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## Analysis and evaluation of regime options and reduction potential for achieving the 2⁰ degree target with respect to environmental effectiveness, costs and institutional aspects

## Summary

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by

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# Summary

Global carbon dioxide emissions need to be reduced by at least 50 to 85 % in 2050 compared to 2000 levels to limit global surface temperature increase to 2°C compared to pre-industrial levels (IPCC 2007). As an intermediate greenhouse gas emission reduction target for industrialized countries in 2020, the IPCC (2007) confirmed a range of 25 % to 40 % compared to 1990, together with a substantial deviation from baseline in some developing regions, which was quantified as reductions in the range of 15 % to 30 % below baseline (den Elzen and Höhne 2008). While the climate summit in Copenhagen (COP 15) failed to come up with an international agreement involving binding greenhouse gas emissions reduction targets, under the Copenhagen Accord (UNFCCC 2009) most Annex I countries pledged quantifiable emission reductions. Similarly, several developing countries submitted nationally appropriate mitigation actions (NAMAs).

This report presents the final report of the research project „Post2012 climate regime options and potential of global GHG emission reduction: Analysis and evaluation of regime options and reduction potential for achieving the 2 degree target with respect to environmental effectiveness, costs and institutional aspects“ (FKZ 3708 41 102). The goal of the project was to support the German Environmental Agency (UBA) and the Ministry of Environment by conducting quantitative and qualitative analyses on various aspects of a future climate regime.

This report explores the environmental and economic effects of the pledges submitted by industrialized and major developing countries for 2020 under the Copenhagen Accord and provides an in-depth comparison with results arrived at in other model analyses. Two scenarios reflect the lower (“weak”) and upper (“ambitious”) bounds of the Copenhagen pledges leading to emission reductions of 17 % below 1990 levels for Annex I countries and 13% below reference levels for Non-Annex I countries. Both scenarios do not achieve a level of emission reductions identified by the IPCC (2007) as necessary to limit the temperature increase to below 2°C. In addition, two scenarios in accordance with the IPCC range for reaching a 2°C target are analyzed with industrialized countries in aggregate reducing their $CO_2$ emissions by 30 % and – for the most ambitious policy scenario – by 40 % in 2020 compared to 1990 levels, respectively. In addition, $CO_2$ emissions of major developing countries remain 15 % below the expected emission levels in 2020. For all four policy scenarios the effects of emission paths leading to a global reduction target of 50 % below 1990 levels in 2050 are also simulated for 2030. In the scenarios for 2030, all but the least developed countries are assumed to take on emission targets, but emission caps are considerably less stringent for developing countries than for developed countries. In addition, a separate scenario is carried out which estimates the costs of an unconditioned EU 30 % emission reduction target, i.e. where the EU adopts a 30 % emission reduction target in 2020 (rather than a 20 % reduction target), while all other countries stick with their “weak” pledges. Not included in the calculations is possible financial support for developing countries from industrialized countries as currently discussed in the climate change negotiations and laid out in the Copenhagen Accord.

The analyses are carried out with the dynamic Computable General Equilibrium Model DYE-CLIP, which accounts for economic and environmental effects resulting from changes in income, prices, exports and imports, or from carbon leakage in response to climate policy.[1] The main findings are:

- Economic costs (in terms of reduced GDP compared to baseline forecast GDP) in 2020 for industrialized and developing countries with "pledges" are - on average - no higher than 0.25 %, assuming that these countries are allowed to trade emission certificates unrestrictedly. The average GDP growth for industrialized countries with "pledges" remains at 27 %, while for developing countries with "pledges" it decreases slightly from 102 % to 100 % between 2004 and 2020. Economic effects for the most ambitious scenario are also rather low: the average GDP growth remains unchanged for industrialized countries (27 % between 2004 and 2020) and decreases to 98 % growth for large developing countries.
- If the EU adopts an unconditioned 30 % emission reduction target in 2020, while all other countries adopt their "weak" pledges, the reduction in GDP in the EU will be rather small (less than 0.005 %).
- All policy scenarios lead to relatively larger reductions in GDP for developing countries than for industrialized countries. However, annual GDP growth rates in developing countries remain significantly above those for industrialized countries.
- Economic losses tend to be above average in regions which depend highly on their reserves of fossil fuels, like Russia. Because climate policies result in lower global demand for these resources, their world prices fall (compared to the baseline) translating into lower incomes for the respective countries. Revenues from selling excess certificates (stemming from "new hot air" implied by the Russian pledge) are not sufficient to compensate for these economic losses.
- Some large developing countries like China and India experience larger GDP losses for tighter global emission targets because their industrial sectors are more energy- and $CO_2$-intensive than in most other regions. Hence, increases in the cost of $CO_2$ emissions lead to larger reductions (compared to baseline) in the output of energy-intensive sectors like iron and steel, non-ferrous metals, pulp and paper, cement, or chemicals. Nevertheless, output in these sectors in China and India generally doubles by 2020.
- In contrast, because these same sectors in the EU and Japan are relatively less energy- and $CO_2$-intensive, the EU and Japan experience slightly higher GDP. Hence, economies which reduce their $CO_2$ intensities earlier are less vulnerable to tighter emission targets in later periods. Similarly, energy-intensive, trade-intensive industries in developed and developing countries alike may particularly benefit from investments, which reduce energy intensity and $CO_2$ emissions of their processes.

[1] Since DYE-CLIP includes $CO_2$ emissions only, all targets submitted under the Copenhagen Accord are applied to $CO_2$ emissions only. Also, the analyses abstract from LULUCF.

- Simulations for the 2030 emission targets imply a reduction in global GDP between 2 % and 3 % compared to baseline. This change corresponds roughly to the growth in global GDP for one year.
- While developing countries experience larger reductions in GDP, this does not necessarily translate into larger declines in net welfare. For example, both China and India experience a gain in welfare in 2020 which is due to strong terms-of-trade improvements, revenues from selling $CO_2$ certificates, and gains in allocative efficiency for energy commodities by taking into account the negative externality from $CO_2$ emissions from the use of fossil fuels.
- Comparing the results to those derived at in other modelling analyses reveals that the costs of meeting the pledges for industrialized countries are low independent of the model used. Differences occur due to model type and model specific assumptions (e.g. on substitution elasticities, technological change, model dynamics, baseline development). Harmonized baselines and model assumptions help to arrive at more comparable results. The main conclusion is, however, that despite these differences the results from all model analyses remain within a relatively narrow range and well within an order of magnitude.