Tajikistan
7	Luxembourg	34	Germany	62	Lebanon	89	Botswana
8	Russian Federation	35	Venezuela	63	Jordan	90	Thailand
9	<i>Trinidad & Tobago</i>	36	Belarus	64	Malaysia	91	Egypt
10	Ukraine	37	Korea (South)	65	Maldives	92	Guyana
11	Australia	38	Iraq*	66	Portugal	93	Saint Lucia
12	<i>Kazakhstan</i>	39	Denmark	67	Malta	94	Tonga
13	Estonia	40	Bulgaria	68	France	95	Ecuador
14	Canada	41	South Africa	69	Moldova	96	Algeria
15	<i>Turkmenistan</i>	42	United Kingdom	70	Croatia	97	Niue
16	<i>Uzbekistan</i>	43	Taiwan*	71	Bahamas	98	Seychelles
17	<i>Brunei*</i>	44	Israel		<i>World average</i>	99	Georgia
18	Czech Republic	45	Slovakia	72	China	100	Zimbabwe
19	<i>Mongolia</i>	46	Greece	73	<i>Lithuania</i>	101	Indonesia
20	<i>Serbia & Montenegro</i>	47	Antigua & Barbuda	74	Bosnia & Herzegovina	102	Uruguay
21	<i>Saudi Arabia</i>	48	Japan	75	<i>Switzerland</i>	103	Sao Tome & Principe
22	<i>Singapore</i>	49	Jamaica	76	<i>Sweden</i>	104	Dominican Republic
23	<i>Suriname</i>	50	Cyprus	77	<i>Turkey</i>	105	Panama
	<i>World average plus standard deviation</i>	51	Slovenia	78	Belize	106	Tunisia
24	Belgium	52	Romania	79	Mexico	107	Armenia
25	Poland	53	Iran	80	<i>Latvia</i>	108	Brazil
26	Cuba	54	Syria	81	Mauritania	109	Kyrgyzstan

110	Pakistan	137	Zambia	164	Nepal
111	Mauritius	138	Vanuatu	165	Gambia
112	Nigeria	139	Benin	166	Burkina Faso
113	Gabon	140	Guinea-Bissau	167	Malawi
114	India	141	Guatemala	168	Mali
115	Morocco	142	Grenada	169	Guinea
116	Colombia	143	Sierra Leone	170	Haiti
117	Saint Kitts & Nevis	144	Papua New Guinea	171	Cape Verde
118	Namibia	145	Togo	172	Comoros
119	Saint Vincent & Grenadines	146	Angola	173	Ethiopia
120	Kenya	147	Madagascar	174	Congo, Dem. Republic
121	Kiribati	148	Bhutan	175	Mozambique
122	Nicaragua	149	Sri Lanka	176	Lesotho
123	Peru	150	Solomon Islands	177	Laos
124	Djibouti	151	Samoa	178	Chad
125	Albania	152	Tanzania	179	Uganda
126	Honduras	153	Cambodia	180	Rwanda
127	Vietnam	154	Cameroon	181	Afghanistan
128	Philippines	155	Sudan	182	Burundi
129	Fiji	156	Myanmar		
130	Senegal	157	Swaziland		
131	Paraguay	158	Ghana		
132	Costa Rica	159	Bangladesh		
133	Dominica	160	Niger		
134	Côte d'Ivoire	161	Eritrea		
135	El Salvador	162	Central African Republic		
136	Congo	163	Liberia		

Appendix 4: Differentiation of countries according to the capability criteria

	Country	28	Portugal	55	Croatia	82	Cape Verde
1	Luxembourg	29	<i>Brunei</i>	56	Uruguay	83	Venezuela
2	United States of America	30	<i>Taiwan</i>	57	Mexico	84	<i>Romania</i>
3	Ireland	31	Greece	58	Lithuania	85	Belize
4	Norway	32	Slovenia	59	Seychelles	86	Saint Lucia
5	Iceland	33	<i>Bahamas</i>	60	Botswana	87	Saint Vincent & Grenadines
6	Denmark		<i>World average plus standard deviation</i>		<i>World average</i>	88	El Salvador
7	Switzerland	34	Bahrain	61	Grenada	89	Paraguay
8	Netherlands	35	Barbados	62	Belarus	90	Nauru
9	Canada	36	Korea (South)	63	Brazil	91	Fiji
10	Austria	37	Czech Republic	64	<i>Latvia</i>	92	Peru
11	Japan	38	Malta	65	Namibia	93	Guyana
12	Belgium	39	Saudi Arabia	66	Colombia	94	Guatemala
13	Germany	40	Oman	67	Dominican Republic	95	Swaziland
14	Australia	41	Hungary	68	<i>Russian Federation</i>	96	Lebanon
15	Italy	42	Argentina	69	<i>Bulgaria</i>	97	<i>Ukraine</i>
16	Finland	43	Slovakia	70	Macedonia, FYR	98	Jordan
17	<i>Singapore</i>	44	Saint Kitts & Nevis	71	<i>Turkey</i>	99	Philippines
18	Sweden	45	South Africa	72	Thailand	100	China
19	United Kingdom	46	Antigua & Barbuda	73	Algeria	101	Turkmenistan
20	France	47	Costa Rica	74	Tunisia	102	Niue
21	<i>United Arab Emirates</i>	48	Estonia	75	Gabon	103	Jamaica
22	<i>Israel</i>	49	Mauritius	76	Panama	104	Suriname
23	<i>Cyprus</i>	50	Poland	77	Dominica	105	Albania
24	<i>Qatar</i>	51	Malaysia	78	Kazakhstan	106	Vanuatu
25	Spain	52	Chile	79	Iran	107	Egypt
26	<i>Kuwait</i>	53	Trinidad & Tobago	80	Bosnia & Herzegovina	108	Morocco
27	New Zealand	54	Libya	81	Samoa	109	Sri Lanka

110	Syria	137	Gambia	164	Mozambique
111	Ecuador	138	Haiti	165	Kenya
112	Indonesia	139	Guinea	166	Eritrea
113	Azerbaijan	140	Comoros	167	Guinea-Bissau
114	Honduras	141	Mauritania	168	Congo
115	India	142	Pakistan	169	Benin
116	Papua New Guinea	143	Cambodia	170	Nigeria
117	Nicaragua	144	Mongolia	171	Niger
118	Kyrgyzstan	145	Cuba	172	Kiribati
119	Zimbabwe	146	Togo	173	Madagascar
120	Iraq*	147	Cameroon	174	Yemen
121	Armenia	148	Côte d'Ivoire	175	Afghanistan*
122	Georgia	149	Bangladesh	176	Mali
123	Uzbekistan	150	Laos	177	Ethiopia
124	Djibouti	151	Myanmar	178	Zambia
125	Lesotho	152	Senegal	179	Congo, Dem. Republic
126	Bolivia	153	Uganda	180	Burundi
127	Serbia & Montenegro	154	Central African Republic	181	Malawi
128	Tonga	155	Nepal	182	Tanzania
129	Ghana	156	Rwanda	183	Sierra Leone
130	Solomon Islands	157	Tajikistan		
131	Angola	158	Sao Tome & Principe		
132	Moldova	159	Bhutan		
133	Maldives	160	Liberia*		
134	Equatorial Guinea	161	Burkina Faso		
135	Sudan	162	Chad		
136	Vietnam	163	Korea (North)		