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Possible future reduction targets for the EU

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Possible future reduction targets for the EU

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Summary

This report provides background information that is relevant to assessing the ambition levels of the major countries involved in the current international climate negotiations. The EU's performance is assessed in detail, including the anticipated impact of the current economic recession. An overview is provided of the emission reductions – globally and per region – that are required to limit global warming to 2°C, as well as ways to share these reductions between the major countries. The proposed actions by major countries are compared to the reductions required to limit global warming to 2°C.

The key findings from the analysis were:

- Emissions in the EU declined by 10.7% from 1990 to 2008 for three reasons: environmental policies that have already been implemented, economic decline in Eastern Europe in the 1990s and the economic recession 2008/2009. Without these three factors, emissions would now be above the 1990 level:
    - Without past environmental policy efforts, current emissions would be at least 7 percentage points higher than they are today. These past efforts were mainly effective for non-CO_2 emissions, renewable energy, and combined heat and power. Past efforts did not include the following major sectors: energy production (except renewables and CHP) and industry. The EU ETS is not yet effective.
    - Emissions in the EU also declined due to the restructuring of economies in the new EU Member States and Germany (including the former East Germany), leading to e.g. closure of inefficient lignite power plants in Eastern Germany and a switch from coal to gas in the UK. Without this effect, current emissions would be roughly 5 percentage points higher.
    - The economic crisis 2008/2009 has contributed roughly half a percentage point in 2008 and further impact is to be expected for 2009.
- The economic crisis will lead to significantly lower emissions by 2020 compared to estimates made before the crisis. This will enable agreements on more ambitious reduction targets compared to 1990. If the current target of a 20% reduction below 1990 levels by 2020 is not made more ambitious, the ETS may be ineffective.

- Some of the pledges made by developed countries represent a fair sharing of reduction efforts, while other developed countries need to do more:
    - The EU needs to reinforce at least its more ambitious pledge of a 30% reduction. For a collective target of 40% below 1990 level in 2020 for developed countries, the EU would have to reduce emissions by at least 40%.
    - The US needs to increase its efforts beyond those reflected in current draft national legislation.

  - Russia's pledge of a reduction in greenhouse gas emissions (which is in effect an increase in current emissions due to falling emissions since 1990) is significantly out of line with any of the current effort-sharing approaches. It will need to reduce emissions more if the overall Annex I target is to be met.
  - Japan's 25% reduction pledge is in line with the effort-sharing approaches, when aiming at a 30% reduction of the group of Annex I countries below 1990 in 2020. For a collective 40% reduction, Japan would have to be more ambitious.
  - It is difficult to draw any conclusions for Australia and New Zealand ahead of the rules determining LULUCF, as the impact of LULUCF is so significant for these countries.

- Determining a fair way of sharing public climate financing (estimated to be 100 billion US$ per year by 2020) between developed countries is sensitive to the type of allocation approach used:
  - We used three approaches: the UN scale of assessment, which is the well accepted method to share financial contributions to the UN, an approach based on the share of global GDP, representing the ability to pay, and an approach based on the current share of global emissions, representing the responsibility for the problem. Note that the EU in its climate and energy package used only GDP as differentiation criterion.
  - If only Annex I countries are considered to contribute to public funds to mitigate climate change, the contribution by the EU-27 would vary between 45.1% (US$45,100 million per year) under the UN scale of assessment approach and 28.3% (US$28,300 million per year) from share of global GHG emissions.
  - Alternatively, all countries could be considered to contribute, where developing countries *receive* more from the fund than they *contribute*. The contribution by the EU would vary between 38.9% (US$38,900 million per year), based on the UN scale of assessments approach and 13.6% (US$13,600 million per year) based on the share of global GHG emissions.
  - The US is a major contributor, regardless of the approach taken, contributing on average 33.5% (calculated with developed countries only).

- The national actions proposed by emerging economies in their current pledges could lead to a reduction in the growth of emissions of 5-15% below 'business as usual emissions' by 2020. This will not be enough to meet the IPCC target of 15-30% reduction by 2020, which is designed to limit global warming to 2°C. But developing countries could be closer to the range than Annex I countries to their 25% to 40% range. There are large differences in the ambition levels between individual countries. Brazil ranks high with its recent reduction proposal. In the middle of the range are emerging economies such as Mexico and South Korea, which propose to reduce the growth of their emissions by the 2020s. Difficult to assess are the international targets in emissions per GDP from China and India.

Table of contents

1 Introduction

This report provides background information relevant to assessing the ambition levels of the major countries within the international climate negotiations. The EU's performance is assessed in detail, including the anticipated impact of the current economic recession. An overview is provided of the emission reductions – globally and per region – that are required to limit global warming to 2°C is provided, as well as ways to share these reductions between the major countries. The proposed actions by major countries are compared to the reductions required to limit global warming to 2°C.

In particular, the paper addresses the following questions:

1. What are the reasons for the emission reductions in the EU from 1990 to today and what level of reductions will current policies achieve by 2020?
2. How can emission reductions be shared in a fair way among developed countries?
3. What would be a fair way of sharing climate financing among developed countries?
4. What is the magnitude of overall reductions proposed by emerging economies?

We address these questions using a mixture of quantitative and qualitative analysis, including a literature review, carrying out relevant calculations, and analysing the outputs of various models.

Chapters 2, 3, 4 and 5 answer each of these questions separately, describing the methodological approach, with a summary conclusion at the end of each chapter.

2 Analysis of current EU performance in terms of emission reductions

This section addresses the first research question in the study: What are the reasons for the emission reductions in the EU from 1990 to today and what will be the reductions achieved through current policies until 2020? To answer this question, this analysis first looks at the impact of environmental policies on the emissions of the six Kyoto greenhouse gases in the EU between 1990 and 2005. Then the projected impact of policies up to 2020 and the impact of the economic crisis on current emissions are considered.

2.1 Past emission reductions

An initial question is what caused the 10.7% emission reduction achieved in the EU between 1990 and 2008? Without the economic downturn and without environmental policies, emissions in the EU would be much higher – probably well above the level in 1990. A precise estimate of "what would have happened if…" is not easy to make.

Such an attempt has been made by Wesselink et al., 2008[1], in which they assess the likely level of emissions without climate policies in the EU. This study only analysed the effects of policies and not the effect of the economic downturn in the 1990s in Eastern Europe. Without environmental policies, these emissions would have been approximately 7% higher in 2005 (Figure 2-1).

Without the economic downturn in the 1990s, emissions would probably be well *above* the 1990 level, but this factor was not included in that study. However, from the data it is evident that emissions declined between 1990 and 1995 without any policy impact. This decline in emissions is due to the restructuring of economies in the new EU Member States and Germany (including the former East Germany), leading to e.g. closure of inefficient lignite power plants in Eastern Germany and a switch from coal to gas in the UK. This accounted for approximately 5% of the decline in emissions since 1990.

[1] Source: http://www.mnp.nl/en/publications/2008/EU2020climatetargetrequiresfive-foldincreaseinimpactofCO2policies.html

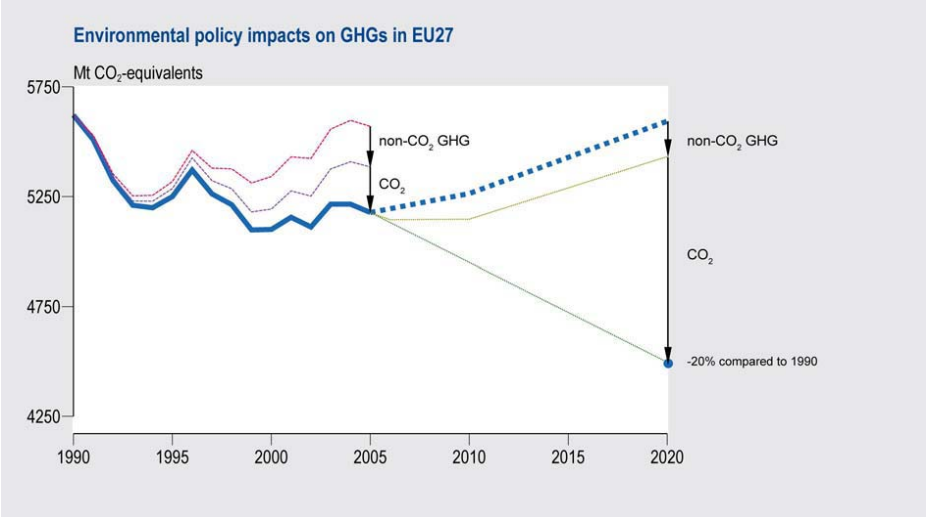

Figure 2-1 1990-2005 showing ex-post impact of environmental policies and 2005-2020 ex-ante baseline and expected policy effect with a pre-crisis baseline (Ecofys, 2009) [2]

The ex-post quantification of environmental policy impacts is based on specific assessments for the nine most relevant policy areas. Table 2 - 1 shows the impact per policy package. Appendix 2 provides a short description of the policy packages implemented in EU between 1990 and 2005.

Table 2 - 1 Abated greenhouse gas emissions in the EU in 2005 (Mt), compared to the reference situation without sectoral environmental policies in the EU between 1990 and 2005

Policy	EU-15	EU-25 (EU27) [d]
Renewable energy	77	96
N_2O industry	73	75
Combined Heat-Power generation (CHP) [c]	42	57
Landfill gas	41	51
Energy efficiency residential space heating[a]	34	34
F-gases[a]	41	41
Passenger cars[a]	21	21
Agricultural policies[b]	17	17
Total (Mt)	347	382
% reduction compared to emissions realised in 2005	8.3%	7.9% (7.6%)
% reduction compared to reference emissions in 2005	7.6%	7.2% (6.9%)

Recent developments show a declining trend in greenhouse gas emissions. In 2006 and 2007, greenhouse gas emissions fell by 1% per year from 5157 Mtonne CO_{2eq} in 2005 to 5045 Mtonne in 2007. In 2008, there was a slightly sharper decline of 1.5%

[2] Source: Ecofys (2009). EU climate policy impact in 2020. Utrecht, the Netherlands.

to 4,971 Mtonne, bringing the overall reduction to 10.7% below the 1990 level (EEA 2009). This may well be the result of the economic crisis that started in 2008. The impact of the EU ETS has been limited.

The recent reductions of 1% per year will not be sufficient to reach the -30% target by 2020 compared to 1990. A decline in the order of 2% per year would be necessary.

2.2 The impact of the recession on future reductions

The economic crisis seems to have mostly affected greenhouse gas emissions from industry, due to the downscaling of production. In 2005, emissions from EU ETS sectors were 2,012 Mtonne CO_{2eq} and in 2007 they were 2,165 in 2007. In 2008, however they fell to 2,118 Mtonne CO_{2eq} (European Commission 2009) which is a decline of 2.2% paired with 2007. For 2009, a further fall in emissions in EU ETS sectors is expected.

The economic recession may have had a considerable impact on future emission levels. Industrial emissions are still falling and the effort required to achieve a given emission cap is therefore lower. This leads to lower carbon prices and an increase in the relative share of units allowed from flexible mechanisms (CDM/JI) in the total abatement effort needed. A prolonged lower carbon price provides lower incentives for deploying technologies with higher abatement costs (e.g. CCS and off-shore wind). The current recession could therefore weaken the contribution made by the emission trading scheme to, for example, the RES objective.

Figure 2-2 illustrates the impact of the recession on the reductions needed under the EU ETS (Ecofys 2009)[3]. The shaded area on the left shows the reduction effort that was intended to be achieved through the ETS before the economic crisis. With the economic crisis, the emissions under the baseline scenario were substantially reduced. In addition, now unused CDM/JI allowances from 2008 to 2012 can be carried over to the third trading period (2013 to 2020), virtually eliminating the reduction effort needed from the ETS (the shaded area on the right).

As a consequence, the current setup of the EU ETS is not ambitious enough to be effective.

This view is also enforced by a study by IIASA (Amann et al. 2009). Pre-crisis data shows EU emissions at 5407 $MtCO_2eq$ in 2020 (-3% to 1990), however using data that takes the economic crisis into account shows EU emissions at 4,671 $MtCO_2eq$ in 2020 (-16% in relation to 1990), without taking any further measures to reduce emissions.

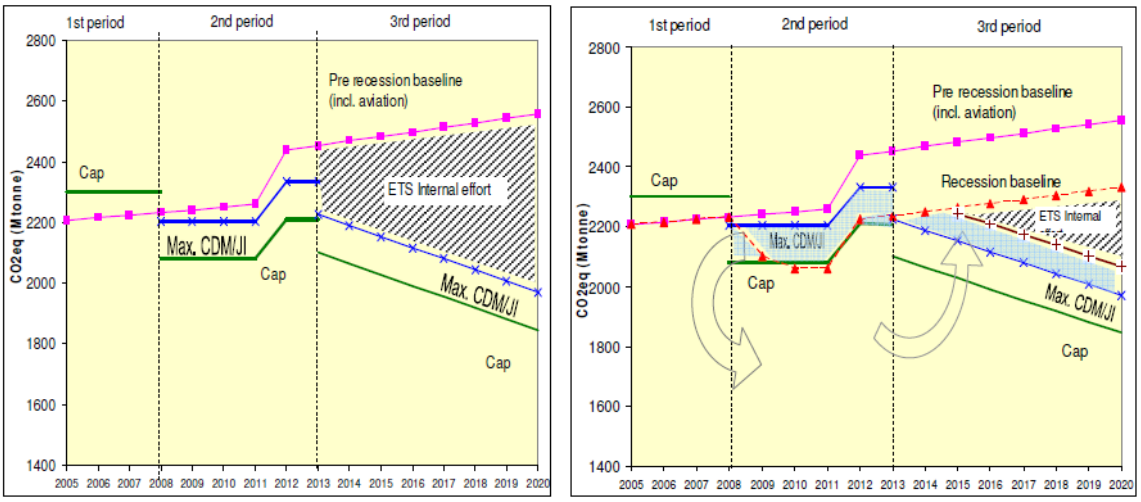

Figure 2-2 Envisaged baseline emissions and cap in a pre-recession (left) and recession scenario (right) (Ecofys, 2009) [4]

2.3 Summary

Emissions in the EU declined by 10.7% from 1990 to 2008 for two reasons: environmental policies and the economic decline in Eastern Europe in the 1990s. Without these two factors, emissions would now be above the level in 1990.

Without past climate policy efforts, current emissions would be at least 7 percentage points higher in 2005. These efforts were mainly effective for reducing non-CO_2 emissions, and increasing renewable energy and combined heat and power. Past efforts did not include the following major sectors: energy production (except renewables and CHP) and industry. The EU ETS has not yet been effective.

Emissions in the EU also declined due to the restructuring of economies in the new EU Member States and Germany (including the former East Germany), leading to e.g. closure of inefficient lignite power plants in Eastern Germany and a switch from coal to gas in the UK. Without this effect, current emissions would be roughly 5 percentage points higher.

The economic crisis 2008/2009 has contributed roughly half a percentage point in 2008 and further impact is to be expected for 2009.

The economic crisis will lead to significantly lower emissions in 2020 compared to estimates made before the crisis. This will make it possible to secure agreements on more ambitious reduction targets compared to 1990. If the current target of 20% reduction below 1990 by 2020 is not made more ambitious, the ETS may turn out to be ineffective.

[4] Source: Ecofys (2009). EU climate policy impact in 2020. Utrecht, Netherlands.

3 A fair approach to sharing emission-reduction targets between developed countries

This section addresses the second research question in the study: how can emission reductions be shared in a fair way among developed countries? In it we discuss the targets that developed countries have pledged to achieve and analyse their effects according to various effort-sharing approaches.

The developed countries, known as Annex I countries, have recognised the statement by the Intergovernmental Panel on Climate Change (IPCC) that their greenhouse gas (GHG) emissions need to be reduced by 25-40% below 1990 levels by 2020, to ensure that the average global temperature does not rise more than 2°C. This 25-40% reduction is the joint target of all Annex I countries, and hence a key issue is determining how it should be shared among the individual countries to ensure that all countries make a comparable contribution to achieving the overall target.

Since the publication of the IPCC Fourth Assessment report, new evidence has shown that faster global reductions are needed to limit the global temperature increase to 2°C. It is therefore desirable for developed countries to reduce their emissions in the more ambitious end of the 25% to 40% range.

To illustrate this, we provide below the results of sharing the efforts in such a way that the group of developed countries meet a 30% reduction by 2020 compared to 1990, bearing in mind that more ambitious reductions may be required.

This paper examines several effort-sharing principles, which are different in nature, but all fall in one of the following two categories:

- Equal future burden, where the efforts a country needs to make relate to the required change compared to 1990 emissions. The approach acknowledges that the current starting point varies between countries and does not credit actions from the past (as its focus is on the future).
- An equal end point, assessing the efforts needed for all countries to achieve the same state in the future. These efforts can for instance be defined in terms of the same energy efficiencies or in per-capita emissions in a certain target year. This perspective accounts for differences in starting points, but aims to achieve the same state in the future – the equal end point. Countries that are already closer to this end point, for example, due to efforts already made in the past, will need to make less of an effort in the future.

There are two general caveats related to this analysis:

- The emission-reduction targets are all relative to the base year 1990, but some countries' emissions have increased considerably since that year, while other countries have reduced their emissions. Therefore, if we want to arrive at a fair

approach and we only look at where countries are today compared to 1990, we will not see the efforts that have been made (or not been made) between 1990 and now. This provides an incomplete picture.

- Including the effects of Land use, Land-Use Change and Forestry (LULUCF) will have a significant impact on the efforts that countries with large forests need to make (e.g. Australia, Norway, Russia, New Zealand and Canada). For these countries, the influence of LULUCF-accounting is usually larger than the influence of the effort-sharing approaches. However, as there are no set rules as of yet on whether LULUCF may be included in achieving emission-reduction targets, and if so, in what way, we have excluded it in this paper.

The results of the various effort-sharing approaches involving the European Union, United States, Russia and Japan are discussed in the following sections, as well as some broad comment in relation to Australia and New Zealand. Historical emissions, projections, pledges, the Kyoto target and the outputs of the various effort-sharing approaches for each country are illustrated graphically, using graphs published by PBL (the Dutch Environmental Assessment Agency[5]).

3.1 EU

For the EU the following picture has been constructed.

[5] PBL Report 500114014/2009 - Sharing developed countries' post-2012 greenhouse gas emission reductions based on comparable efforts, by M.G.J. den Elzen, N. Höhne, M. Hagemann, J. van Vliet, D.P. van Vuuren

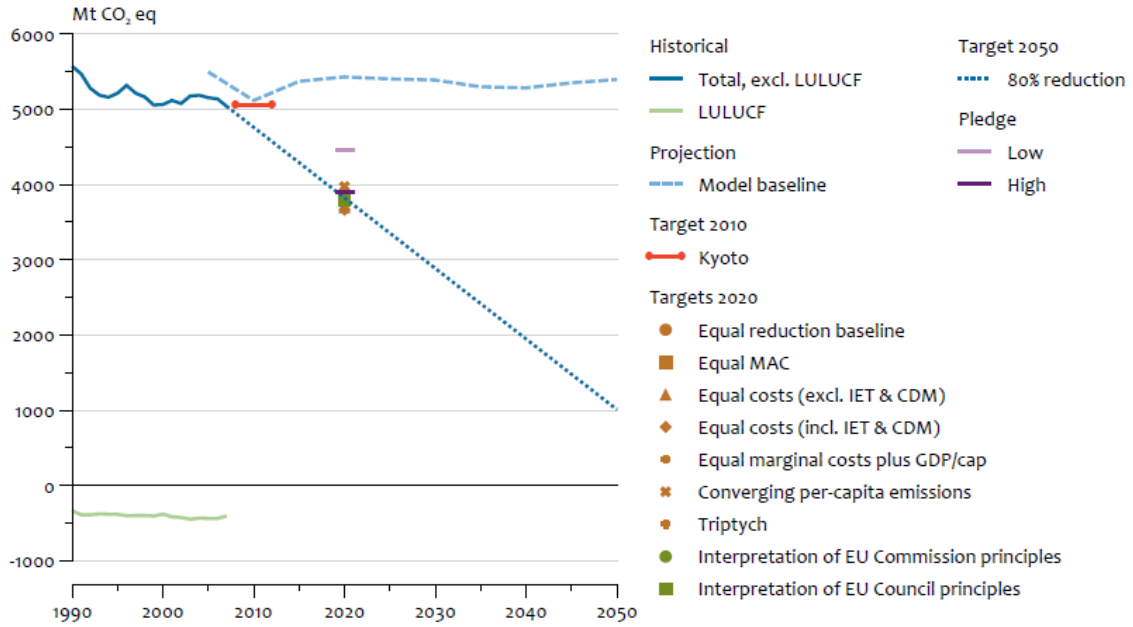

Figure 3 - 1 Historical emissions, (post-crisis) projections, Kyoto target and possible targets for 2020, for the EU27 (but excluding Malta and Cyprus) - note that the projection is for the EU30 (including Switzerland, Norway and Iceland) (Source: den Elzen et al. 2009)

Historical emissions in the EU declined between 1990 and 2007. The green and brown dots depict the outcomes of the various effort-sharing approaches designed to achieve the overall target. The two purple horizontal lines show the pledges the EU has made to reduce its GHG emissions. The top line (light purple) is the 20% emission-reduction pledge, whereas the bottom one represents the offer the EU has made to increase its target to 30% if there is an international agreement. This more ambitious pledge is almost exactly on the straight line from 2007 emissions to an 80% reduction in emissions below current levels by 2050 (included here for purposes of illustration).

The results of different effort-sharing approaches vary for the EU and the brown and green points show some spread. But, despite the variety of countries that make up the EU, almost all approaches are in the range of, or more ambitious than, the -30% pledge, while all approaches are more stringent than the less ambitious pledge of -20%.

This means that no matter which effort-sharing approach is chosen, the EU as a whole needs to reduce its emissions by at least 30% to achieve the overall target of a 30% reduction in greenhouse gases for developed countries. This target has to be reached domestically and should not be achieved with offsets. If the developed countries decided to reduce their emissions as a group by 40%, then the EU will need to reduce its emissions by roughly 10% more, i.e. by at least 40%.

3.2 United States

The results of the calculations for the United States are shown in the following graph:

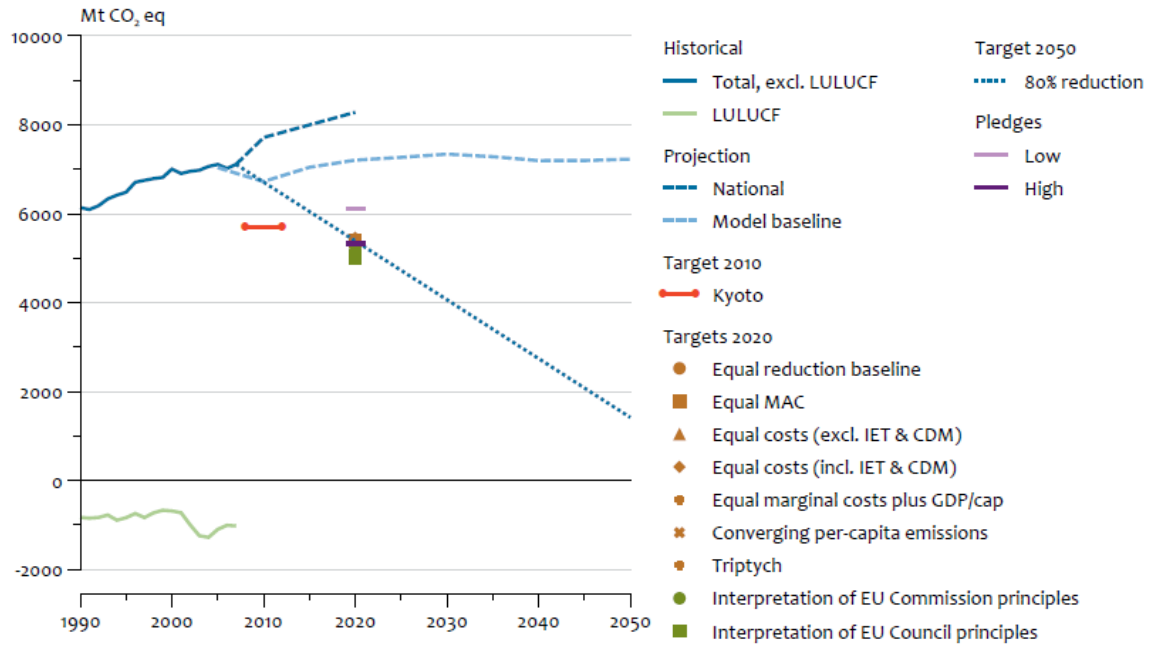

Figure 3 - 2 Historical emissions, projections (higher pre-crisis, lower post-crisis), Kyoto target and possible targets for 2020, for the United States (Source: den Elzen et al. 2009)

President Obama has recently made an announcement that USA is willing to reduce its emissions by 17% below the 2005 level by 2020. The Waxman/Markey bill, which includes a 17% reduction in greenhouse gas emissions by 2020 compared to 1990, has been passed by the House of Representatives. A similar bill is being discussed in the Senate. This figure includes a 14% (based on an earlier announcement) to 20% (ambitious interpretation in the Waxman/Markey bill) reduction below the 2005 level by 2020.

Due to the fact that the USA produces a large proportion of the emissions of all Annex I countries, their contributions affects the average of all effort-sharing approaches. The different approaches are therefore relatively similar (the brown and green dots are very close together). However, all approaches require a greater effort than that included in the pledge.

3.3 Russia

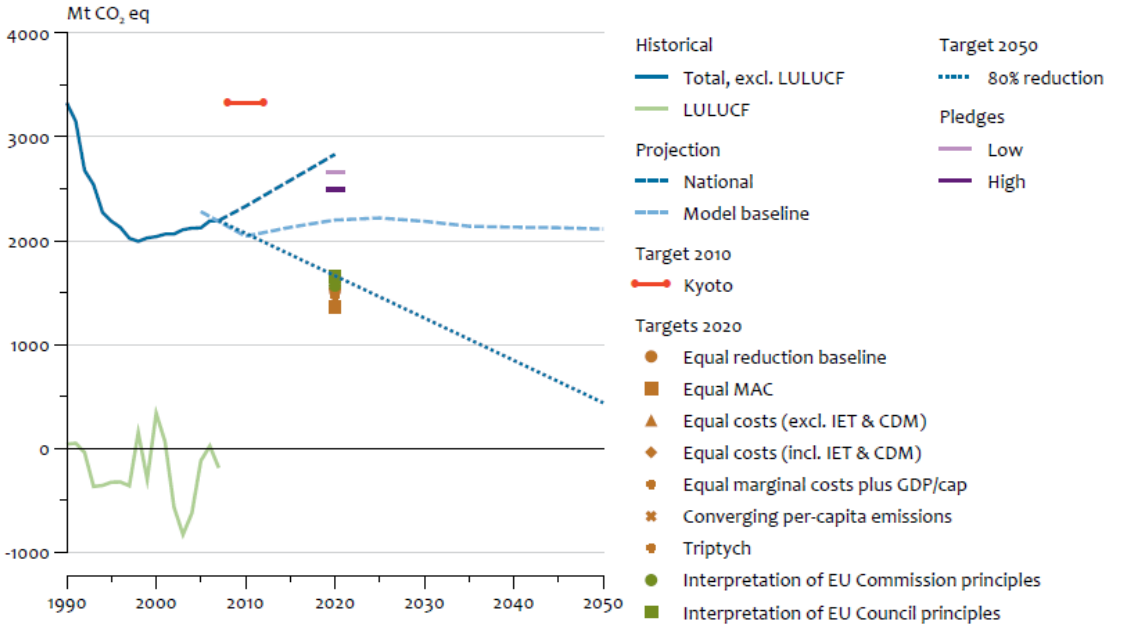

Figure 3 - 3 Historical emissions, projections (high pre-crisis, low post-crisis), Kyoto target and possible targets for 2020, for Russia (Source: den Elzen et al. 2009)

Russia has pledged to reduce its emissions by 20 to 25% from the 1990 levels, which at first sight looks very ambitious against an initial pledge of 20% by the EU. However, when you consider that Russia's emissions have plummeted by 35% between 1990 and now, a -25% target means that allowance has been made for emissions to increase. This -25% target is even above a recent baseline that includes the impact of the crisis.

The various effort-sharing approaches give a range of results for Russia, with the green and brown dots fairly well spread out. This is due to Russia's comparatively low GDP, resulting in different efforts, depending on whether or not the approach includes GDP as a factor.

But regardless of how the variations in the results of the various approaches, they all agree that Russia's 25% reduction pledge is nowhere near sufficient to achieve the overall Annex I target of -30%.

3.4 Japan

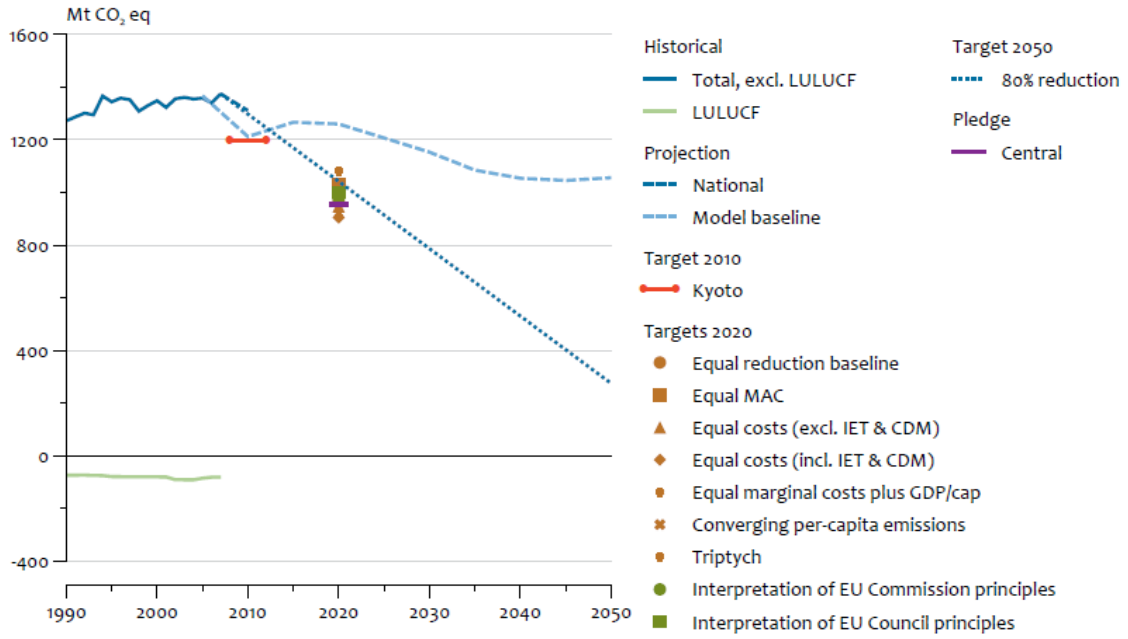

Figure 3 - 4 Historical emissions, projections, Kyoto target and possible targets for 2020, for Japan (Source: den Elzen et al. 2009)

Even though Japan's domestic emissions are above the target under the Kyoto Protocol, its pledge of a 25% reduction in greenhouse gas emissions compared to 1990 levels (the horizontal purple line in the graph) is in the lower half of the result of the effort-sharing approaches (the brown and green dots).

The various approaches do require rather different efforts from Japan, which can be explained by the country's very particular emissions profile with high efficiency and a high proportion of nuclear energy. This results in less stringent reductions in approaches that assume that emission reductions in Japan are relatively costly (marginal-cost approaches), but tougher targets in total cost approaches because of Japan's high GDP.

Despite this spread, Japan's emission reduction pledge is relatively stringent. Extensive use of offsets could however dilute the target.

3.5 Australia / New Zealand

Both the pledges from Australia and New Zealand (compared to the efforts) will be significantly influenced by any decision on the rules for forests (LULUCF). It is therefore sufficient to say here that Australia's pledge could be considered significant. Especially the most ambitious variant is in the ambitious end of the effort sharing

approaches. But the ultimate stringency will depend heavily on the definition of the rules for LULUCF.

The ambitious pledge by New Zealand (a 10% to 20% reduction in emissions compared to 1990), is at the ambitious end of the results of the effort-sharing approaches. But the rules on LULUCF will determine the real ambition level.

3.6 Conclusion

A summary of the results is presented in Table 3-1.

Table 3 - 1 Reductions below 1990 for the pledges and selected effort-sharing approaches

	Less ambitious pledge	More ambitious pledge	Equal reduction baseline	Equal MAC	Converging per capita emissions	EU Commission principles
EU	20%	30%	33%	31%	29%	33%
USA	0%	7%	13%	12%	15%	15%
Russia	20%	25%	54%	59%	53%	55%
Japan	25%		24%	19%	22%	23%

After comparing the pledges that the most important of the developed countries have made with the results from various effort-sharing approaches to achieve the overall Annex I emission reduction target, we can conclude the following:

- The EU needs to reinforce at least its more ambitious pledge of a 30% reduction. For a collective target of 40% below 1990 level in 2020 for developed countries, the EU would have to reduce emissions by at least 40%.
- The USA needs to increase its efforts above those in current draft national legislation.
- Russia's pledge of reduction in greenhouse gas emissions (which is in effect an increase in current emissions due to falling emissions between 1990 and now) is significantly out of line with any of the effort-sharing approaches. It will need to reduce emissions more if the overall Annex I target is to be met.
- Japan's 25% reduction pledge is in line with the effort-sharing approaches, when aiming at a 30% reduction of the group of Annex I countries below 1990 in 2020. For a collective 40% reduction, Japan would have to be more ambitious.
- It is difficult to draw any conclusions for Australia and New Zealand until the rules for LULUCF are determined, as the impact of LULUCF is so significant for these countries.

4 A fair approach to sharing climate financing between developed countries and emerging economies

This section addresses the third research question in the study: what would be a fair way to share the necessary climate financing among developed countries? This chapter examines this question, looking at climate financing among developed countries, but also climate financing among emerging economies.

According to the Bali Action Plan agreed by the UNFCCC Parties in December 2007, developed countries will help developing countries (i.e. also emerging economies) mitigate climate change and achieve their GHG reduction actions through additional technology, financing and capacity building. This financial flow from developed countries to emerging economies is in addition to the higher emissions reduction effort required from developed countries.

External financing for emerging economies can take two main forms: financing through the global carbon market and financing via dedicated public funds. To achieve the 2°C limit, it is estimated that these two streams together will need to equal around 100 billion US$ per year by 2020. The total volume necessary, the contribution that each stream makes to the total and the share of public versus private financing is a matter of debate. In the following analysis we have assumed that the full amount would come from public funds.

This financing estimate, which represents the *additional* costs required for climate mitigation, is an order of magnitude lower than the total investment costs that would in any case need to be made over the same period in, for example, global energy systems.

4.1 Financing emissions reductions in developing countries

IPCC estimates of the emission reductions required from developed and developing countries are based on sharing regional emissions targets, *before* the use of the global carbon market is taken into account. (The carbon market here refers to the Kyoto Protocol Mechanisms of emissions trading and the Clean Development Mechanism, CDM). These emissions targets are indicated as red lines in Figure 4-1 below.

The actual emissions from developed and developing countries may ultimately deviate from the red lines due to the use of the carbon market. The CDM is currently the only international climate policy tool that leads to measured, verified and quantified emission reductions in developing countries. However, since the emissions credits that arise from CDM projects are used by developed countries to comply with their targets ("offsetting"), CDM projects do not actually reduce total global emissions.

Figure 4-1 illustrates this mechanism. The actual emissions of developed and developing countries are shown as grey lines. For developed countries, actual emissions are higher than their target, assuming that they buy carbon credits from developing countries. For developing countries, actual emissions are lower than their target emissions by a corresponding amount, assuming that investment in emissions reduction projects in these countries leads to the creation of carbon credits that these countries can sell. Using the Kyoto Mechanisms always changes actual emissions in both countries that take part.

This implies that developed countries should be able to achieve their reduction *targets* in part through domestic action and in part by using credits resulting from emission reductions in developing countries (offsetting), Figure 4-1 (left). Emission reductions in developing countries could be achieved by investing in emission reduction projects which have a negative cost (e.g. no regret projects, such as those that pay back through savings in energy costs), through their own financial contributions, and through direct financial support from developed countries (Figure 4-1, right, red line). Additional reductions could be financed through carbon trading or other such mechanisms (Figure 4-1, right, grey line).

In this way, mitigation in developing countries can be partly financed using their own resources, and partly through multi-lateral public or international funding.

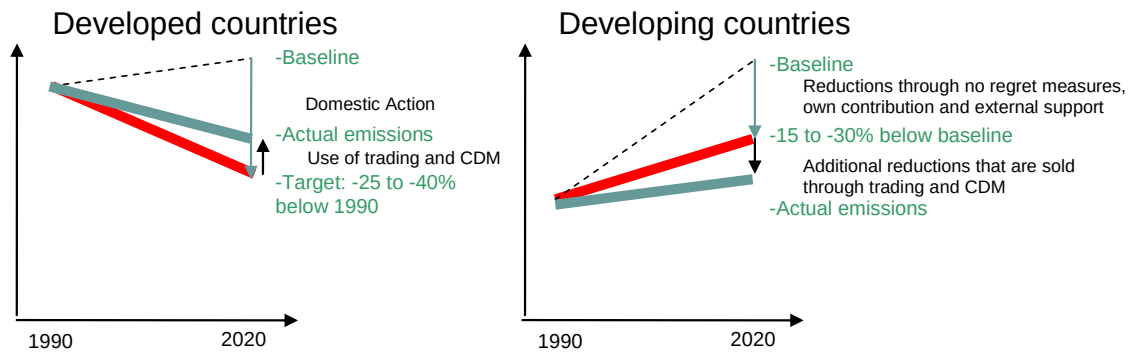

Figure 4 - 1 The target and actual emissions of developed and developing countries

4.2 Different approaches to sharing the financing

The first question that must be considered when analysing how climate financing can be divided between countries is which countries should contribute?

Developed countries have historically contributed the majority of global GHG emissions and have higher GHG emissions per person today than emerging economies. It can therefore be argued that developed countries should pay for climate change mitigation measures. It was also for this reason that developed countries (the

so-called 'Annex I' countries[6]) set emission reduction targets under the Kyoto Protocol.

On the other hand, to achieve the 2°C limit it will be necessary for all countries to make emission reduction efforts. Some emerging economies are also now of a size where their per-capita GHG emissions are of the same order of magnitude as those from Annex I countries. It can also therefore be argued that all countries should contribute to climate financing, but in proportion to their size, wealth or emissions. For example, a proposal by Mexico suggests that all countries contribute to a fund according to a predefined criterion. Developing countries would however receive more from the fund than they contribute.

In the following sections, we describe three potential approaches to sharing the necessary direct public financing of climate actions. Section 4.2.1 explores the three approaches based on sharing the contributions between Annex I countries only, and section 4.2.2 explores the same three approaches, but based on sharing the contributions between all countries.

The three approaches are based on:

1. the UN scale of assessments for obligatory contributions to the regular UN budget for 2007-2009 (United Nations 2006)[7];
2. the share of global gross domestic product (GDP) in 2006; and
3. the share of global GHG emissions in 2006, excluding emissions from land use, land use change and forestry (LULUCF).

Note that the EU in its climate and energy package used only GDP as differentiation criterion.

4.2.1 Sharing the financing between Annex 1 countries only

Table 4 - 1 shows the top 20 Annex 1 countries that would contribute to public climate financing if the financing is shared between only those countries in Annex 1. The contribution according to the three approaches is shown, ranked by the final column – the average of the three approaches.

Table 4 - 2 shows the actual annual contribution (in million US$) towards the 100 billion US$ per year climate financing of these top 20 Annex 1 countries, according to the three approaches.

[6] http://unfccc.int/parties_and_observers/parties/annex_i/items/2774.php

[7] Previously, the new scale of assessments for the next three year period has been agreed in the UN General Assembly in the December before the period is due to start. We might therefore reasonably expect a revised scale to be agreed for 2010 to 2012 in December this year.

Table 4 - 1 Top 20 Annex 1 contributors to climate financing, ranked by the final indicator – the average of the three approaches

Country	Share of Annex 1 UN scale of assessments 2007-2009	Share of 2006 Annex 1 GHG emissions (excl. LULUCF)	Share of 2006 Annex 1 GDP	Average indicator
US	25.5%	39.2%	35.8%	33.5%
Japan	19.3%	7.6%	11.1%	12.7%
Germany	9.9%	5.5%	7.2%	7.6%
Russia	1.4%	12.0%	5.1%	6.2%
UK	7.7%	3.6%	5.4%	5.6%
France	7.3%	3.1%	5.3%	5.2%
Italy	5.9%	3.1%	4.6%	4.6%
Canada	3.5%	4.1%	3.3%	3.6%
Spain	3.4%	2.4%	3.4%	3.1%
Australia	2.1%	3.0%	1.9%	2.3%
Netherlands	2.2%	1.2%	1.6%	1.6%
Turkey	0.4%	1.8%	2.2%	1.5%
Poland	0.6%	2.2%	1.5%	1.4%
Ukraine	0.1%	2.4%	0.8%	1.1%
Belgium	1.3%	0.8%	1.0%	1.0%
Switzerland	1.4%	0.3%	0.8%	0.8%
Sweden	1.2%	0.4%	0.8%	0.8%
Austria	1.0%	0.5%	0.8%	0.8%
Greece	0.7%	0.7%	1.0%	0.8%
Norway	0.9%	0.3%	0.6%	0.6%
EU-27	**45.1%**	**28.3%**	**37.7%**	**37.0%**

Table 4 - 2 Annual contribution in million US$ of top 20 Annex 1 countries to climate financing

Country	Share of Annex 1 UN scale of assessments 2007-2009 (US$M/yr)	Share of 2006 Annex 1 GHG emissions (excl. LULUCF) (US$M/yr)	Share of 2006 Annex 1 GDP (US$M/yr)	Average indicator (US$M/yr)
US	25,509	39,168	35,779	33,485
Japan	19,275	7,639	11,093	12,669
Germany	9,945	5,480	7,237	7,554
Russia	1,391	11,987	5,114	6,164
UK	7,701	3,608	5,445	5,585
France	7,306	3,054	5,327	5,229
Italy	5,889	3,127	4,647	4,554
Canada	3,452	4,053	3,258	3,587
Spain	3,441	2,384	3,436	3,087
Australia	2,072	2,968	1,862	2,301
Netherlands	2,172	1,153	1,624	1,649
Turkey	442	1,833	2,240	1,505
Poland	581	2,196	1,543	1,440
Ukraine	52	2,385	791	1,076
Belgium	1,278	754	961	998
Switzerland	1,410	297	757	821
Sweden	1,242	371	844	819
Austria	1,028	506	811	782
Greece	691	702	951	781
Norway	907	298	634	613
EU-27	**45,054**	**28,306**	**37,719**	**37,027**

4.2.2 Sharing the financing between all countries

Table 4-3 shows which countries the top 20 contributors to climate financing would be, if climate financing is shared between all countries. Again, the three approaches are ranked by the final column, which shows the average of the three approaches.

Table 4 - 3 Top 20 contributors to climate financing, ranked by the final indicator – the average of the three approaches

Country	UN scale of assessments 2007-2009	Share of 2006 global GHG	Share of 2006 global GDP	Average indicator

		emissions (excl. LULUCF)		
US	22.0%	18.8%	21.9%	20.9%
China	2.7%	19.2%	10.2%	10.7%
Japan	16.6%	3.7%	6.8%	9.0%
Germany	8.6%	2.6%	4.4%	5.2%
UK	6.6%	1.7%	3.3%	3.9%
France	6.3%	1.5%	3.3%	3.7%
Russia	1.2%	5.7%	3.1%	3.4%
India	0.5%	5.0%	4.6%	3.3%
Italy	5.1%	1.5%	2.8%	3.1%
Canada	3.0%	1.9%	2.0%	2.3%
Brazil	0.9%	2.6%	2.8%	2.1%
Spain	3.0%	1.1%	2.1%	2.1%
Mexico	2.3%	1.7%	2.1%	2.0%
South Korea	2.2%	1.5%	1.9%	1.8%
Australia	1.8%	1.4%	1.1%	1.4%
Netherlands	1.9%	0.6%	1.0%	1.1%
Indonesia	0.2%	1.5%	1.3%	1.0%
Iran	0.2%	1.5%	1.2%	1.0%
Saudi Arabia	0.7%	1.1%	0.9%	0.9%
Turkey	0.4%	0.9%	1.4%	0.9%
EU-27	**38.9%**	**13.6%**	**23.0%**	**25.2%**

Table 4 - shows the actual annual contribution (in million US$) towards the 100 billion US$ per year climate financing of these top 20 countries, according to the three approaches, if the financing is shared among all countries.

Table 4 - 4 Annual contribution in million US$ of top 20 countries to climate financing

Country	UN scale of assessments 2007-2009 (US$M/yr)	Share of 2006 global GHG emissions (excl. LULUCF) (US$M/yr)	Share of global GDP 2006 (US$M/yr)	Average indicator (US$M/yr)
US	22,000	18,769	21,864	20,878
China	2,667	19,179	10,200	10,682
Japan	16,624	3,661	6,779	9,021
Germany	8,577	2,626	4,422	5,208
UK	6,642	1,729	3,327	3,899
France	6,301	1,463	3,255	3,673
Russia	1,200	5,744	3,125	3,357
India	450	4,973	4,588	3,337
Italy	5,079	1,499	2,839	3,139
Canada	2,977	1,942	1,991	2,303
Brazil	876	2,640	2,814	2,110
Spain	2,968	1,142	2,099	2,070
Mexico	2,257	1,684	2,109	2,017
South Korea	2,173	1,471	1,851	1,832
Australia	1,787	1,422	1,138	1,449
Netherlands	1,873	552	992	1,139
Indonesia	161	1,506	1,280	982
Iran	180	1,517	1,168	955
Saudi Arabia	748	1,078	867	898
Turkey	381	878	1,369	876
EU-27	**38,857**	**13,564**	**23,049**	**25,157**

4.2.3 Which of the three approaches?

The three approaches to sharing climate financing have various advantages and disadvantages and each affects the amount that some countries would contribute more than others.

The UN scale of assessments approach

An advantage of using the UN scale of assessments approach is that it is a recognised scale that has already been negotiated and agreed in a UN forum. It is based largely on gross national product (GNP). The US contribution is capped at 22%. All countries contribute to the UN regular fund according to the scale; the minimum contribution is 0.001%. The top 6 countries on the scale (US, Japan, Germany, UK, France and Italy)

already contribute 65% of the fund. The top two countries (US and Japan), plus the EU-27, together contribute 77% of the funding. The top 20 countries contribute already 90% of the funding. The EU-27 contribution under this approach would be **38.9%, or 38,900 US$M per year**.

Annex 1 countries as a group make up 86% of the UN funding according to the UN scale of contributions. If only Annex 1 are considered, the contribution by the USA in particular rises above the cap of 22% to 25.5%. The EU contribution under this approach would be **45.1%, or US$45,100 million per year.**

A precedent has been set for a modified version of the UN standard scale being used. For example, UN peacekeeping budgets use a modified version of the scale.

Share of GDP approach

Contributions to a fund could be based on economic capability, measured, e.g. in GDP. If just Annex 1 countries are included, the top 5 ranking of countries would be the US, followed by Japan, Germany, the UK and Russia. The EU contribution under this approach would be **37.7%, or US$37,700 million per year.**

If all countries are included, the USA would still be the largest contributor, contributing almost exactly the same percentage as under the UN scale. According to this scale, China jumps from ninth in the UN scale to second in the list, contributing a significantly larger proportion. Japan drops to third and contributes a significantly lower amount to the find. Russia drops to eighth. The EU-27 contribution under this approach would be **23.0%, or US$23,000 million per year**.

Share of GHG emissions

Contributions to a fund could be based on responsibility for the problem, measured, e.g. in current emissions. The approach we have used is to analyse the proportion of 2006 GHG emissions, excluding emissions from LULUCF.

If only Annex 1 countries are considered, the USA tops the list (39.2%), followed by Russia (12%), then Japan (7.6%) and Germany (5.5%). This is the largest contribution by the USA under any approach. The contribution by the EU would be smaller than under many approaches at **28.3%, or US$28,300 million per year**.

Including all countries and ranking country contributions according to share of global GHG emissions (excluding LULUCF) produces yet another picture. Major developing countries appear high on the list. Under this approach, China in fact tops the list ahead of the US, with the two countries making an implied contribution to climate financing of 19.2% and 18.8%, respectively. Russia and India would also rise to third and fourth in the list, respectively. EU countries only just appear in the top 6 contributors on the list, with Germany in joint sixth place with Brazil, each contributing 2.6%. The EU-27 contribution under this approach would be **13.6%, or US$13,600 million per year**.

The proportion of global emissions for countries affected by deforestation, in particular countries such as Brazil and Indonesia, is quite heavily affected by whether LULUCF emissions are included in the calculation or not. Here we have excluded these emissions. If these emissions are included, Brazil's share in global emissions rises from 2.6% to 3.9%; for Indonesia the share rises from 1.5% to 2.2%. Otherwise the ranking of the main emitters remains largely unchanged. The EU-27 contribution under this approach would drop slightly, to **12.4%, or US$12,400 million per year**.

4.3 Summary

If only Annex I countries are expected to contribute to public funds to mitigate climate change, the highest contribution by the USA would be 39.2% (US$39,200 million per year), which would be the case if the share of GHG emissions approach were adopted. The highest contribution by the EU-27 would be 45.1% (US$45,000 million per year) under the UN scale of assessment approach.

If all countries are taken into account, the three potential approaches to sharing the necessary public financing of climate actions would result in very different implied contributions by the EU-27. Again, the UN scale of assessments would result in the highest implied contribution by the EU, at 38.9% (US$38,900 million per year). According to the share of global GDP approach, the EU's share would be 23% (US$23,000 million per year). Taking the share of global GHG emissions in 2006 (excluding LULUCF), the EU-27 contribution would be 13.6% (US$13,600 million per year). If you include LULUCF emissions, this contribution drops further to 12.4% (US$12,400 million per year). Taking the average of the first three indicators, the EU-27 contribution would be 25.2% (US$25,200 million per year).

Note that the EU in its climate and energy package used only GDP as differentiation criterion.

5 Current positions of emerging economies on emission reductions

This section addresses the fourth research question in the study: what is the magnitude of overall reductions by emerging economies? We consider the situation of China, India, Brazil, South Africa, Mexico and South Korea.

This analysis is based on the Climate Action Tracker designed by Ecofys and Climate Analytics, an independent science-based assessment which tracks the emission commitments and actions of countries.[8] The Climate Action Tracker provides an up-to-date assessment of pledges by individual countries to reduce their greenhouse gas emissions.

We also assessed what other studies have examined adequate pledges for these emerging economies (Project Catalyst 2009, UNFCCC 2009, Winkler 2009, Höhne and Sterk 2009, Höhne et al. 2009). These studies applied a wide range of effort-sharing principles, some of which are based on equity principles such as equal per-capita emissions or capability to pay, while others are based on the staged or delayed participation of developing countries, based on historical responsibility. Yet others are based on the principle that efficiencies across all countries should converge. As a result, the range of pledges proposed by the studies for a specific country is usually large.

5.1 China

Current pledge

China has announced to reduce its CO_2 emissions per unit of GDP by 40% to 45% from 2005 to 2020 (Government of the People's Republic of China 2008, National Development and Reform Commission (NDRC) 2007). China has agreed and is implementing a domestic energy efficiency target (-20% per unit of GDP from 2005 to 2010) and a renewable energy target (15% of primary energy by 2020), in addition to a number of other reduction measures.

Current and project performance against 15-30% target

China's international target to reduce CO_2 emissions per unit of Gross Domestic Product (GDP) is inconsistent with China's domestic national climate plans. It is difficult to assess the GDP intensity target, because the data underpinning the basis of the proposed target, such as assumed emissions or GDP growth, were not provided. Using different data sources and future GDP growth rates to convert the GDP intensity

[8] www.climateactiontracker.org

target to absolute emissions, the proposed reduction is close to 'business as usual' and probably less than would be expected if current national policies are implemented.

China's domestic climate plans include targets and policies on energy efficiency and renewable energy which are ambitious and would see China achieve a rating of 'moderate to sufficient'. While these plans would still equate to an absolute increase of emissions, they would also improve CO_2 emissions per GDP by -50 to -60% from 2005 to 2020 at the assumed GDP growth rate. However, the new target falls short of that ambition.

It is to be welcomed that China has proposed a quantitative emission target, as this allows for international verification. Since this is China's own contribution, further reductions may be feasible if financial resources are made available.

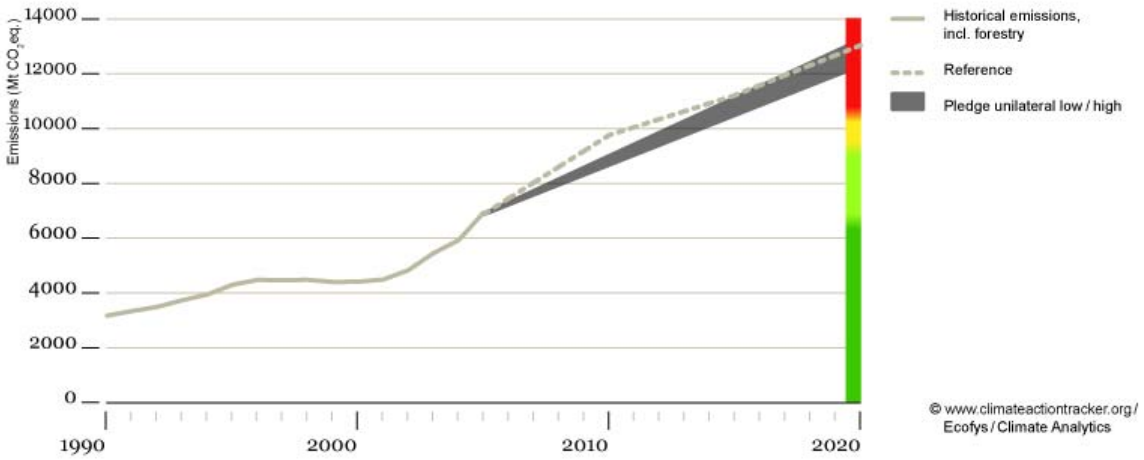

Figure 5 - 1 Historical emissions, projected emissions and pledge for China

5.2 India

Current pledge

India's climate plan provides eight national missions in key areas (Government India 2008, Government India and Planning Commission 2008). While several measures are provided, only a few are quantified in terms of the anticipated resulting emission reductions and most are rather general, e.g. promoting public transport or fuel switching in industry. The plan does not provide an overall baseline and mitigation scenario. However, detailed targets on the electricity sector are contained in the 11th five-year plan.

Current and project performance against 15-30% target

India's goals are rated medium, because while India has provided a national climate plan, it focuses on qualitative elements and does not quantify the effects on total emissions.

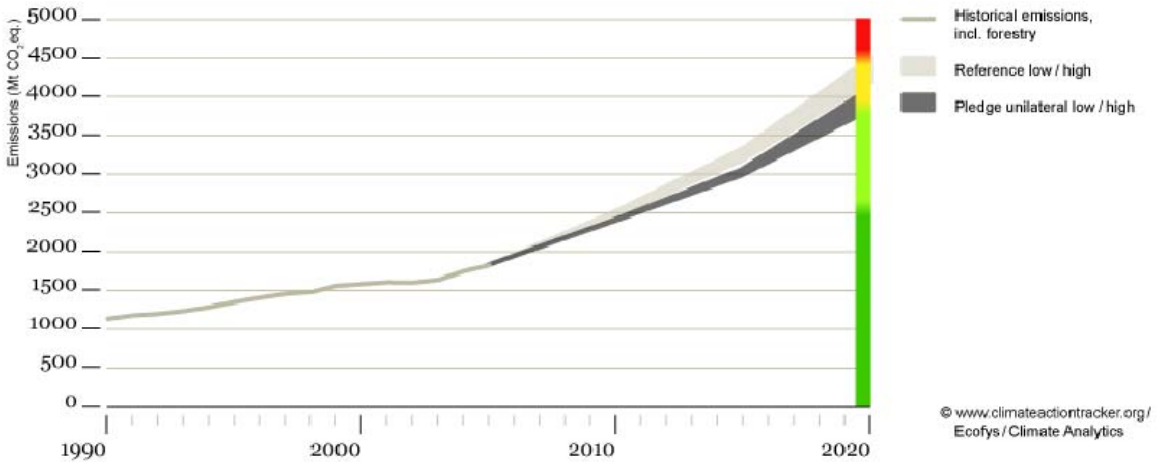

Figure 5 - 2 Historical emissions, projected emissions and pledge for India

5.3 Brazil

Current pledge

Brazil has announced that it will reduce emissions by 36% to 39% compared to reference emissions in 2020, i.e. to around 1994 levels (Government Brazil 2009, Government Brazil 2008a, Government Brazil 2008b). It is still necessary to "define the sources of funding for each of the initiatives that need to be taken to achieve the targets" and the pledge is conditional on external financing. Earlier, Brazil provided a detailed national climate change plan that covers all relevant sectors (energy, forestry & agriculture, industry, waste and transport). The most important measure is a plan to reduce the deforestation rate in the Amazon region by 80% between 2005 and 2020. Brazil has created the Amazon Fund, which receives international financing designed to achieve this goal.

Current and project performance against 15-30% target

Brazil's climate target is ambitious. Brazil is one of the first major developing countries to have set an emission reduction target. It provides very ambitious goals for reducing emissions from deforestation, the main source of greenhouse gas emissions in the country. However, current emissions from deforestation are highly uncertain, so the impact of measures to reduce deforestation rates on national emissions is also uncertain, and achieving the target is conditional on external financing. Non-forestry-related measures could be strengthened, as these are covered in less detail and their emissions are projected to increase significantly under the reference scenario (they will also grow under the proposed target).

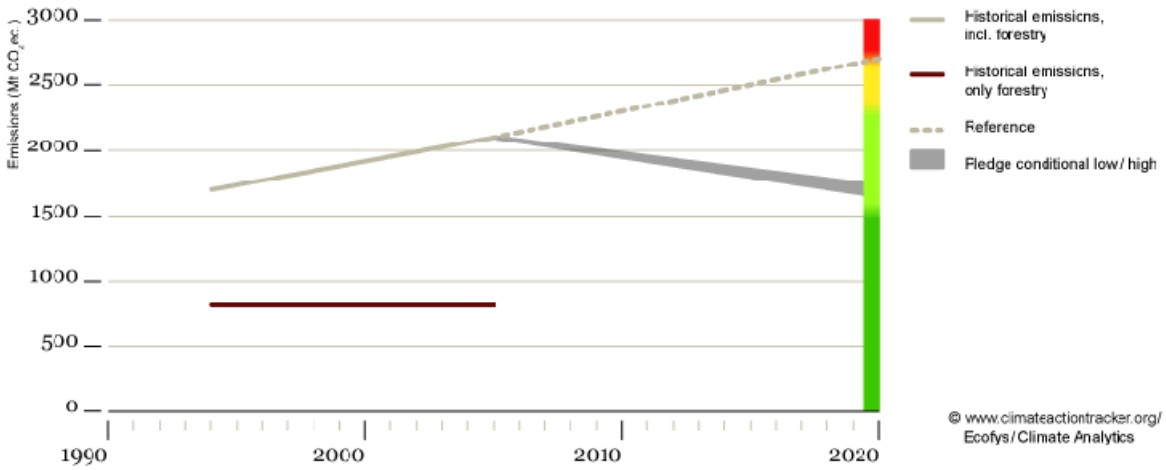

Figure 5 - 3 Historical emissions, projected emissions and pledge for Brazil

5.4 South Africa

Current pledge

South Africa has provided a comprehensive study of long-term mitigation pathways and options up to 2050 (DEAT 2007). There are, however, no concrete plans or priority measures for implementation. A decision on domestic measures is scheduled to be made by 2012.

Based on this plan, South Africa announced on 6 December to reduce its emissions 34% below reference in 2020.

Current and project performance against 15-30% target

South Africa provided a detailed, comprehensive scenario analysis, but has not specified which of the measures will be implemented. Two scenarios from the national study are provided in the figure below.

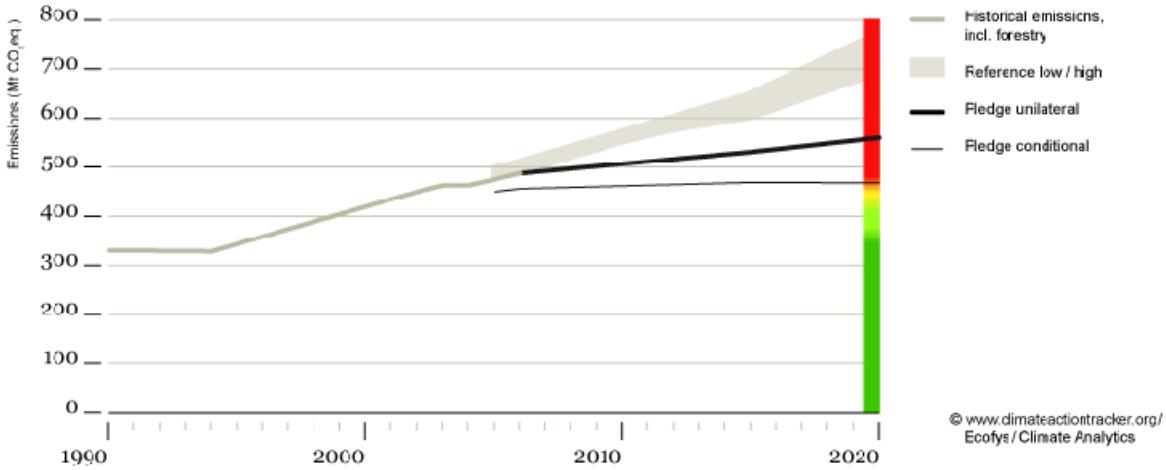

Figure 5 - 4 Historical emissions, projected emissions and pledge for South Africa

5.5 Mexico

Current pledge

Mexico has a very detailed national plan up to 2012, which includes measures and their effects on emissions (SEMARNAT 2009). The emission reductions up to 2012 can be considered a first step, noting that funding has been secured for implementation up to 2012. The plan is in line with an overall strategy to reduce emissions by 50% by 2050, which assumes moderate reductions in the early years and more ambitions reductions later.

Current and project performance against 15-30% target

Mexico has an extremely detailed climate plan with significant actions up to 2012 and ambitious long-term goals. It is a 22% reduction below reference. However, on the downside, Mexico has made reductions after 2012 conditional on external financing, without further specification.

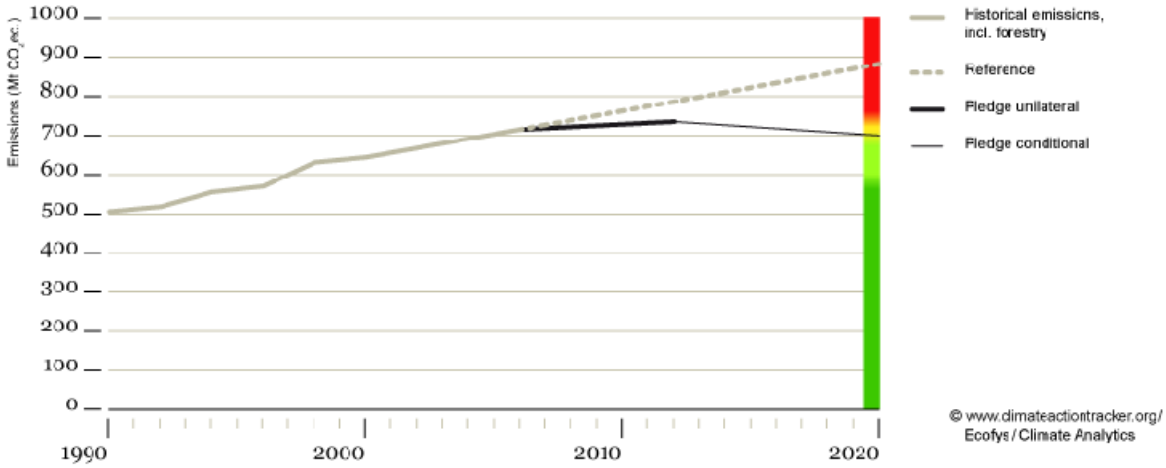

Figure 5 - 5 Historical emissions, projected emissions and pledge for Mexico

5.6 South Korea

Current pledge

South Korea has agreed to reduce its emissions 30% below reference emissions by 2020, which is 4% below the 2005 value (Greengrowth 2009). South Korea recently provided a climate change strategy, but only in the Korean language.

Current and project performance against 15-30% target

South Korea has proposed a voluntary reduction target that is relatively stringent and represents a substantial deviation from 'business as usual' (30%). However, the comparable effort range requires more ambitious reductions due to the country's relatively high level of development.

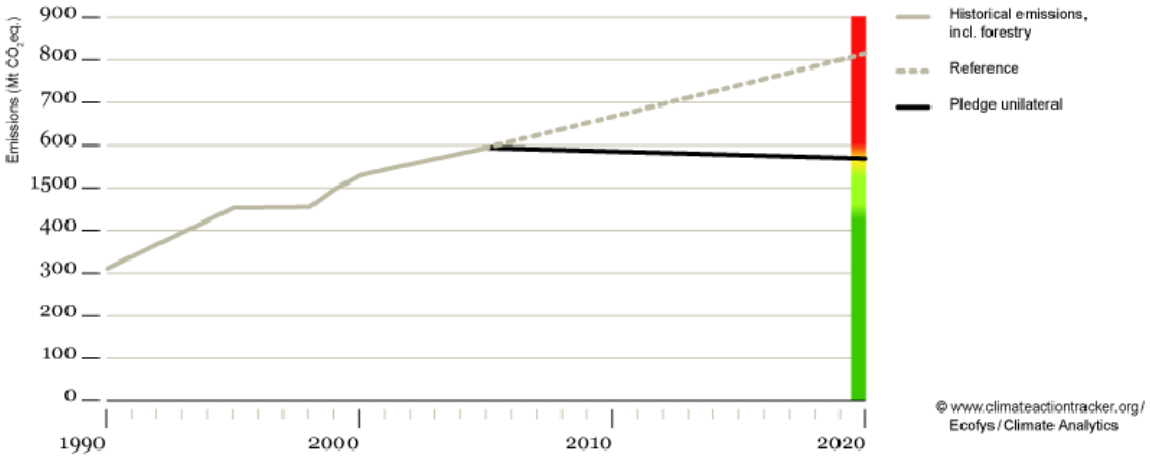

Figure 5 - 6 Historical emissions, projected emissions and pledge for South Korea

5.7 Summary

The actions proposed by emerging economies and developing countries in their current pledges could lead to a reduction in the growth of emissions of 5-15% below business-as-usual emissions by 2020. This is not enough to meet the 15-30% reduction needed by 2020 to limit global warming to 2°C or even lower. But developing countries could be closer to the range than Annex I countries to their 25% to 40% range. The assessment is difficult to make, due to data limitations and uncertainties around the developing country proposals.

There are large differences between the ambition levels of the countries in this group. Brazil ranks high with its recent reduction proposal. In the middle of the range are emerging economies such as Mexico and South Korea, which propose to reduce the growth of their emissions by the 2020s. Difficult to assess are the international targets in emissions per GDP from China and India.

Appendix 1 - Reference sources

M. Amann, Cofala, J., Rafaj, P., and Wagner, F. (2009). *The impact of the economic crisis on GHG mitigation potentials and costs in Annex I countries*. http://gains.iiasa.ac.at/gains/reports/Annex1-2009.pdf.

Biofuels Research Advisory Council. (2006). *Biofuels in the European Union, A Vision for 2030 and Beyond. Final draft report.*

DEAT. (2007). *Long-Term Mitigation Scenarios. Strategic Options for South Africa*. Pretoria, South Africa.: Development of Environment Affaires and Tourism (DEAT).

ECOFYS. (2009). Climate Action Tracker.In: http://www.climateactiontracker.org.

EEA. (2004). *Annual European Community greenhouse gas inventory 1990-2002 and inventory report 2004, Technical Report 2/2004*. Copenhagen, Denmark:

EEA. (2006). *Annual European Community greenhouse gas inventory 1990-2004 and inventory report 2006, Technical Report 6/2006*. Copenhagen, Denmark:

EEA. (2007). EEA greenhouse gas data viewer. In: http://dataservice.eea.europa.eu/dataservice/viewdata/viewpvt.asp?id=418.

EEA. (2009). *EU27 greenhouse gas profile summary 1990-2020*. http://www.eea.europa.eu/themes/climate/ghg-country-profiles/tp-report-country-profiles/eu-27-greenhouse-gas-profile-summary-1990-2020.pdf.

W. Eichhammer. (2006). *Lessons from the Evaluation of Measures in Industry and Transport in Europe, ADEME-WEC workshop on energy efficiency policies*. Paris:

European Commission. (2006). *Implementing the Community Strategy to Reduce CO_2 Emissions from Cars: Sixth Annual Communication on the effectiveness of the strategy*. Brussels:

European Commission. (2009). *Emissions trading: EU ETS emissions fall 3% in 2008*. http://europa.eu/rapid/pressReleasesAction.do?reference=IP/09/794&format=HTML&aged=0&language=EN&guiLanguage=en.

European Commission. (2002). *Renewable Energy Sources Statistics in the European Union, Eurostat*. Luxemburg:

Eurostat. (2003). *New Cronos Database, energy and households statistics*. http://europa.eu.int/comm/eurostat.

Eurostat. (2006). *Table "Municipal waste landfilled" (Website)*.

Government Brazil. (2008b). National Plan on Climate Change Brazil, Executive Summary. In: Interministerial Committee on Climate Change (Ed.) Decree No. 6263 ,http://www.mma.gov.br/estruturas/imprensa/_arquivos/96_11122008040728.pdf.

Government Brazil. (2008a). *Mitigation Scenario*. http://www.mma.gov.br/estruturas/182/_arquivos/cenarioemissoes_182.pdf.

Government Brazil. (2009). Brazil presents its proposal for the UN convention on Climate Change. In: http://www.mma.gov.br/sitio/en/index.php?ido=ascom.noticiaMMA&idEstrutura=8&codigo=5329.

Government India. (2008). *National Action Plan on Climate Change*. New Delhi: Government of India, Prime Minister's Council on Climate Change.

Government India and Planning Commission. (2008). Eleventh Five Year Plan 2007-12 Volume III. In: agriculture, rural development, industry, services, and physical infrastructure , http://planningcommission.nic.in/plans/planrel/11thf.htm.

Government of the People's Republic of China. (2008). *China's Policies and Actions for Addressing Climate Change*. Beijing, China:

Greengrowth. (2009). *Press release of the Presidential Committee on Green Growth*. http://www.greengrowth.go.kr.

N. Höhne, Phylipsen, D., and Moltmann, S. (2009). *Factors underpinning future action. For the department for Environment Food and Rural Affairs (DEFRA), UK*. http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=2&ProjectID=14848#RelatedDocuments.

N. Höhne and Sterk, W. (2009). *GHG reduction options in emerging economies, Ecofys and Wuppertal Institute. For the Federal German Environmental Agency*. http://www.umweltbundesamt.de/klimaschutz-e/klimapolitik/weiterentwicklung/index.htm.

IEA. (2003). Electricity Information. In: France:

IEA. (2005). *Energy balances*. CD database, Paris: International Energy Agency.

IEA. (2006). *Energy Balances*.

P. R. o. C. National Development and Reform Commission (NDRC). (2007). *Medium and Long-Term Development Plan for Renewable Energy in China*. http://www.nytimes.com/2009/09/23/world/asia/23hu.text.html?_r=1.

Öko-Institut. (2006). *Trends of N_2O emissions in the European Community, presentation by Anke Herold and Jakob Graichen for the ECCP review Topic Group 'Other Greenhouse Gases'*.

Project Catalyst. (2009). *Setting a Benchmark: How Developed Countries Might Equitably Contribute Towards a 450 ppm Pathway*. http://www.project-catalyst.info.

SEMARNAT. (2009). *Programa especial de cambio climático 2008-2012*. Mexico D.F.: SEMARNAT.

UNFCCC. (2009). Submission by South Africa. In: http://unfccc.int/documentation/documents/items/3595.php#beg.

United Nations. (2006). *UN General Assembly Resolution (RES/61/237)*. http://www.un.org/ga/search/view_doc.asp?symbol=a/res/61/237.

H. Winkler. (2009). *Analysis of possible quantified emission reduction commitments by individual Annex I parties*. http://www.erc.uct.ac.za/Research/publications/09Winkler-etal-possible-reduction-commitments.pdf.

Appendix 2 - EU environmental policies implemented between 1990 and 2005

Renewable energy policies

- Due to the influence of renewable energy policies in the EU and the Member States, renewable electricity production in the EU-25, excluding large-scale hydropower, increased four-fold between 1990 and 2005. Production of renewable heat and liquid biofuels for transport both increased by 20% (Biofuels Research Advisory Council 2006; European Commission 2002; IEA 2003).

Landfill gas policies

- As a result of waste policies, emissions of methane from landfill sites in the EU-25 fell by 40% between 1990 and 2005 (EEA 2007). At the EU level, the Landfill Directive was introduced. Among other things, this stipulates increased use of landfill gas collection and energy recovery from the produced methane.

N_2O from industry

- N_2O emissions from industry in the EU-25 fell by more than 50% between 1990 and 2005 (EEA, 2006). Most N_2O emissions from chemical industries come from adipic acid and nitric acid production. The N_2O emissions from adipic acid production in the EU-25 fell by 80% between 1990 and 2005. Most of the reductions were achieved between 1997 and 1999 due to reduction measures in German, French and UK adipic acid production (Öko-Institut 2006; EEA 2004) and in 2004 due to an additional reduction in France (EEA 2006).

Combined Heat-Power generation (CHP)

- There has been a significant increase in the level of installed cogeneration capacity (mainly fired by natural gas) in the EU; the amount of electricity produced by cogeneration plants in the EU-25 doubled between 1990 and 2004, while the amount of heat produced by cogeneration increased by 40% over the same period (IEA 2005; IEA 2006). Cogeneration, also known as CHP, was promoted through various types of national policies such as subsidies, fiscal measures, feed-in tariffs and obligations.

Efficiency improvements in the built environment

- Temperature-corrected energy consumption for space heating per household in the EU-15 (in the cold and moderate central climatic zone, i.e. excluding Italy, Greece, Portugal and Spain) fell by approximately 23% between 1990 and 2005, which is approximately 1.8% per year (Eurostat 2006; Eurostat 2003). In the study it was estimated that a 0.8% per year improvement in energy consumption was the result of national policies that have promoted thermal insulation and energy efficient heating systems through building standards and financial incentives.

Common Agricultural Policies (CAP)

- Europe's Common Agricultural Policies were not specifically designed to reduce greenhouse gases. But one side effect of CAP policies has been a reduction in the numbers of livestock, leading to a reduction in methane emissions.

F-gases

- EU-15 emissions of HFC (hydrofluorocarbons) from the production of halocarbons fell by 86% in the period 1997-2005 (EEA 2007). This decline was mainly a result of policies stimulating end-of-pipe measures in the production of HCFC-22.

Passenger cars

- Between 1990 and 2005, CO_2 emissions from road transport increased by 30% in the EU-15. Between 1995 and 2005, however, the specific CO_2 emissions of new passenger cars fell by 13%, from 185 gCO_2/km to 161 gCO_2/km (European Commission 2006). This improvement has been attributed to two developments: the agreement between the European Commission and the auto industry (referred to as the ACEA Agreement) and the increasing proportion of diesel cars, which are on average more efficient than petrol-fuelled cars. The latter trend is mainly caused by the price difference between diesel and petrol and was not considered to be due to the impact of policy. This shift explains approximately 20% of the improved CO_2 performance of cars. The remaining improvement has been attributed to the ACEA Agreement.

Efficiency improvements and fuel switch in industry and the energy sector

- In the period 1990-2005, substantial reductions in CO_2 emissions from the energy sector were observed in the United Kingdom and Germany. The most important reason for German CO_2 reductions in electricity and heat production were efficiency improvements in coal-fired power plants. This is considered to be an autonomous effect due to old plants being replaced by new plants with greater efficiency and not the result of policy. In the United Kingdom, the most important factor in the emission reductions mentioned above was the fuel switch from coal to natural gas in electricity production. This so-called 'dash to gas' was mainly driven by the privatisation of the UK electricity industry and low natural gas prices in the 1990s. This was not considered to be the result of policy within the scope of this study and is therefore not included in the figures. The same applies to the energy sector in other EU countries; changes in CO_2 emissions were mainly driven by the liberalisation of the energy market and the prices of various fuels. This is why we have limited our estimates of the policy effect on CO_2 emissions from the energy sector to the effects of renewable energy and CHP.
- Based on evaluations of voluntary agreements in the period 1990-2004 in different countries (Eichhammer 2006) concluded that the policy effects were 'rather weak' compared to autonomous developments.