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accompanying the

COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS

Towards a comprehensive climate change agreement in Copenhagen

- Extensive background information and analysis

-PART 2-

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1. ANNEX 1: A BRIEF DESCRIPTION OF MODELS USED IN THIS STAFF WORKING DOCUMENT

POLES:

POLES is a long-term energy model for the world that represents 47 regions. It models demand and supply in the energy sector as well as greenhouse gas emissions in industrial sectors. The model used in this staff working document is an improved version of the POLES model used for the 2007 impact assessment accompanying the Communication "Limiting Global Climate Change to 2 degrees Celsius The way ahead for 2020 and beyond". The main novelties regard:

a) the adoption of a detailed energy balance structure for the 47 countries/zones in the model, and no longer only for the most relevant ones.

b) the introduction of a capital vintage approach in some energy transformation sectors, capturing more adequately technological improvements.

c) the broadening of the technological portfolio in electricity generation to cover 26 technologies.

d) the introduction of a detailed model for biomass and biofuels (1st and 2nd generation), including international trade of raw biomass and biofuels..

e) the coupling with IIASA LULUCF model.

f) the reviewed emission coefficients according to the latest UNFCCC values.

g) the treatment of non-CO2 GHG gases according to the EDGAR reference.

h) the GDP growth rates are also revised for Europe based on the basis of the latest available long term ECFIN forecast.

i) the update of population growth data according to the latest UN forecast (version 6, medium variant)

GEM-E3:

The world version of the GEM-E3 model is an applied general equilibrium model, covering the interactions between economy, energy system and environment for 18 World Regions. The GEM-E3 model integrates micro-economic behaviour into a macro-economic framework and allows the assessment of medium to long-term implications for policies.

The output of GEM-E3 includes projections of input-output tables, employment, capital flows, government revenues, household consumption, energy use, and atmospheric emissions. The model allows for the evaluation of the welfare and distributional effects of various environmental policy scenarios, including different burden sharing scenarios, environmental instruments and revenue recycling scenarios. Although the model is global, the output is sectorally and geographically disaggregated.

The model distinguishes between eight categories of government revenues, including indirect taxes, environmental taxes, direct taxes, value added taxes, production subsidies, social security contributions, import duties, and foreign transfers.

The model evaluates the emissions of carbon dioxide (CO2), other GHG (e.g. CH4), and there is a possible extension for a number of other air pollutants (NOx, SO2, VOC, NH3, and PM10). There are three mechanisms for emission reductions: (i) substitution between fuels and between energetic and non-energetic inputs, (ii) emission reduction due to less production and consumption, and (iii) purchasing abatement equipment.

The direct emissions and the potential for mitigation from agriculture were estimated using the land use change model from the integrated assessment model IMAGE of the Netherlands Environmental Assessment Agency.

IMAGE:

The Integrated Model to Assess the Global Environment (IMAGE version 2.4) is an integrated assessment model framework that explores the long term dynamics of global change as a function of drivers such as demographic and economic development, and developments in the energy and agricultural system (Bouwman et al. 2006). Within IMAGE, energy scenarios are developed using the energy model TIMER (Van Vuuren et al. 2006b). The climate policy model FAIR (den Elzen & Lucas 2005) is used to calculate global emission pathways that lead to a stabilization of the atmospheric greenhouse gas concentration. The developments in the energy system and in agricultural demand and production are described on the scale of 24 or 26 world regions, respectively. Environmental parameters are simulated at a 0.5 by 0.5 degree resolution by the ecosystem, crop and land-use models of IMAGE. Greenhouse gas emissions from energy and industry, land use, land-use change, crop and livestock production systems and natural ecosystems are computed largely on the basis of guidelines of the Intergovernmental Panel on Climate Change (IPCC 2006). IMAGE also describes the biosphere-atmosphere exchange of carbon dioxide (CO2), and feedbacks of climate and atmospheric CO2. Global mean temperature change is first calculated by the simple Atmosphere-Ocean model MAGICC model (Wigley & Raper 1992, Hulme et al. 2000), and subsequently downscaled via a pattern-scaling method (Schlesinger et al. 2000) to project climate change at the 0.5 by 0.5 degree resolution.

G4M:

The model is based mainly on a global afforestation model and calculates the net present value of forestry compared to the net present value of agriculture with equation. The main drivers for the net present value of forestry are income from carbon sequestration, wood increments (timber sales), rotation period length, discount rates, planting costs and wood prices. Main drivers for the net present value of agriculture on current forest land are population density, agricultural suitability and risk adjusted discount rates. These two values are compared against each other and deforestation is subsequently predicted to occur when the agricultural value exceeds the forest value by a certain margin. If deforestation occurs the speed of deforestation is constrained. The speed of deforestation is a function of sub-grid (0.5° x 0.5°) forest share, agricultural suitability, population density and economic wealth of the country.

GLOBIOM:

GLOBIOM (Global Biomass Optimization Model) is a global partial equilibrium static model integrating the agricultural, forestry, and bio-energy sectors. Within the agricultural sector about 20 major crops and the pertinent management alternatives are represented. The livestock sector is so far represented through an aggregate commodity – animal calories. Within the forestry sector, it is distinguished mainly between traditional forests and fast growing forest plantations. Both crop yields and mean annual forest increments are estimated for the different management strategies by means of biophysical models, like EPIC, or through downscaling of country level information, on the level of "simulation units". The latter are defined as intersection of different soil, slope and altitude classes, with a 0.5˚ grid, and with the country boundaries. Finally, three bio-energy production pathways are taken into account: (1) biofuels based on conventional feedstocks (sugar cane, maize, soybeans and rapeseed), (2) biofuels based on woody feedstock, and (3) heat and power generated by direct combustion of woody biomass. The equilibrium solution is found in the model through maximization of the market surplus under technological and resource constraints. Prices and international trade flows are endogenously computed for 27 world regions.

TM5:

The TM5 model is an off-line global transport chemistry model (Krol et al. 2005) that uses meteorological fields, including large-scale and convective precipitation and cloud data, from the European Centre for Medium Range Weather Forecast (ECMWF). The standard version of TM5 employs 25 vertical layers which are derived from the 60 layers of the operational ECMWF model. The model resolution can be chosen flexibly. For this work high resolution 1ºx1º zoom regions are utilized over the main centres of pollution North America, Europe, India and China. The spatial resolution for most of the remaining Northern Hemisphere is 3ºx2º, where as a resolution of 6ºx4º in the remaining less polluted regions such as the Southern Hemisphere is used. Natural emissions of gases and aerosol (precursors) are taken from recommendations by GEIA, and AEROCOM. Anthropogenic emissions were taken from the EDGAR/POLES emissions. Concentrations of ozone and PM were than translated into physical damage using population data and dose-response functions from the literature.

GAINS Europe - GAINS Asia:

GAINS is an extension of IIASA's RAINS (Regional Air Pollution Information and Simulation) model. It explores synergies and trade-offs between the control of local and regional air pollution and the mitigation of global greenhouse gas emissions. The GAINS (Greenhouse Gas and Air Pollution Interactions and Synergies) model assists in the search for pollution control strategies that maximize benefits across all scales.

The European implementation of the GAINS model has been released in December 2006. It covers 43 countries in Europe (including the European part of Russia. The new GAINS model incorporates the latest version of the RAINS-Europe model as it has been prepared for the 2007 revision of the National Emissions Ceiling directive. GAINS combines it with estimates of emissions, mitigation potentials and costs for the six greenhouse gases included in the Kyoto protocol, fully compatible with the methodology applied for the conventional air pollutants.

The GAINS-Asia project integrates policy-relevant information from several models[1]. It includes a reduced-form representations of these models and allows to combine functional relationships at the meta-level for the newly developed GAINS-Asia policy assessment framework. The GAINS-Asia tool allows the interactive assessment of the cost-effectiveness and benefits for a wide range of technical and market-based policy options. It can assess combinations of policies aimed at reducing long-range and hemispheric air pollution alongside greenhouse gas emissions in order to optimize overall benefits in the medium- and long-term.

[1] BernCC carbon cycle model, MESSAGE global energy scenario model, RAINS air pollution integrated assessment model, GAINS Model, TM5 hemispheric atmospheric chemistry and transport model, MARKAL and IPAC energy models for India and China respectively

2. ANNEX 2: RESULTS OF THE STAKEHOLDER CONFERENCE

Overview of specific issues raised during the stakeholder conference on 15 October 2008:

- There is a need for a clear vision for tomorrow's low carbon world. This work should be based on latest scientific findings.
- Domestic cap-and-trade systems for greenhouse gas emissions are important tool to deliver emission reductions in developed countries. Complementary measures such as standards, regulations and taxes could be used in sectors that cannot be covered by cap-and-trade schemes.
- Comparability of emission reduction efforts by developed countries is an important element of the post-2012 agreement. There are various ways to measure it, however, the criteria of assessing comparability should be forward looking (historic responsibility should not be the only factor).
- For scaling up and sharing financial support to developing countries both public and private financing is needed. Institution building in developing countries is the first priority. In order to ensure the most effective use of financing, conditions for developing country access to financing in terms of governance would need to be elaborated.
- While developed countries should continue to take the lead in committing to ambitious emission reduction targets, developing countries have to be part of the solution according to the principle of common but differentiated responsibilities and capacities. One of the central issues to support general engagement in mitigation is to find the appropriate way to provide sufficient incentives for developing countries to act ambitiously.
- The great diversity of situations, vulnerabilities and mitigation potentials among non-Annex I countries has to be recognized and taken into account in international response. Further differentiation among non-Annex I countries for emission reduction actions should be explored.
- Mitigation actions by developing countries depend largely on support by developed countries. In general, developing countries should focus on actions and policies that provide co-benefits. For instance, sustainable development and climate change policies like energy efficiency have positive impact on health (reduced urban air pollution). Moreover, they enable to reduce energy costs and increase energy independence like energy efficiency and developing renewable energies.
- Sectoral approaches in non-Annex 1 countries were considered a possible promising track to be explored. However, a number of critical issues must be addressed such as benchmarks and possible perverse effects (that may reduce mitigation potential). Also, more reflection is needed on whether sectoral approaches could provide any solution to carbon leakage. However, it was recognized that sectoral approaches is not a substitute for cap and trade systems.
- Technology cooperation should address primarily sectors with greatest emission reduction potential, support joint ventures among highly competitive sectors and best practices. There is a need to reflect if some technologies could be considered as a public good, however it mentioned that importance of IPR in technology transfer might be overstated. The idea of guaranteed support for some technologies (technological leapfrog) and demonstration projects was underlined.

- Regarding financial support, it was noted that relying on CDM is largely insufficient. The uneven distribution of CDM projects is quite revealing the limits of this mechanism. An efficient financial architecture will require a combination of public and private financing.
- Adaptation is already a reality for an increasing number of countries, especially for developing countries which will bear the brunt of climate impacts. Even with a global temperature rise limited to 2 degrees, adaptation will be a huge burden.
- Adaptation and mitigation are of equal importance in the convention and adaptation can be a deal maker or breaker for the negotiations on a post 2012 regime. In addition, adaptation and mitigation are closely interlinked
- Considering free standing adaptation activities versus mainstreaming adaptation in national planning and strategies, participants recognised a need to be pragmatic as adaptation is very context-specific issue. Free standing activities have a direct appeal to the population, but mainstreaming will be required to achieve the scale of adaptation action needed, integrated approach and to prevent short term solutions. Mainstreaming actions will need to be monitored, verified and reported. The additional cost of mainstreaming adaptation needs to be evaluated and taken into account.
- Regarding technological cooperation and capacity building, learning by doing and building on the National Adaptation Programmes of Action (NAPAs) and their implementation is the first step in right direction. There is important role of private sector in sharing know-how in risk sharing, management and transfer.

3. ANNEX 3: THE SCIENCE OF CLIMATE CHANGE, UPDATE

3.1. Recent scientific findings on Climate Change

The most recent comprehensive assessments by the Intergovernmental Panel on Climate Change, the IPCC 4th Assessment report[2] published during 2007 presents the most complete and authoritative assessment of the status of climate science to date. It thus provides an authoritative scientific basis for the EU and the international climate policy and highlights the urgency to act. The IPCC AR4 Synthesis report (http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr.pdf) summarises the findings from the three IPCC Working groups.

The IPCC highlighted inter-alia the following as robust findings:

– The warming of the climate system is unequivocal, as is now evident from observations

– As a result of anthropogenic emissions, atmospheric concentrations of CO2 now far exceed the natural range over the last 650,000 years.

– Many natural systems, on all continents and in some oceans, are being affected by regional climate changes.

– Anticipated increases in the frequency and intensity of some extreme weather events are expected to lead to larger impacts than previously estimated.

– Impacts are very likely to increase due to increased frequencies and intensities of some extreme weather events.

– More extensive adaptation is required to reduce vulnerability to climate change.

– Making development more sustainable by changing development paths can make a major contribution to climate change mitigation and adaptation and to reducing vulnerability.

– Unmitigated climate change would, in the long term, be likely to exceed the capacity of natural, managed and human systems to adapt.

– A wide range of mitigation options is currently available or projected to be available by 2030 in all sectors.

– Many impacts can be reduced, delayed or avoided by mitigation.

– Mitigation efforts and investments over the next two to three decades will have a large impact on opportunities to achieve lower stabilisation levels.

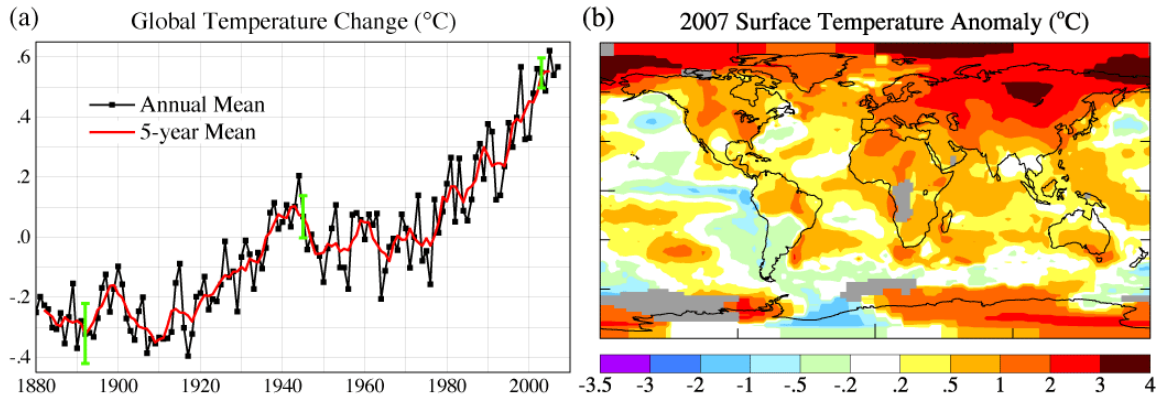
[2] IPCC AR4 WG1: http://www.ipcc.ch/ipccreports/ar4-wg1.htm; IPCC AR4 WG2: http://www.ipcc.ch/ipccreports/ar4-wg2.htm; IPCC AR4 WG3: http://www.ipcc.ch/ipccreports/ar4-wg3.htm ;

Science on climate change has made further progress since finalization of the IPCC WG1 AR4[3]. As a result, a number of risks could be larger than assessed in the AR4, in particular the risk of large sea-level rise already in the current century and the risks from increases in extreme weather events. This chapter highlights a selection of findings published since the finalisation of the IPCC AR4[4].Improved data and analyses techniques have improved understanding of observed climate change. These findings add to the already extensive evidence of the anthropogenic signal on all aspects of current climate.

3.2. Observed climate change

The IPCC AR4 published in 2007 stated that 11 out of the 12 warmest years on record (i.e., since 1850) had occurred during the last 12 years. According to the NASA Goddard Institute for Space Studies (GISS), 2007 was another exceptionally warm year that tied with 1998 for Earth's second warmest year on record. The eight warmest years have all occurred since 1998. [GISS, 2008]

Figure 1 Observed change in global mean temperature (left) and 2007 surface temperature anomaly



Source: NASA GISS, 2008

Comparison of the most recent observed climate trends for carbon dioxide concentration, global-mean surface temperature and sea level with the projections in the IPCC Third Assessment Report (TAR) indicate that previous projections are relatively conservative. The observed increase in global mean surface temperature since 1990 is 0.33 °C; this is in the upper part of the range given by the IPCC projections. Sea level data from tide gauges and satellite data show a linear trend of 3.3 mm/yr, which is faster than the best-estimate projections in the TAR of 2 mm/yr. [Rahmstorf et al., 2007]

Sea surface temperatures in the North Sea and the Baltic Sea show an unprecedented warming trend since the mid-1980s. Temperatures in summer since 1985 have increased at nearly triple the global warming rate and summer temperatures have risen two to five times faster than those in other seasons. Therefore, globally averaged warming is likely to underestimate the

[3] This chapter on recent findings does by no means aim to supplant the body of knowledge presented in the IPCC AR4. It only provides a selection of publications with updates of scientific developments in these areas occurred since the IPCC AR4 publication.

[4] Due to it's thorough and comprehensive review procedures the IPCC AR4 could assess only scientific literature (for physical climate science, impacts and adaptation) published by mid of 2006 to early 2007, depending on the working group; for details see: http://www.ipcc.ch/ipccreports/index.htm

magnitude of climate change in the North and Baltic Sea and the resulting impacts. [Mackenzie & Schiedek, 2007]

A new study analysing satellite observations suggests that precipitation and total atmospheric water have increased at about the same rate over the past two decades, while climate models suggest that precipitation would increase much more slowly. If this observed trend continues, climate change will result in substantially more rain than currently predicted by climate models. [Wentz et al., 2007]

Scientists from the UK Met Office found that greenhouse gas emissions have led to a rapidly increasing risk of extremely hot summers in the Northern hemisphere, such as those experienced in large parts of Europe in 2003 and 2006. Hot summers which were infrequent 20-40 years ago are now much more common and the current sharp rise in incidence of hot summers is likely to continue. [Jones et al., 2008]

The human influence on climate has for the first time been detected in precipitation at global and regional scales. A recent study finds that anthropogenic forcing contributed significantly to observed increases in precipitation in the Northern Hemisphere mid-latitudes, drying in the Northern Hemisphere subtropics and tropics, and moistening in the Southern Hemisphere subtropics and deep tropics. These changes cannot be explained by internal climate variability or natural forcing. [Zhang et al., 2007] New analyses combining climate model simulations with satellite data and surface measurements have also shown that the atmospheric moisture content over land and over oceans has increased substantially in recent decades, and that the increase is primarily due to greenhouse gas emissions. [Santer et al., 2007, Willett et al., 2007]

Some previously unclear findings could be solved recently as a team of British and US scientists was able to explain an abrupt drop of in the temperature record (summer 1945). This climate large shift in the 20th century that climate models were unable to explain is actually a mirage and was a result of uncorrected instruments. [Thompson et al., 2008] A new analysis of data for the upper troposphere the first time shows a warming trend, which agrees well with predictions from global climate models. The consistency between model simulations and inferred data increases confidence in model-based climate projections. [Allen & Sherwood, 2008].

1. Detection and attribution of recent climate change

Improved data and analyses techniques have improved understanding of observed climate change. These findings add to the already extensive evidence of the anthropogenic signal on all aspects of current climate.

Scientists from the UK Met Office found that anthropogenic greenhouse gas emissions have led to a rapidly increasing risk of extremely hot summers in the Northern hemisphere, such as those experienced in large parts of Europe in 2003 and 2006. Hot summers which were infrequent 20-40 years ago are now much more common and the current sharp rise in incidence of hot summers is likely to continue. [Jones et al., 2008] Another study was able to detect and separate the effect of greenhouse gases from that of sulfate aerosols on the observed warming trend since 1950 in nine world regions, including southern Europe. [Zhang et al., 2006]

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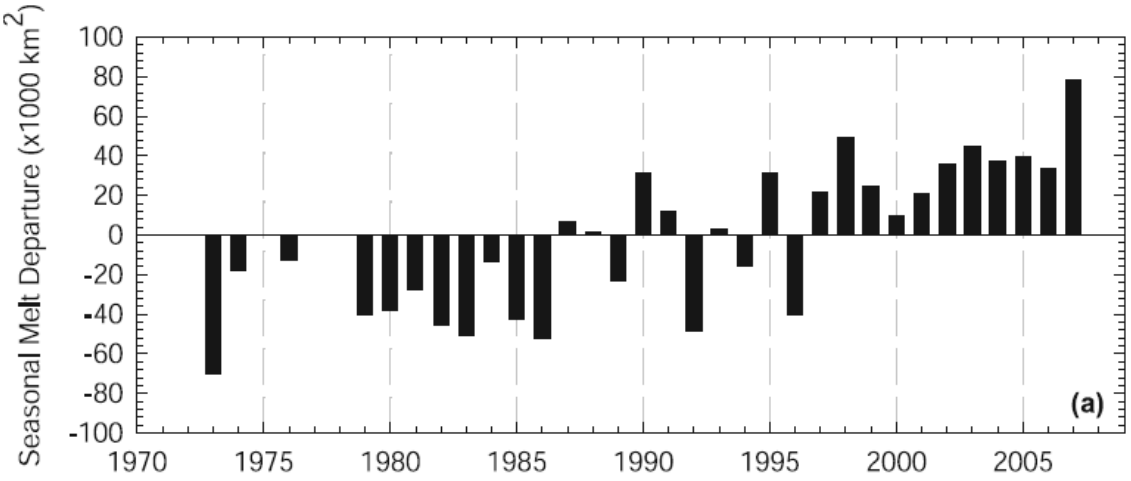
2. Changes in ice sheets, glaciers and sea level

Many new studies have investigated prehistorical and recent changes in glaciers, large ice sheets and sea level in order to improve projections of future sea-level rise. The average annual melting rate of mountain glaciers has doubled after 2000, in comparison with the already accelerated melting rates observed in the two decades before. [UNEP/WGMS, 2008]

Figure 2 Change in melting area of the Greenland ice sheet



Source: [Mote, 2007]

Melting of the Greenland ice sheet in summer 2007 established a new record, which was 60% above the previous high in 1998. The most recent 11 summers have all experienced melting greater than the average of the available time series (1973 to 2007). [Mote, 2007]The current and future contribution to sea level rise from Antarctica has been subject to large uncertainties. A recent study used extensive satellite observations to estimate the total Antarctic ice flux into the ocean from 1992 to 2006. The Antarctic ice sheet as a whole was found to be losing mass, mostly in West Antarctica, and the mass loss increased by 75% in 10 years. [Rignot et al., 2008] Other studies have also found that changes in the Greenland and

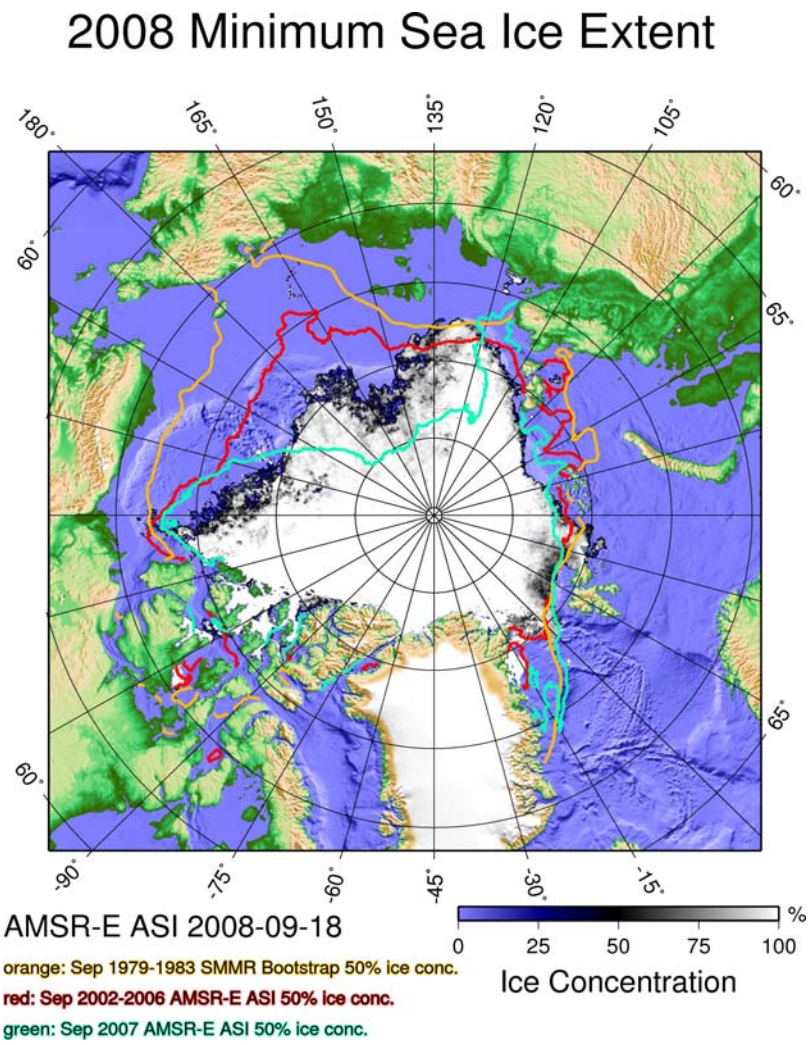
the West Antarctic ice sheets are accelerating. [Shepherd & Wingham, 2007, Velicogna & Wahr, 2006]

A team of US and Canadian scientists found that between 9000 and 8500 years ago, melting of the ice sheet on Greenland contributed around 6.6 m of sea level rise at about 1.3 m per century. Other scientists have found that the average rate of sea-level rise during the last interglacial period, around 120,000 years ago, was about 1.6 m per century. The two groups suggest that climatic conditions (in terms of the increase in summer surface air temperatures and global mean temperature, respectively) in these periods were comparable to those projected for the 21st century under business-as-usual emission scenarios. [Carlson et al., 2008, Rohling et al., 2008]

A team of US scientists has combined climate modelling and paleoclimatic data to assess the potential for large increases in sea level by the end of the 21st century. Their maximum and best estimates of total sea-level rise by 2100 are 2 m and 0.8 m, respectively. [Pfeffer et al., 2008] Also the German institute PIK [Rahmstorf, 2007, Horton et al., 2008] has developed a model of sea-level rise, which suggests figures that are substantially higher than the estimates in the IPCC AR4, which did not include ice-sheet dynamics. Thus, the risk of large sea-level rise in the 21st century is now estimated to be much greater than in the AR4.

According to data from the United States National Snow and Ice Data Center, Arctic sea ice area reached a new all-time minimum on 14 September 2007 at 3.6 Mio km2, which is 27% lower than the previous record low reached in 2005. The decline in ice cover has accelerated substantially. [Comiso et al., 2008] The observed sea ice decline is about three times faster than the model mean, which suggests that melting of Arctic sea ice is likely to happen much faster than projected by current climate models. [Stroeve et al., 2007, Arzel et al., 2006].

Figure 3 Area of Minimum Arctic sea ice



Source: Spreen, G., L. Kaleschke, and G. Heygster (2008), Sea ice remote sensing using AMSR-E 89-GHz channels, J. Geophys. Res., 113, C02S03, doi:10.1029/2005JC003384."

3. Carbon cycle feedbacks

Inclusion of geological and ecosystem feedbacks in warming projections could increase global warming over the next century due to human emissions of greenhouse gases by an additional 15-78%. [Scheffer et al., 2006, Torn & Harte, 2006] New measurements of methane emissions from Siberian thaw lakes revealed that these emissions are already five times greater than previous estimates. Hence, future methane releases from decaying Arctic permafrost may create a new positive climate feedback that has not yet been fully analysed. [Walter et al., 2006]

4. Changes in extreme events

Knowledge on recent and future changes in extreme events has improved significantly, due to better models and improved analysis techniques. New research reveals that since 1950 extremely warm temperatures have increased by between 1 and 3°C, which is much larger than the change in average temperature. [Brown et al., 2008] A recent study by German scientists projects that indices of extreme precipitation will also increase significantly in most regions, especially those that are presently experiencing significant precipitation. Conversely those regions which are presently dry are projected to become drier because of longer dry spells. In conclusion, the difference between humid and arid regions in terms of extreme

events is projected to become even greater under a changing climate. [Sillmann & Roeckner, 2008]

The European PRUDENCE project has investigated changes in climate extremes during the 21st century. The scientists found that the frequency, intensity and duration of heat waves will substantially increase over Europe due to increases in average temperature as well as temperature variability. Heavy winter precipitation will increase in central and northern Europe and decrease in the south; heavy summer precipitation increases in north-eastern Europe and decreases in the south. Mediterranean droughts start earlier in the year and last longer. The models show stronger winter storms over the North Sea, which cause an increased risk of storm surges along coastal regions of Holland, Germany and Denmark, in particular. [Beniston et al., 2007]

5. Risk of abrupt climate change

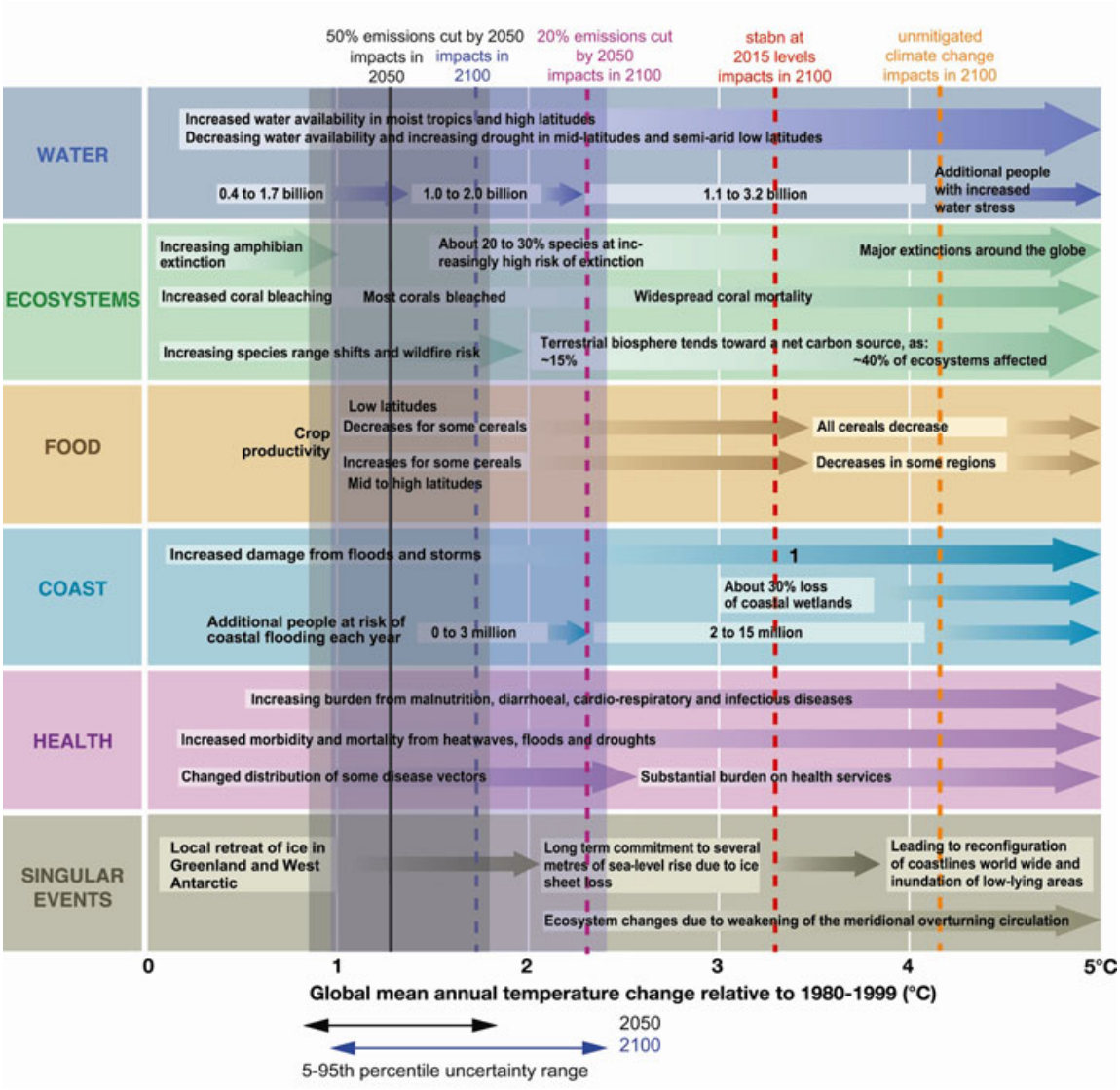
New findings based palaeoclimate records underpin the concept of risks of abrupt climate change. [Dakos et al., 2008] and [Brauer et al., 2008] Sensitive mechanisms have been identified with Arctic summer ice and the Greenland ice sheet, where the thresholds for an abrupt change of the earth system was estimated in a range from 1°C to 2.5°C above pre-industrial level.

3.3. Impacts of Climate Change

Also the projections of climate impacts and understanding of adaptation have improved significantly since finalization of the IPCC WG2 AR4 in 2007. Many recent studies conclude that the consideration of current climate variability and its potential changes in climate impact assessments increases the estimated adverse impacts of climate change on agriculture, natural ecosystems, coastal regions, and human health. Furthermore, evidence increases that ocean acidification presents a very substantial risk from anthropogenic greenhouse gas emissions for marine ecosystems, which is independent of climatic changes.

Leading scientists [Parry et al., 2008] have compiled information from the IPCC AR4 on climate impacts for different mitigation levels. They project (see figure below) major global impacts even for a 50% reduction of global emissions by 2050 compared to 1990 and that the extent of impacts increases significantly for less stringent emission cuts. These results confirm that both adaptation and mitigation are essential.

Figure 4 Selected global impacts from warming associated with various reductions in global greenhouse gas emissions.



Vertical lines indicate likely impacts of the median warming expected to result from indicated emissions scenarios (percentage cuts are from 1990 levels); shaded columns show 5 to 95% uncertainty ranges for impacts of a 50% cut. Source: [Parry et al., 2008], adapted from the IPCC WG2 AR4 Technical Summary

1. Climate impacts on key ecosystems

Coral reefs are most important biodiversity hotspots, and they provide significant services to society, including for coastal protection and coastal tourism. A recent review study shows the crucial role of ocean acidification in the destruction of coral reefs during previous mass extinction events. The study suggests that ocean acidification has the potential to trigger a further mass extinction. [Veron, 2008] Another study finds that atmospheric carbon dioxide concentration exceeding 500 ppm and a global temperature rise of more than 2°C significantly exceeds conditions of at least the past 420,000 years during which most extant marine organisms evolved. [Hoegh-Guldberg et al., 2007] Many corals rely on their symbiotic algae for survival. Without stringent mitigation measures coral reefs will undergo a substantial reduction in biodiversity during the 21st century because most coral species are unable to adapt. [Goulet, 2006]

Recent research has underlined the risks to the Amazon rainforest from climate change. One study projects a 70% reduction in the extent of the Amazon rain forest by the end of the 21st century for a high emissions scenario. Rain forest vegetation are projected to disappear entirely from Bolivia, Paraguay and Argentina and most of Brazil and Peru. While these dramatic results are dependent on the global climate model applied, they add to the previous evidence that most of the Amazon rainforest may be at risk from climate change. [Cook & Vizy, 2008] Another study suggests that aerosol forcing has delayed greenhouse gas-induced reductions in Amazonian rainfall but is unlikely to do so for much longer. Model simulations suggest a substantial increase in droughts in western Amazonia, such as the one that occurred in 2005, under conditions of increased greenhouse gas concentrations and reduced aerosol loading in the Northern Hemisphere. A '2005-like' year is an approximately 1-in-20-yr event currently but is projected to become a 1-in-2-yr event by 2025 (at about 450 ppm CO2) and a 9-in-10-yr event by 2060 (at around 610 ppm CO2). [Cox et al., 2008]

The impact of climate change on terrestrial organisms is often predicted to increase with latitude, in parallel with the rate of warming. Recent research suggests that also warming in the tropics, although relatively small in magnitude, may have most deleterious consequences because most tropical animals are relatively sensitive to temperature change and are currently living very close to their optimal temperature. The study suggests high extinction risks from global warming also in the tropics, where biological diversity is also greatest. [Deutsch et al., 2008]

A detailed analysis of all 400 large wildfires in the western USA over a 34 year period has found that large wildfire activity increased suddenly and markedly in the mid-1980s, with higher large-wildfire frequency, longer wildfire durations, and longer wildfire seasons. Earlier snowmelt and higher summer temperatures are critical factors in this increase; years with early snowmelt had five times as many wildfires as years with late snowmelt. The marked increase in wildfire activity happened in spite of increased expenditure in fire suppression, pointing to the limited success in adaptation. Projected temperature increases until the 2050s alone are projected to increase wildfire activity further threefold. [Westerling et al., 2006]

In a comprehensive study of climate-induced changes in key ecosystem processes across the globe during the 21st century, a global vegetation model was used with multiple scenarios from 16 climate models. The model results suggest that with >3°C of warming, the estimated land sink of carbon may convert to a source, suggesting a positive climate feedback. [Scholze et al., 2006].

2. Climate impacts on coastal regions

Sea-level rise is expected to effect coastal properties in two-ways: inundation of low-lying property and episodic flooding of properties at an elevation. A recent detailed study estimated the cost from episodic storm events to be much greater (up to 250 times) than the costs from inundation alone. While the specific numbers represent the particular circumstances of the study area, the results strongly suggest the total cost of sea-level rise could be underestimated if the costs of episodic flooding are not accounted for. [Michael, 2007].

3. Climate impacts on human health

Recent research has shown that the death toll of the unprecedented 2003 European summer heat wave was much larger than previously estimated. Based on an analysis of daily mortality numbers at the regional level from 16 European countries this study finds that more than

70,000 additional deaths occurred in Europe during the record heat wave in summer 2003. [Robine et al., 2008] The new results show that even wealthy countries can be vulnerable to climate change, in particular when it involves extreme climatic conditions never experienced before in a region. The initial results of the FP6 research project EDEN, (Emerging diseases in a changing European environment - involving 24 countries from Europe, the Middle East and Africa are suggesting that climate change, among other factors, could alter the distribution of tick-borne and rodent-borne diseases. http://www.eden-fp6project.net/).

3.4. Adaptation to Climate Change

Several recent studies have highlighted challenges for future adaptation. They highlight that adaptation to climate change requires being a cross-cutting issue to which all relevant government departments must sign up. Adaptation to climate change will be particularly difficult in countries where institutional networks between governments departments and relevant non-governmental adaptation actors are weak. [Koch et al., 2007] and [Patt & Schröter, 2008]

1. Built Environment

Recent studies highlight the cost of adaptation in the built environment. The additional costs of making new infrastructure and buildings resilient to climatic changes, in OECD countries, could range from $15 - $150 billion per year (depending on temperature change). One of the main components of this cost can be attributed to protecting key infrastructure from storm surge and flood damage [Stern 2007]. Land use planning, construction codes and performance standards could provide mechanisms where the private markets and simple measures can yield significant benefits or cost avoidances [Stern 2007]. The potential of the green infrastructure to moderate climate change impacts in towns and cities has been shown to be significant. Green infrastructure can moderate summer temperatures and reduce surface runoff at the local level, if coupled with storage to take account of expected increase in winter precipitation [Gill et al, 2007] and [Gill et al, 2008]. There is a case for adopting the precautionary principle within the construction industry, together with wider adoption of market mechanisms, and stronger application of regulatory safety nets where market mechanisms are ineffectual. [Shipworth 2007].

2. Energy Infrastructure

Climate changes will have significant impacts on the power sector (in particular where depending on water for hydropower and cooling). Where regions are dependent on hydropower as a source of electricity, recent findings suggest that a different portfolio of generating sources would be preferable to protect the electricity system from the effects of climate change [Markoff et al 2007]. Also the temporal and spatial distribution of electricity consumption is forecasted to change, depending on the region in question; this change is likely to have significant effects on the peak load capacity of the electricity systems. Energy infrastructure, especially for electrical distribution, is likely to need upgrading sooner than expected; adaptation measures should be taken in sectors which are highly dependent on the electricity supply [Jollands et al, 2006].

A study projects climate change could add 10–20% to costs to Alaska's public infrastructure, including the energy infrastructure, by 2030. Additional costs are projected to be relatively higher in the short run (2030 vs 2080), because of less time to adapt infrastructure to changing conditions [Larsen et al 2008]. For the US, a study suggests climate impacts on the energy

balance. Increased cooling will require more energy than what is saved on avoided heating, resulting in a net increase in energy consumption as temperatures rise (assuming no passive ventilation or cooling). If the US warms by 2.5°C (compared to the 1961-1990 baseline) energy expenditures are predicted to increase by $26 billion annually, while a 5C° temperature increase by 2100 would cause an increase of $57 billion [Mansur et al 2007].

3. Risk management

One of the barriers to effective adaptation is uncertainty; insurance markets need high quality information in order to send out the right signals to support adaptation, especially with regards to costs, benefits and uncertainty. Insurance markets can send out appropriate price signals, corresponding to concise risks and encourage adaptation, especially to reduce flood risk. However, if the impacts of climate change increase in frequency and extent, insurance mechanisms may not be able to cope with the additional risk. When the risks reach very high levels, costs may become too large for the industry to bear and these mechanisms might fail. Governments should put in place guidelines and frameworks for private stakeholders to stimulate adaptation [Stern 2007]. Measures that mitigate and adapt are doubly beneficial. Insurers can serve as proactive risk managers and promote practices that simultaneously contribute to loss-prevention and enhance sustainability. [Evan Mills 2007].

At the global level, the economic cost of weather damage could exceed 1 trillion USD in a single year by 2040. A new study is calling for approaches that integrate adaptation, disaster management and sustainable economic development [Dlugolecki, 2008]. The insurance industry can promote efforts to adapt to the impacts of weather hazards through the promotion of three measures: disseminating information about reducing the vulnerability of properties; offering financial incentives to invest in reducing the impacts of extreme weather; and establishing partnerships with policy-makers. [Ward et al, 2008, Botzen et al, 2008].

4. ANNEX 4: SOME KEY STATISTICS FOR THE G8 AND KEY MEM PARTICIPANTS

Table 1 Key statistics Annex I parties

Total GHG excl. LULUCF and Bunker Fuels	Ratified Kyoto	GDP/cap 2005[a]	Ton CO_2/ Cap 2005[b]	CO_2 intensity energy mix 2005[c]	CO_2 intensity GDP 2005[d]	Change 1990 - 2005[e]	Kyoto Target	Distance from target 2005
EU27	31/05/02	22.5	8.09	52.3	0.43	-8%	-	
EU15	31/05/02	32.8	-	-	-	-2%	-8%	-6%
Australia	12/12/07	28.1	18.4	73.8	0.8	27%	8%	-19%
Canada	17/12/02	28.3	17	48.2	0.67	25%	-6%	-31%
Iceland	23/05/02	43.7	7.46	14.50	0.21	11%	10%	-1%
Japan	04/06/02	28.7	9.5	54.7	0.24	7%	-6%	-13%
N. Zealand	19/12/02	21.2	8.51	49.3	0.56	25%	0%	-25%
Norway	30/05/02	52.8	8	27.5	0.2	9%	1%	-8%
Russia	18/11/04	4.3	10.79	57.00	4.41	-29%	0%	29%
Switzerland	16/03/98	41.3	6	39.60	0.17	2%	-8%	-10%
Turkey	-	5.7	3.04	61.4	0.89	73%	-	-
Ukraine	12/04/04	1.5	6.31	49.50	6.56	-55%	0%	55%
USA	-	33.8	19.61	59.4	0.53	16%	-7%	-23%

[a] 1000 € per capita, Data for 2005 , 1000€ per capita, Adapted from World Bank and Eurostat

[b] Data from IEA2007

[c] ton CO_2 /terajoule, Data from IEA2007

[d] kg CO_2/US$ using 2000 prices and exchange, Data from IEA2007

[e] Data database UNFCCC website

Table 2 Key statistics MEM participants other than G8

Total CO_2 excl. LULUCF and Bunker Fuels	GDP/cap 2005[a]	Ton CO2/ Cap 2005[b]	CO2 intensity energy mix 2005[c]	CO2 intensity GDP 2005[d]	CO2 1990[e]	CO2 2005[e]	Change CO2 1990-2005[e]
Brazil	3851	1.77	37.5	0.49	192.7	329.3	71%
China	1381	3.89	70.2	2.43	2243.9	5100.6	127%
India	577	1.05	51	1.78	586.9	1147.5	96%
Indonesia	1049	1.55	45.4	1.64	141.6	341	141%
Mexico,	5991	3.7	52.7	0.61	293.2	389.4	33%
South Africa	4156	7.05	61.8	2.07	254.6	330.3	30%
South Korea	13229	9.3	50.2	0.7	227.1	448.9	98%

[a] Data for 2005, € per capita, Adapted from World Bank and Eurostat

[b] .Data from IEA2007

[c] ton CO_2 /terajoule, Data from IEA2007

[d] kg CO_2/US$ using 2000 prices and exchange, Data from IEA2007

[e] Date from IEA2007

5. ANNEX 5:VIEWS OF THE 3RD PARTIES CONCERNING CLIMATE CHANGE POLICIES

5.1. The role of the G8 and the Major Economies meeting

In order to facilitate the negotiations under the UNFCCC, several other negotiating platforms have contributed to the climate change negotiations. Most notably the G8 and the Major Economies Meetings[5] (MEM) have discussed climate change in 2007/08. These meetings have proven useful to exchange views and improve understanding among major economies; this should contribute to reaching a global and comprehensive agreement in 2009 under the UNFCCC.

This resulted for instance in a clear recognition that global action is necessary. Most notably the G8 Summit in Hokkaido, in July 2008, endorsed a clear reference to the need for a global long term reduction target and invited, inter alia, to "consider and adopt in the UNFCCC negotiations, the goal of achieving at least 50% reduction of global emissions by 2050", without mentioning the base year against which this reduction needs to be measured. Also the MEM, who met back to back with the G8 recognised the need for a long term emission reduction goal but without a specific figure. In accordance with the principle of common but differentiated responsibilities and respective capabilities, it was affirmed that developed major economies would take on mid-term economy-wide quantitative targets (e.g. for 2020) while developing major economies would pursue national action on their emissions, supported and enabled by technology, financing and capacity-building, with a view to achieving a deviation from business as usual emissions.

For a more detailed overview of some of the differences in key statistics between some of the parties that participate in the international negotiations, see 4. (see Table 1 Key statistics Annex I parties and Table 2 Key statistics MEM participants other than G8).

5.2. Developed countries

United States of America

The US is part of Annex I under the UNFCCC and has an emission reduction target under Annex B of the Kyoto Protocol. The US has not ratified the Kyoto Protocol, following its rejection by the Bush Administration in March 2001. US GHG emissions from sources[6] have increased above 1990 levels to around 16% in 2005. Since 2001 US policies to tackle climate change have focussed on promoting research and technologies and on an overall intensity objective (reducing emissions per unit of GDP) to be achieved through voluntary policies. In promoting technology, the US administration has also pursued bilateral or multilateral frameworks such as the Asian Pacific Partnership on climate change.

The US has not accepted binding emission reduction targets but has agreed to the Bali Action Plan under the UNFCCC in December 2007 that includes a reference to comparability of

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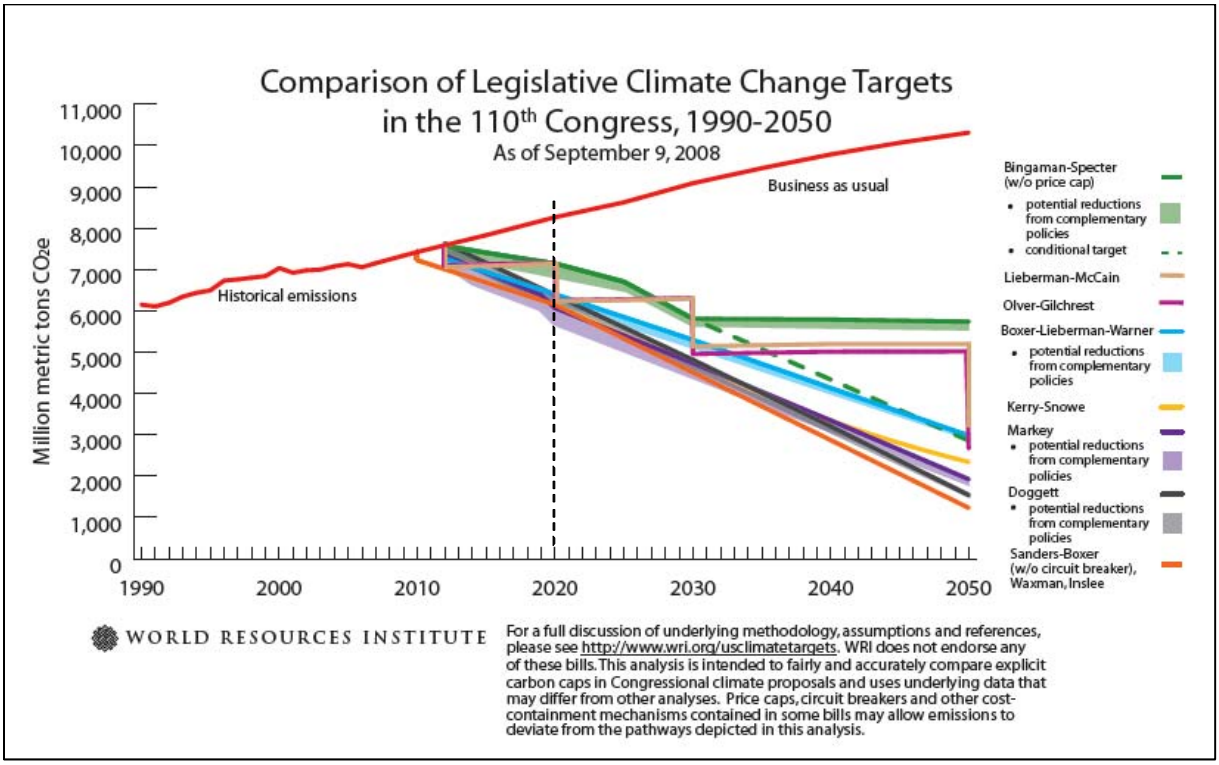
5 The MEM was started by the US administration. The MEM brings together representatives of major economies that are responsible for around 80% of global CO2 emissions. It includes the members of the G8 plus China, India, Brazil, South Africa, Indonesia, Mexico, South Korea and Australia as well as the Presidency of the EU. The EU supports a successor to the MEM to be set up by the new US administration in early 2009.

6 This refers to GHG emissions from sources but not emissions or absorption by Land Use, Land Use Change and Forestry.

mitigation commitments or actions by developed countries including quantified emission limitation and reduction objectives. President Bush's new policy announcement in April 2008 included an acknowledgement that the MEM should negotiate a long term goal for emission reduction but he set 2025 as the stabilisation date for US GHG emissions, thereby falling short of expectations. The US also signed up to the conclusions of the Hokkaido G8 summit that state that developed countries "will implement ambitious economy-wide mid-term goals in order to achieve absolute emissions reductions"

In the US congress several bills are debated that would lead to a cap and trade system for US companies indicating that the US might be willing to accept some type of binding commitment. Most bills include a large set of emissions sources, including emissions from transport and heating of housing via and upstream trading system. One of the prominent bills under debate is the Boxer-Lieberman-Warner bill that would see emissions in 2020 be reduced to around 1990 levels.

Figure 5 Comparison of legislative climate change targets under discussion in the US congress



Source: Adapted from World Resources Institute, http://www.wri.org/usclimatetargets

Although the new US administration is likely to engage much more constructively in the international negotiations, participation by all major emitters in a post-2012 agreement will remain key to enable the US to sign up. Both presidential candidates supported the establishment of federal cap and trade system. On 18 November 2008, President Elect Barack Obama, during a taped speech for the Bi-Partisan Governors Climate Summit, declared that he had the intention to establish strong annual targets that set us on a course to reduce emissions to their 1990 levels by 2020 and reduce them an additional 80% by 2050.

EU-US bilateral cooperation on climate change is happening in the framework of the High Level Dialogue (HLD) on Climate Change, Energy Efficiency and Sustainable Development, which has been held twice since established by the 2006 EU-US Summit in Vienna.

Canada

Canada is a Party to both the UNFCCC and its Kyoto Protocol. Although it has a 6% reduction target under the Protocol, its GHG emissions from sources were in 2005 25% higher than in 1990. With frequent government changes and the absence of ambitious GHG reduction policies or large-scale investment in the CDM, it appears increasingly unlikely that Canada will be able to meet its Kyoto target. There have been attempts to introduce emission trading scheme based on intensity targets[7]. Currently several Canadian states (British Columbia, Manitoba, Ontario, Qubec) are part of Western Climate Initiative, that created to identify, evaluate and implement collective and cooperative ways to reduce greenhouse gases in the region, focusing on a market-based cap-and-trade system.

Canada is actively engaged in the post-2012 negotiations, sharing the EU's view that we need to reach an agreement on a comprehensive, global post-2012 agreement in 2009 but does not show the leadership expected from developed countries in reducing GHG emissions. Like the US, Canada is of the view that such agreement must ensure the participation of all major emitters.

Australia

The Australian government only recently ratified the Kyoto Protocol at the end of 2007, following the Labor Party's victory in the November 2007 elections. Australia's Kyoto target allows it to increase its emissions by 8%. Although Australia's greenhouse gas emissions from sources have increased by 27% in 2005 compared to 1990, it is expected to meet its target using its considerable potential for carbon sinks under the Protocol. Australia has announced a long-term goal of reducing Australia's greenhouse emissions by 60% by 2050 and is currently preparing to announce a mid-term goal. Garnaut Climate Change Review[8] recommends Australia to reduce its emissions by 10% until 2020 and 80% by 2050 from 2000 levels, provided that a binding international agreement designed to stabilise concentrations at the 550ppm CO2 equivalent. In case more ambitious international agreement is concluded aiming to reach 450ppm overshoot scenario, Australia's emission reduction share would be 25 % by 2020 and 90 % by 2050 compared to 2020 levels. In the absence of comprehensive global agreement at Copenhagen in 2009, the review recommends Australia to reduce emissions by 5% from 2000 levels by 2020, which is consistent with current government policy of a linear track to achieving 60% by 2050.

The Australian Carbon Pollution Reduction Scheme has been released at the end of 2008[9]. The Scheme will commence on 1 July 2010, has a broad coverage, and plans for the majority of permits to be auctioned, with free allowances for trade exposed industries based on yearly historical average emissions in the sector, and will have a price cap. Australia's mid term goal is to reduce emissions by 2020 to between 85% and 95% of 2000 levels: a target range for Australia-wide emissions reductions of between 5% and 15%. The 5% target is unconditional, whereas the 15% target represents the extent to which Australia will accept tighter targets in the context of "a global agreement under which all major economies commit to substantially restrain emissions and advanced economies take on reductions comparable to Australia". While this notes a fairly modest level of ambition, Australia deems a 450 ppmv emissions path as in their genuine interest.

New Zealand

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7 Regulatory Framework for Air Emissions (RFAE).

8 Final Report, 30 September 2008, http://www.garnautreport.org.au/

9 http://www.climatechange.gov.au/whitepaper/index.html

Under the Kyoto Protocol, New Zealand is required to stabilise its greenhouse gas emissions at 1990 levels. In 2005 its emissions from sources were up by 25% compared to 1990. It recently adopted an almost economy-wide greenhouse gas emissions trading system that together with action in the forestry sector represent its two main avenues to meet its Kyoto target. The New Zealand ETS operates within the cap on emissions established by the Kyoto Protocol during its first commitment period (2008–2012). There is no cap on the emissions that occur within New Zealand. However, domestic emissions that exceed New Zealand's allocation under the Kyoto Protocol must be matched by emission units bought internationally from within the Kyoto cap on emissions. The New Zealand ETS foresees to include gradually until 2013 all major sectors (stationary energy, transport, industrial processes, forestry, agriculture, and waste) and all greenhouse gases specified in the Kyoto Protocol. The forestry sector is planned as the first to enter the scheme, where overall 21 million NZUs[10] will be allocated during the first commitment period (2008-2012). No free allocation is foreseen for transport, stationary energy and waste.

New Zealand and the EU share the overall objective of a comprehensive, global climate agreement and the development of the global carbon market. New Zealand has however not defined its level of ambition for a post 2012 framework. Like Canada, Australia and the US, New Zealand is concerned about engaging large emitters in more immediate action to mitigate global greenhouse gas emissions.

The new government has announced an upcoming reform of New Zealand's cap and trade system.

Japan

Under the Kyoto Protocol, Japan has a quantified reduction target of 6%. Japanese total GHG emissions had increased in 2005 by 6,9% compared to their level in 1990, thus requiring a reduction of 12,9% from 2005 levels to meet its Kyoto target. Japan intends to make use of sinks (LULUCF), and industry would also contribute through voluntary action. A voluntary emission trading system already exists and could be extended next year on a trial basis. But with no mandatory domestic emissions trading scheme or a carbon tax so far, Japan will recourse extensively to the Kyoto flexible mechanisms to meet its target.

Japan's main objective in the context of the post-2012 climate negotiations is to ensure that China and India take adequate action to reduce their emissions, not only for environmental purposes but also because of competitiveness concerns.

On May 24, 2007, Prime Minister Abe launched Cool Earth 2050 initiative in preparation of Japan's G8 presidency in 2008. It sets a global common goal of achieving a global reduction of GHG by half by 2050. Unlike the EU, the current levels of emissions would be taken as a basis, not 1990 levels as called for by the EU.

Japan proposes to reach this long-term target through a mix of developing innovative technologies (including increased use of nuclear energy) and creating a societal change towards a "low carbon society". The Speech of Prime Minister Fukuda in Davos on 25th January 2008 confirmed the focus of Japan for bottom-up reductions stemming from improvements in energy efficiency and development of new technologies, instead of the top-down approach of fixing an overall ambition level for absolute emission reductions. PM

[10] New Zealand Unit (NZU) equals to 1 metric ton of CO2 equivalent.

Fukuda however indicated his preference for a nation-wide cap, i.e. one single numerical target for Japan. But a mid-term (2020) GHG emission reduction target is still unknown.

The Japanese are the biggest proponents of sectoral approaches (SA). They propose two distinctive kinds of SA, one that would be used for target setting for developed economies, and the other ("cooperative SA") to enhance technology cooperation with developing countries. Japan suggests using a bottom-up sectoral approach to determine medium targets for individual countries. On a sector by sector basis, the emission reduction potential would be calculated by identifying the gap between current practice and best available technology. This means considering mainly the technical potential and not the cost of bridging the gap between current and best technology; other important factors to be taken into account, such as the capacity to finance the transition to a low-carbon economy. Due to important pressure from developing countries (especially China) and the EU, Japan acknowledges that the bottom up approach cannot replace national caps for developed countries (but should be considered within their numerical emission reduction target) and that intensity targets should be differentiated according to the situation of countries and sectors.

On other issues under negotiation for the post-1012 climate regime, Japan advocates for further differentiation between UNFCCC countries along three categories. Included among developed countries would be: current Annex I Parties; OECD Members or countries with equivalent economic development; or countries that want to be treated as Annex I. Developing countries would also be classified into three different groups, according to their level of economic development. Actions undertaken by developing countries would range from setting binding intensity targets per sector for the most advanced Developing Countries, to submission of voluntary national action plans for the others. Japan also supports an automatic graduation between the categories pursuant to e.g. economic and GHG criteria.

Cooperation between the EU and Japan, founded on the 2001 Action Plan, takes place at all levels culminating in the EU-Japan annual summit meetings. In addition, EU and Japan are engage in regular sectoral dialogues with the dialogue on Environment having Climate Change as one of its key points of discussion. G8. Contacts between the peoples, academics and business communities of the EU and Japan are being promoted through the activities of 'EU Centres' in Japan and cooperation in the field of education, as well as through business dialogue and a number of programmes offering training in Japan to European executives.

Russia

The Kyoto protocol entered into force on 16 February 2005 thanks to Russia's ratification of the Kyoto Protocol in November 2004. Russia's Kyoto target is the same as its emission level in 1990, i.e., 100% of 1990 emissions in 2008-2012. Its greenhouse gas emissions (GHG) fell by 29% between 1990 and 2005. Russia's GDP/capita was relatively low at 4300 USD in 2005 but its CO2 intensity is very high, up to 10 times the EU average.

In the UN climate negotiations Russia has so far not been a vocal participant in the discussions under the Bali Action Plan and it has not been open to discuss more concrete future emission reduction targets. Russian negotiators have indicated that Russia might accept to limit its emissions in 2020 at the 1990 level, the same level as the current target for Russia for the period 2008 to 2012. This would mean an actual substantial increase compared to current emission levels, which are around 30 % lower than 1990 levels. One reason for Russia's cautious position appears to be that it lacks sufficient analysis of its own long-term mitigation potential and policies for realising these reductions.. Earlier analysis shows that

there are significant emission reduction potentials in the Russian energy sector, for example by reducing gas flaring, and also by improving energy efficiency in industry and in residential buildings.

Russia's position in the climate change negotiations will depend on the new government's decisions on domestic energy efficiency and how they impact on long-term emission projections. In June 2008 President Medvedev signed a decree that requests the government to elaborate policies and measures to reduce the energy intensity of the Russian economy by at least 40% by 2020 compared with 2007 in order to guarantee the rational and environmentally responsible use of energy and energy resources. The new President has highlighted environmental concerns, which he describes as a crucial challenge for Russia's socio-economic development. It remains to be seen what effect this policy shift will have on Russia's position in the international climate negotiations.

Expert level co-operation on climate change is well established between the EU and Russia thanks to a tradition of regular informal bilateral meetings and workshops since 2001. An Expert Group on Climate Change was established under the EU-Russia Environment Working Group in October 2006 and has met regularly since then. It has also organised joint seminars on topics such as adaptation, the EU's emissions trading system and post-2012 negotiations.

Ukraine

Ukraine is a Party to UNFCCC since May 1997 and ratified the Kyoto Protocol in April 2004. Ukraine's Kyoto target requires it to stabilise its GHGs emissions at the level of its base year. Ukraine supported the EU's objective of reaching a global and comprehensive post-2012 agreement to fight climate change by 2009 in the joint statement of the EU-Ukraine summit of 2007 and 2008. Between 1990 and 2005, Ukrainian GHGs emission decreased by 55%, as a result of the major industrial and economic restructuring following its transition to a market-based economy. A law on monitoring GHG emissions and promoting the efficient use of natural resources was adopted in 2007 covers all aspects of Kyoto implementation and the use of Kyoto mechanisms. Ukraine has several Joint Implementation (JI) projects under the Kyoto Protocol. Ukraine has stated its aspiration to become a member of the EU while underlining that, at present, it remains within the Umbrella group (which includes the US, Russia, Japan, Iceland, Norway, Canada, New Zealand and Australia) under the UNFCCC negotiations in order not to be excluded from the negotiating groups. Ukraine has expressed its willingness to accept a 20% reduction target, however without referring to the base year for such a commitment.

A EU-Ukraine Joint Working Group on Climate Change (WGCC) was established that organised a seminar on post-2012 action in Kiev in 2007, which was the first joint EU-Ukraine event on climate change in Ukraine. At the meeting of the WGCC in Brussels 14 November 2007, Ukraine stressed its strong interest in EU mitigation policies and proposed closer co-operation with the EU on long-term measures, including modelling of emissions and mitigation scenarios. The next WGCC meeting and seminar on post-2012 action against climate change was foreseen in October 2008.

5.3. Asia

China

China ratified the UNFCCC in 1993 and the Kyoto Protocol in 2002. As a non-Annex I country, it does not have binding emissions reduction targets.

Reflecting the rapid economic growth of the country, Chinese emissions have been increasing rapidly. Between 1990 and 2005, they increased by 127%. At present China is at least the 2nd largest global emitter of GHGs, although recent studies[11] suggest that China has already overtaken the US at the top spot for emissions from CO_2 from energy. CO_2 intensity of both the energy mix and GDP is particularly high in China. Per capita emissions still remain below those in developed countries, but are already around 4 tons CO_2 per capita, roughly half those of the EU, and continue to grow rapidly.

China's position on climate change has changed, realising that unfettered emission growth is not in line with a sustainable climate but also realising the links between climate change, energy security and air pollution policies. China has put in place some domestic policies and measures (e.g. energy efficiency targets in the 11th Five Year Plan and the 2007 National Climate Change Programme) that, if implemented, will reduce emissions from baseline. The programme identifies a list of measures to control GHG emissions over the period 2006-2010 and estimates that these will amount to 1500 Mt CO2-eq emissions avoided[12] The programme outlines several objectives for 2010: to reduce energy consumption per unit GDP by 20%, to raise the proportion of renewable energy (including large-scale hydropower) in primary energy supply up to 10%, to stabilise nitrous oxide emissions from industrial processes at 2005 levels, to control the growth rate of methane emissions, and to increasing the forest coverage rate to 20% and to increase carbon sink by 50 Mt over the level of 2005.

China is in a potentially pivotal position to contribute realistic ideas as to how emerging economies can tackle their greenhouse gas emissions and serve as a role model to others. This is a key strategic objective of the EU-China Partnership on Climate Change. The Partnership was established at the 2005 EU-China Summit and the aims are to improve practical capacity to tackle climate change and mutual understanding of each other's positions and policies. Agreed joint activities are set out in a Rolling Work Plan, and include a commitment to work together on demonstration of near zero emissions coal with carbon capture and storage technology; capacity building at national and provincial levels on mitigation and adaption, and the EC's largest capacity building project for the Clean Development Mechanism (CDM).[13]

China has indicated readiness to include its domestic emission reduction policies in an international agreement, provided that developed countries commit to mid-term reduction targets for 2020 and that an effective financial mechanism is put in place to promote technology transfer.[14]

Over the course of the last year, China has increasingly focused its arguments on the need for technology transfer from Annex I countries in order for it to fulfil its own adaptation needs and our mitigation expectations. China is a major player in the Kyoto Protocol's Clean Development Mechanism (CDM), with the largest flow of Certified Emissions Reductions (CERs) of any host country, and often argues that it should have delivered more technology transfer. It is difficult to estimate transfers between the EU and China in this regard, but up until 2012, they run to billions of €, the EU being the main purchaser by far.. The UNFCCC estimates that China could generate with its CDM projects that are already registered,

11 International energy agency, World Energy Outlook 2008 (check with final version WEO 2008).

12 China's National Climate Change Programme, June 2007.

13 More information at: http://ec.europa.eu/environment/climat/china.htm

14 Barroso joint press conference with PM Wen Jiabao in Beijing, April 2008.

annually on average 116 million CDM credits[15] which represent a value of around 2 billion € annually at current prices for CDM credits[16].Interest is also growing in China in implementing emissions trading as a domestic policy tool (the focus is currently on emissions of local environmental pollutants rather than CO_2) and there is increasing interest in gaining domestic experience of carbon trading. The Ministry of Science and Technology is preparing an "adaptation plan", which will set out options for China to deal with climate change. The EC is assisting with the development of similar plans at provincial level.

India

India ratified the UNFCCC in 1993 and the Kyoto Protocol in 2002. As a non-Annex I country, it does not have binding emissions reduction targets.

Reflecting the rapid economic growth of the country, Indian emissions have been increasing rapidly. Between 1990 and 2005, they increased by 96%. India is the 5th largest global emitter of CO2[17]. CO2 intensity of GDP is relatively high but its per capita emissions are very low, also compared to China, reflecting the fact that almost half the Indian population survive on less than a dollar a day[18] and several hundred million people do not have access to basic energy supplies[19].

India's stance on climate change and reluctance to submit to targets is driven by its overriding desire to secure development and alleviate poverty through economic growth (preferably by maintaining current 8% growth rates). India demands the right economic development and sees the increasing wealth of the population as the best means to adapt to climate change. India has on several occasions stated that its per capita GHG emissions will not exceed the per capita GHG emissions of the developed industrialised countries, however not specifying which developed country – US per capita emissions are more than twice those of the EU. India has a number of policies (e.g. on renewables, energy efficiency and urban transport) which, although not driven by climate change concerns, contribute to mitigate measures. The publication of the first Indian Climate Change Action Plan[20] complements these policies, but continues in the same vein (i.e. mainly a focus on adaption plus energy and research policies and activities) and does not set out clear objectives.

The Plan seeks to promote sustainable development through the use of clean technologies and focuses on domestic actions under eight "missions", i.e. in the areas of solar energy, energy efficiency, sustainable habitat, water, Himalayan eco-system, forestry, sustainable agriculture and research. However, the Plan does not set out clear objectives for any of those actions. Comprehensive documents for each of those areas with objectives targets and measures are under development and will be institutionalised via several ministries and through inter-sectoral groups. These should be ready by December 2008.

Given its per capita low emissions, India advocates that the objective of a post-2012 agreement should be to ensure that emissions *per capita* become equal for all countries, still

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15 http://cdm.unfccc.int/Statistics/Registration/AmountOfReductRegisteredProjPieChart.html (16.09.2008)

16 Point Carbon, CDM & JI Monitor, Vol 6 - Issue 18 - 17 September 2008, Secondary CER assessment

17 USA, China, EU and Japan had more CO2 emissions from energy in 2004

18 http://www1.worldbank.org/devoutreach/summer00/document.asp?id=60

19 According to the 2001 census, nearly 700 million people in India were without access to modern energy sources

20 India's National Action Plan on Climate Change, June 2008.

allowing growth in per capita emissions for poorer countries. Prime Minister Singh stated that India's per capita emissions would never exceed those of the Western Developed countries. In a recent report, Greenpeace accused India of "**hiding behind the poor**" through their reiteration of their current low per capita emissions (which hide a large disparity between social groups and an ever-increasing middle class which looks to the West for its lifestyle inspiration).

The CDM has been very successful for India, which is the host country with the most projects (358 projects out of a total of 1,170 registered projects – 31% - on 29 September 2008). India is the second largest (after China) in terms of Certified Emissions Reduction (CERs) generated, with 14% of the market.

Like China, India places great emphasis on the need for **technology transfer** from the developed world to the developing countries in order for them to fight climate change (mitigation and adaptation). The Indian government is developing a venture capital fund to facilitate this, e.g. by buying down IPR on key technologies, and frequently pushes this idea in the UNFCCC negotiations. However, Indian industry has been very active in acquiring and investing in low carbon technologies. For instance in the sector of wind energy it acquired two of the EU's leading companies, i.e. gearbox producer Hansen Transmissions and wind turbine manufacturer REpower.

At the India-EU Summit of 2005, an EU-India Initiative on Clean Development and Climate Change was established, although it has been difficult to establish as many concrete cooperation projects under this banner as the EU would have like. However, at the 2008 Summit in Marseille on 29 September, a Joint Work Programme for EU-India co-Operation on Energy, Clean Development and Climate Change was agreed, which we anticipate will enable us to have regular and constructive dialogue with the Indians to build political will and practical capacity to tackle climate change.

South Korea

The Republic of Korea (South Korea) signed the UNFCCC in 1993 and ratified its Kyoto Protocol in 2005.

South Korea is not among the Annex I countries to the UNFCC. Membership to Annex I in 1992 was determined on the basis of OECD Membership plus countries with economies in transition, including the Russian Federation, the Baltic States, and several Central and Eastern European States. Since then, despite increasing pressure on South Korea to become an Annex I group, it still argues that it is still a developing country with regard to the UNFCCC. Together with Mexico and Turkey it are the only OECD members that have no reduction commitments under Annex B of the Kyoto Protocol.

The Government is considering announcing a mid-term target in the course of 2009, which will be likely use as reference year the 2009 emissions[21]. In addition, it is also planning to introduce a trial voluntary emission trading scheme at local level. In September 2008, a national action plan on climate was released. It focuses on fostering green industries (improving energy efficiency in the industrial sector; increasing the share of renewable energy (obj. to go from current 2% to 11% in 2020 and 20% in 2050) and R&D (share of climate R&D in total government R&D investment: from 6.4% in 2008 to 8.5% in 2012; improving

[21] Cf. presentation by the Korean Environmental Management Corporation and on 29 September 2008 in Seoul during the "Korea-EU Workshop on Climate Change Policies and Business Contributions".

quality of life (e.g. developing green transport) and contributing to global efforts (e.g. national mid-term target in 2009; development and cooperation assistance towards developing countries, including an East-Asia Climate Partnership with 200 million USD for 5 years).

As regard the EU –Korea bilateral relation a Framework Agreement (FA) on Trade & Co-operation with the Republic of Korea (ROK), in recognition of South Korea's increasing role in the world economy and in Asia, were signed in October 1996, and entered into force on 1 April 2001. The FA is currently in the process of being updated, and the EU wishes that meaningful provisions on climate change are included in the upgraded agreement.

The third summit meeting between the EU and the Republic of Korea was held in Helsinki on 9 September 2006 (fourth Summit is due to take place on October 25, 2008). The Leaders agreed to foster EU-ROK cooperation on climate change.

In addition, the Commission has been invited to participate in several conferences and seminars focusing on climate change in Korea in recent years, and is interested in continuing such cooperation.

Indonesia

Indonesia ratified the UNFCCC in 1994 and the Kyoto Protocol in 2004. As a non-Annex I country, it does not have binding emissions reduction targets.

Indonesian emissions have been increasing rapidly. Between 1990 and 2005, they increased by 140%. Excluding land use change, Indonesia is in the top 20 of largest global emitters. However, when land use change is included, Indonesia's contribution to global greenhouse gas emissions rises considerably and is estimated to make it one of the top 5 emitters globally through emissions from deforestation, land use change, peat land degradation and forest fires[22]. CO2 intensity of GDP is slightly less that of India (see Table 2) but per capita emissions are slightly higher.

The Indonesian Government is aware of the challenge that climate change poses globally and the country's vulnerability to the phenomenon. Deforestation alone makes up over 80% of Indonesia's total GHG emissions and is an issue of key concern to Indonesia in the context of the UNFCCC. As host of the UNFCCC Bali conference in December 2007, Indonesia positioned itself as a supporter of a successful post-2012 outcome.

Indonesia is showing interest in projects under the Clean Development Mechanism[23] (CDM) of the Kyoto Protocol, from which it has not benefited to the extent possible. For instance, according to a 2001/02 study there is a reduction potential of 23-24 million tonnes of CO_2 equivalent per year in Indonesia's energy and forestry sectors alone. Indonesia believes that procedures for approving CDM projects should be simplified with a view to increasing the participation of developing countries in such projects. In October 2008, Indonesia had registered 16 CDM projects.[24]

At the UNFCCC COP-11 in Montreal in December 2005, Indonesia was among a group of 15 rainforest-rich countries that proposed to allow carbon credits for "avoided deforestation" (i.e.

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22 WRI, 2005

23 In august 2008, 16 CDM projects were registered in Indonesia

24 UNFCCC, 7 October 2008.

compensation for preventing deforestation that would otherwise occur) under the Kyoto Protocol's Clean Development Mechanism..

Reducing emissions from deforestation requires effective forest management policies at the international and domestic levels, alongside economic incentives. While Indonesia has adequate forestry policy and legislation, implementation and enforcement are weak. Moreover, preserving remaining forests and high carbon stock land is jeopardised by the Government's policy to expand biofuel production. This policy is driven by the need to reduce dependency on fossil fuels and by export market potentials. Negotiations began almost 2 years ago on the adoption of a Voluntary Partnership Agreement between the EU and Indonesia under the EU's Forest Law Enforcement, Governance and Trade (FLEGT) Action Plan, which the EU side is keen to conclude.

Closely related to climate change is the issue of air pollution, and particularly the problem of trans-boundary haze pollution resulting from the burning of peat land in Indonesia. 2006 was the worst year since 1997, with haze covering parts of the region as far away as Micronesia. This also contributes substantially to Indonesia's CO_2 emissions.

Other Asian Countries

The other countries in Asia are a very heterogeneous group. The range spans the Asian LDCs (such as Myanmar with a GDP per capita of €177 in 2005, Bangladesh, Laos and Cambodia, with a GDP/capita of €577) which have concerns mainly related to poverty eradication, economic development and adaptation to climate change through the emerging economies of Thailand and Malaysia who have attained high economic growth rates over the last decades, to the non-Annex I anomaly of Singapore, which as a small island developing state does not currently have an emissions reduction target, but has a GDP higher than some EU Member States.

There are two notable regional groupings in Asia, namely the Association of Southeast Asian Nations (ASEAN – all of whom have ratified the Kyoto Protocol except Brunei), which exemplifies the range of economic development and political systems of Asia[25] and the South Asian Association for Regional Cooperation"[26]"(SAARC).Climate change interests in the SAARC countries, grouped around issues related to water (floods and scarcity as well as glacial melting), sea level rise (much of Bangladesh is at or near sea level) and the impact of changing weather patterns on agriculture that are more homogenous than in ASEAN. Neither grouping has managed to develop a common position on climate change, although ASEAN has expressed the desire to politically integrate more closely at the regional level, including on climate change. For Indonesia and Malaysia in particular, forestry and land use and the related issue of biofuels are very important. The EC has a climate change dialogue with ASEAN, which met for the second time in Bangkok in July 2008, back-to-back with an EU-ASEAN CDM workshop, where ASEAN countries present expressed their interest in greater participation in the CDM and in improving its functioning for the future.

[25] ASEAN members include Brunei Darussalam, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand and Vietnam.

[26] SAARC members include Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka.

5.4. Argentina, Mexico, Brazil and other Latin America

Mexico is the world's ninth largest economy and is a member of the OECD. As a large oil producer and exporter, it is the 12th largest emitter of greenhouse gases, accounting for about 1.54% of global emissions. Mexico's National Strategy on Climate Change"[27]"has identified specific mitigation measures for energy sector (improved energy efficiency and saving, increased use of renewables, increase rail coverage for freight transportation) and forestry and land use (sustainable forest development, conservation of forest ecosystems in protected areas, reforestation and recovery of lands apt for forestry, soil restoration with reforestation). Their estimated emission reduction potential is ~106,8 Mt CO2-eq by 2014 for energy sector and 12800-23350 Mt CO2-eq by 2012 for carbon conservation in forestry and 30,2-54,2 Mt CO2-eq by 2012 for forestry and land use. Mexico recognises that "current division between AI and non-AI countries has to move towards a more realistic differentiation" and explicitly mentions group of advanced developing countries including themselves in this group. Considers no-lose targets appropriate for this group.

5.5. Africa

South Africa

South Africa ratified the United Nations Framework Convention on Climate Change (UNFCCC) in August 1997 and acceded to the Kyoto Protocol in 2002.

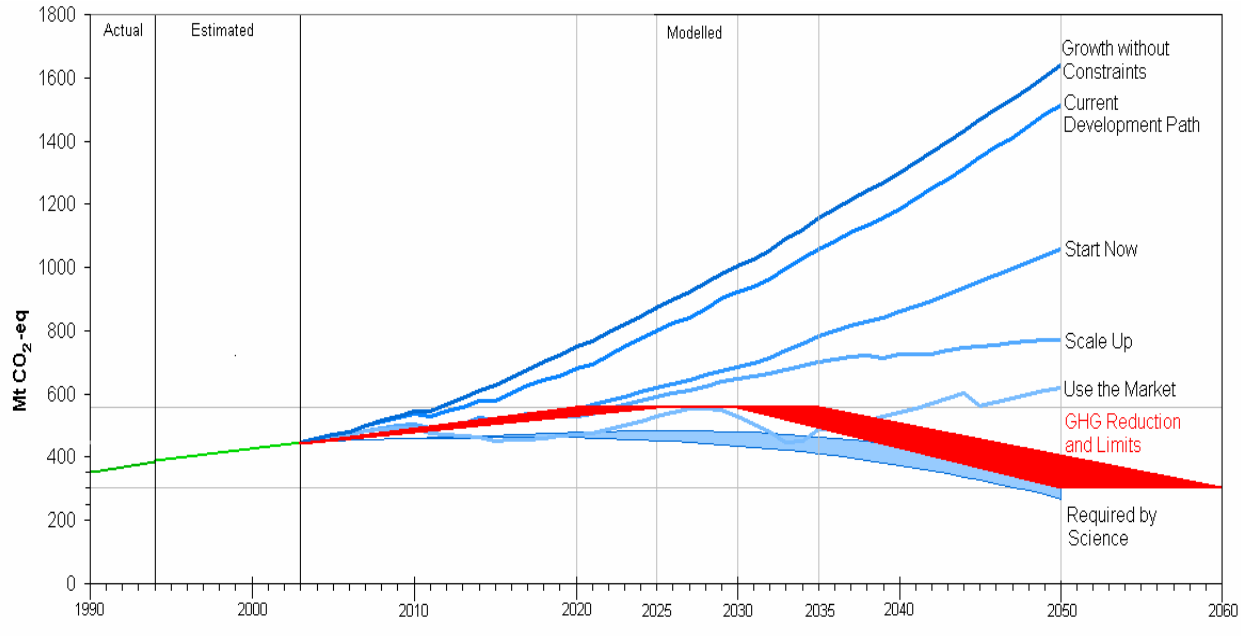
The South African government has outlined a vision for the road ahead on climate change[28], where they foresee to demonstrate leadership in the multi-lateral system by committing to a substantial deviation from baseline, enabled by international funding and technology. This vision states that South Africa's GHG emissions must peak around 2020-2025, stabilise around 100 Mt above current levels for up to ten years and then decline in absolute terms. South Africa has estimated what the gap would be between a baseline scenario which they name 'growth without constraints' and an emissions reduction scenario that would see sufficient reductions as proposed by sound science, i.e. leading to a 30 to 40% reduction by 2050 compared to 2003 GHG levels[29].

Figure 6 South Africa's vision on climate change: GHG emission reductions and limits

[27] Mexico's National Strategy on Climate Change, 2007

[28] http://www.info.gov.za/speeches/2008/08072816451001.htm

[29] Long Term Mitigation Scenarios: Strategic Options for South Africa, October 2007.



Source: Long Term Mitigation Scenarios: Strategic Options for South Africa, October 2007

South Africa outlines several options how to fill the gap between the baseline scenario and the ambitious reduction scenario. "Start now" option covers about 44% of the gap in 2050 and contains net negative cost measures and other sustainable development co-benefits, like increasing energy efficiency in industry and transport, as well as use of more renewable and nuclear sources for electricity production. "Scale up" option covers two thirds of the gap between two scenarios by 2050 and foresees actions going beyond negative costs, such as further increasing energy efficiency for industry and transition to zero-carbon electricity generation by mid-century, where nuclear and renewable sources have equal share of electricity production. "Use the market" option closes the gap by three fourths between the two scenarios and foresees escalating CO2 tax and incentives for technology acceleration, renewables for electricity generation, biofuels and solar water heaters. The fourth option "Reaching for the goal" is needed to close the gap between two scenarios and reach emission reductions required by science. For this new technology development and behavioural change will be needed.

Other African Countries

Africa contributes little to global climate change, with low carbon dioxide emissions from fossil fuel use and industrial production in both absolute and per capita terms. Africa accounts for 2–3% of the world's carbon dioxide emissions from energy and industrial sources, and 7% if emissions from land use (forests) are taken into account.[30]
At the same time, Africa will be particularly affected by climate change in terms of food security, sustainable water supply and extreme weather phenomena such as floods, droughts and threats of desertification. Economies and livelihoods of an increasing number of communities, countries and sub-regions in Africa continue to decline due to desert encroachment partly emanating from climate change and locally generated land degradation processes. African countries engage in UNFCCC negotiations as members of different groups, mainly the G77 & China, and the African Union. Africa expects substantial commitments by

30 Harnessing Technologies for Sustainable Development, Economic Commission for Africa, 2002

Annex I parties for capacity building, climate change adaptation measures and, to a lesser extent, mitigation measures. On many occasions, South Africa has been expressing these views on behalf of the African nations.

5.6. Middle East & OPEC

The Middle East and OPEC members are key countries in the international energy system and also in the fight against climate change. As the main fossil fuel producers they have in the past often delayed international negotiations, fearing the impact of climate change measures on the future demand for fossil fuels..

Membership of OPEC is very diverse. All, except Iraq, have ratified both the UNFCCC and the Kyoto Protocol. OPEC includes developing countries with a low GDP per capita but also some countries which have higher GDP per capita than the EU average. Moreover, 5 OPEC members have higher GDP per capita emissions than the EU average while some of them have very low ones. CO_2 emissions per capita and energy intensity in some OPEC Members is quite high.

Table 3 Key statistics OPEC (excl. MEM members)

Total CO_2 excl. LULUCF and Bunker Fuels	GDP/cap 2005[a]	Ton CO_2/ Cap 2005[b]	CO_2 intensity energy mix 2005[c]	CO_2 intensity GDP 2005[d]	CO_2 1990[e]	CO_2 2005[e]	Change CO_2 1990-2005[e]
Algeria	2512	2.57	57.9	1.21	54.7	84.3	54%
Angola	1599	0.53	20.4	0.57	4.1	8.5	107%
Ecuador	2264	1.77	53.5	1.14	13.2	23.4	77%
Indonesia	1049	1.55	45.4	1.64	141.6	341	141%
Iran	2209	5.96	59.8	3.07	175.3	407.1	132%
Iraq	-	2.94	65.7	4.43	52.9	84.6	60%
Kuwait	21732	29.44	63.3	1.43	25.6	74.6	191%
Libya	5730	7.76	56.9	1.03	27.4	45.4	66%
Nigeria	663	0.42	12.6	0.91	29.2	54.8	88%
Qatar	42906	44.73	54.9	1.54	14.4	36.4	153%
Saudi Arabia	10988	13.83	54.4	1.4	159.3	319.7	101%
UAE	26059	24.35	56.2	1.06	50.1	110.4	120%
Venezuela	4387	5.35	55.8	1.09	105.1	142.3	35%

[a] Data for 2005, € per capita, Adapted from World Bank and Eurostat

[b] Data from IEA2007

[c] ton CO_2 /terajoule, Data from IEA2007

[d] kg CO2/US$ using 2000 prices and exchange, Data from IEA2007

[e] Date from IEA2007

Over the past few years, the EU has stepped up its cooperation with this group of countries to foster their shift towards a low carbon economy based on low carbon emitting uses of fossil fuel and on the potential of the Middle East region to develop and deploy new technologies like carbon capture and storage (CCS) and new energy sources like solar energy

The EU is engaged in supporting R&D efforts in the Middle East and in the OPEC countries. A new Inco-Net (European International Cooperation Network for R&D) platform was launched this year by the Commission targeted at Gulf Cooperation Council (GCC) countries. Some countries, like the United Arab Emirates, are already undertaking major renewable energy projects.

Under the EU-GCC Joint Cooperation Council it was decided to organise a regular dialogue between the EU and the GCC on environment and especially climate change. Two meetings were already organised in 2007 and 2008. In these meetings some issues of common interest were identified like adaptation, technology development and deployment including CCS and solar, and CDM.

5.7. Candidate countries and potential candidate countries

Candidate countries and potential candidates regularly align themselves with EU positions, supported EU statements and submissions to the UNFCCC.

Candidate countries

Turkey

Turkey only became a Party to the UNFCCC in May 2004 and are in the process of ratifying the Kyoto Protocol. Between 1990 and 2005 GHGs emission of Turkey increased by 73%, currently CO2 emission/capita are at level of 3.04 ton and GHG is relatively high, comparable to that of Australia. Although Turkey is classified under the UNFCCC as a developed country, its late ratification of the Convention meant that it does not have a target under the Kyoto Protocol. As a result of this Turkey is neither allowed to participate in the CDM, nor allowed to participate in international emissions trading or JI.

Turkey's recent ratification of the Kyoto Protocol demonstrates its wish to be proactively engaged in the international negotiations on a post-2012 agreement. At recent meetings Turkey has been regularly aligning itself with EU positions, supporting EU statements and submissions to the UNFCCC. In view of its low per capita emissions and GDP, Turkey has however continuously stressed its discomfort with being classified among developed countries under the Convention and its Protocol. Turkey will want to ensure that its participation in a future regime recognizes its actual level of greenhouse gas emissions and economic development.

Turkey's first national communication to the UNFCCC was submitted in January 2007. During the preparations of the national communication, Turkey also compiled the first inventory of greenhouse gases emissions and removals in the country as of 2004.

In February 2007, the Turkish Grand National Assembly adopted a decision to establish a Research Commission on Global Warming, which will also focus on the position of Turkey with respect to the international process including the Kyoto Protocol.

The EU funded SYNERGY Project has build up capacity in relation to the flexible mechanisms under the Kyoto Protocol. During an International Workshop in Istanbul in February 2005 Turkey showed an interesting in CDM project but this could not be taken forward given that it is an Annex I party under the UNFCCC. Under EU program TAIEX a workshop regarding greenhouse gas emission mitigation policy in EU was foreseen in October 2008 in Ankara.

Croatia

The Republic of Croatia is a Party to the United Nations Framework Convention on Climate Change (UNFCCC) from April 1996 and ratified the Kyoto Protocol in May 2007 committing to a 5% reduction of GHG compared to base year. Between 1990 and 2005 Croatia's CO2 emissions from energy decreased by 4%. CO2 emissions/capita are at 5 ton and CO_2 intensity of GDP is around the double of that of the EU. GDP/capita in 2005 amounted to around 7000 €.

Croatia drafted its National Strategy with an Action Plan for the Implementation of the UNFCCC and the Kyoto Protocol in 2007. The latter was incorporated in May 2008 in Croatia's National Air Quality Protection and Improvement Plan for the period 2008-2011. Croatia's position on a post-2012 agreement has been closely aligned with that of the EU and it frequently supports the EU's statements and submissions.

The Air Protection Act partially transposes the provisions of Directive 2003/87/EC. It *inter alia*, prescribes the contents of the National Allocation Plan for Greenhouse Gas Emission Allowances thereby preparing for eventual greenhouse gas emission trading under the EU ETS if Croatia would join the EU. It also foresees the implementation of the Kyoto Protocol mechanisms, prevention and abatement of emissions and the establishment of the Greenhouse Gas Emissions Register managed by the Croatian Environment Agency (CEA). The Regulation on the monitoring of greenhouse gas emissions in the Republic of Croatia (OG 1/07) sets out the requirements for the implementation of Commission Decision 280/2004/EC on the monitoring of greenhouse gases and Commission Regulation 2216/2004/EC for a standardised and secure system of emission registers amended by Commission Regulation 916/2007/EC.

The Former Yugoslav Republic of Macedonia (FYRoM)

FYRoM became a Party to UNFCCC in January 1998 and ratified the Kyoto Protocol in November 2004. FYRoM is considered a developing country under the Convention and its Protocol. As such it can participate in the CDM, for which it adopted a national strategy in 2007 identifying potential projects.

Between 1990 and 2004 FYROM's GHGs emission decreased by around 10%, currently CO2 emission/capita are at level of 4.1 ton and CO2 intensity of GDP is high at 2.15 kg CO2/US$. GDP/capita amounts to 2300 € in 2005.

FYRoM adopted the National Strategy for the Clean Development Mechanism in February 2007, giving the Ministry of Environment the responsibility to continue the coordination of all activities related to the implementation of CDM projects.

FYRoM prepared a Draft Inventory of Greenhouse Gas Emissions taking 2000 as base year. A Final Action Plan on adaptation to climate change and a Draft Report on climate change reduction by sectors were also prepared.

Potential candidate countries

Albania became a party to the UNFCCC in January 1995 and acceded to the Kyoto Protocol in April 2005. Albania is considered a developing country under the Convention and its Protocol and as such it can participate in the CDM.

Bosnia and Herzegovina became a party to the UNFCCC in December 2000 and acceded to the Kyoto Protocol in April 2007. It is considered a developing country under the Convention and its Protocol and as such can participate in the CDM.

Montenegro became a party to the UNFCCC in January 2007 and acceded to the Kyoto Protocol in June 2007. The Ministry of Tourism and the Environment has been designated as the national authority for projects related to the CDM.

Serbia became a party to the UNFCCC in June 2001 and acceded to the Kyoto Protocol in October 2007. Serbia can participate in the CDM.

6. ANNEX 6: COMPARISON BASELINE (EXCLUDING LULUCF) WITH THE OTHER BASELINES

Compared to the SRES scenarios the assessment in this staff working document has conservative estimates for the emission growth in developed countries. For the developing countries the baseline projections of GHG emissions, excluding LULUCF, is similar to the outcome of the original SRES B2 scenario and higher than the recently updated B2 scenario. But emission growth in developing countries is substantially lower than the A1 scenario from the SRES and the baseline in the study by Sheenan which has high projections for GHG emissions growth in the baseline[31].

Table 4 GHG Baseline emissions staff working document compared to other baseline projections (excluding LULUCF)

Increase of emission levels compared to 1990 in 2020 in %*			
2020	Developed countries vs 1990	Developing countries vs 1990	World vs 1990
IPCC A1 2001	+27%	170%	84%
IPCC A2 2001	+25%	132%	67%
IPCC B1 2001	+4%	121%	50%
IPCC B2 2001	+11%	143%	63%
IPCC A1f 2001	30%	173%	87%
IPCC A1t 2001	24%	160%	78%
Baseline staff working document	-2%	166%	63%
Common Poles Image Baseline 2003	14%	147%	66%
Update IPCC B2	21%	114%	57%
Sheenan 2008	17%	204%	92%

*: Adapted from den Elzen and Höhne, 2008

[31] Sheenan, 2008

7. ANNEX 7: GDP GROWTH IN BASELINE IN THE POLES MODEL

Baseline (incorporating impact financial crisis)	Yearly growth				Total growth over period
	1990-2005	2005-2010	2010-2020	2005-2020	2005 -2020
World	3,4%	4,1%	3,7%	3,9%	76,6%
Developed countries	2,1%	2,1%	2,6%	2,4%	43,3%
EU	1,9%	1,8%	2,2%	2,1%	36,1%
USA	3,1%	2,0%	2,8%	2,5%	45,5%
Japan	1,5%	1,5%	2,0%	1,8%	31,2%
Russia	-0,7%	6,0%	4,3%	4,8%	103,0%
Developing countries	5,4%	6,4%	4,8%	5,3%	117,8%
Brazil	2,5%	3,1%	3,2%	3,2%	59,6%
China	9,8%	9,1%	5,7%	6,8%	169,9%
India	5,9%	7,3%	5,5%	6,1%	142,5%

Baseline before financial crisis	Yearly growth				Total growth over period
	1990-2005	2005-2010	2010-2020	2005-2020	2005 -2020
World	3,4%	4,8%	3,7%	4,1%	81,8%
Developed countries	2,1%	3,1%	2,6%	2,7%	50,0%
EU	1,9%	2,7%	2,2%	2,4%	42,3%
USA	3,1%	3,0%	2,8%	2,9%	53,0%
Japan	1,5%	2,5%	2,0%	2,1%	37,3%
Russia	-0,7%	6,5%	4,3%	5,0%	108,4%
Developing countries	5,4%	6,7%	4,8%	5,4%	121,2%
Brazil	2,5%	3,5%	3,2%	3,3%	62,1%
China	9,8%	9,4%	5,7%	6,9%	173,5%
India	5,9%	7,7%	5,5%	6,2%	147,5%

8. ANNEX 8: MITIGATION ACTION BY DEVELOPED COUNTRIES - QUANTIFIED EMISSION LIMITATION OR REDUCTION OBJECTIVE

The global mitigation challenge can only be met if all countries contribute according to their common but differentiated responsibilities and respective capabilities. Due to their large historic contribution to GHG emissions and their currently higher per capita emissions and more advanced economic development, developed countries need to take the lead in reducing emissions.

With the exception of the United States, all developed countries have not ratified the Kyoto Protocol and thus did not accept a quantitative emission limitation or reduction commitments for the first commitment period of the Kyoto Protocol (2008-2012).

The approach of quantitative emission limitation or reduction commitments for developed countries should be continued beyond 2012. Quantitative targets provide environmental effectiveness by determining the maximum permissible emission levels of countries covered by those targets. A single economy-wide target gives countries maximum flexibility as regards the policy approach it wants to pursue, e.g. the sectors in which reductions need to be made as well as the choice of policy instruments (e.g. standards, market based instruments taxation). The domestic policy mix can be defined bottom-up taking into account national circumstances. Quantitative targets also provide a reliable basis for cap and trade-based emission trading systems at private entity level. In fact, an increasing number of developed countries have introduced or are preparing emission trading systems based on an absolute ceiling for GHG emissions.

Intensity-based targets, one of the main alternatives for quantitative caps, do not provide this environmental effectiveness and significantly complicate the implementation of cap and trade based emissions trading systems at private entity level such as the EU ETS. In theory, intensity-based targets could provide for an adjustment of mitigation efforts in case of unexpected economic development in individual countries. For developed countries, however, the main trend of GDP is relatively robust and comparable across countries, so that absolute emission reduction targets can be applied without unnecessary economic risks. In addition, the global carbon market provides for significant flexibility in achieving absolute emission reduction targets in a cost-effective manner, thus allowing countries with higher than expected GDP to fulfil part of their mitigation commitment by purchasing emission credits on the international market.

The EU has set itself a unilateral target or QELRO of -20% compared to 1990 by 2020 and expressed its willingness to increase this to 30% given a sufficiently ambitious global agreement. Other developed countries have expressed targets for the long term up to 2050, but there is much less clarity on their willingness to what an acceptable QELRO could be for them in the mid term, i.e. 2020. See the table below on the positions and policies of other developed countries.

One of the main challenges in continuing a quantitative target-based approach will be the inclusion of the US into a post-2012 agreement. The United States have not ratified the Kyoto Protocol and are not bound by an economy-wide quantitative emission limit or reduction

target. In 2005, the US represented about 40% of the developed countries[32]. Including the US emissions into the future reduction commitments is therefore indispensable to ensure the environmental effectiveness of the global regime.

Table 5 Objectives and policies set unilaterally by developed countries

Country	Target and assessment
USA	President Bush's announced in April 2008 a US goal for stabilising US emissions, but only in 2025. In the US congress several bills are debated that would lead to a cap and trade system for US companies indicating that the US might be willing to accept some type of binding commitment. Most bills include a large set of emissions sources, including emissions from transport and heating of housing via and upstream trading system. One of the prominent bills under debate is the Boxer-Lieberman-Warner bill that would see emissions in 2020 be reduced to around 1990 levels. Presidential elect, Barack Obama supports emission reductions of 80% below 1990 levels by 2050[33]. He also supports the establishment of federal cap and trade system. In addition, Obama proposes to reduce energy intensity of economy by 50% by 2030 and to reduce oil consumption overall by at least 35% by 2030.
Canada	The Government of Canada has committed to reducing emissions by 60-70% by 2050 and by 20% by 2020 compared to 2006 levels[34]. As in 2005 Canada was 25% above 1990 levels, mid-term target would mean that Canada's emissions will be around 2% above 1990 levels by 2020, thus reaching its Kyoto target of reducing emissions by 6% relative to 1990 levels only around 2025. However, several Canadian provinces have come up with more ambitious targets, but they all use different base and target years:[35] Several provinces have also set their own targets: Alberta: stabilize emissions by 2020, 14% below 2005 by 2050. Ontario: 6% below 1990 by 2014, 15% below 1990 by 2020, 80% below 1990 by 2050. Quebec: 6% below 1990 by 2012 Saskatchewan: Stabilize emissions by 2010, 32% below 2004 by 2020, 80% below 2004 by 2050

32 According to data reported to the UNFCCC, excl. LULUCF emissions.

33 http://www.barackobama.com/issues/pdf/EnergyFactSheet.pdf

34 A Climate Change Plan for the Purposes of the Kyoto Protocol Implementation Act – 2007.

35 Climate Change-Energy report from the European Heads of Missions in Canada,

	British Columbia: 33% below 2007 by 2020, 80% below 2007 by 2050 Manitoba: 18% below 1990 by 2010 and 23% below 1990 by 2012
Australia	The Garnaut review recommended: 25% by 2020 and 90% by 2050 compared to 2000 for 450ppm scenario 10% by 2020 and 80% by 2050 compared to 2000 for 550ppm scenario 5% by 2020 compared to 2000 in absence of comprehensive international agreement, which is consistent with current government policy of a linear track to achieving 60% by 2050. The Australian Carbon Pollution Reduction Scheme has been released at the end of 2008[36].. Australia's mid term goal is to reduce emissions by 2020 to between 85% and 95% of 2000 levels. The 5% target is unconditional, whereas the 15% target represents the extent to which Australia will accept tighter targets in the context of "a global agreement under which all major economies commit to substantially restrain emissions and advanced economies take on reductions comparable to Australia".
Japan	Reduce emissions by 60-80% by 2050. No firm mid-term target is set yet but announced for 2009.
Russia	Russia set itself the objective to reduce the nation's energy intensiveness by 40% from 2007 levels by 2020[37]. Between 2000 and 2005 actual energy intensity fell by 21 % in Russia partly due to structural shifts in the economy and mostly to higher revenues from oil and gas exports which pushed up the GDP. There were no efficiency gains in the residential and transport sectors, focus in Medvedev's decree. High energy savings potential that could easily be realised in industry and manufacturing but will demand more targeted measures and support in residential sectors (especially heating). Russian negotiators have indicated that Russia might accept to limit its emissions in 2020 at the 1990 level, the same level as the current target for Russia for the period 2008 to 2012. This would mean an actual substantial increase compared to current emission levels, which are around 30 % lower than 1990 levels.

[36] http://www.climatechange.gov.au/whitepaper/index.html

[37] Decree signed by President Dmitry Medvedev, June 2008.

9. ANNEX 9: TARGET CALCULATION FOR THE DEVELOPED COUNTRIES ON THE BASIS OF 4 INDICATORS

An example of how a combination of four indicators can be combined to give the total target per country in 2020. The target is set as follows:

(1) For the indicator GDP per capita the country with the highest level gets minus a -20% (i.e. Norway) target by 2020 compared to 2005 attributed while country with the lowest level gets a target equal to 0% (i.e. Ukraine). A country that is around the average gets around -11.5% attributed for this indicator.

(2) For the indicator GHG intensity of GDP the country with the highest level gets minus -20% by 2020 compared to 2005 attributed as target while country with the lowest level gets -4% (i.e. Switzerland). A country that is around the average gets around -11.5% attributed for this indicator. The maximum level of the indicator is topped, to avoid allocation of extreme targets for Russia and Ukraine. Both Russia and Ukraine get a -20% attributed for this indicator.

(3) For the indicator Early action the country with the lowest level of early action (i.e. Australia) gets minus -20% by 2020 compared to 2005 attributed as target while country with the highest level of early action is allowed to increase its emissions with 8%. A country that is around the average early action gets around -8.5% attributed for this indicator. The minimum level of the indicator is topped, to avoid allocation of extreme targets for Russia and Ukraine. Both Russia and Ukraine get a +8% attributed for this indicator

(4) For the indicator Population trend the country with the highest decreasing population trend gets 0% by 2020 compared to 2005 attributed as target (i.e. Ukraine) while country with the highest increasing population highest level is allowed to increase its emissions with 10% (i.e. Australia. A country that is around the average of population trend gets around 2% attributed for this indicator.

(5) The total target by 2020 compared to 2005 is simply the sum of the 4 targets attributed for each of the indicators.

Table 6 Target for developed countries, using 4 indicators

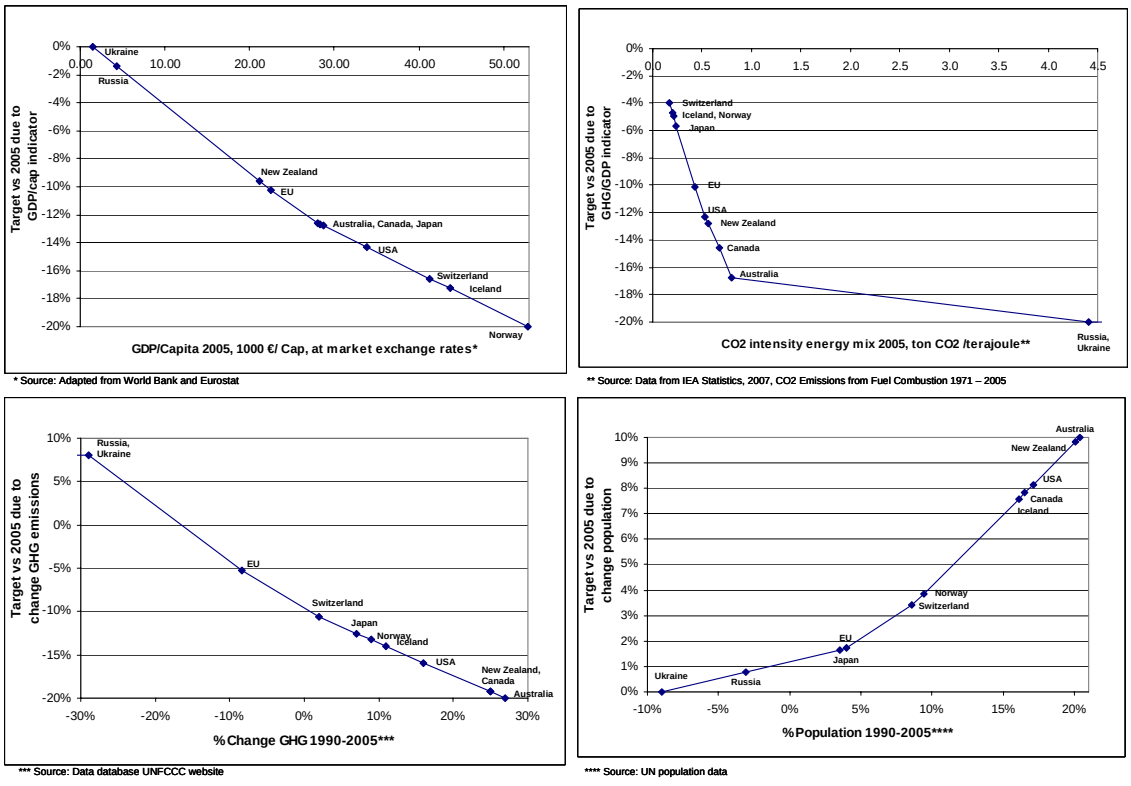
	Share according to GDP/cap	Share according to GHG/GDP	Share according to GHG '90-'05	Share according to Population '90-'05	Target relative to 2005	**Target relative to 1990**
	(a)	(b)	(c)	(d)	(e) = (a+b+c+d)	
EU27	-10.2%	-10.1%	-5.2%	1.7%	-24%	**-30%**
Australia	-12.6%	-16.7%	-20.0%	10.0%	-39%	**-24%**[38]

[38] Figures in this table were calculated using GHG emissions excluding emissions from land use, land-use change and forestry (LULUCF). In accordance with Article 3.7 of the Kyoto Protocol, the base year for Australia will include a significant net volume of emissions from LULUCF. If this is taken into account

Canada	-12.6%	-14.6%	-19.3%	7.8%	-39%	**-23%**
Iceland	-17.3%	-4.9%	-14.0%	7.6%	-29%	**-21%**
Japan	-12.8%	-5.6%	-12.5%	1.7%	-29%	**-24%**
New Zealand	-9.6%	-12.8%	-19.3%	9.8%	-32%	**-15%**
Norway	-20.0%	-4.7%	-13.3%	3.9%	-34%	**-28%**
Russia	-1.4%	-20.0%	8.0%	0.8%	-13%	**-38%**
Switzerland	-16.5%	-4.0%	-10.7%	3.4%	-28%	**-27%**
Ukraine	0.0%	-20.0%	8.0%	0.0%	-12%	**-60%**
USA	-14.3%	-12.3%	-15.9%	8.2%	-34%	**-24%**

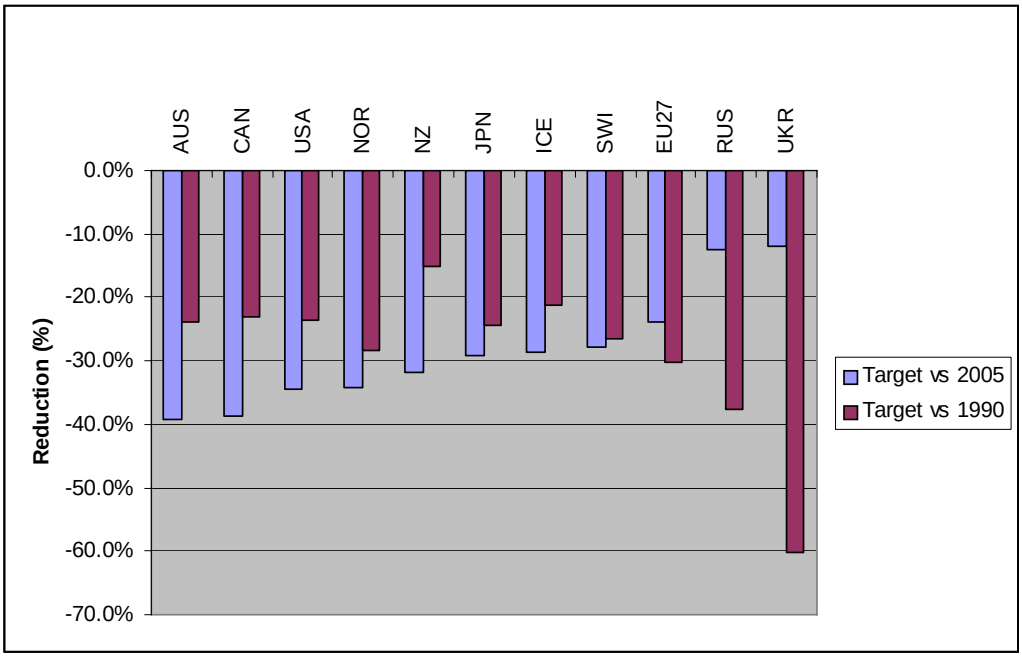
The figures below give a graphical representation of this approach. Figure 7 gives the target as set for each individual indicator (x-axis gives the indicator, y-axis the resulting target). Figure 8 gives an overview of what this would mean if targets compared to 2005 emission levels are summed up and also gives what this would mean in comparison with 1990.

Figure 7 Distribution according to each of the four criteria



for both base year and emission trends since 1990, the target figure for Australia would be in the order of 27% below the Kyoto base year levels (incl. LULUCF).

Figure 8 Total target according to the combination of the four criteria



10. ANNEX 10: SPECIFIC ACCOUNTING RULES FOR LULUCF SECTORS UP TO 2012 UNDER THE KYOTO PROTOCOL

10.1. Which LULUCF activities can one account for under the present rules?

Following activities are recognised under the Kyoto Protocol as LULUCF activities for the period 2008-2012:

– Afforestation (Article 3.3 of the Kyoto Protocol)

– Deforestation (Article 3.3 of the Kyoto Protocol)

– Reforestation (Article 3.3 of the Kyoto Protocol)

– Forest management (Article 3.4 of the Kyoto Protocol)

– Cropland management (Article 3.4 of the Kyoto Protocol)

– Grassland management (Article 3.4 of the Kyoto Protocol)

– Revegetation (Article 3.4 of the Kyoto Protocol)

Note that these are all specific activities that in principle require human/anthropogenic actions.

10.2. Which LULUCF activities does one have to account for?

A developed country has to report for any emissions or sinks that come from Afforestation, Reforestation or deforestation.

For the other activities it can choose if it wants to account for but if it does, it is obliged to continue to do so also in the future.

10.3. How does one account for a sector?

Net-net accounting methodology:

In this methodology one compares the net total flow in one LULUCF sector for a year during the compliance period, with the net total flow of that sector in some base year. The difference between those two defines the net emissions or sink for that sector.

The sectors where net-net accounting is applied are Cropland management, Grassland management and revegetation.

> An example:
>
> In the base year the cropland management sector emits the equivalent of 1 million ton CO2. But in 2010 this has changed and it removes the equivalent of 2 million ton CO2. This means that the net flow for this LULUCF sector that has to be accounted for in 2010 is equal to a removal of 3 million ton CO2.

Gross-net accounting methodology:

In this methodology one does not compare flows for a year during the compliance period with the flows in some base year, but one simply accounts for the net flow of that year in that LULUCF sector.

The sectors where gross-net accounting is applied are Afforestation, Reforestation, Deforestation and Forest management.

If a country chooses forest management, it needs to account for all its forests on its territory.

For Afforestation, Reforestation, Deforestation a country (for which accounting is obligatory) only needs to account for those areas of land where the 'use' has changed between the period 1990 and 2012. Changes of use are those where land have been converted from forests into other uses (deforestation) or has been planted with forests for the first time (afforestation) or replanted after having been deforested before 1990 (reforestation).

> An example:
>
> In the 1998 the country has converted long-time pasture land into new forest to create a national park. The trees are still growing in 2010 and are good for a net absorption (in that year and only over the area that was afforested in 2008) of 100.000 ton CO2.
>
> This means that the net flow for this LULUCF 'area' that has to be accounted for in 2010 is equal to a removal of 100.000 ton CO2.

10.4. What is the problem with the forest management sector?

The emission removals that can be accounted for under forest management, are capped, as agreed in the Marrakech Accords in 2001. One can never account in this sector for more than this cap. This limits the use of removals from forest management. This was done for two reasons:

– The proportion of the net removals that are human-induced in relation to total (natural) removals is still unknown and is relatively small. If no cap was put on the amount that can be accounted for, then the amount of human induced removals would have been overestimated.

– By applying the gross-net methodology (that does not require the comparison with a base year) the total removals can be very large. In many cases they can be larger than the reductions targets agreed under Kyoto Protocol for the period 2008-2012.

If this cap was not put in place, some countries simply would have had the option to issue an amount of additional emissions rights which often would have been larger than the net target they received under the Kyoto Protocol compared to base year.

The definition of the Cap was also a political solution that was part of the agreement on the first commitment period of the Kyoto Protocol by allowing some developed countries relatively more access than others to make use of part of the removals achieved by their managed forests for compliance purposes.

The Marrakech also explicitly foresaw that the forest management cap needed to be reviewed for the period after 2012.

10.5. What are the options under debate at present in the international negotiations?

The international technical discussions carried out since the Bali conference have led to the identification of four main groupings of options that are considered as the future accounting framework for LULUCF after 2012 in developed countries.

The first 3 groupings of options are based on activity based reporting: i.e. related to specific land use activities as already known under the Kyoto Protocol (see annex 10.1).

The fourth one (land based accounting) is based on the accounting under the UNFCCC which is different from the accounting under the Kyoto Protocol. Under the UNFCCC, countries do not account for specific activities but they monitor all GHG emissions fluxes occurring on their land and report them, whatever activity has led to such a net flux of GHGs.

– **Option 1:** This is the options that would require least changes. It would simple keep the existing accounting framework but would require an evolution to mandatory accounting for all activities and thus no optional choices anymore. For the forest management sector some propose to go away from the present cap which was to some extent determined on a political basis, and simply apply a discount factor for the whole sector which is equal for all countries.

– **Option 2:** Under this option everything would be kept as in the existing accounting framework with the exception of the forest management sector. For this sector countries could not anymore account for by the gross-net methodology but have to account for through a net-net accounting methodology comparing annual net flows with those of a base year or base period. Additionally under this option some propose to evolve towards mandatory accounting for all LULUCF activities.

– **Option 3:** This option was introduced by Canada as a way to tackle both historical management effects and the effect of natural disturbances. It would maintain for all sectors the same approach as present except for the forest management sector.

For the forest management sector the idea is to produce a baseline for all or part of the foreseen GHG fluxes on the basis of the knowledge of past and planned land use policies and the statistical occurrence and quantified effects of natural disturbances. This is the so-called "forward looking baseline".

But after the end of the commitment period, this "forward looking baseline" is further adapted to take into account the real effect of natural disturbances which was larger or smaller than those assumed ex ante before the commitment period. This is the so-called "natural disturbances corrected forward looking baseline".

The amount of credits or debits accounted for by the country for the forest management sector would be the difference between the "natural disturbances corrected forward looking baseline" and the real monitored and reported emission flux in this sector. As such this rewards actions in the forest management sector that were more ambitious than assumed when the baseline was constructed and punishing behaviour and actions in the forest management sector that were less ambitious than assumed when the baseline was constructed and it could factor out at the same time any natural disturbances.

– **Option 4:** This option would be the most drastic change compared to the present framework (even though countries do report already on it under the UNFCCC). It would require to account for all GHG emissions fluxes occurring on a country's land and would compare this net flow with an historic base year (as such a net-net approach) It is innovative in the sense that it would lead to a complete and harmonised coverage of GHG fluxes in the LULUCF sector, which is far from being achieved by the current LULUCF accounting rules.

11. ANNEX 11: ACTIONS AND TECHNOLOGIES FOR ENERGY EFFICIENCY

Part of the induced energy efficiency improvements is driven through the fact that energy price differentiation becomes smaller across developed and developing countries, and all economies become fully exposed to the same energy price increases and the same price volatility. Developing countries have as such stronger incentives for the early adoption of innovative energy saving technological solutions. Examples of these are shifting to secondary iron, steel and non-ferrous metal production or substituting materials that are the most energy intensive in the production processes (e.g. reducing clinker content in cement, application of inert carbon anodes in aluminium production, or simply applying higher recycling rates in paper and glass making, shifting to more sustainable building materials and insulation).

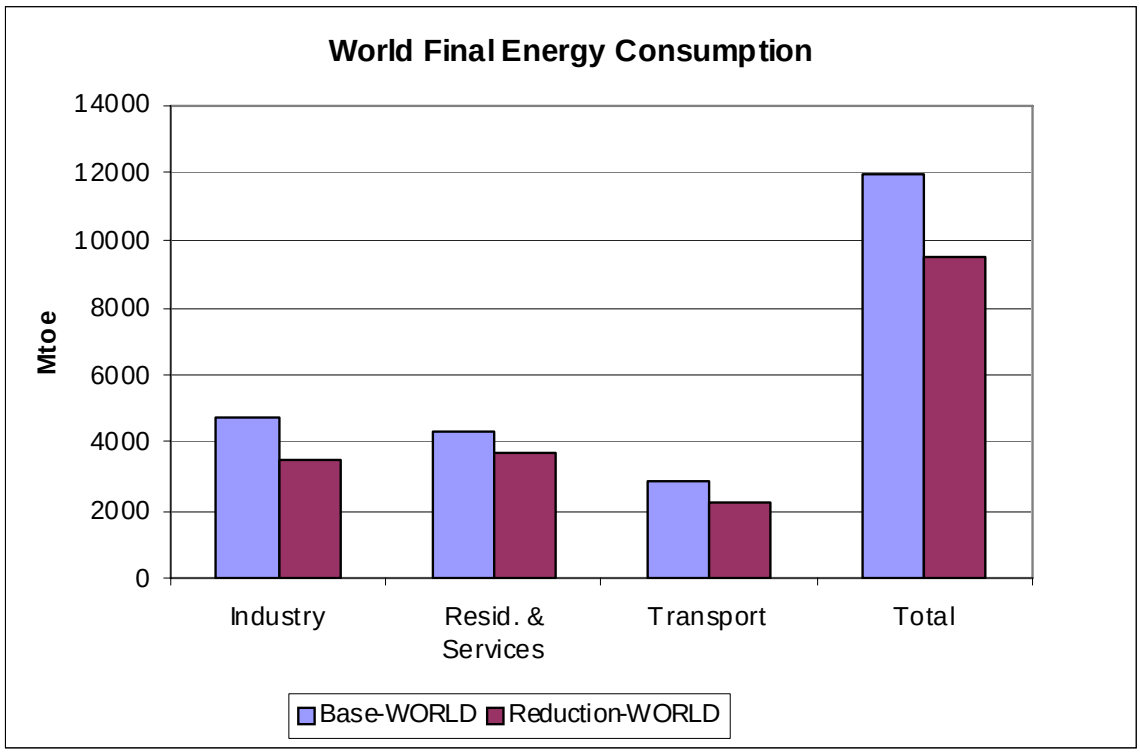
A large potential also remains to be exploited in power generation, with the continuous cost efficient improvement of certain power plant types (from combined cycle gas turbines to supercritical coal plants). This potential is very large in both developed and developing countries, but particularly interesting in developing countries such as China and India. Among developed countries, the United States have ample room for efficiency improvement. But in developing countries, if coupled with use of air pollution abatement technologies, the efficiency improvements would also bring immense health benefits. See chapter 6.9.1 in Part 1 of this Staff Working Document for an analysis of the co-benefits of climate change policies in relation to air pollution policies.

Important efficiency gains can be reaped by improving the overall architecture of the power generation system and of the transmission and distribution grid, with effective integration of intermittent power sources like renewables or distributed generation like CHP. Smart grids, superconducting electric lines, power storage devices ranging from pumping hydro to new generation batteries are the crucial technologies to realise these efficiency gains.

Energy efficiency improvements in the industrial sector are the second most important. They are potentially very large in emerging economies, especially in those where economic growth is accompanied by a fast development of energy intensive industries (typically the case of China and other East Asian economies). Faster economic growth also fosters rapid capital equipment turnover, opening possibilities for adopting best available technologies (BAT) from the international technology market. Their benefits are reinforced by the fact that very often BAT deliver not only the most energy efficient performance but also considerable co-benefits in terms of reducing air and water pollutants.

Comparing the Baseline and the Appropriate global action scenarios in terms of final energy consumption, the latter suggests a balanced effort between sectors, bearing in mind the different technological possibilities. At global level, the Appropriate global action scenario anticipates by 2030 a lower global final energy consumption of 20.4% compared to the Baseline scenario.

Figure 9 Final Energy Consumption, World

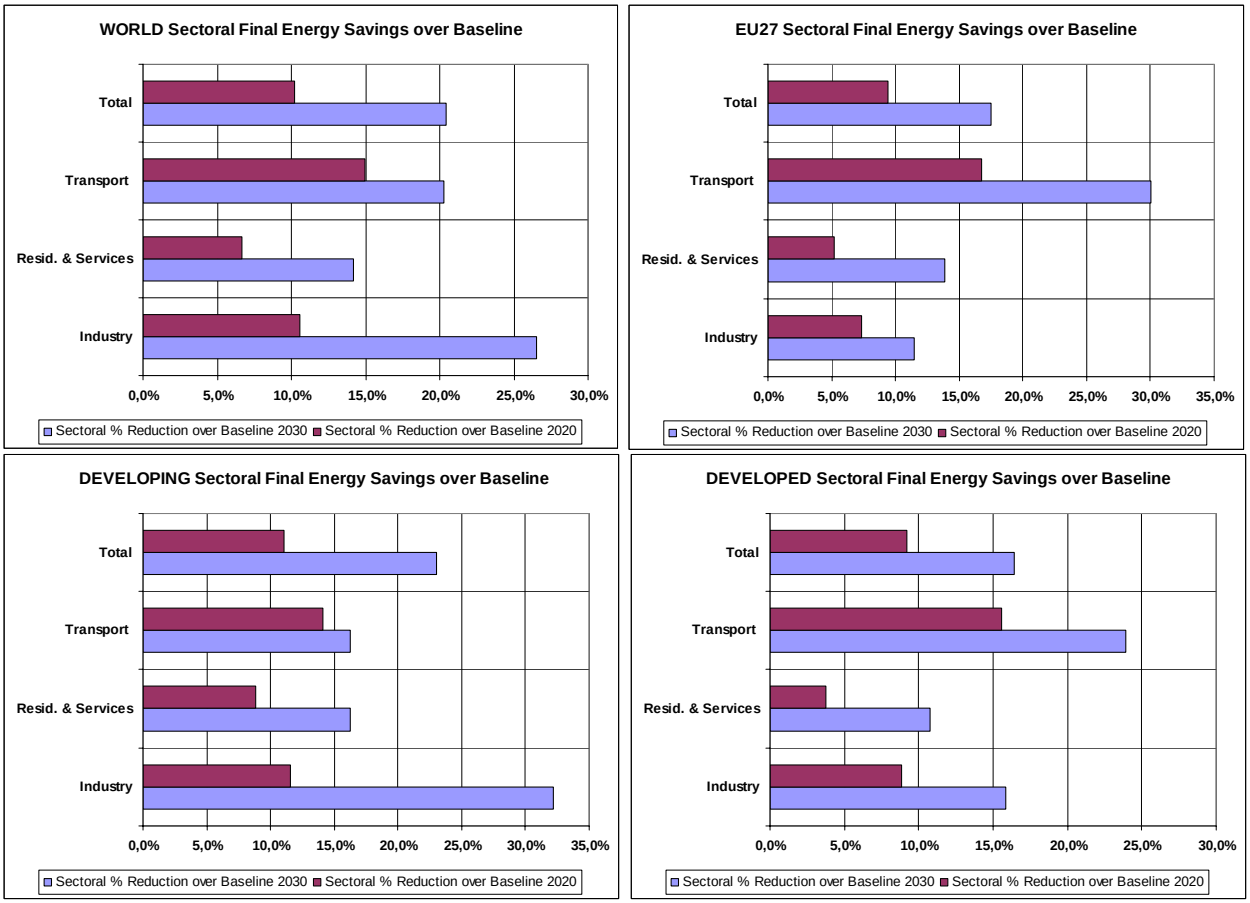


Source: JRC, IPTS, POLES

This large potential for efficiency gains in final energy demand, can be either driven by policy interventions (e.g. setting standards, targeted loan programmes, increasing final energy prices) which lead to technology improvement. The potential for improvement in the residential and transport sector are proportionally more important in the EU-27 and in other developed countries (at least in the short term), as larger shares of energy consumption in these two sectors are typical of wealthy economies. Within the residential and tertiary sector, several emerging electric and heating appliances can play a significant role. Compact light bulbs offers already a large saving potential (80%) at virtually zero cost, to occupy a market niche of about 20% of the electricity consumed in dwellings. LEDs are likely to offer even larger savings and is a technology that is rapidly becoming available. Intelligent management of stand-by electronic appliances also offers substantial savings potential. More efficient electric motors and compressors can further improve the performances of washing machines and refrigerators. Heat consumption can also be lowered with appropriate building standards and the generalised introduction of low temperature solar thermal producing domestic hot water and other uses. These technologies will be particularly crucial in those emerging countries with a relatively lower energy intensity growth path (India, Brazil, etc) but where income growth is expected to push up domestic energy consumption. Out of the final consumption sectors, the transportation sector provides the best opportunities, via (a) improvement in power trains engine efficiency (b) lowering the weight of engines and cars, (c) shifting to less carbon-intensive fuels (i.e. biofuels), and (d) shifting from private to public transport or from road to rail.

Tertiary sectors are expected to deliver less, especially in developing countries: this will be due to counterbalancing income effects as per capita incomes are expected to rise but also due to changing social patterns and population dynamics. The figures for the residential and services sector are 14.2% and 13.9%, for the world and EU-27, respectively.

Figure 10 Sectoral Final Energy Savings compared to Baseline[39]



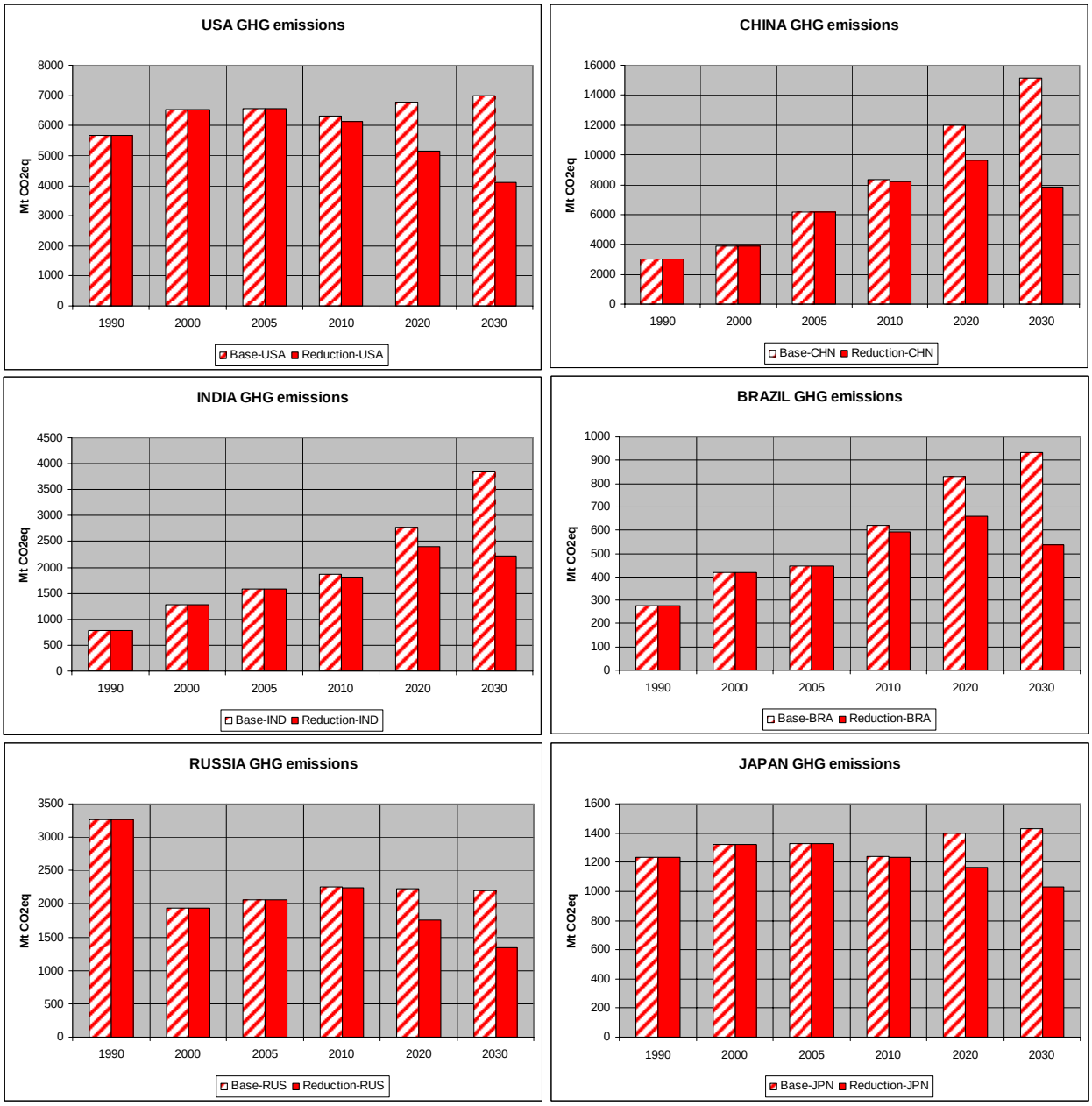
Source: JRC, IPTS, POLES

The transport sector, even if technologically rigid, can achieve substantial reductions of final energy demand between the two scenarios thanks to energy efficiency improvements, a modal shift towards more performing electric transportation schemes, and an increased use of public transport. In 2030, energy savings from the transport sector are expected to amount in the Appropriate global action scenario to around 20% and 30% compared to the baseline for the world and the EU-27, respectively.

39 See in annex 12 for more details on impacts of the Appropriate global action scenario on selected MEM participants.

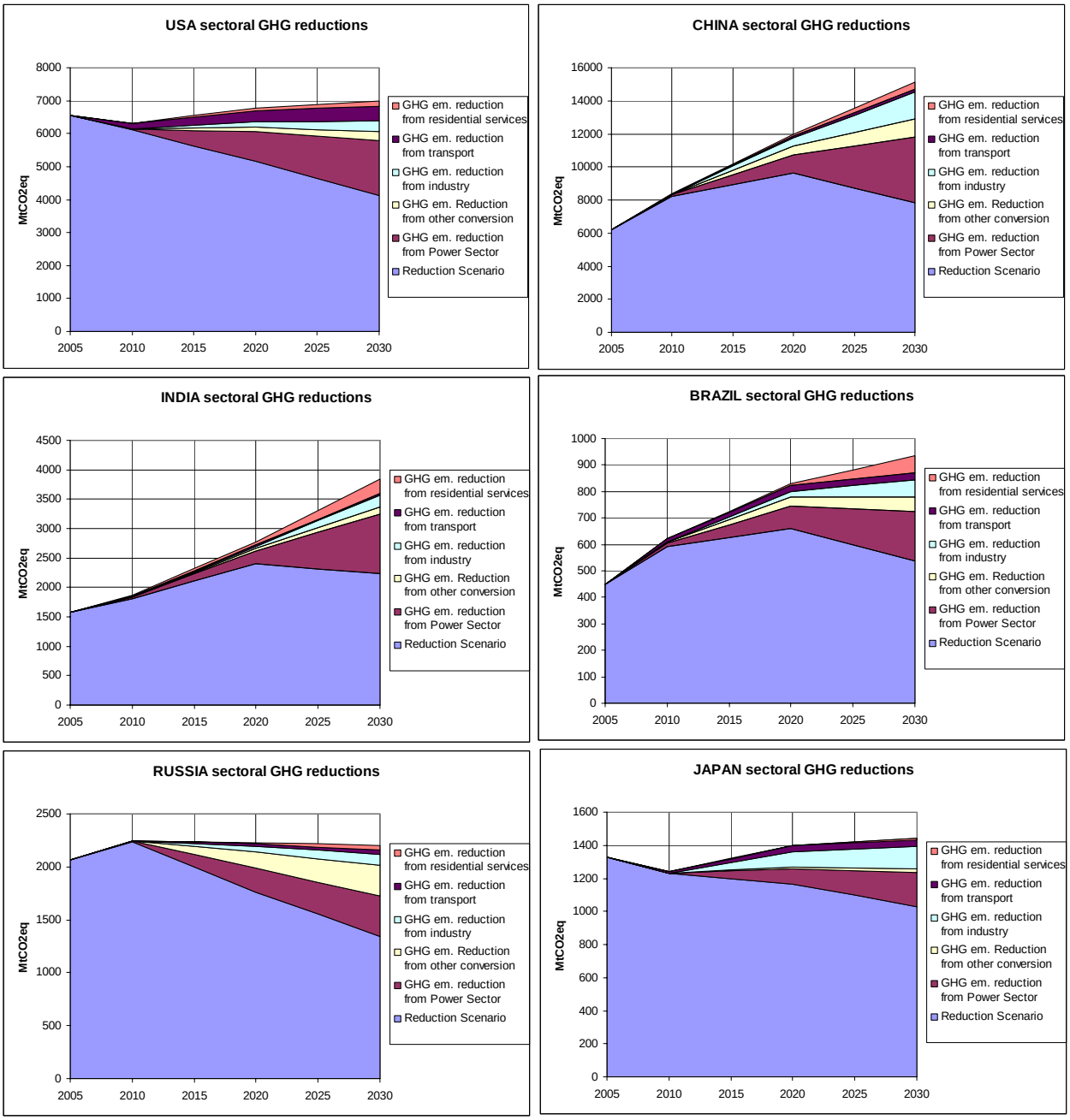
12. ANNEX 12: IMPACTS OF THE APPROPRIATE GLOBAL ACTION SCENARIO ON SELECTED MEM PARTICIPANTS

Figure 11 Emissions, excluding agriculture and LULUCF, in baseline and the Appropriate global action scenario for selected MEM participants



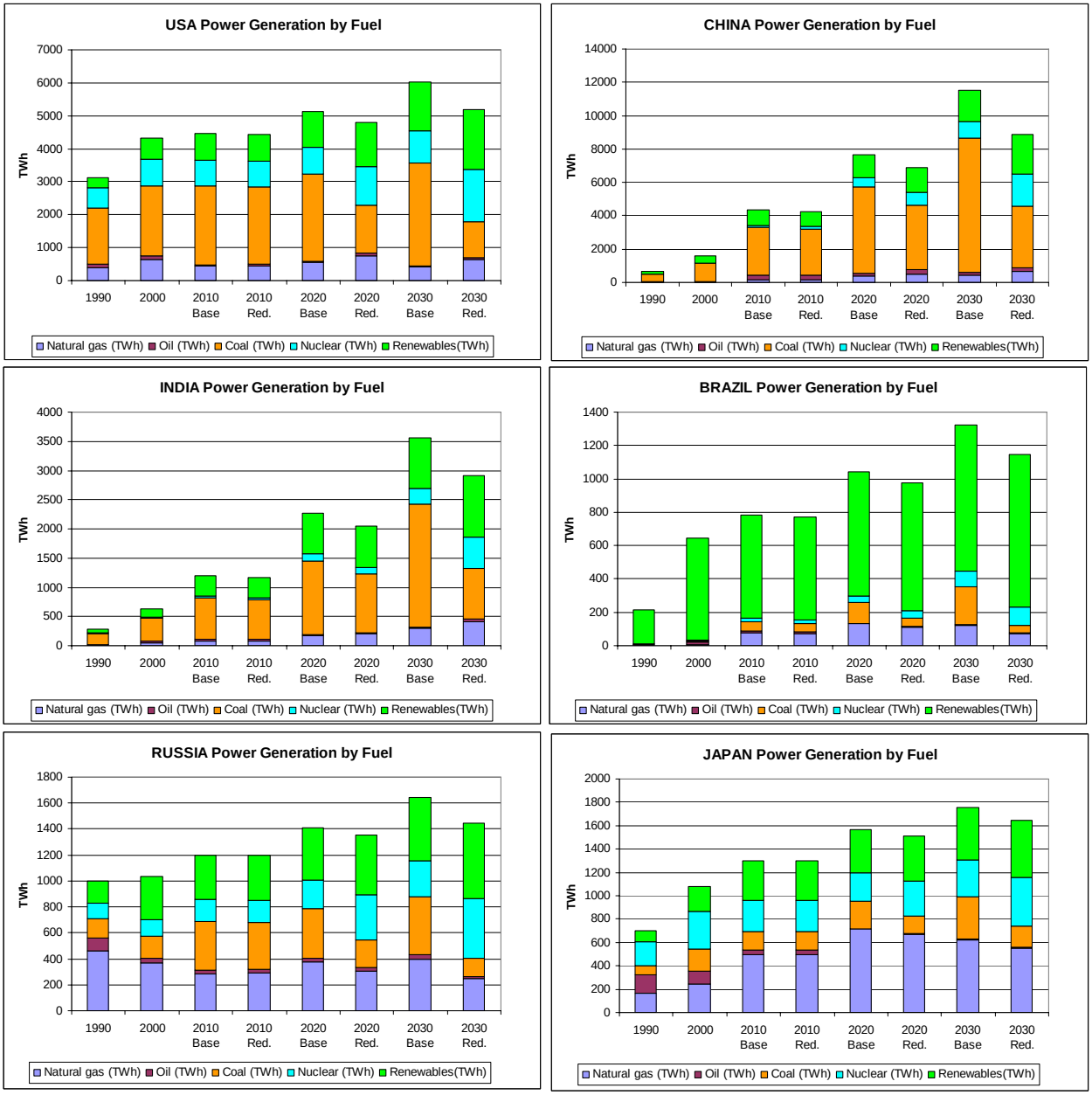
Source: JRC, IPTS, POLES

Figure 12 Emissions reductions per sector compared to baseline in the Appropriate global action scenario for selected MEM participants



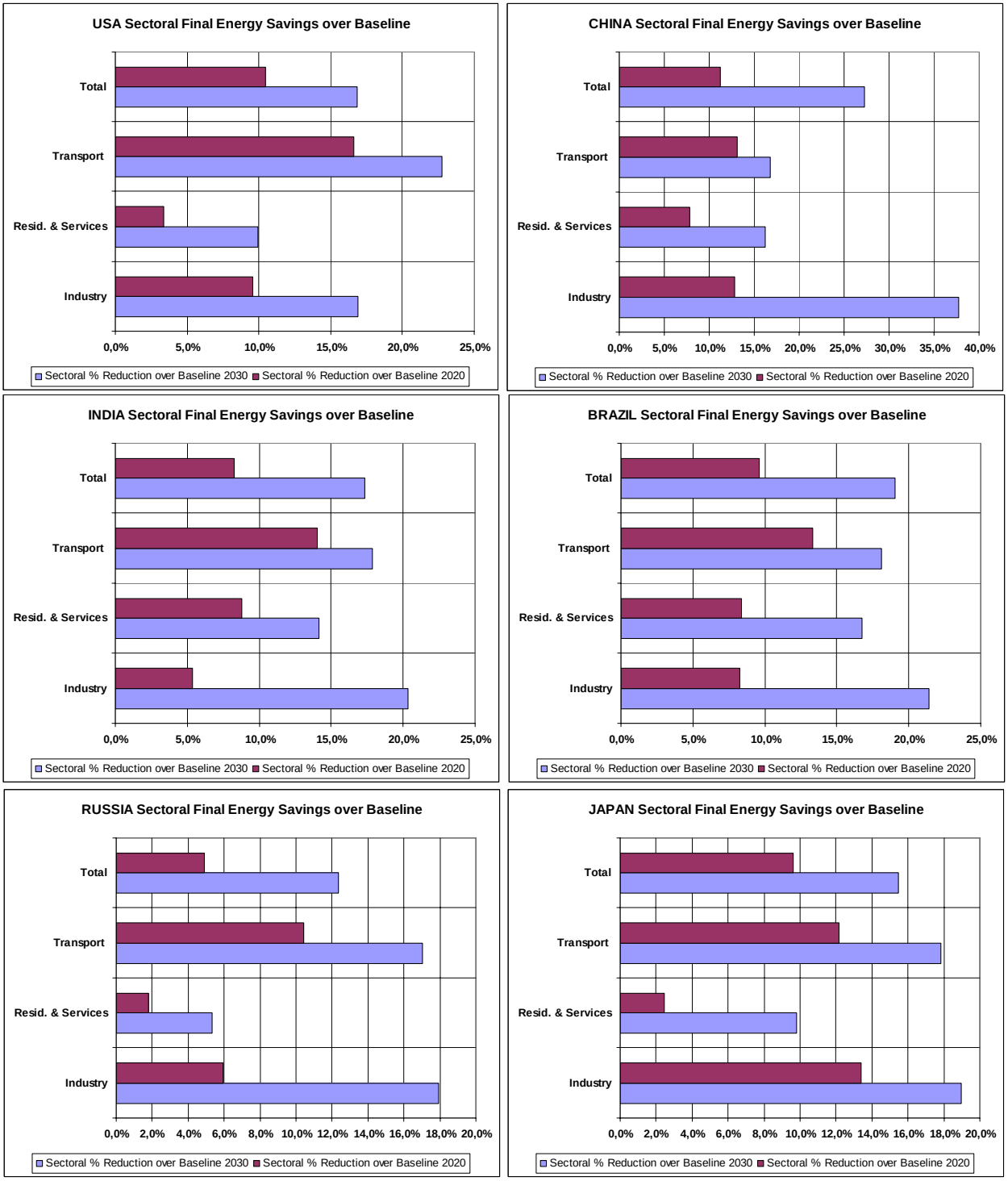
Source: JRC, IPTS, POLES

Figure 13 Power Generation by Fuel type in the Appropriate global action scenario for selected MEM participants



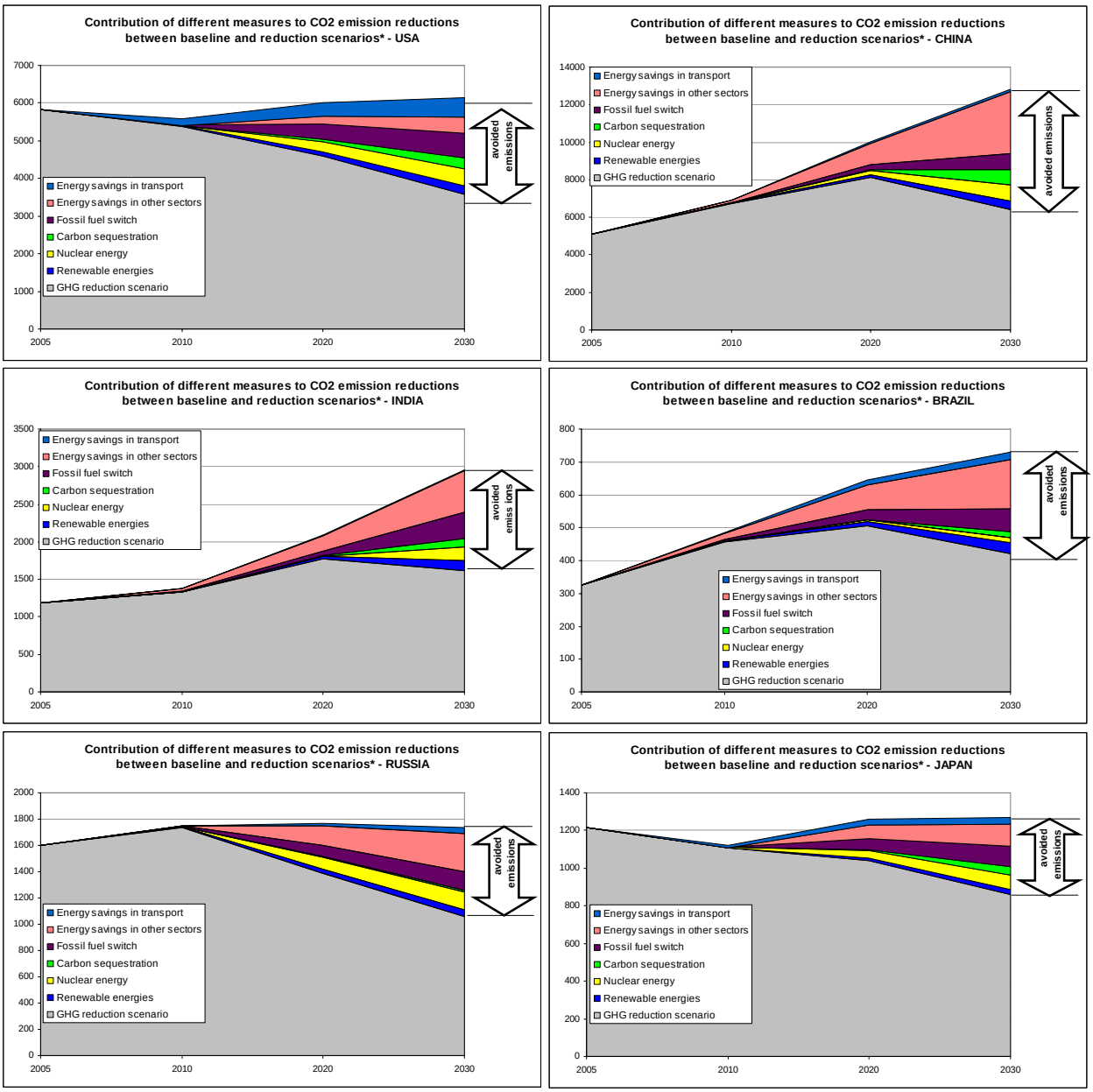
Source: JRC, IPTS, POLES

Figure 14 Sectoral Final Energy Savings compared to Baseline in the Appropriate global action scenario for selected MEM participants



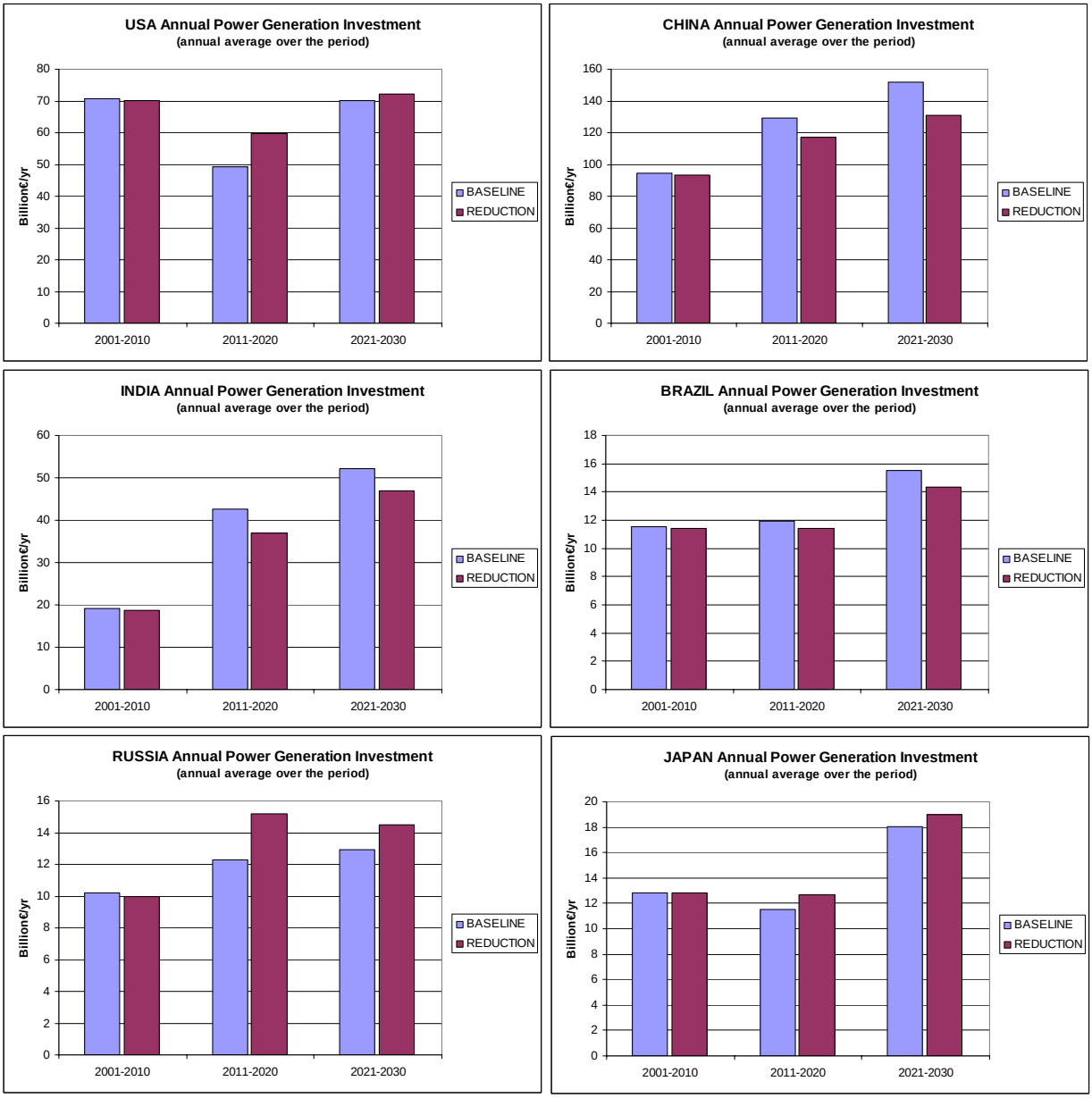
Source: JRC, IPTS, POLES

Figure 15 Contribution of different technologies to reduce CO2 emissions in the Appropriate global action scenario for selected MEM participants



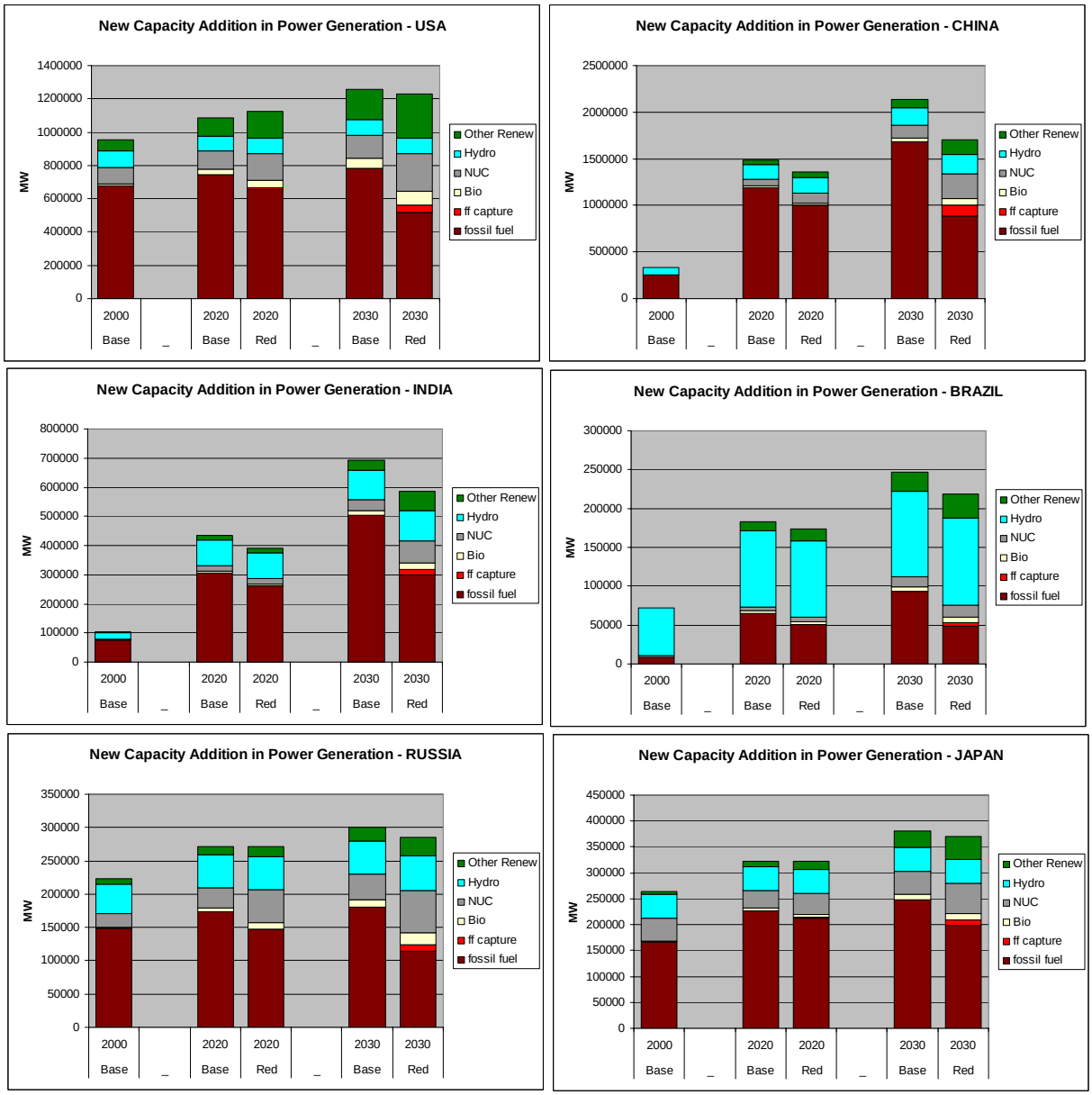
Source: JRC, IPTS, POLES

Figure 16 Annual Power Generation Investments in the baseline and in the Appropriate global action scenario for selected MEM participants



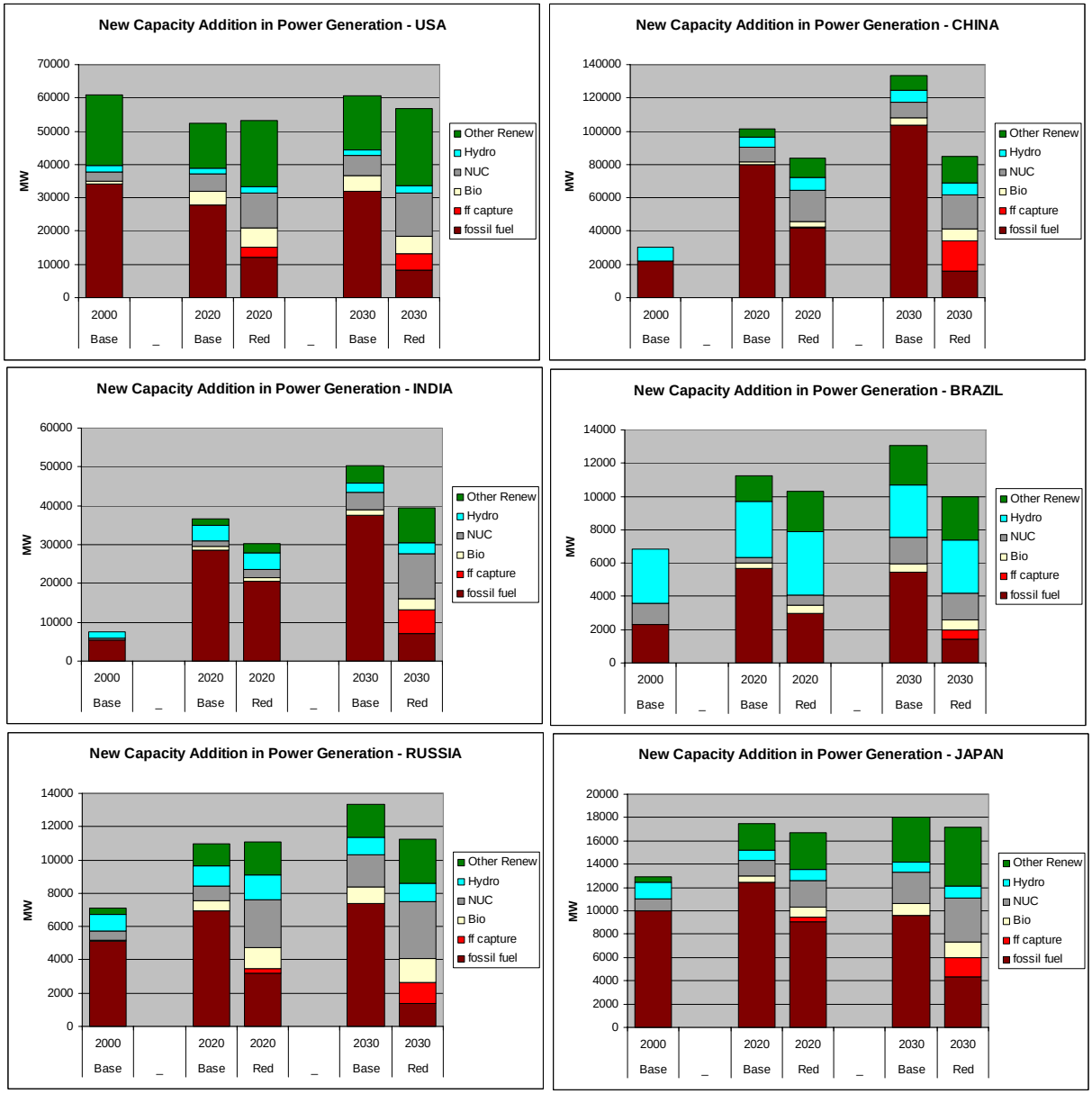
Source: JRC, IPTS, POLES

Figure 17 Changes in Power generation mix in the baseline and in the Appropriate global action scenario for selected MEM participants



Source: JRC, IPTS, POLES

Figure 18 Additional, new capacity in Power generation compared to 2000 in the baseline and in the Appropriate global action scenario for selected MEM participants



Source: JRC, IPTS, POLES

13. ANNEX 13:APPROPRIATE MITIGATION ACTION BY DEVELOPING COUNTRIES

The Bali Roadmap recognizes the need for developing countries mitigation actions to be nationally appropriate and to be defined in the context of sustainable development. In order to meet the lowest stabilisation scenarios assessed by the IPCC, substantial deviations from business as usual are needed in advanced developing regions in addition to significant reductions in developed countries. The deviations have been further quantified in recent studies as a reduction of emissions below business as usual of around 15 to 30% by 2020 for developing countries as a group.[40]

As set out above, nationally appropriate mitigation action by developing countries as included in the Bali Action Plan will have a different meaning for different countries according to their very different responsibilities and respective capabilities. Key questions to be discussed with regard to developing countries participation are:

– In which sectors can and should a country take what type of action?

– -What overall deviation from BAU should result from those actions and what level and type of support is required to achieve that ambition?

– What institutions or processes are required to monitor implementation of action and review results in terms of emission reductions achieved?

As a general rule, the level of financial and technical support for possible mitigation actions identified in different sectors in developing countries should be differentiated according to countries respective capabilities. Moreover, mitigation action should at least cover those sectors in each developing country with regard to which this country is among the most relevant global emitters. For more advanced developing countries, action should be more comprehensive and cover a broad set of sectors. Indicators, such as per capita GDP and the Human Development Index as published by UNDP could provide a useful reference in this respect.

There is significant diversity in socio-economic circumstances even among those developing countries that have been participating in the major economies meetings (MEM). Those differences will need to be reflected in the stringency of different countries' contributions to mitigation as part of the Copenhagen agreement.

The following graphs illustrates differences among developing MEM countries according to a number of relevant indicators.

Figure 19 Diversity in CO2 Intensity and Per Capita Income in selected developing countries (MEM)

[40] den Elzen and Höhne, 2008

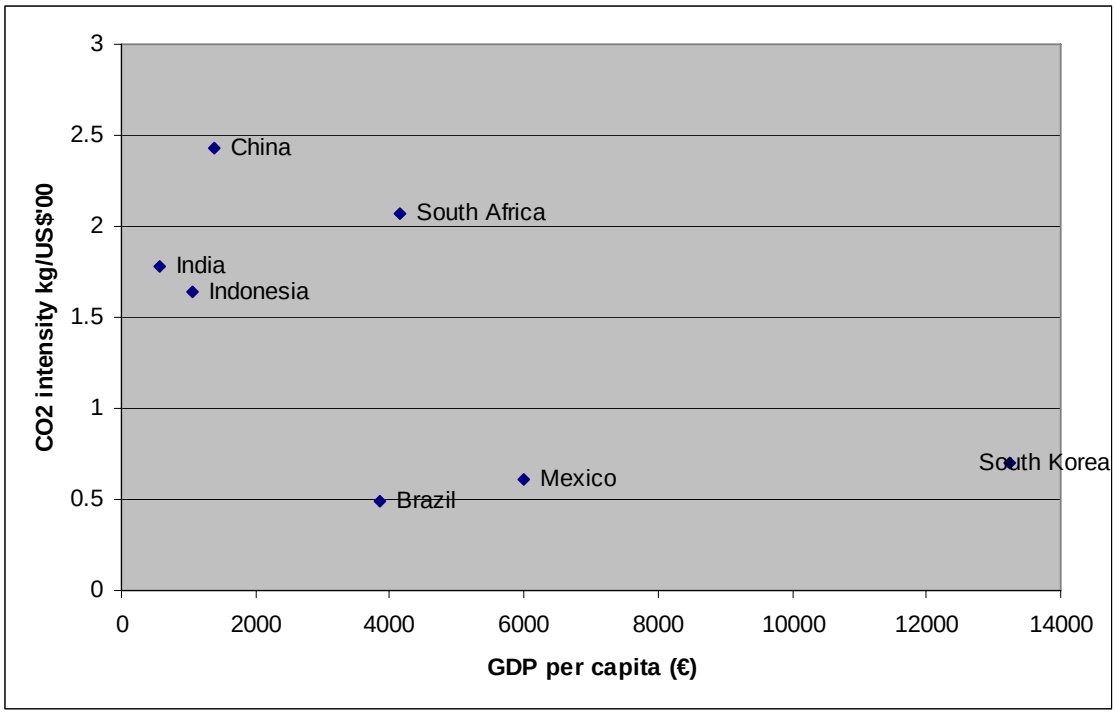
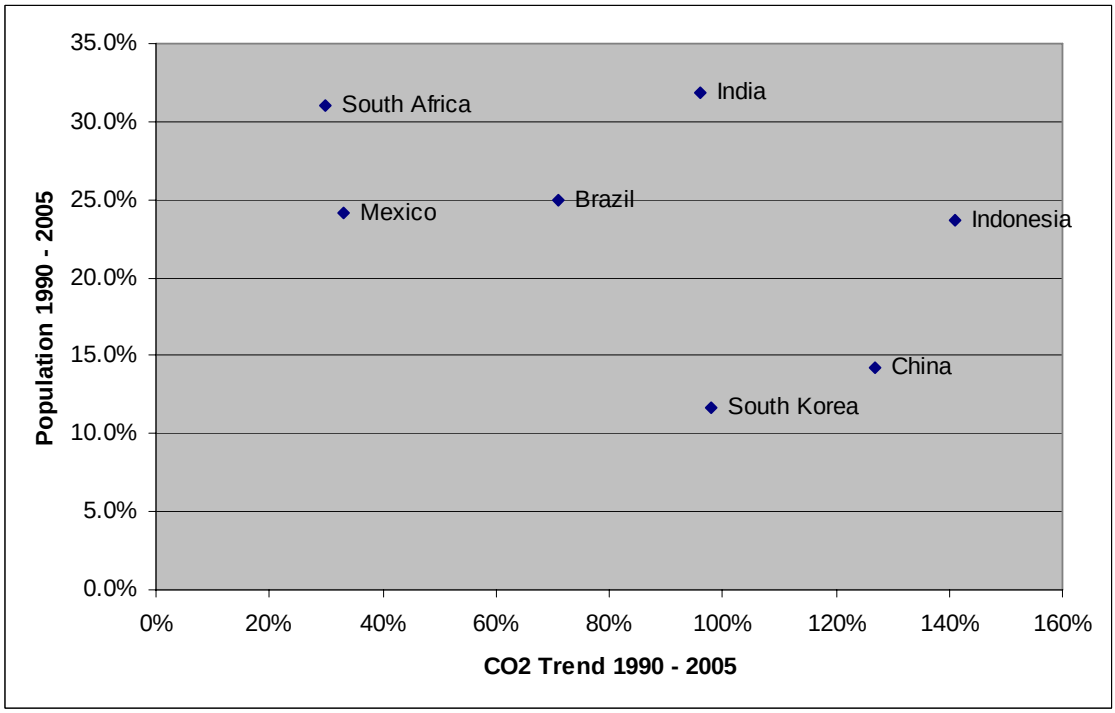


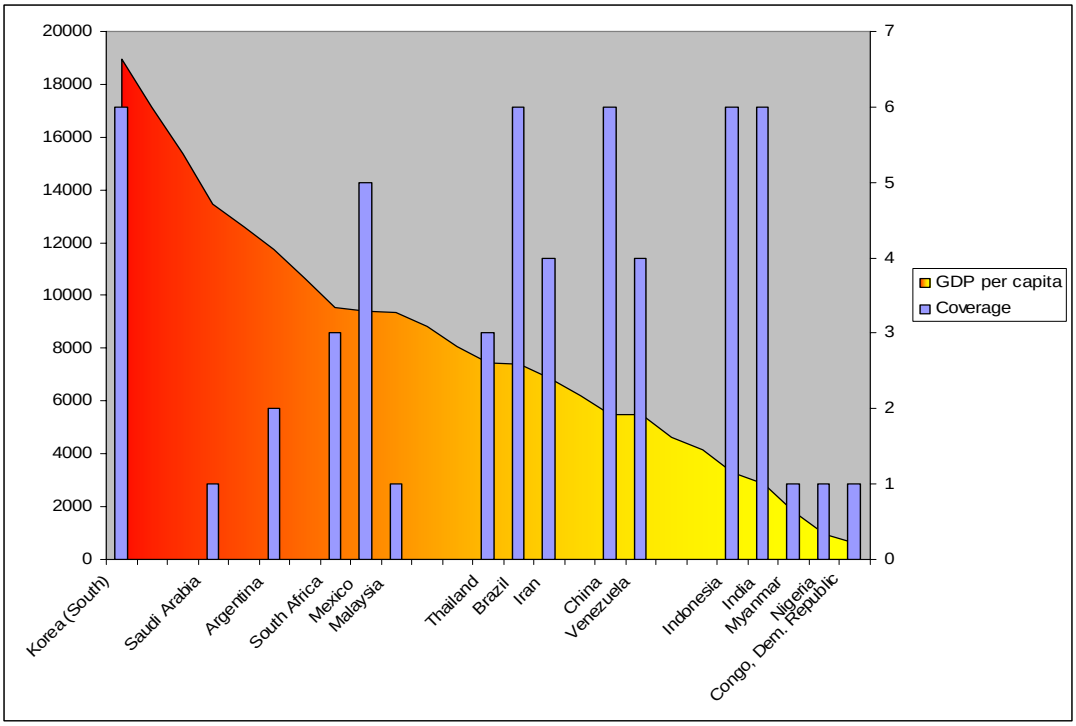
Figure 20 Diversity in Emission and Population trajectories 1990 to 2005 in selected developing countries (MEM)



In order to allow for a comprehensive assessment of mitigation actions by developing countries and to identify needs and options for supporting those actions, developing countries should devise National Low Carbon Development Plans. These plans should set out the low carbon development pathway for each country up to 2050 formulating specific milestones for 2020. For each of the key emitting sectors of the economy specific actions should be identified, estimating expected emission reductions below business as usual. The development of such plans would be optional for LDCs. The sectoral coverage of these national plans

should be more comprehensive the higher the respective income level of a developing country. Moreover, those countries that are among the top emitters in a particular sector should be required to include this sector in their national low carbon development plan.

Figure 21 Major developing GHG emitters in key sectors and GDP per capita



Note: 7 key sectors are looked at: Electricity, Iron & Steel, Chemical & Petrochemical, Aluminium, Cement & Limestone, Paper, Pulp & Printing and LULUCF. The value on the right vertical axis reflects for each country for how many of those seven sectors it is among the top 10 developing countries emitters. The left hand side vertical axis shows countries per capita income in US$ per person. Values are shown for those developing countries that are among the global top 30 GHG emitters in absolute terms. (Data source: Schmidt et al. 2008[41] and WRI CAIT http://www.cait.wri.org).

There are a number of options of which actions could be included in a country's national low carbon development plan to address emissions of different sectors. These could include, inter alia, such options as sustainable development policies and measures (SDPAMs), technology cooperation, sector-based technology standards, transnational sectoral efforts (e.g. related to emissions from aviation or maritime transport), project based CDM, sectoral crediting (e.g. no-lose targets), binding sectoral targets (with appropriate financial and technical support) as well as other domestic policies such as carbon taxes, subsidy removal or quantitative policy targets – e.g. related to renewable energy production or energy intensity. Each of these options will need to be assessed in light of developing countries respective capabilities for policy implementation and with regard to the specific situation in different sectors.

Table 7 Overview of policy tools for developing countries

	SD-Pams	Technology cooperation	Technology standards	Transnational emission	Project based CDM	No-lose targets	Binding sectoral

[41] Schmidt et al. Sector-based approach to the post-2012 climate change policy architecture, Table 1, Climate Policy 8 (2008) 494-515.

				targets			targets
Legal status	Binding/non-binding	Non-binding	Binding/non-binding	Binding	Non-binding	Non-binding	Binding
Responsible entity	Government	Government and industry	Government	Business associations	Companies	Government	Government
Scope	Sectoral/economy-wide	Sectoral	Sectoral	Sectoral	Project-based	Sectoral/economy-wide	Sectoral
Target Type	Policy implementation	Technology/ R&D	Standard implementation	Absolute/intensity	Absolute/intensity	Absolute/intensity	Absolute/intensity
Stringency	Defined by government	n.a.	Uniform base, with some regional differentiation	Determined multilaterally	Reductions below BAU	Reductions below negotiated crediting baseline	Negotiated or government defined reduction target
Relation to Carbon market	None	None	None	None / within / separate market	Within	Within	Within
Financing	Private sector / international funds / ODA	Public and private sector	Private sector / international funds /ODA	Private sector / carbon market / international funds / ODA	Carbon market	Carbon market / international funds	Carbon market / international funds
Examples	South Africa: Promotion of energy efficient low cost housing	Steel: APP steel sectoral task force – SOACT steelmaking handbook	Automotive: Top-Runner-Approach Japan; Canadian automobile industry commitment for total reduction by 2010	Aviation: Emission trading system for international aviation linked to Kyoto Protocol carbon market	Steel: Introduction of heat recovery for blast furnaces	Cement: National baseline expressed in tCO2 per ton cement	Cement: National target expressed in tCO2 per ton cement

Source: Adapted from ECOFYS 2008

To prepare international negotiations on how to support the implementation of these plans in the most effective manner, those plans should identify:

- win-win measures that could be implemented autonomously and which measures would require implementation assistance in form of capacity building, policy assistance and/or awareness raising;
- further measures that could be taken if targeted support would be provided, indicating the type and extent of necessary support (both financial and technical);
- expected emission reductions resulting from actions identified above.

Each of these plans will be submitted for review to an expert panel that will assess:

– the feasibility and level of ambition of win-win measures and required assistance for those measures and

– the proposals for further measures and in particular the required support for implementation.

On the basis of this analysis, the panel may invite a country to strengthen its autonomous actions and propose support measures for doing so, including concrete recommendations for further mitigation actions and support mechanisms for implementation.

Those plans would need to be regularly updated and re-assessed. An interval of up to 5 years seems appropriate.

A number of developing countries have recently put forward national climate change action plans or strategies that identify concrete actions these countries plan to take that will reduce the projected growth of their greenhouse gas emissions (see table below). All of these plans identify win-win measures and measures that those countries intend to implement for non climate related reasons. Some of these plans also identify more ambitious measures that would require external technical or financial support to ensure their implementation.

Table 8 Policies undertaken and objectives set by selected developing countries

Country	**Target and assessment**
South Korea	South Korea has put forward a National action plan on climate[42] focusing on fostering green industries with the following aims: improving energy efficiency in the industrial sector; increasing the share of renewable energy from current 2% to 11% in 2020 and 20% in 2050 increase climate R&D share in total government R&D investment from 6.4% in 2008 to 8.5% in 2012 improve quality of life (e.g. developing green transport) contribute to global efforts (e.g. national mid-term target in 2009; development and cooperation assistance towards developing countries, including an East-Asia Climate Partnership with 200 million USD for 5 years).
China	China has a National Climate Change programme[43] that identifies a list of measures to control GHG emissions by 2010 and estimates that these will amount to 1500 Mt CO2-eq emissions avoided. The programme outlines several objectives for 2010: • reduce energy consumption per unit GDP by 20%, • raise the proportion of renewable energy (including large-scale

[42] Released September 2008

[43] China's National Climate Change Programme, June 2007.

	hydropower) in primary energy supply up to 10% • to stabilise nitrous oxide emissions from industrial processes at 2005 levels • control the growth rate of methane emissions • increase forest coverage rate to 20% and increase carbon sink by 50 Mt over the level of 2005.
India	The Indian Climate Change Action Plan[44] seeks to promote sustainable development through the use of clean technologies and mainly focuses on domestic actions under eight "missions", i.e. in the areas of solar energy, energy efficiency, sustainable habitat, water, Himalayan eco-system, forestry, sustainable agriculture and research. However, the Plan does not set out clear objectives for any of those actions. More detail on the 8 'missions' is expected in early 2009.
Mexico	Mexico's National Strategy on Climate Change[45] has identified specific mitigation measures for energy sector and forestry and land use. Their estimated emission reduction potential is ~106,8 Mt CO2-eq by 2014 for energy sector and 12800-23350 Mt CO2-eq by 2012 for carbon conservation in forestry and 30,2-54,2 Mt CO2-eq by 2012 for forestry and land use. Mexico recognises that "current division between AI and non-AI countries has to move towards a more realistic differentiation" and explicitly mentions group of advanced developing countries including themselves in this group. Considers no-lose targets appropriate for this

[44] India's National Action Plan on Climate Change, June 2008.
[45] Mexico's National Strategy on Climate Change, 2007

	group.
Brazil	Brazil has seta long-term goal of a 15% renewable energy share of the primary energy supply until 2020.However in 2003, hydropower provided 13.8% and biomass 26.3% of primary energy supply. Other measures include[46]: Guaranteed sales contracts for electricity from renewable energy sources (PROINFA) Financial incentives for reducing supply side losses (PROCEL) Direct investment support for energy efficiency measures National electricity saving programme (PROCEL) National programme for the rational use of fuel (CONPET) National alcohol programme (PROALCOOL) Tax incentives for less powerful vehicles Programme for air pollution from automotive vehicles (PROCONVE)
South Africa	The South African government has outlined a vision for the road ahead on climate change[47]., where they foresee to demonstrate leadership in the multi-lateral system by committing to a substantial deviation from baseline, enabled by international funding and technology. This vision states that South Africa's GHG emissions must peak around 2020-2025, stabilise around 100 Mt above current levels for up to ten years and then decline in absolute terms leading to a 30 to 40% reduction by 2050 compared to 2003 GHG levels[48]. South Africa outlines several options how this could be achieved "Start now" option covers about 44% of the gap in 2050 and contains net negative cost measures and other sustainable development co-benefits, like increasing energy efficiency in industry and transport, as well as use of more renewable and nuclear sources for electricity production. "Scale up" option covers two thirds of the gap between two scenarios by 2050 and foresees actions going beyond negative costs, such as further increasing energy efficiency for industry and transition to zero-carbon electricity generation by mid-century, where nuclear and renewable sources have equal share of electricity production.

[46] Ecofys, Wuppertal Institute, Proposals for contributions of emerging economies to the climate regime under the UNFCCC post 2012, July 2008

[47] http://www.info.gov.za/speeches/2008/08072816451001.htm

[48] Long Term Mitigation Scenarios: Strategic Options for South Africa, October 2007.

	"Use the market" option closes the gap by three fourths between the two scenarios and foresees escalating CO2 tax and incentives for technology acceleration, renewables for electricity generation, biofuels and solar water heaters. "Reaching for the goal" option is needed to close the gap between two scenarios and reach emission reductions required by science. For this new technology development and behavioural change will be needed.

A significant part of these reductions can be achieved at low or even negative cost. All developing countries should strive to harvest "low hanging fruits" by way of domestic action, e.g., to improve energy efficiency in key sectors such as buildings, transport and power generation. Many other policy options exist at slightly higher cost but with a whole range of economic and social co-benefits such as reduced air pollution, increased access to energy and reduced energy bills. As demonstrated in chapter 6.9 in Part 1 of this Staff Working, the value of these co-benefits can be high, as such reducing the real additional cost of taking action against climate change.

14. ANNEX 14: SECTORAL APPROACHES

Sectoral approaches could become a possible element of a post 2012 agreement. They address the emissions of a specific sector by a particular policy instrument. The sectors can cover, e.g., steel production, transport or the power generation sector.

Three major options of sectoral approaches are currently mainly under discussion:

1. The first option includes sectoral crediting approaches which are a type of offsetting mechanism (see annex 17 on the global carbon market). A baseline that includes own appropriate action or an intensity target would be defined or negotiated for one specific sector. Emission credits are then generated for reductions below the negotiated baseline. Under this approach, international financing would be limited to carbon financing. Reductions up to the negotiated baseline would count as own appropriate action by developing countries. Reductions that go beyond the baseline and generate credits, do not count for own action.

2. The second option is the cooperative type where national governments as part of their national action plan define certain domestic policy measures, e.g. intensity targets, technology deployment plans for specific economic sectors. Within an international framework such approaches could be formally recognised and supported. In this way, action of developing countries could focus on key emitting sectors. For these sectors some measurable, reportable and verifiable policy objectives could be defined. The type and scale of external support (e.g. capacity building, technology transfer) could be tailored to the respective capabilities of the developing country. If several Governments would voluntarily subscribe to the same approach within the same sector, this could become a co-ordinated sectoral approach. This could be a particularly useful instrument if a single agreement among a few countries could cover the major part of emissions of a specific industrial sector. In this case, the risk of carbon leakage could be reduced. Reductions within such an approach, which does not generate credits, would count as own appropriate action by developing countries.

3. The third option is the bottom up approach for target setting, for instance in the context of the Kyoto Protocol) proposed by the Japanese government.

4. This option is based on determining the technical potential of GHG emission reductions in each sector on the basis of high performance benchmarks or best available technologies. This is a useful analytical instrument to define the mitigation potential in different sectors in order to inform policy decision making. As such it could become an essential element when drawing up national action plans.

If used for the setting of targets, as proposed, the mitigation potential would have to be complemented with additional information, e.g. the mitigation costs and the financial capability of the country to finance the implementation of concrete emission abatement options. Otherwise this approach would not lead to an equitable result.

In all these approaches, the principle of common but differentiated responsibilities and respective capabilities can be applied.

15. ANNEX 15: TECHNOLOGY COOPERATION

Technology will be an essential part of a post–2012 climate agreement. Most of the options to implement mitigation and adaptation actions will require the deployment of clean and safe low carbon technologies. Many recent studies explore the role of different technologies for different GHG emission reduction scenarios (IEA Energy Technology Perspectives; IPCC; UNEP)[49]. One of the essential messages is that for ambitious mitigation scenarios a broad portfolio of technologies will be needed. While some technologies are already contributing to mitigation today and will increasingly do, others will contribute significantly over the medium to long-term.

For global emissions to be stabilised at 2000 levels, the UNFCCC estimated the overall annual additional financial needs mitigation investments in developed and developing countries to be roughly between US$ 200 and 210 billion by 2030[50].

Until 2030, US$ 25 trillion alone needs to be invested in energy infrastructures[51]. To make sure that the additional funds will be invested in low GHG emitting technologies, Governments will have to design and implement supportive policies.

Obstacles to technology development and deployment exist at various stages of the technology cycle. Those obstacles can include unfavourable enabling environment (e.g. missing regulation, investment risks), lack of economic incentives (e.g. fossil fuel subsidies, higher costs of low GHG emitting technologies, cash-flow problems for high upfront investments) and in some cases in relation to intellectual property rights (IPR).

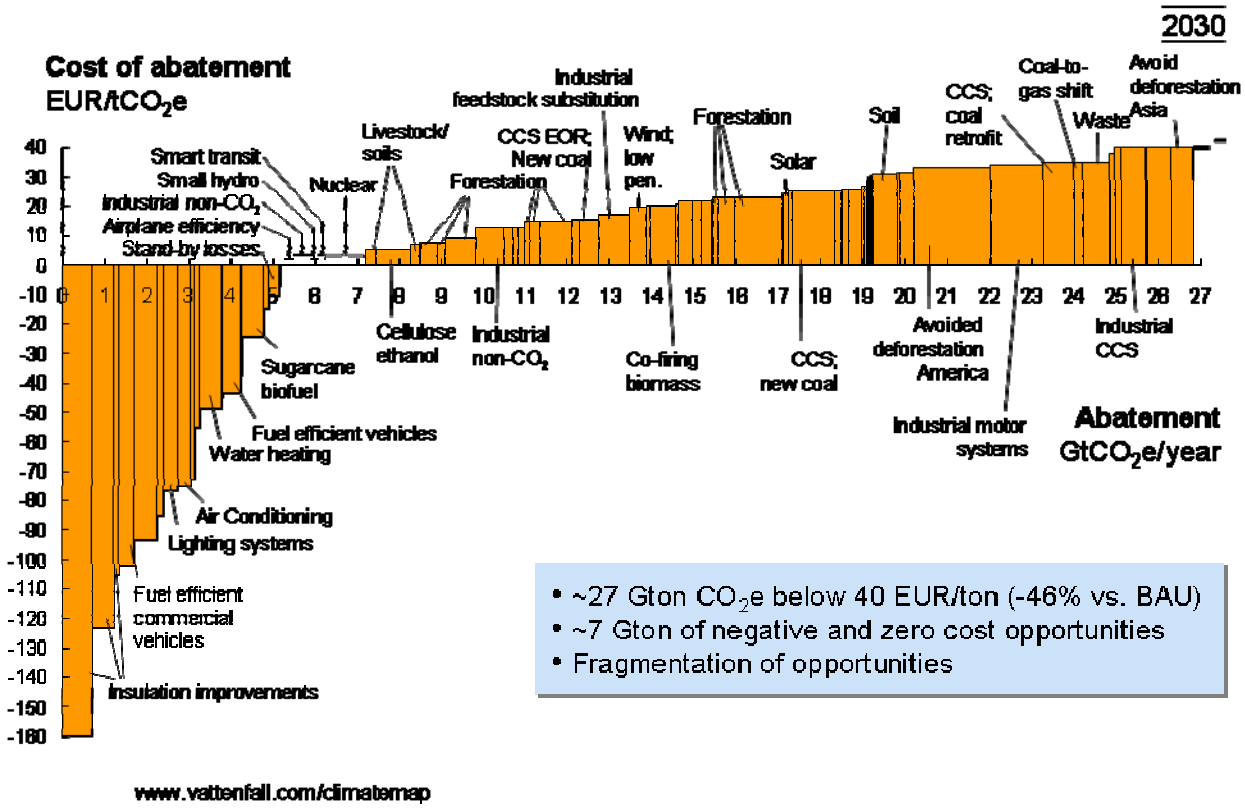
The graph below illustrates the spectrum of technologies that will be needed to address climate change in the next decades.

Figure 22 Abatement cost and potential for different mitigation technologies

49 IEA Energy Technology Perspectives 2008; IPCC TAR WG III on mitigation; IPCC report on Methodological and Technological Issues in Technology Transfer; IPCC report on Carbon Dioxide Capture and Storage; UNEP-SEFI Global Trends in Sustainable Energy Investment 2008 Report

50 UNFCCC Investment and financial flows to address climate change, 2007

51 IEA Energy Outlook, 2007



According to the IPCC, even low stabilisation levels "can be achieved by deployment of a portfolio of technologies that are either currently available or expected to be commercialised in coming decades, assuming appropriate and effective incentives are in place for their development, acquisition, deployment and diffusion and addressing related barriers".[52] This essentially implies that the post-2012 agreement should include incentives to drive technologies at three different stages:

a) Accelerate diffusion of existing low carbon technologies;

b) Accelerate development and large scale demonstration of near-commercia technologies, such as Carbon Capture and Storage (CCS), second generation biofuels, solar energy and advanced transmission and grid technologies;

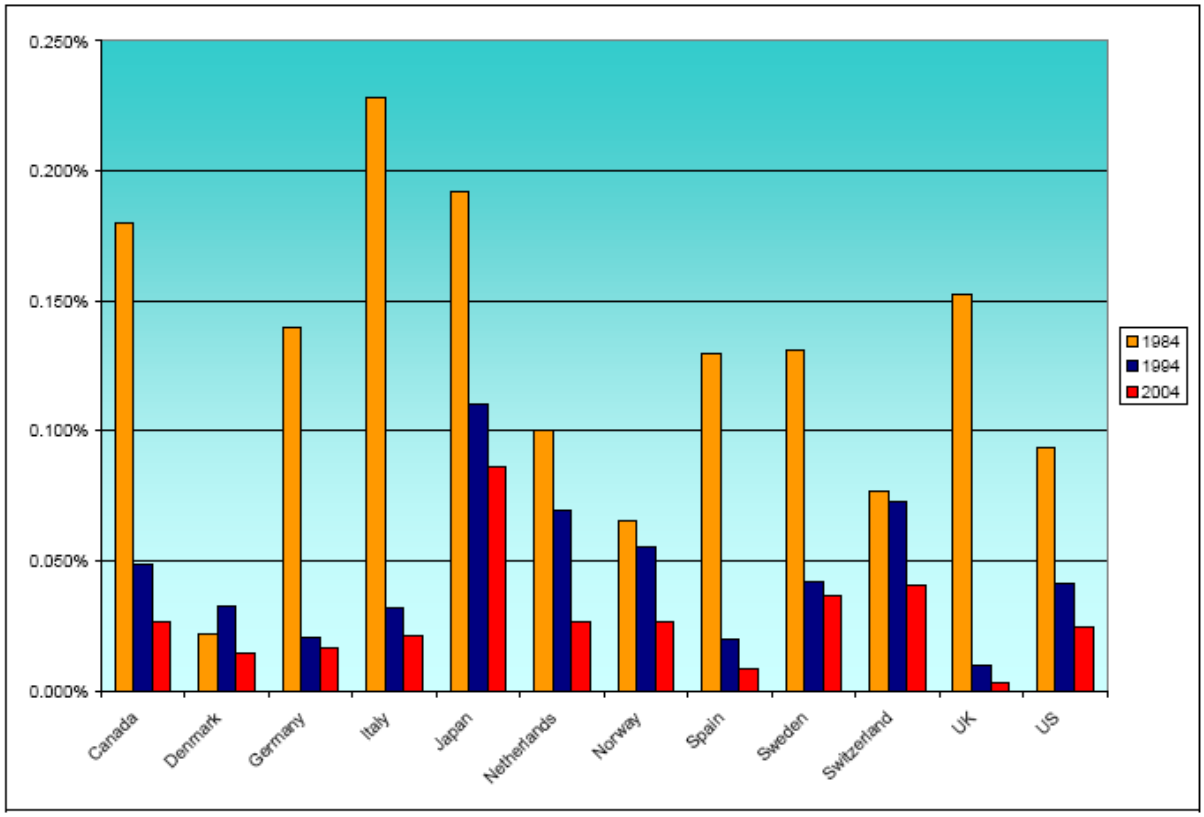
c) Increased spending on research and development of new technologies.

Different approaches to supporting technology deployment will be needed with regard to different parts of this spectrum.

Domestic policies and the carbon market will be the main driver behind faster diffusion of existing technologies. For near-commercial and new technologies, however, current public expenditure on energy related research, development and demonstration is far from sufficient to achieve the technological advances and cost reductions that are needed in the medium to long term. Over the last two decades, public energy R&D spending in developed countries has dropped dramatically, on average to below half of 1984 levels in 2004 (see figure below).

Figure 23 Energy R&D Investment Patterns in IEA Countries

[52] Intergovernmental Panel on Climate Change, IPCC 2007, Synthesis Report, p.20.



Source: Pacific Northwest National Laboratory/Joint Global Change Research Institute Technical Paper PNWD-3581 Energy R&D Investment Patterns in IEA Countries: An Update, Paul Runci, October 6, 2005

Initial assessments in the literature suggest that an increase of about 10bnUS$ is needed over the next two decades to create the conditions for new technologies to become commercially available.[53] In fact, this would imply a doubling of current expenditures.

Also the IEA estimated the R&D investment needs in its recent "2008 Energy Technology Perspectives". It listed several studies that recommend a multiplication of the current spending levels. For instance it list the Stern report that recommends a doubling of the public investment in energy RD&D (Stern et al., 2006) while several other studies even make the case that overall RD&D investments need to be increased from two to ten times the current spending levels (PCAST, 1997, 1999; Schock, et al., 1999; Davis and Owens, 2003; Nemet and Kammen, 2007). The IEA also concludes that RD&D can be considered an inexpensive insurance policy to hedge against the future risks of climate change. Current levels of investment are very unlikely to achieve the sort of step change in technology that is needed to deliver the sought outcomes. Even a doubling of current levels of investment may not be enough. It concludes in its executive summary of the "2008 Energy Technology Perspectives" that *'While details are difficult to establish, independent studies have suggested that public-sector RD&D needs to increase by between two and ten times its current level.'*

As such a doubling public-sector energy-related RD&D by 2012 and increase it to four times its current level by 2020 seems a sensible and minimum strategy.

53 UNFCCC 2007: Investment and Financial Flows, p90.

Still today, the largest part of energy R&D is spent on nuclear and fossil fuel-based technologies. Therefore, in addition to a significant increase of R&D expenditures, a shift of focus towards renewable energy is needed.

In addition, targeted plans for large-scale demonstration to remove uncertainties and lower future technology costs. Collaborative R&D programmes with participation of developing countries as well as technology roadmaps for deployment of certain key technologies will help to make advanced technologies available at a larger scale in both developed and developing countries in the future.

Options with a positive return on the investment (or negative to zero costs) in the left part of the graph are typically found in sectors such as households, buildings and transport. To a large extent the realisation of those potentials should be the prime responsibility of each Party. Support could focus on capacity building, e.g. exchange of good practice in policy design (e.g. energy efficiency standards, building codes, labelling schemes) as foreseen by the recently launched International Energy Efficiency Platform. Cash flow issues could be addressed by targeted loan schemes. In general, funding and support for these options would not subsidise the cost of technologies as such, but address other obstacles to technology transfer.

The central part of the clean technologies in the figure above represents options with a low to medium abatement cost. Those technologies are typically commercially available and incentives for deployment could be provided by domestic policies (e.g. SD-PAMs) and the international carbon market (e.g. the CDM or possible new carbon market mechanisms). So far, technology transfer is not a mandatory requirement for the CDM. Host countries can, however, encourage technology transfer via their project approval practice.

The discussion above highlights some of the obstacles to transfer and deployment and of low GHG emitting technologies. Even if the carbon market is a strong incentive to invest in those technologies, a number of other measures are needed to improve technology development, transfer and deployment that could be taken in the context of the Copenhagen agreement.

The current technology framework under the UNFCCC has already implemented many actions related to technology especially on capacity building and information sharing on technology. The GEF has been a useful, but too modest, instrument to finance specific technology projects. However, the current framework needs to be enhanced in order to deliver the results expected from the future climate regime.

Under the UNFCCC AWG LCA the discussion about the future technology framework has already started. An overview of proposals made in the negotiations so far is provided in the box below.

Box 1 Proposals by Parties to the UNFCCC on a future technology framework

Many parties (China, Ghana, Bangladesh) proposed the creation of a technology board as a new subsidiary body within UNFCCC for technology transfer.

A body to coordinate and manage technology-related activities within and outside UNFCCC should be considered. Various options exist and should be evaluated to identify the best option based on the different tasks that need to be performed (e.g. reinforcing the EGTT, creating a new body, or appointing a UN existing agency). The type of body depends on the function and has to be framed through the mitigation (and adaptation) commitments.

Discussions and agreement on tasks is key and must be settled before institutional arrangements are agreed. There would be added value in using an existing institution rather than creating a new one. Appointing an existing body would provide better value as it would maximise the use of existing institutional and organisational arrangements to fulfil this role. For example, UNEP could act at central level and UNDP at a local level.

Ghana and India proposed some enhanced institutional arrangements.

Institutional arrangements are essential for an enhanced technology transfer framework. Such arrangements would need to include coordination and management related functions to technology commitments within and outside the UNFCCC. The main part of technology cooperation and transfer will happen outside the convention. Such functions could cover activities such as information sharing, coordination and follow up of support to developing countries as well as arrangements for measuring, reporting and verifying technical (and related financial and capacity building) support by developed countries, and related mitigation activities by developing countries. (See also position on Technology Board, above).

Ghana, China, Brazil, South Africa and Mexico proposed a **multilateral technology fund** for enhancing transfer of existing technologies.

Although existing financial mechanisms such as the GEF will continue to play a key role in assisting all countries in their mitigation and adaptation efforts, different financial instruments will need to be considered in financing the development, deployment and transfer of technology. A single funding vehicle under the UNFCCC is unlikely to be sufficient. Likewise the carbon market is not sufficient to ensure technology development and deployment in the realm of mitigation and adaptation. Discussions on funds (with public capital) should not neglect the specific function/task of the funds, i.e. what exactly should be funded and by which mechanisms.

Japan proposed a sector specific international cooperation.

Such cooperation could contribute to removing barriers that are specific to certain sectors and enhance technology R&DD in key sectors. But those cooperation schemes are only a supplementary means to overall binding mitigation commitment to meet mitigation targets. A number of focused technology agreements could be formulated, e.g. agreements on R&D cooperative projects focusing on a few sectors (e.g. 2nd and 3rd generation biofuels, better integration of wind power in the electricity networks, climate observation systems, etc.), and international large-scale demonstration projects for key technologies (e.g. CCS, concentrated solar power).

India proposed a global public procurement scheme for Intellectual Property Rights (IPR).

This proposal wouldn’t be very productive. First of all, the existence of IPRs is a less important barrier to technology transfer. On the opposite, an IPR regime is key to driving innovation and investment in technologies. Thus, lack of IPR regimes in Developing Countries can be a barrier. A scheme for compulsory access to certain technologies, particularly existing technologies, is likely to be opposed by the private sector. IPR questions should be treated differently referring to existing and new technologies respectively. A recent review of the three technologies photovoltaics, bio fuels, and wind showed that there are few concerns with the costs related to intellectual property rights of these technologies, and even where such protection exists, the royalty costs embodied in license fees may approximate as

little as one percent of the cost of the investment. It is pointed out that import tariffs typically constitute a larger fraction of the cost of the technology than do license fees or patent fees[54].

Japan, Pakistan and India proposed an enhanced RD&D and scientific collaboration.

Selected international R&D cooperative projects could be part of sectoral technology oriented agreements. Such projects could focus on a few sectors (e.g. 2nd and 3rd generation biofuels, Concentrated Solar Power, better integration of wind power in the electricity networks, climate observation systems). Selected international large-scale demonstration projects could also be considered for some key technologies such as CCS and concentrated solar power. Despite its importance for realising large scale emission reductions in the long-term perspective, the focus shouldn't be put only on RD&D. Deployment and diffusion of existing low-carbon technologies is key to halt increasing emissions in advanced developing countries.

The **enhanced technology framework** proposed in this chapter focuses on four key areas:

Capacity building and Enabling Environments

Technology Agreements

Financing

Organisational Arrangements

a) Capacity-Building and Enabling Environments

Providing for capacity building and the formation of enabling environments is essential to affecting a paradigm shift in the development, deployment and diffusion of Environmental Sound Technologies (ESTs). They are also the areas most likely to ensure significant long-term economic development. Enabling environments are the conditions for creating well-functioning markets, regulation and policy conducive to deploying ESTs. It also includes the people and organisations capable of providing this environment. There are numerous tools and significant support structures already in place in these areas.

Programmes for future action could include:

- Tools related to the identification of country-specific needs and circumstances
  - Technology needs assessments (TNAs)
  - Technology capacity and market assessments
  - Technology innovation systems assessments
- Tailored tools for capacity building
  - Strengthening of national climate change technology focal points
  - Technology training and education (finance, engineering, management, planning, installation)
  - Development of best-practice guidance
  - Personnel exchange programmes
  - Development of technical testing and certification centres
- Design and implementation of domestic policies and measures

[54] John. H. Barton. "Intellectual Property and Access to Clean Energy Technologies in Developing Countries: An Analysis of Solar Photovoltaic, Biofuel, and Wind Technologies," October 2007. International Centre for Trade and Sustainable Development Issue Paper No. 2. Geneva: ICSTD.

- Support for national policies, regulations, and programs for technology,
- Support for developing technology goals and roadmaps
- Focused support on energy efficiency barrier removal
- Support for South-South cooperative activities

– Technology information platforms
  - Information on reduction potentials etc. of different technologies

Strengthening (or creation) of regional, national and sub-national organisations to house some or all of these functions will allow for synergies across the different stages of technology development, and serve as an important link to private sector participation.

b) Technology Agreements

It is essential to include options for focused technology oriented agreements (TOAs) in the Framework for International Technology Cooperation. New and existing TOAs, which complement the role of market mechanisms, accelerate, facilitate or leverage the development, deployment and diffusion of specific technologies. TOAs should be designed to deliver measurable, reportable and verifiable results.

Having in mind that many current TOAs are public-private initiatives, TOAs should be flexible instruments that provide a robust basis for action, and are intended to guide and facilitate cooperation between two or more Parties within and outside the UNFCCC. They should be aimed at enhancing development, deployment and diffusion of prioritised technologies.

Technology oriented agreements could be made in the following areas:

– Cooperative R&D projects (such as):
  - N-S and S-S projects through consortiums
  - International research centre collaboration
– Cooperative large-scale demonstration projects (such as):
  - Joint projects in a few large-potential, priority emerging technologies
  - Support for in-country application of appropriate technologies
– Deployment cooperation on technology (such as):
  - Energy efficiency in the residential and SME sectors
  - Possible discrete agreement in specific sectors
– Cross-cutting (such as):
  - IPR and trade analysis (Legal)
  - Finance experts advisory network

– c) Financing for Development and Transfer of Technology

The EU is committed to scale-up, mobilise and optimise finance and investment for ESTs. Innovative mechanisms and instruments are necessary to facilitate, leverage and complement private investment. There are many existing significant funds and bodies financing activities related to ETS technology. These include: GEF, IGOs, and multi-lateral banks, and bilateral arrangements.

Financing tools in the enhanced technology framework must be focused on clear market "gaps" identified along stages of technology development where public sector interventions are most required. Priorities range from risk management instruments, to early-stage financing, transaction support, and local transaction support. Public funding for technology must be guided by country needs and circumstances, and be directly linked to MRV actions. On the basis of agreed criteria, it could provide some support for:

– Capacity building (Section a)
– Technology agreements (Section b)

d) Organisational Arrangements

There is a need to ensure that future organisational arrangements support the delivery of the enhanced technology framework. These arrangements will need to help guide, support, monitor and verify the activities and commitments related to technology both within and outside the Convention.

Many organisations are now undertaking important work in this area and some have an established regional and national presence. Building on these initiatives will ensure an optimal response. Various reporting, human resource, and structures should be explored to ensure and optimise delivery of the enhanced technology framework.

This enhanced technology organisational arrangement could be structured to focus on the priority delivery topics of: capacity building and enabling environments and technology agreements. It could provide both information and advice to Parties with a focus on: technical information, financial information, and monitoring, reporting and verification. It could also coordinate with activities and organisations outside of the UNFCCC.

What is the EU currently doing on technology transfer?

The EU is currently working on a number of concrete projects for large scale low carbon technology development and deployment. For instance, the Mediterranean Solar Plan is an initiative launched during the Paris Summit for the Mediterranean (13 July 2008) to implement in total 12 GW installations of Concentrated Solar Power plants in the Northern African Region with network connection to Europe to make the project viable.

In June 2005 the EU and the group of African, Caribbean and Pacific countries launched the Energy Facility with the general objective to contribute to achieving the Millennium Development Goals (MDGs), e.g. poverty reduction through increased access to sustainable energy services. With an overall budget of €220M, the facility is supporting 75 projects including on renewables, power transmission, capacity building and gas distribution.

At the 2005 China-EU Summit, an EU-China Climate Change Partnership was agreed (see also Annex 5.3), a key element of which was cooperation on Near Zero Emissions Coal (NZEC). This entails research, development and deployment of clean coal and carbon capture and storage (CCS) technology in China and Europe. Memorandums of Understanding were agreed between the European Commission and China and the UK and China on Phase I of the project, which covers the initial research to explore options for demonstrating carbon capture and storage (CCS) for coal-fired power generation in China. Two complementary projects (one funded by the European Commission and another funded by the UK – in total ca. €7m), managed by a Joint Steering Committee, are conducting the work under Phase I and will conclude in 2009. Phase II will examine the site-specific feasibility issues and design while

Phase III will see the construction and operation of a commercial-scale demonstration plant in China. The European Commission is plans to adopt a Communication on the financing of these latter two phases in spring 2009.

16. ANNEX 16: ADDRESSING THE CHALLENGES OF DEFORESTATION AND FOREST DEGRADATION TO TACKLE CLIMATE CHANGE AND BIODIVERSITY LOSS

On 17/10/2008[55] the Commission launched a communication "Addressing the challenges of deforestation and forest degradation to tackle climate change and biodiversity loss" that set out an objective to halt global forest cover loss by 2030 at the latest, and reduce gross tropical deforestation by at least 50 % by 2020. This will require a clear vision of how to achieve it, to be integrated into the post-2012 UN climate agreement in Copenhagen.

Halving gross deforestation – the total forested area lost – by 2020 will deliver major environmental benefits on top of climate change mitigation. It will also prevent irreversible loss of biodiversity and soil degradation.

In the impact assessment accompanying the Communication on REDD, costs of halving gross deforestation by 2020 is estimated at €15-25 billion per year, if a reward mechanism would be used and if leakage can be limited to a regional scale.

The Global Forest Carbon Mechanism

In this Communication on REDD the European Commission proposes the development of an international mechanism under the UNFCCC - The Global Forest Carbon Mechanism - through which developing countries will be rewarded for emission cuts achieved by REDD.

Developed countries would have to contribute a fair share of finance to the Global Forest Carbon Mechanism (GFCM). While institutional and operational details remain to be worked out, GFCM should be guided by the following principles:

- Developing countries that ratify the post-2012 climate agreement will be eligible to benefit from GFCM
- The GFCM will focus on REDD and support capacity-building activities in developing countries
- Financial support from GFCM will be provided on the basis of a country's performance towards REDD, taking account of its respective capabilities
- Beneficiary countries will need to have effective forest governance structures in place and to respect the rights of forest-dependent people
- Nationwide implementation involving the entire forestry sector will be required in order to minimise in-country leakage
- GFCM will aim to secure the highest co-benefits possible (e.g. by protecting biodiversity and combating poverty)
- Emission cuts must be assessed, monitored and accounted for at national level, with independent verification of the reductions achieved.

[55] COM(2008) 645 final

Besides GFCM, complementary ways to help developing countries conserve their forests will be needed in order to reduce the risk of international leakage.

Funding for the GFCM

Public funding is the most realistic tool to provide incentives for REDD over the period 2013 to 2020. A major portion of EU funding for GFCM could come from proceeds from the auctioning of emission allowances under the EU Emissions Trading System (EU ETS). It is estimated that if 5% of auctioning revenue were made available to GFCM, this would raise €1.5 to 2.5 billion in 2020, and that in the present set up where the EU is taking a unilateral target of -20% GHG emission reductions by 2020 compared to 1990.

A global response to deforestation needs support beyond REDD incentive schemes. Funding is also required to improve governance and resolve technical issues, such as monitoring using satellites and other technologies. Development assistance from the Commission and EU Member States can play a role here. This assistance can be channelled through existing arrangements at national level, as well as through international and multi-lateral agreements.

Public funding for GFCM should be complemented by private funding.

Testing the inclusion of deforestation credits in carbon markets

In 2008 to 2012 afforestation and reforestation activities are recognised, subject to strict quantitative limits, for government compliance and can generate credits in the Clean Development Mechanism (CDM). This recognition, within current limits, should be continued post-2012. In addition, the Commission proposes to test the recognition of also deforestation credits for **government compliance in the period after 2012.** But certain pre-conditions would need to be met before any inclusion of forests in carbon markets could be considered as a realistic option.

1. There would need to be an international agreement with ambitious mid-term emission reduction commitments. This would be necessary to generate a sufficiently high demand for emissions reductions, so that developed countries actually reduce their emissions instead of simply offsetting them with carbon credits. The analysis in chapter 6.6 in Part 1 of this Staff Working Document for instance demonstrated that **if all reductions compared to baseline to achieve the EU REDD objective would be allowed to become credits in an offsetting mechanism, then the target for developed countries needs to increase from -30% compared to 1990 to -38% to ensure that in total emissions stay at the same at global level for all sectors together** (Assuming both the target of developed countries is met and the REDD objectives are reached).
2. As with CDM afforestation and reforestation projects, the additional impact of reduced deforestation on carbon emissions would need to be properly monitored and independently verified.
3. The permanence of forestry credits, and liability, are matters that would need to be resolved. For these reasons, a new sectoral market mechanism is needed to avoid leakage problems and to ensure a benefit in terms of net-deforestation.

Therefore inclusion of forestry credits in emission trading systems should only be considered after a thorough review of the experience of using deforestation credits for **government compliance** and only for the period after 2020.

Furthermore full reliance on carbon value would focus solely on the services of forests as carbon stocks, while not rewarding other important services that forest ecosystems provide and whose value can be significantly higher. This is an issue that will also have to be resolved.

17. ANNEX 17: THE GRADUAL DEVELOPMENT OF A GLOBAL CARBON MARKET

The carbon market is a rapid developing set of policy instruments. It covers a varied set of policy instrument, from cap and trade systems at country and company level, to offsetting mechanisms that create credits for countries/sectors that do not have a cap on their emissions.

In order to clarify the terminology used in this staff working document in relation with the global carbon market, see also glossary.

17.1. Domestic cap and trade systems – the core of the emerging global carbon market

A cap and trade system is one of the many instruments at the disposal of individual countries to reduce greenhouse gas emissions. The instrument has gained popularity due to the combined advantages of environmental effectiveness (assured by the emissions cap) and cost efficiency (due to the flexibility offered by trade in allowances). The EU has gained first mover experience in setting up the EU Emissions Trading System (EU ETS) as the world's largest company-based emissions trading system.[56]

Inspired by the EU's progress many countries (and regions within countries) across the OECD consider to use or actually are in the process of designing domestic cap and trade systems paralleling the EU ETS. Most notable in this regard is the progress in the Asian-Pacific region which both New Zealand having introduced a system in 2008 and Australia firmly committed to starting a scheme in 2010. Japan is also working on introducing a system, which in contrast to other emerging systems is of a voluntary nature. In the United States the momentum towards a federal cap and trade system is growing, while a first regional system[57] will start operation in 2009 in the Northeast and two other regional groupings work on system design.

Linking of domestic emissions trading systems

The Directive underpinning the EU ETS foresees the possibility to link with other domestic systems by means of mutual recognition of the emission allowances. The EU considers the gradual linkage of robust and mandatory (company-based) emissions trading systems on a bilateral basis as the central pillar to build a global carbon market.[58] Linking domestic trading systems reduces cost of achieving the combined cap of the linked systems. It expands the carbon market, boosts market liquidity and increases its cost-effectiveness. In addition, it strengthens the cooperation between parties with binding targets and increases incentives for others to take appropriate action.

While emerging systems will differ in one respect or the other from the EU ETS design, as much as the EU ETS design will evolve over time, systems needs to share some basic common features to be linkable. Most important in this regard is the environmental ambition level (stringency of the cap) and the mandatory nature of the system. Linking to poorly-designed or voluntary systems would undermine the environmental effectiveness of ambitious systems like the EU ETS.

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[56] For further information on the EU ETS, see: http://ec.europa.eu/environment/climat/emission.htm

[57] Regional Greenhouse Gas Initiative (RGGI)

[58] For further information, see http://www.icapcarbonaction.com/declaration.htm

17.2. Complementary (UN-based) offsetting mechanisms – the first step for developing countries to participate in the global carbon market

The evolution towards a robust global carbon market

Chapter 6.5.2 in Part 1 of this Staff Working Document describes the potential cost benefits, if the post-2012 climate change framework allow for the developing gradually a robust global carbon market. The key instrument to achieve cost-effective mitigation is through a robust global carbon market based on cap and trade systems with comprehensive coverage implemented across all major emitting countries, i.e. the perfect carbon market. But in the middle term the nucleus of this emerging global carbon market will have to be national and/or regional cap-and-trade emissions trading systems in OECD countries linked to each other.

Successfully implementing a cap and trade system requires sound governance structures and strong domestic institutions which are at this stage not sufficiently developed in most developing countries. The Kyoto Protocol has created a vehicle for developing countries to participate in the carbon market prior to the introduction of full-fledged cap and trade systems. The Clean Development Mechanism (CDM) is designed as a project-based offsetting mechanism and allows developing countries to monetise the value of emission reductions achieved on their territory without actually taking on commitments to reduce or limit greenhouse gas emissions. Implementing CDM projects offers many benefits for a developing country and builds capacity and institutions for more comprehensive climate policy. This is one of the reasons for the EU ETS to recognise CDM credits for compliance purposes subject to quantitative and qualitative constraints. The recognition of CDM (offset) credits is also discussed in other emerging domestic trading systems.

In contrast to cap and trade systems based on a robust cap, offsetting mechanisms do not contribute to global mitigation efforts in a direct way. They do offer an alternative means to achieve agreed reductions. Mainly due to this characteristic they are widely recognised as an important step, but only a temporary first step for developing countries to participate in and benefit from the demand for emission reductions created by cap and trade systems.

Reforming the CDM – a first step beyond pure offsetting

The CDM has been a success in leveraging finance for low-cost abatement opportunities. In 2007, the CDM market value was around €9.4 billion out of a €47 billion in the global carbon market[59]. However, the CDM needs to be reformed as regards its environmental integrity, its contribution to technology transfer and economic transformation in less developed regions[60].

Sufficiently advanced developing countries should soon move beyond the offsetting approach of the current CDM, which at present often compensates offsetting projects at low cost which those countries could undertake themselves. CDM will in those countries also need to start to ensure an increase in energy efficiency in the electricity sector. Recognition of CDM credits in the EU ETS and other emerging cap and trade systems will become increasingly dependent on the environmental standards. Furthermore, any carbon finance should in the future only come on top of sufficient substantive deviations from baseline by developing countries to ensure that the credits generated go beyond mere offsetting compared to baseline. As

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59 World Bank – State and Trends of the Carbon Market, May 2008.

60 See Lambert Schneider, Is the CDM fulfilling its environmental and sustainable development objectives? An Evaluation of the CDM and options for improvement, Ökoinstitut, 2007.

demonstrated in chapter 6.5.2 in Part 1 of this Staff Working Document also offsetting mechanisms can generate revenues that can compensate the cost of these own action that are not credited.

In the medium-term, the CDM as a voluntary, project-specific offsetting mechanism can only continue for those countries that are not expected to implement a comprehensive national low carbon development plan (see also annex 13), and eventually only for the least developed countries that would have no obligation to develop such plans.

Develop a new market mechanism at sectoral level – a second step towards cap and trade systems

As developing countries increasingly make contributions to limit or reduce their emissions, the CDM will loose importance over time. This reduced role, however, does not mean fewer opportunities in the carbon market in developing countries, but it implies an evolution to new market mechanisms in the evolution towards cap and trade systems.

Such new market mechanisms should be designed at sectoral level, .e.g. as sectoral crediting[61] to increase participation by developing countries to the scale required. Credits could be awarded for beating reinforced ambition levels, while no penalties would be imposed for missing these ambition levels. Sectoral targets – even on a "no-lose" basis – could help advanced developing countries to avoid locking in expensive investments into high carbon technologies.

The Commission aims for the development of a new carbon market mechanism at sectoral level as an intermediate step towards the introduction of cap and trade systems. Such a new mechanisms and a reformed CDM allows countries to participate in the global carbon market according to their different responsibilities and capabilities.

A sectoral carbon market mechanism could be focused on key sectors where emissions are increasing most rapidly or that are part of competitive world markets and where data collection is relatively simple and straightforward. In addition, binding sectoral emission targets might be attractive to richer emerging economies (e.g. OECD type countries), some of which already enjoy a higher income per capita than some of the poorer EU Member States. In order to have a well functioning sectoral crediting or trading system, monitoring, reporting and verification needs to be ensured. A sectoral carbon market mechanism could also mitigate carbon leakage concerns and therefore ensure the overall environmental effectiveness.

Financing climate change mitigation or adaptation through the carbon market

Emissions trading can be a cost-effective and flexible mitigation tool and a key source of finance for a rapid and wide diffusion of efficiency improvements in industry and the development and application of clean technologies as long as they are not mere offsetting but pay for those reductions that go beyond what one could see as appropriate action by developing countries. In addition, auctioning of allowances from emission trading systems can raise significant revenues for financing climate change mitigation or adaptation activities.

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61 For the concept, see Background Note on Sectoral Approaches for a Post-2012 International Climate Framework, Pew Center, 2008; CEPS, Global Sectoral Industry Approaches to Address Climate Change – the Way forward, 2008; R. Baron, Sectoral Approaches to GHG Mitigation: Scenarios for Integration, 2006 OECD. See also Stern, - Key elements of a Global Deal on Climate Change, 2008, p. 13.

For example, if in the EU ETS auctioning would become the main allocation mode it could potentially generate around €50 billion of revenues in 2020 within the present set-up of the EU's unilateral reduction target .[62]

[62] Based on a carbon price of 30 € per ton CO2 and with a reduction target in 2020 equal to -21% compared to 1990 and access to CDM/JI credits in accordance with the Commission's proposal for the post-2012 EU ETS of January 2008.

18. ANNEX 18: SECTORS AND SOURCES

The inclusion of new sectors and gases in the future climate regime aims to enhance the environmental effectiveness of the future agreement by means of broadening its coverage.

The Kyoto Protocol covers a "basket" of six gases: carbon dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_2O), Hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs) and Sulphur Hexafluoride (SF_6). The selection of these gases is largely based on data and knowledge from the beginning of the 1990s, as set out in the "revised" 1996 IPCC guidelines. Since then there have been new scientific and technical developments and enough experience has been gained with reporting on various sectors and gases and in the implementation of the relevant methodologies and guidelines.

Expanding the coverage of the climate regime by including new sectors and gases would have three effects:

– it would enhance the environmental effectiveness of the system, since it would cover a larger share of global GHG emissions;

– it would introduce new and additional abatement opportunities into the system, thereby offering a higher abatement potential and lower abatement costs. It would thus render the system more cost efficient;

– it would prevent a shift to larger-scale application of these new substances resulting in significant anthropogenic GHG emissions.

Whether or not new sectors and gases can be included will depend on whether certain criteria can be met. These concern first and foremost the monitoring, reporting and verification (MRV) requirements, as the implementation of robust MRV is imperative for the inclusion of new sectors and gases, but also criteria to exclude perverse incentives for the production of the gases in question or similar substances in the future. Otherwise, the environmental integrity of the new agreement could be jeopardised.

Criteria for inclusion of new sectors and gases

In line with the requirements to ensure effectiveness, efficiency and consistency of possible policy options, the following criteria should be applied to determine whether new sectors and gases should be included under a post-2012 agreement:

1. Availability of a global warming potential in the 4th IPCC Assessment Report and the 2006 IPCC guidelines.

2. Availability of estimation methodologies in the 2006 IPCC guidelines. If new methodologies are necessary, can these be developed in a short time frame?

3. Implications for reporting of GHG inventories, i.e., need for additional information to be reported in the national inventory report, changes in common reporting format tables (CRF).

4. Complexity of MRV requirements: Where complexity is high this will entail higher administrative costs and hence emissions reductions may be achieved in a more cost-effective way via alternative measures.

5. Data collection: if it is not possible to easily collect information on emissions this could undermine environmental effectiveness.

6. Significance of the source (this criterion does not necessarily exclude smaller sources. It needs to be demonstrated that inclusion is the most cost-effective way to achieve emissions reductions compared to alternative measures outside the future agreement).

7. Significance of the source: this does not necessarily exclude smaller sources in relation to global emissions. It needs to be demonstrated that inclusion is the most cost-effective way to achieve emissions reductions compared to alternative measures outside the future agreement.

8. Current global production of the new gases and regional distribution (if possible, including data or assumptions for future production trends).

9. Source of emissions (production, application, decommissioning) and field of application and purposes for which new gases are used (if possible, relevance of individual applications should be provided).

10. Potential growth in the production and use of new halogenated gases for substitution of other F-gases covered by the Kyoto Protocol.

11. Existing regulation: If the source is subject to sufficient emissions reductions under alternative regulations, e.g. the Montreal Protocol, then there is little need to bring it into the scope of a future climate change agreement.

12. Abatement potential and cost: gases with limited abatement potential should not be excluded as it is important to give clear signal to industry on the need to eliminate or limit substances contributing to climate change

13. Compliance and abatement costs (this criterion does not necessarily exclude gases when the costs are high. It needs, however, to be demonstrated that the environmental benefits from their inclusion outweigh these costs.)

Inclusion of additional gases as part of the Copenhagen Agreement

The IPCC's Fourth Assessment Report (AR4) identified additional greenhouse gases which are not covered by the Montreal Protocol and published GWPs for additional substances compared to those included in the Third Assessment Report (TAR). The additional GHG from anthropogenic sources under consideration are:

– New PFCs and HFCs

– Nitrogen trifluoride (NF3)

– Trifluormethyl sulphur pentafluoride (SF5CF3)

– Fluorinated ethers

– Perfluoropolyethers,

– Other halocarbons including iodotrifluoromethane (CF3I), dibromomethane (CH2BR2), bromo difluoro methane (CHBrF2), methyl chloroform (CH3CCl3), dimethyl ether (CH3OCH3), dichloromethane (CH2Cl2) and methyl chloride (CH3Cl), used in the electronics industry or occurring as by-products.

On the basis of the criteria presented above, those new halogenated substances that are not covered by the Montreal Protocol should be included in a post-2012 agreement. The detailed list with the individual chemical species is provided in. These gases should be treated similarly to fluorinated substances currently covered by the Kyoto Protocol and be included in the scope of future quantified emission limitation and reduction objectives (QELROs) and revised reporting guidelines.

If these substances were left unregulated, a shift towards their larger-scale application would be likely. This would result in significant anthropogenic GHG emissions due to the high GWP of these substances ranging from 59 to 17 700 (see table below).

An exception could be made with regard to the substances listed under "other halocarbons" that have relatively low GWPs. Necessary monitoring efforts do not seem to be justified by the limited contribution of these gases to global warming.[63]

[63] Those include, e.g., Iodotrifluoromethane (CF3I), Dibromomethane (CH2BR2), Bromo difluoro methane (CHBrF2), Dimethyl ether (CH3OCH3), Dichloromethane (CH2Cl2), Methyl chloride (CH3Cl).

Industrial Designation or Common Name (years)	Chemical Formula	Global Warming Potential for Given Time Horizon		
		SAR* (100-yr)	TAR (100-yr)	AR4 (100-yr)
Hydrofluorocarbons				
HFC-245fa	$CHF_2CH_2CF_3$	950	3 380	1 030
HFC-365mfc	$CH_3CF_2CH_2CF_3$		890	794
HFC-43-10mee	$CF_3CHFCHFCF_2CF_3$ or (C5H2F10)	1 300	1 500	1 640
Perfuorinated compounds				
Nitrogen trifluoride	NF_3		10 800	17 200
PFC-9-1-18	$C_{10}F_{18}$			>7,500
Trifuoromethyl sulphur pentafuoride	SF_5CF_3		17 500	17 700
Fluorinated ethers				
HFE-125	CHF_2OCF_3		14 900	14 900
HFE-134	CHF_2OCHF_2		2 400	6 320
HFE-143a	CH3OCF3		750	756
HCFE-235da2	$CHF_2OCHClCF_3$			350
HFE-245cb2	$CH_3OCF_2CHF_2$			708
HFE-245fa2	$CHF_2OCH_2CF_3$		570	659
HFE-254cb2	$CH_3OCF_2CHF_2$			359
HFE-347mcc3	$CH_3OCF_2CF_2CF_3$			575
HFE-347pcf2	$CHF_2CF_2OCH_2CF_3$			580
HFE-449sl (HFE-7100)	$C_4F_9OCH_3$			297
HFE-43-10pccc124 (H-Galden 1040x)	$CHF_2OCF_2OC_2F_4OCHF_2$			1 870
HFE-236ca12 (HG-10)	$CHF_2OCF_2OCHF_2$			2 800
HFE-338pcc13 (HG-01)	$CHF_2OCF_2CF_2OCHF_2$			1 500
HFE-227ea			1 500	
HFE-236ea2			960	
HFE-236fa			470	
HFE-245fa1			280	
HFE-329mcc2			890	
HFE-338mcf2			540	
HFE-347mcf2			360	
HFE-356pcf2			260	
Perfluoropolyethers				
PFPMIE	$CF_3OCF(CF_3)CF_2OCF_2OCF_3$			10 300
Other halogenated compounds				
	CHBrF2		470	
	$(CF3)_2CHOCHF_2$		370	
	$(CF3)_2CHOH$		190	
	$(CF3)_2CFOCH_3$		330	

19. ANNEX 19: EMISSIONS FROM INTERNATIONAL AVIATION AND MARITIME TRANSPORT

19.1. International aviation emissions

Climate impacts of aviation

The climate impacts of aviation arise from emissions of CO_2, NOx, water vapour, sulphate and soot particles. Attention of policymakers has so far has been on CO_2 emissions, as its effects on the climate are well understood and it is relatively easy to quantify the emissions. However, the climate impacts of other emissions, particularly stratospheric NOx, the formation of contrails and cirrus clouds associated with aircraft remain uncertain. According to some studies[64], it could be several times greater than the impact due to the CO_2 alone. Mitigation of these non CO_2 emissions is therefore more difficult due to the complexities of quantifying the precise climate impacts. Further scientific study and analysis is therefore required to more accurately quantify the total climate impacts of aviation from non CO2 emissions.

Levels of emissions

The International Civil Aviation Organisation (ICAO) has estimated that global emissions from aviation were in the order of 600 million tonnes of CO_2 in 2005[65]. Later estimates suggest suggests that global emissions of CO_2 from aviation were 673 million tonnes in 2007[66]

Emissions from air transport have increased strongly in recent years. The European Environment Agency reports that the EU CO_2 emissions from international aviation have grown 96% between 1990 and 2005[67].It is likely that emissions will continue to grow further. Indeed, the IPCC estimates[68] that global emissions of civil aviation could reach between 800 and 2,300 million tonnes of CO_2 by 2050.

A key driver of the increase in emissions is due to the demand for air travel increasing at a faster rate than efficiency improvements in aircraft. Forecasts of traffic growth suggest that total air passenger traffic worldwide will increase at an average annual rate of 4.6% for the period 2005–2025[69]. Whilst the distance travelled measured in aircraft kilometres will see 4.1% annual growth. Fuel efficiency of jet aircraft also has improved over time, but is improving at a much slower rate than the increase in demand. Industry estimates suggest that fleet average fuel economy improved and could continue to improve at a rate of 1.5% per

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64 Climate forcing of aviation emissions in high altitudes and comparison of metrics, An update according to the Fourth Assessment Report, IPCC 2007, Hartmut Grassl1, Dietrich Brockhagen, December 2007.

65 ICAO Environmental Report 2007

66 http://www.wiltonpark.org.uk/documents//947%20presentations%20for%20website/Pearce.pdf

67 European Environment Agency – Greenhouse gas emission trends and projections in Europe 2007. EEA Report No 5/2007

68 IPCC 4th Assessment Report, Working Group III Report "Climate Change 2007 - Mitigation of Climate Change"

69 ICAO Environmental Report 2007

year[70] due to replacement of older inefficient fleet with newer aircraft. Therefore overall emissions from aviation are likely to increase for the foreseeable future.

Demand for business and leisure travel tends to increase as the economy grows. Into the future, if these trends continue it is possible that air travel will account for an increasing proportion of greenhouse gas emissions, especially if other sectors such as electricity successfully decarbonise.

Possibilities for reductions

In air transport, important fuel efficiencies can be achieved by the use of modern aircraft technologies, for example using lighter materials or better propulsion systems. Better air traffic management can also be important in shortening routes between airports, improving flight profiles and approach procedures and minimising the holding and stacking of aircraft around airports. Improvements can also be made through other infrastructure and operational measures such as increasing passenger occupancy, reducing speed, route optimisation, reducing the traffic of aircraft while on the ground, improving logistics and through better design of air-terminals.

Some of the abatement options for aircraft are perceived to be higher than for other sectors. Indeed aviation may be one of most difficult to modes of transport to de-carbonise as there are currently few or no alternatives to aviation fuels and engines. For example, in the medium term it seems more feasible to electrify road transport than introduce low carbon air transport. For this reason the introduction of biofuels could mitigate some of aviation's carbon emissions. However, aviation fuel specifications are demanding, in particular for safety purposes, and it is unclear as to the costs and methods of production of sustainable biofuels that meet specifications necessary for aviation.

Further mitigation of climate impacts of aviation can occur through minimising NO_x emissions and contrail formation. Such measures may occur through improved engine design (e.g. to reduce NO_x emissions) or through different operating patterns to avoid climatic conditions where contrails are likely to form. As most aviation policy instruments currently focus on CO_2 emissions, it will become increasingly important to ensure that the correct policies and incentives are in place to manage wider climate impacts. Greater scientific understanding of the non CO2 climate impacts of aviation will enable these impacts to be better managed.

EU Comprehensive approach

The Commission has adopted a comprehensive approach to reduce emissions from aviation. A key part of this approach is to improve airspace management. The Single European Sky and SESAR initiatives aim to improve the efficiency of aircraft movements in Europe and foresee reductions of carbon emissions of up to 10% per flight. In addition, significant resources are being devoted to research and technological development. The EU 7th Research Framework Programme includes the Clean Sky programme that finances research into improvements, in particular for aircraft, engines and navigation systems.

To support the development of low carbon aviation, it is necessary to provide the right incentive for research and investment. Part of this involves ensuring greenhouse gas emissions

[70] http://www.wiltonpark.org.uk/documents//947%20presentations%20for%20website/Pearce.pdf

are priced correctly. Therefore a further aspect of the comprehensive approach has been the introduction of market based measures, through the inclusion of aviation in the EU emissions trading scheme, which will provide a framework for managing emissions from the sector.

Global impacts of the Comprehensive Approach

Some of the actions in the EU have potential to have a global impact in reducing emissions from the sector. Improvements in aircraft technology in particular will be of benefit across the world, as new the technology will benefit all those who use it. Improvements in air traffic management in Europe benefit all operators flying in our airspace whatever is their origin. The ATM technologies developed under the SESAR programme may also be used in third countries. . Finally the design of the EU ETS provides an example for managing emissions that could easily be adopted by many non-EU countries and incentivises third countries to develop and implement policies to manage to the climate impacts of aviation.

Measures to be developed under a global sectoral approach

Various technological, regulatory, operational and economic measures can be developed and promoted globally. To identify the appropriate measures to address specifically the climate change impact of international aviation, ICAO created in 2007 a high level group on international aviation and climate change (GIACC).

Participation of international aviation in a global carbon market should be part of this set of measures to be developed under a sectoral approach. It would enable to emissions from aviation to be offset by cheaper reductions in other sectors. An open scheme, such as the EU ETS, has the advantage of ensuring that the compliance costs are contained and will be lower than in a closed system.

Distribution of allowances through auctioning is a means to avoid windfall profits accumulating in the sector. But it also generates revenues that can be used to address climate change.

For isolated regions, peripheral islands and developing countries especially dependent on aviation, it may be necessary to consider mechanisms that take any net negative effects into account. The development of specific financing instruments can be one option.

Possible approaches to allocation of international aviation emissions

The EU ETS includes aviation emissions in the scheme on the basis of the route flown. This approach was adopted as the best way forward after consideration of all other options in the impact assessment[71] and received the most support from the aviation stakeholders involved in the preparation of the legislation.

An airspace based approach to allocating emissions was rejected since it is incompatible with UNFCCC guidelines, due in particular to issues about ownership of emissions over the high seas. It would also be very complex to implement.

[71] Commission Staff Working Document – Impact assessment of the inclusion of aviation activities in the scheme for greenhouse gas emissions trading within the Community, SEC(2006)1684

Allocating emissions on the basis of nationality of operator would also be problematic; there is a risk of significant competition issues between operators. For these reasons, attributing emissions on the basis of the route flown was clearly the preferred option.

A route based approach would result in the more developed countries having responsibility for a substantially larger share of emissions, due the significantly higher levels of air traffic that take place in those territories.

As demonstrated in the analysis in chapters Chapter 6.5.1 and Chapter 6.5.2 in Part 1 of this Staff Working Document, including aviation emissions in the target setting at country level is not detrimental for the total mitigation costs. More importantly, if well designed, mitigation policies for the aviation sector can leverage resources for mitigation at a broader scale.

Design issues for including international aviation in an ETS

Aviation has been included in the EU ETS in a way which enables to emissions from aviation to be offset by cheaper reductions in other sectors. Such an open scheme has the advantage of ensuring that the compliance costs are contained and will be lower than in a purely closed system.

It is also possible to generate significant revenues to address climate change with an ETS through the auctioning of allowances. Auctioning is also a means to avoid significant windfall profits accumulating in the sector. When allocation is free, the risk of this happening is much higher. Auctioning revenues have a number of potential uses.

For isolated regions, peripheral islands and developing countries especially dependent on aviation, it may be necessary to consider mechanisms that take any negative effects of allocating emissions on a route based approach into account. Development of specific financing mechanisms could be one option.

Implication of lack of robust action from international aviation

Given the high increases forecast in international aviation emissions, it is essential that a comprehensive framework is developed to manage these emissions effectively. Limited or no reductions from international aviation will put increasing strain on other sectors and require them to make even deeper reductions in emissions.

19.2. International maritime emissions

Climate impact of ships

The main climate impact of international maritime transport is due to the CO_2 created by the burning of fossil fuels, largely for propulsion of ships but also for the generation of steam and electricity. There are other short and long term impacts of ships on the climate (such as cloud formation) but the dominant, long term effect is caused by the CO_2 emissions.

Level of emissions

Data about the level of GHG emissions from ships is very poor because there are no international requirements for ships to report fuel used or emissions. Estimates have been

made based on assumptions on fleet composition and shipping activity, however despite expert's best efforts estimates vary considerably. Recent reports[72] for the International Maritime Organisation (IMO) indicate that ships engaged in international maritime transport currently emit approximately 843 Mt CO_2 per year, equivalent to the emissions from a large developed country like Germany or 3.5% of global greenhouse gas emissions. The vast majority of these emissions are from the 60.000 largest vessels (those over 400 GT) and just two categories of vessels, container ships (225 Mt CO_2 from approximately 13.000 ships) and tankers (230 Mt CO_2 from approximately 4000 ships) contribute almost half of these emissions.

Emissions trends

Increases in emissions are largely driven by the growth in world trade, 90% of which is carried by sea, and the recent trend towards larger, faster, more powerful vessels. Global maritime transport emissions are estimated to have risen 86% since 1990, far faster growth than the growth in international aviation emissions (increased by a third over the same period[73]). In recent years emissions have been growing in excess of 3.5% per year. Maritime transport GHG emissions are set to rise a further 35% - 50%[74] by 2020 and to have doubled again by 2050 (in total a four fold increase between 1990 and 2050) unless firm action is taken at the global level.

Reduction potential

While emission are rising fast there is considerable potential for reduction in emissions from ships using currently available technologies and techniques for both existing and new vessels. While some vessel operators are already successfully using these technologies and techniques to reduce emissions there is little evidence of the widespread uptake of currently available technologies across the industry. Operational improvements for both new and existing vessels can deliver reductions of up to 40% in CO_2 emissions, technical improvements to engines, hulls and propeller could deliver reductions of up to 30%[75]. Such measures, if implemented across the whole fleet, could have delivered a 28% reduction by 2020 compared to BAU.

Looking to the future new and improved technologies, materials, vessel designs, fuels and vessel operations can together lead to further very significant (up to 75%) improvements in transport efficiency by 2050. Alternative lower carbon fuels, such as LNG and biofuels, may also be more widely used on some ships by 2050. Setting clear and meaningful targets for maritime emissions will give the signal necessary to stimulate research and technological developments and implementation.

However, despite their potential, technical and operation improvements if implemented will not be sufficient to offset the expected growth in maritime transport demand in the next decades.

No more favourable treatment

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72 Input from the four subgroups and individual experts to the final reports of the informal Cross Government/Industry Scientific Group of Experts, IMO, BLG 12/INF.10, 28th December 2007 and "Update Study on GHG emissions from ships (Phase 1)" for the IMO, 1st September 2008

73 CO2 emissions from fuel combustion (2006 edition), IEA, Paris, 2006

74 From POLES model baseline projections.

75 IMO "Study of Greenhouse Gas Emissions from Ships", March 2000

Measures to address GHG emissions from ships should be developed irrespective of the flag of ships taking into account that in ports the authorities will ensure that no more favourable treatment is given to ships entitled to fly the flag of a state which is not party to the instrument. It is also important to take into account the specificities of shipping where ships operate throughout the world and compete for the same trade with the possibility of easily changing flags of registry. Any action to address GHG emissions from ships which does not respect these specificities could be easily avoided and so would therefore be environmentally ineffective.

Impact on costs and demand

In most cases shipping is the most energy efficient means of mass freight transport[76] and for the vast majority of intercontinental freight transport there is no viable alternative mode of transport. Because of the lack of alternatives and high level of competition any extra costs associated with reducing GHG from ships incurred by ship owners or operators can be passed on, through their customers, to the final consumers.

Maritime transport costs are approximately 1%[77] of the final consumer price of goods. Action to reduce GHG emissions from ships has been estimated to increase maritime transport costs by 4% - 8% leading to an average increase in the final cost of goods to consumers of less than 0.1%.

Maritime freight transport has very low price elasticity so such small changes in cost are expected to have very small impact on overall demand. The impact on maritime passenger transport and the cruise industry requires further analysis.

Impact on developing countries

Some developing countries' economies are heavily dependent on maritime transport either because of their reliance on imports, or exports, or from income from cruise ships.

Any possible negative impacts of addressing these emissions on the least developed countries need to be carefully considered. While global action is required it may be necessary, for example, to exclude routes to, from and between the least developed countries.

Any revenues from the use of market based instruments (e.g. a fuel levy, Emissions Trading Schemes or a freight tax) to address GHG emissions from should be used to cover part of the financing needs of a new international climate change agreement. Such additional funding will benefit Developing Countries.

International shipping is a truly international business and can be owned, controlled, managed and operated by entities all in different countries and fly the flag of yet another country. Unlike airlines that are often owned, registered, managed and operated from a single state, in shipping in some countries a vessel may be registered without any genuine link with the ship or its owner therefore there is often a very weak link between a ship and the flag state whose flag the ship flies. In addition legal and financial arrangements are complex and can change on a daily basis. The majority of the world fleet fly the flag of developing countries[78] (and

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[76] Very large ships can consume less than 5g of CO2 per tonne-km of freight transported.

[77] MISS 2005

[78] Panama, Liberia, Bahamas and the Marshal Islands have the largest registered fleets.

generate significant income for the flag states) but largely provide goods to Developed Countries and most vessels are ultimately controlled by nationals of developed countries[79].

Risk of mode shift

Although there are limited alternatives for the majority of international maritime transport there is a fear that in some regions, including in Europe, and for some products on some routes, that action to reduce maritime GHG emissions could lead to a counter productive mode shift from maritime transport to other modes of transport e.g. road freight transport, with significantly higher GHG emissions per tonne kilometre and higher external costs. Any action to reduce GHG emissions from maritime freight transport should take into account the competitive situation of maritime transport and the consequent possibility of such counter productive mode shift that would undermine the environmental effectiveness of any action.

Overall cost of reductions

Whilst there is little public information available about the marginal costs of reducing GHG emissions from maritime transport it is likely that significant reduction can be made within the sector cost effectively. However to ensure reductions are made at the lowest possible cost it is necessary to combine the implementation of technical and operational measures such as the one currently being developed by the IMO and the use of market based measures, such as open emissions trading or others, to minimise compliance costs. These are also instruments that potentially could leverage resources for mitigation actions on a broader scale.

19.3. Emissions from international aviation and maritime transport: institutional architecture to address these sectors

Left unchecked emissions from these two unregulated sectors could increase over the period 1990-2020 by more than 1.7 Gt CO_2. This is a very large increase and is equivalent to half the emissions from deforestation at present. If these sectors do not contribute appropriately, then other sectors will need to make significantly greater reduction efforts, in order to achieve any given GHG reduction objective.

Without action to reduce international transport's share of total global GHG emissions will grow dramatically in the next decades. The likely growth would offset a significant part of the reduction being made by other sectors of the economy. Significant reductions are possible, particularly in shipping where improved ships efficiency and performance are highly encouraged using currently available technologies and strategies. To achieve the necessary long term reduction investments in R&D need to be increased and co-ordination of research efforts needs to be enhanced. Whilst there is a case for public funding, strong binding global targets and a price for carbon dioxide emissions could help stimulate private sector investments.

No targets have been set for international transport emissions and no sufficient measures to reduce these emissions have been adopted at this stage neither by the International Civil Aviation Organisation (ICAO) for international aviation nor by the International Maritime Organisation (IMO) for maritime transport.

[79] UNCTAD, 2007, Review of Maritime Transport, New York/Geneva

The European Commission strongly supports a global approach to effectively address these emissions and deeply regrets the lack of progress towards agreeing global binding rules under ICAO or IMO since the adoption of the Kyoto Protocol in 1997.

Responsibility

If no global sectoral approaches have been agreed within ICAO by the end of 2010, emissions from international aviation could be included into national totals of all countries on the basis of the route flown in the context of an international post 2012 agreement. This can be done by attributing emissions from each flight to the country of arrival or departure. Developed countries would then have to actually agree on comparable action to reduce these emissions.

Faced with the lack of global action, the EU has adopted legislation to include aviation in the EU ETS. Member States and the European Parliament have considered carefully the choice of policy instrument and the design parameters. The approach adopted in the EU could serve as a model for a global approach.

Likewise, if no global sectoral approaches have been agreed within IMO by the end of 2010, emissions from maritime transport could be included into national totals of all countries by attributing emissions from each leg to the country of arrival and/or departure. Developed countries would then have to actually agree on comparable action to reduce these emissions. In the absence of global progress to reduce maritime transport emissions the European Commission has been asked to come forward by the end of 2011 with a proposal to address these emissions with the aim of its entry into force by 2013[80]. Any European action should be effective, not disadvantage European maritime interests, minimise negative side effects and contribute to the development of global action to address GHG emissions from ships.

Market based mechanisms

Absolute caps on the emissions from these sectors could limit the development of these sectors which are so crucial for balanced economic development. As a result a market based mechanisms are appropriate to allow these sectors to purchase emissions reductions from other sectors of the economy in order to limit their climate impact and minimise costs.

Overall, the approaches developed by ICAO and IMO could include the adoption of market-based measures, such as a global emission trading system.

In such a case, auctioning allowances could contribute to generating significant financial resources that could be used to support action to address climate change, including in developing countries, as is foreseen already in relationship to the auctioning of allowances for international aviation in the EU ETS from 2012 on.

A tax on international bunker fuels or international transport emissions could be a way to give a price signal, stimulate RTD and raise revenues for tackling climate change. However to avoid evasion this would require a global approach and unanimous agreement, so would be

[80] See recital (2) of the "Decision of the European Parliament and of the Council on the effort of Member States to reduce their greenhouse gas emissions to meet the Community's greenhouse gas emission reduction commitments up to 2020" and recital (3) of the "Directive of the European Parliament and of the Council amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emission allowance trading system of the Community"

difficult to agree and implement. The environmental effectiveness would ex ante be unknown and depend on the level of the tax.

Impacts on Least Developed Countries

The possible negative impacts of mitigation measures on isolated and/or peripheral regions and islands and developing countries should be taken into account.

Whilst specific global targets for both sectors should be agreed in order to respect to respect the different situation and capacities of LDC reduction measures could be implemented with differentiated targets for different categories of routes.

20. ANNEX 20: F-GASES

Fluorinated gases (F-gases) are extremely powerful and long-lived greenhouse gases mainly used in commercial and industrial refrigeration, air conditioning and heat pump systems, fire-protection, as blowing agents in insulation forms, as aerosol propellants, in electrical transmission systems and various industry processes. F-gases covered by the Kyoto Protocol include sulphur hexafluoride (SF6), and two groups of gases called hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs). SF6 has a GWP of 22 800. The GWP for HFCs ranges between 124 (HFC 152a) and 14 800 (HFC 23) and for PFCs between 7 390 (perfluoromethane) and 12 200 (perfluoroethane). Most frequently used F-gases feature in the 1 500 to 4500 range.

Since the 1990s, HFCs steadily entered the market mainly in developed countries, including the US, Japan, and the EU, due to the phase out of production and consumption of hydrochlorofluorocarbons (HCFCs) as mandated by the Montreal Protocol on substances that deplete the ozone layer. Contrary to HCFCs, HFCs have no ozone depleting potential.

By the turn of the century, F-gas emissions represented approximately 1.5% of the global GHG emissions, but their use and emissions are steadily increasing due *inter alia* to the gradual phasing-out of HCFCs under the Montreal Protocol as well as the rapidly growing refrigeration and air conditioning sector and the increasing use of insulation foams.

Global HFC production amounts to an estimated 0.4-0.5 million tonnes per annum i.e. around 0.5 to 1.2 billion tonnes $CO_{2\text{-eq.}}$ emissions if these gases are not contained, recovered and destroyed at the end-of-life stage. In 2006, HFCs accounted for an estimated 70% of HCFC replacements in the EU, but non-HFC low-GWP alternatives are rapidly gaining market shares mainly in Germany. Similar HFC substitution rates apply to other developed countries. Developing countries have significantly lower HFC substitution rates as the phase-out of HCFCs was not mandated until 2040 without defined freeze, baseline and phase-out steps. In 2007, the Parties to the Montreal Protocol adopted a Decision (XIX/6) to accelerate the phase out of HCFC, mainly in developing countries for which the end of the schedule, albeit a servicing tail, was brought forward from 2040 to 2030 with earlier stepped reductions. There are already first signs of increasing HFC production in developing countries. Current increases are mainly directed towards supplying industrialized countries although it can be expected that domestic demand, under BAU, would increase in the coming years.

Considering the high GWP of F-gases, and as part of its commitment to reduce GHG emissions by 8% during the period 2008-2012 (compared to 1990), a two-pillar EU policy framework was established in the context of European Climate Change Programme. HFC use in mobile air conditioning is governed by the EC type-approval legislation, notably through Directive 2006/40/EC relating to emissions from air-conditioning systems in motor vehicles. HFC use in stationary applications is governed by Regulation 842/2006 which entered into force in July 2007. The former progressively bans the sale of cars equipped with an air-conditioning system containing HFCs with a GWP higher than 150 between 2011 and 2017. The latter, includes, inter alia, provisions on containment, recovery and labelling of F-gases in a number of applications, and for a limited number of products and equipment containing these gases it bans their use and/or placing on the market. Furthermore, the Regulation requires producers, importers and exporters of more than 1 tonne of fluorinated greenhouse gases to report to the European Commission relevant data, including the identification of the

main categories of applications in which the substances placed on the EC market are expected to be used. A review of Regulation 842/2006 is due in 2011.

Globally, F-gas emissions are expected to increase from the current share of about 1.5% in global GHG emission to double in 2020 and further increase beyond 2020. Despite their currently low share of global emissions, there is a growing consensus that this business as usual scenario is not compatible with the GHG reductions needed to fight climate change.

Whilst HFCs are not ozone depleting substances (and thus not governed by the Montreal Protocol), the use of HFCs to replace HCFCs remains also a topic of interest to the ozone policy community. The accelerated phase-out schedule referred to above could lead to significant net climate change benefits.[81] The actual benefits, however, depend on the volume of HFCs that will be phased in during the period ending in 2030 to replace the HCFCs for the relevant applications. Currently available alternatives in the EU include CO_2, hydrocarbons (refrigeration, air-conditioning and foams), and ammonia (refrigeration systems). Based on substitution rates presently observed, and without a major push towards low-GWP alternatives, the benefits may be reduced by 70% or more.[82] Hence the Decision called on Parties (and the Montreal Protocol's Multi-Lateral Fund) to prioritize the further development and phase in of low-GWP HCFC alternatives. During the 2008 Meeting of the Parties to the Montreal Protocol, a decision was adopted requesting the Protocol's Technical and Economic Assessment Panel to update the HCFC and HFC scenarios as well as the available information of HFC alternatives and to discuss the matter, including possible policy options, at a July 2009 workshop also involving climate experts and UNFCCC/KP bodies. In this context, ideas are surfacing to develop an international HFC agreement building on the Montreal Protocol's architecture whereby the HFC production and consumption would be capped and subsequently phased-down. Such a cap would be set in terms of CO_2-eq. at a level allowing a gradual transition out of HCFCs, e.g. starting with a freeze around 2011-2013 and a cap that would decline at a certain annual rate towards an agreed target level in line with a target agreed by Parties under a future UNFCCC agreement. If developing countries would sign up to such an agreement, a different year to freeze emissions could apply to developed countries and developing countries allowing for technology transfer.

Whilst there is a need for further data collection and analysis before the potential benefits and costs can be assessed in more detail, the idea of an international F-gas agreement merits serious consideration as it could offer a much needed "technology push" towards low-GWP HFC alternatives, similar to the effects already generated by the EU F-gas policy framework. In November 2008, the Montreal Protocol Parties decided to ask TEAP to analyse, by 15 May 2009, the current and future growth of HFCs resulting from the HCFC phase-out and to hold a joined Montreal Protocol/UNFCCC experts workshop before the 29th OEWG to study the TEAP results and to consider further action (Decision XX/8).

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81 Because HCFCs have a GWP ranging between 77 and 2310, the theoretical climate benefit of Decision XIX/6 of MOP19 related to the accelerated phase out of HCFCs amounts to more than 20 Gt $CO_{2\text{-eq.}}$ for the period until 2030.

82 The European Commission has already sponsored technical workshops to promote the EU current legal framework for containing HFC emissions and the use of low GWP HCFC alternatives in developing countries (Montreal, April 2008). Follow-up actions to support developing countries are scheduled to start in 2009.

21. ANNEX 21: MONITORING, REPORTING, VERIFICATION

Monitoring, reporting and verification (MRV) of emissions and emission reductions are indispensable for several reasons. Firstly, any rational policy making leading to environmentally effective and cost efficient policies and measures needs to be firmly based on reliable information. Designing a national action plan requires therefore information on emissions, trends, and mitigation potentials by sectors. Sound policy making also requires ex-post evaluation of the policies implemented in order to assess, for instance, their effectiveness and cost efficiency. Secondly, Governments are accountable for the use of financial resources which requires that countries must have trust and confidence in the overall MRV framework in connection to allocating significant financial resources in developing and developed countries. Thirdly, the integrity of the MRV framework is the backbone of any link of emission reductions to international carbon markets. Fourthly, monitoring, reporting and verification can also be the basis for international compliance with commitments like for countries with reduction commitments under the Kyoto Protocol.

Therefore, the Bali Action Plan foresees the need for appropriate action by developing countries that is measurable, verifiable and reportable. Hence, it is important that, no matter how, the future agreed framework on action against climate change shapes up, developing countries have the ability to adhere to its MRV requirements and developed countries are able to prove that they have adequately supported these actions through monitored, reported and verified contributions, whether financial or other.

In moving forward with MRV issues, it is important to draw on the lessons learned in implementing the Kyoto protocol and the Convention with the overall aim of improving quality, consistency, comparability and transparency of the information provided.

As discussed above the range of possible actions by developing countries as part of their national low carbon development plans is rather broad and can be different across sectors. It could include voluntary policies in a limited number of sectors, possibly qualitatively recognised by the UNFCCC as reported by the respective country. It could, however, also go as far as including quantitative targets, possibly set at a sectoral level first. In order to assess the effectiveness of actions in developing countries, monitoring, reporting and verification needs to cover implementation of actions as well as emissions of the relevant sectors.

Likewise, different actions taken by developing countries will require different means of support, ranging from crediting of action via the carbon market, fund-based approaches to technology transfer and direct support for policies from individual Parties – both inside and outside the institutional setting of the UNFCCC. A broad set of possible means of support for those actions should therefore be acknowledged under the monitoring, reporting and verification provisions of the Copenhagen agreement, while avoiding any double counting of actions towards existing commitments of Parties under separate multilateral agreements.

Current situation

The key problems with the existing MRV of GHG emissions in particular for developing countries are:

1. There is generally a lack of national data compilations and statistics, which are accurate, complete and consistent. The resources available are inadequate in order to

implement quality control and quality assurance procedures to ensure the accuracy and quality of the information collected. Mandatory reporting is limited to CO_2, CH_4 and N_2O while reporting of F-gases remains voluntary.

2. Reporting is only done irregularly with the reporting year being at the discretion of each developing country. Most developing countries do not go beyond this requirement and only report emissions for one single past year (e.g., China and India). Developing countries are not required to report a time series of GHG emissions thus there is not much information on emission trends available, nor consistent information over time.

3. Developing countries are not required to provide a national inventory report, or information on methodologies, data sources or emission factors used for the estimation of emissions. This lack of transparency makes review and verification difficult. Most developing countries do not have national systems for monitoring, reporting and verification of their emissions. Most developing countries have difficulties retaining capacity and expertise and have limited resources.

4. There is currently no review system in place to assess the reports prepared by developing countries. This makes it difficult to assess the progress made by developing countries in adapting to climate change, in taking actions that lead to limitations in the growth of GHG emissions, and finally in establishing and/or improving their MRV system.

Objectives for improvement

– Against this background monitoring, reporting and verification needs to systematically enhanced in order to guarantee environmental effectiveness and integrity of the system.

– Reporting needs to become more regular and comprehensive and include trends and projections as a basis to assess adequacy of action plans.

– Depending on the type of action in different sectors, higher consistency, quality, comparability and transparency is needed to provide a basis for meaningful verification of information provided.

– It is also evident that significant efforts in capacity building are needed to support developing countries ability to establish adequate emission inventories.

– Increased resources are also needed to support the use of data and information as part of domestic policy analysis, design, and implementation, as well as the necessary internal and external review system to assess progress in implementing action plans.

Options to enhance Monitoring and Reporting

The analysis above implies that existing monitoring and reporting guidelines should be broadened which could include guidelines for national systems, institutions to be involved, inspection and potential enforcement/compliance measures (penalties). It would also require developing countries to report additional data and information, such as for F-gases. This would offer the potential to ensure the necessary quality and reliability in terms of monitoring data, thereby providing an essential precondition for the identification, implementation and

evaluation of national action plans. This will also be conducive for making policies and measures overall environmentally effective. The implementation of such a system would, in the short term, incur higher costs in comparison to the status quo. In the longer term, however, the higher costs would pay off through ensuring the implementation of cost efficient policies and measures, higher consistency and transparency – and thus credibility – of the system.

The promotion of higher reporting frequency for advanced developing countries does not necessarily ensure higher quality and consistency, unless accompanied by a robust verification system. However, when this is put in place it could contribute to the development of a national system in developing countries geared towards the preparation and support of these reports, enhancement and further development of the reporting formats. The establishment of such a system would result in greater consistency and transparency in the information provided.

Such improvements are likely to entail higher costs, which however, seem to be justified in the light of more effective and reliable reporting and of the increased transparency, and comparability of the information provided. In some cases costs can be expected to be even lower in an enhanced scheme as standardized reporting formats are easier in their implementation.

Options to enhance Verification

Verification requirements could be extended and broadened, including changes to the existing verification guidelines for developed countries as well as establishing a verification system for developing countries. In addition, stricter rules would apply for all operational aspects of the verification system. Due to the broad range of different possible actions to be undertaken by developing countries the verification systems could follow a set of basic rules and principles but would be adjusted to the particular needs of each measurable and reportable type of activity. Implementing such improvements could increase the consistency, reliability, transparency and credibility of the system. Moreover, maintaining a common thread among all verification processes would ensure that costs are kept at the minimum level possible.

Impacts

The assessment criteria used in the following section remain the same as in the previous one, i.e., environmental effectiveness, economic efficiency, administrative costs.

Monitoring

Harmonising the way GHG emissions are monitored allows for consistency in implementation through the establishment of a national system. Guidelines on monitoring lead to comparable and reliable monitoring results and would ensure that countries that do not have solid monitoring systems in place are identified and supported. Exchanging good practice can facilitate implementation and improvement.. Frequent reviews of these guidelines could assist with understanding where the main issues lie and how they can best be resolved.

However, this enhanced system could entail broadening the current framework to include guidelines on monitoring and compliance. The UNFCCC would then need to develop a work programme, which could involve the use of additional expertise from outside the UN system and considerable time of UNFCCC staff and country representatives to engage in discussions and workshops. All countries would need to have active input and involvement into developing the guidelines. The total costs of doing this are hard to estimate. If these

guidelines are developed it is very likely that many countries and in particular developing countries would need assistance to help them implement those internally. In developed countries where such systems may already exist there may still be the need to review and modify those to be able to deal with any additional requirements of the new guidelines.

Reporting

Reporting requirements should be broadened and expanded as new instruments and new actions have surfaced over time and as countries needs have evolved. More information is needed to support these recent developments and subsequently more checks and verifications. Furthermore, as experience has been gained with the implementation of current requirements it is now time to take the lessons learned on board and improve existing practices. The provision of comprehensive and comparable data can help develop environmentally and economically effective solutions which really take into account the relevant aspects of the process and current needs. A higher reporting frequency would help to improve transparency and knowledge of historic and projected emission trends, mitigation efforts and adaptation needs and allow for timely assessments of the key influences on carbon emissions.

Common reporting formats and templates – thus a standardised system – may ensure better comparability and completeness of data, easy access to information and automated data checks to improve data quality and reduce errors. More robust and trustworthy data that is easier to access for assessments and verification checks will increase environmental integrity of the system.

However, the implementation of additional guidelines, metrics and mechanisms can be complex. Sufficient resources would need to be allocated for the preliminary research and design of these options. Same as for monitoring, the UNFCCC would need to prepare a work programme, which could involve the use of additional expertise from outside the UN system and considerable time of UNFCCC staff and country representatives to engage in discussions and workshops. Overall, costs of reporting such additional information would likely be lower for developed countries than for developing as developed countries already have regular reporting requirements and have permanent systems in place to handle collection and dissemination of GHG related information.

Compulsory higher frequency reporting would incur additional costs, as many countries would need to put a permanent MRV system in place. However, these costs would be expected to level off once the system would be in place and would be operating for a few years. Regular, standardized reporting would ensure predictability, and consistency of the information provided and would lead to lower costs and operational efficiency as experience increases. Compulsory frequent reporting could lead to a disproportionate burden on LDCs and other less advanced or smaller developing countries. For those countries, the necessary scope and frequency of reporting should be considered carefully and according to their respective capabilities.

Verification

Current verification requirements are clearly not adequate to cover all the aspects of a future agreement, as detailed in this communication, and may not ensure the quality of data for all processes. More comprehensive processes and guidelines on verification would enhance transparency, would help clarify requirements and would result in consistent verification across all countries and years. Institutionalizing the verification system in essence means that

verification activities will be acknowledged as an integral and fundamental part of the implementation of a future agreement and all related aspects. It would, in particular, mean that all resource requirements are considered and properly accounted for in advance and the necessary mechanisms are in place to address all issues that arise on a continuous and systematic way rather than on an ad-hoc basis. Thus, a strengthened verification system is expected to significantly improve the functioning of the current system, which relies heavily on voluntary contributions and commitments by countries as regards human and financial resources, and which does not include specific detailed standards for all parts of the verification process.

In terms of costs, a lot of guidance and frameworks are already in place but the structures need to be strengthened. Building on existing frameworks will almost certainly be more cost-effective than preparing them separately or devising completely new ones. In addition to these costs, there will also be ongoing costs from reviewing the effectiveness of this new institutionalized system. Overall, the "upgraded" system could be expected to contribute to ensuring manageable costs fluctuating with the scale and complexity of the particular checks implemented.

MRV for support

According to the Bali Action Plan, financial and technical support provided for action by developing countries should also be measurable, reportable and verifiable.

Such support would mainly focus on the means of implementation of national low carbon development plans of developing countries. It would, however, also include support for capacity building for both the development of adequate national plans as well as for the necessary monitoring and reporting systems to be put in place in developing countries. Support provided to different countries should generally be differentiated according to countries respective capabilities.

Options for financial support include, inter alia, carbon market finance, public spending through international funds, bilateral support for mitigation programmes or capacity building measures. It could also include private sector flows, in the form of foreign direct investment related to mitigation in developing countries. To keep track of the variety of different streams of support, an international review mechanism should be established that clearly defines principles, criteria and possible avenues for support measures and regularly monitors flows through those channels for each Party.

The current monitoring, reporting and review framework under the UNFCCC could serve as a basis for reporting of mitigation-specific support, but needs to be improved to ensure consistent, more frequent and complete provision of information, including flows through multilateral development banks, non-UNFCCC funds and financial flows under the flexible mechanisms of the KP.

Improvements of guidelines for national communications could serve as a starting point for more complete and consistent information on financial support by developed countries. Information from institutions other than the UNFCCC needs to be drawn in a systematic manner.

New frameworks are being discussed under the UNFCCC to monitor support efforts related to technology transfer and capacity building. …

MRV for Technology

The EGTT is currently working on some performance indicators to monitor, report and verify technology development and transfer. Performance indicators should measure induced changes defined by the technology transfer framework. They are used to observe progress and to measure the results achieved against the results required. Performance indicators are usually expressed in qualitative or quantitative terms, and should be objectively verifiable (e.g. numeric values, percentages, scores and indices).

Monitoring, reporting and verification would capture the levels of annual investments of various kinds (e.g. official development assistance, foreign direct investment, the clean development mechanism and the Global Environment Facility (GEF)) that have been made in individual countries. In addition, information on additional key policy indicators should be collected in order to explain patterns of investment and to estimate the environmental result of the investments.

22. ANNEX 22: INSTITUTIONAL ARCHITECTURE TO ENSURE APPROPRIATE ACTION ON ADAPTATION

The IPCC's fourth assessment report confirmed that climate change effects on natural and human environments are already emerging. A diverse set of likely future impacts was described ranging from impacts on water management, ecosystems, food production, coasts and health.

Even ambitious mitigation strategies will require significant adaptation. A wide array of adaptation options are available that can reduce vulnerability to climate change. This is a challenge facing all countries and especially countries that are vulnerable to climate change, such as the least developed countries, small island developing states and African countries that are prone to extreme weather events such as drought, storms, floods and desertification. The Bali Action Plan recognised this consensus, and agreed there was a need for immediate and urgent action on adaptation, to ensure the availability of both financial and technological resources for adaptation, focusing on the most vulnerable countries, in particular to LDCs, SIDS[83] and Africa.

The elements outlined below are the main items of the discussions on adaptation within the UNFCCC. They are also covered by the EU proposal for a framework for action on adaptation (FAA), which recognises that effective adaptation is a shared challenge that requires shared solutions, and aims to be an agreement that coherently sets out the responsibilities of all parties involved.

22.1. Mainstreaming

Since climate change affects many sectors, systems and groups, successful adaptation policies need to be spread across sectors and adopted by a wide range of actors within and beyond the state. Climate change risk should thus be factored into and responses integrated into all decision making at the local, national and where applicable, regional levels.

Globally, the need for mainstreaming for adaptation action is the object of a rather large consensus.

In practice, a lot of ongoing adaptation activities, including these funded through the Least Developed Countries Fund (LDCF) and the Special Climate Change Fund (SCCF), are already mainstreaming activities.

In 2005, the EU and other OECD member countries agreed to develop and apply coherent approaches to integrate climate change adaptation into development co-operation, in collaboration with relevant partners, and bearing in mind other international initiatives. Progress has been made to raise the awareness among international financial institutions, bilateral agencies and multilateral banks on climate risks and vulnerabilities. The 2004-2008 action plan on climate change in the context of development cooperation, ensures climate change is incorporated into all aspects of EU development policy and the new Joint Africa-EU Strategy and first Action Plan (2008-2010) supports the efforts of Africa, particularly LDCs and SIDS, to counter the effects of climate change to move towards sustainable development and to adapt to the negative effects of climate change, notably through the

[83] Small Island Developing States

integration of climate change considerations into development policy. The Commission Green Paper on Adaptation stresses the importance of mainstreaming adaptation into the EU's external assistance policies.

The FAA therefore regards mainstreaming efforts as a responsibility of both developed countries (integrating adaptation into external policies and programmes) and developing countries (through climate resilient plans and budgets and providing enabling environments) and as a key mean to meet adaptation commitments under the Convention.

Mainstreaming climate change however, poses a number of challenges to all countries and in particular developing countries. Notably:

– there needs to be an adequate information basis to make the right decisions and define necessary policies and associated responses.

– climate change adds on to the challenge of development and mainstreaming does have an additional cost.

In order to address these two fundamental issues, the EU proposes that a FAA would provide the basis to develop guiding principles and approaches to facilitate the integration of adaptation actions into national and sectoral planning processes, taking into account existing work in this area, for example by the OECD/DAC. In addition, the FAA would have a strong capacity building element to facilitate efforts to prepare vulnerability assessments and develop methods and tools to prioritise adaptation actions. Additional efforts and costs necessary for mainstreaming should also be supported.

In practice, several 'entry points' for mainstreaming can be envisaged, among them, making full use of Strategic processes like National Adaptation Strategies, but also recognising NAPAs, existing national environmental and development strategies and plans, screening and climate proofing procedures applied across policies, strategies and plans, as well as public finance, sectoral, and local decision making.

22.2. Addressing vulnerability

Vulnerability as defined by the IPCC[84] is the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity.

Defining adaptation strategies requires therefore a better understanding of the relationship between impacts, which forms the basis for the ‘reasons for concern’, and vulnerability, which includes the ability and willingness to adapt to impacts

Scientific evidence has shown and the Bali action Plan has recognised, however, that it will be the poorest regions and countries in the world (particularly the least developed countries, Africa, and small island states), and within them foremost the poorest fringes of population, that will be affected the earliest and hardest. Climate change is a serious challenge to poverty reduction in developing countries and threatens development policy achievements. The weakest countries will have most difficulties with adapting to climate change, which may lead

84 IPCC, 2007a

to less growth, more forced migration and possibly radicalization and state failure causing internal and external security risks.

Recognising the need for focusing on the most vulnerable, some parties, such as Australia have asked for a general scale of vulnerability for Parties in terms of physical impacts and capacity to respond.

In its FAA proposal, the EU focuses rather on the need to develop further vulnerability assessments in country, and stresses the need to ensure that the focus is on the most vulnerable as a major responsibility for developing countries.

22.3. Facilitating assistance to tackle barriers to implementation

Capacity building is central to and cuts across all aspects of adaptation. Enhancing the capacities of Parties, in particular LDCs, SIDS and African countries prone to drought, desertification and floods, is essential if they are to address the challenges posed by climate change and to design and implement effective responses. Furthermore, enhancing the capacities of relevant international and regional centres, networks and other organisations is critical to enable their engagement in adaptation action.

The FAA would outline specific areas for capacity building on approaches and principles embodied in relevant decisions by the Conference of the Parties to the UNFCCC and call on Parties and relevant organisations, including the private sector, to take these into consideration in their activities. For example, under the Framework, the important role of regional centres undertaking work relevant to climate change would be acknowledged and underscored.

Parties may want to make specific commitments to support such centres and networks to ensure that knowledge, technical and other necessary expertise is developed, used, shared and sustained at the regional and national levels.

22.4. Incentive mechanisms

Risk can be reduced through commercial and non commercial means. Non-commercial means involve strategic planning to anticipate the probability of risk as well as measures to strengthen the preparedness of key institutions. Risk management approaches range from capacity building to ensure institutional preparedness (including to enhance the information base for risk assessment) to mitigation actions which in themselves are long term risk reduction measures (to reduce the risk of dangerous anthropogenic interference with the global atmosphere).Insurance is one possibility of providing clear financial incentives to private sector and citizens to reduce risks, and a way of providing a quick pay-out in case of the insured event happening.

The Bali Action Plan calls for “consideration of risk sharing and transfer mechanisms, such as insurance” as a means to address loss and damage in developing countries.

Through the FAA, the work of other relevant actors in the risk management area, such as the International Strategy for Disaster Reduction (ISDR) and International Federation of Red

Cross and Red Crescent Societies (IFRC) as well as the work of many donors[85], would be acknowledged and drawn up in efforts to address adaptation at all levels. This would avoid duplication of efforts and improve synergies. Public-private partnerships, which harness the power of the market, are an attractive mechanism for supporting risk sharing. The FAA would serve to facilitate such partnerships, while calling on Parties to create and enhance enabling environments for adaptation actions.

The Munich climate insurance initiative proposes[86] an insurance module with two pillars (prevention and insurance) as part of a multi-pillar adaptation fund. The Prevention Pillar puts reduction of human and economic losses as its top priority. The Insurance Pillar has two tiers. The first tier is a Climate Insurance Pool that would absorb a predefined proportion of high-level risks of disaster losses in vulnerable non-Annex 1 countries. The second tier would provide technical support and other forms of assistance to enable public-private insurance systems that provide cover for the medium and low losses of risk in these countries, as opposed to high risk layers which represent very high losses. This two-tiered insurance pillar would (1) meet the principles set out by the UNFCCC for financing and disbursing adaptation funds (2) provide assistance to the most vulnerable, and (3) include private market participation.

22.5. Technology for adaptation

Adaptation technologies are specific and likely to require a larger share of public funding than, mitigation technologies for instance. They range from "soft technology" aimed at facilitating the process of adaptation (vulnerability assessments, early warning systems etc.) to technologies for implementing adaptation (resilient crop types, improved techniques for water management etc.) Technologies for adaptation include basic tools and know-how already applied in day-to-day activities around the world, and more complex advanced techniques such as data observation systems. In enhancing technologies for adaptation, it is important to address actors in both the public and private sectors and recognise country specific needs and conditions.

The Framework for Action on Adaptation (FAA) would assist in identifying priority technology needs for adaptation. The framework for action on adaptation would also mobilise those organisations with relevant expertise (for example the Global Climate Observing Systems (GCOS) or the Consultative Group on International Agricultural Research (CGIAR)). Furthermore it would facilitate support for technology research and development, deployment, and diffusion, including from the private sector. The priority areas aimed at strengthening the adaptive capacities of the most vulnerable countries could include inter alia technologies to facilitate monitoring, forecasting and modelling climate change; those for improving the resilience of agriculture to the impacts of climate change and technologies for coastal zone management.

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85 For instance, in the European Commission DG ECHO has been very supportive of recent global efforts to strengthen Disaster Risk Reduction efforts, which includes disaster preparedness measures. The DIPECHO programme therefore targets highly vulnerable communities living in some of the most disaster-prone regions of the world. Since the launch of the DIPECHO programme in 1996, DG ECHO has invested more than EUR 120 million in disaster preparedness.

86 Munich Climate Insurance Initiative, 2008

22.6. Scaling-up of predictable financial flows

The UNFCCC secretariat has estimated the necessary global annual financial flows needed in 2030 for adaptation reasons in its report on investment and finance. This report estimated that a range for global adaptation needs of US$ 49-179 billion. For developing countries the estimate was somewhere between $28-67 billion. While it is not easy to attribute these costs specifically to adaptation and estimate the amounts[87] it is clear that this represents an additional cost to development relative to a world with a stable climate. And this figure will rise - strongly after 2030 - if global efforts to reduce emissions are not sufficiently ambitious and temperatures increase gradually but well before 2100 above 2°C. Furthermore, despite improved efforts to adapt, severe weather events will continue to pose a huge challenge for developing countries, including increased humanitarian and reconstruction costs,[88] as well as escalating prices for climate sensitive goods (e.g. food) and services (e.g. insurance).

There is also information on priority adaptation needs in LDCs in the National Adaptation Programmes of Action (NAPAs). These are prepared using the LDC Fund of the Global Environment Facility (GEF). NAPAs have been finalised for 30 of the 50 LDCs and overall immediate priority investment needs amount to $650 million. The priority needs for all LDCs are likely to be above $1 billion.[89]

Developing countries need to integrate their climate change concerns into their national development strategies which will facilitate ODA-funding for climate activities. Development cooperation should integrate climate change in their policies to leverage investment flows. GEF grant funding is available for piloting new innovative approaches, but its financing potential at its current scale is limited in comparison to the scale of financing that is needed. When comparing the above figures with the current (2007) flows of Official Development Assistance (ODA) of $ 104 billion[90], it becomes clear that ODA alone – unless significantly scaled up - will not be sufficient to cover additional climate adaptation needs. New sources of financing should therefore be explored.

Presently available resources, as well as likely available resources in the near future, are very small in comparison to the medium and long term adaptation needs. The recently created Adaptation Fund (AF) under the Kyoto Protocol, financed largely outside ODA by a two per cent levy on the investments under the Clean Development Mechanism, is expected to generate around $300 million by 2012. After 2012 the AF may become much more important, depending on the outcome of the Copenhagen COP.

The World Bank proposed a Pilot Programme for Climate Resilience (PPCR) with a target size of $ 300 – 500 million. Donors are invited to contribute to the PPCR, which is planning to engage in adaptation support in some pilot countries. The cooperation dimension of EU's Global Climate Change Alliance (GCCA) is focused on adaptation in LDCs and SIDS.€60 million of additional resources are available (2008-10) under the Environment and Natural

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87 The UK and the Netherlands are jointly funding a research study with the World Bank to better understand the budgetary needs for developing countries to achieve cost-effective climate resilient development.

88 This was seen recently with Cyclone Sidr in Bangladesh where adaptation efforts were estimated to have saved up to 100,000 lives but the country still experienced loss of human lives and livestock and national economic loss.

89 World Bank, 2008.

90 http://www.oecd.org/dataoecd/27/55/40381862.pdf, note: The data for 2007 are preliminary pending detailed final data to be published in December 2008.

Resources Thematic Programme (ENRTP). Responding to an appeal to the Member States by the European Commission to pool resources for the GCCA Sweden has contributed € 5.5 million and other are considering a contribution. The European Parliament has been strongly supportive of the GCCA, calling for a substantial long-term financing goal for the initiative, in the order of at least €2 billion annually by 2010 and €5 to10 billion annually by 2020, guaranteed by both the European Commission and Member States. Current levels of ODA will not be sufficient to cover these amounts.

Although much adaptation will be undertaken by individual agents, notably where risks to private assets can be reduced or insured, many adaptation actions have the character of a public good, with no market mechanism in place to ensure sufficient private investment. Those countries which are already reliant on international development assistance are unlikely to be able to meet these additional costs and deliver their development goals. Additional support will be essential if they are to be able to shift to climate-resilient development paths.[91.]

Options for meeting urgent and immediate needs

In accordance with the Council's invitation to consider innovative means of financing, the Commission has explored the option of a Global Climate Financing Mechanism (GCFM). Similar to the International Finance Facility for Immunization (IFFIm), the GCFM would frontload finance through capital markets based on Member States' guarantees of repayments at a later stage.

For more information on the GCFM option, see annex 23.

Options for new sources of finance

The European Commission is working on building a Global Climate Change Alliance (GCCA) between the European Union and those developing countries which will be hit hardest by the impact of climate change, in particular Least Developed Countries (LDC) and Small Island Developing States (SIDS). The Council, in November 2007, welcomed the timeliness and purpose of the GCCA proposal, noting the Commission's invitation to Member States to join the initiative and dedicate part of their agreed commitments to increase Official Development Assistance (ODA) over the coming years. The Council also invited the Commission to consider innovative means of financing. In their recent Conclusions on speeding up progress towards the achievement of the Millennium Development Goals, EU Heads of State and Government recognised climate change as a new challenge to development, and committed the EU to working for the effective implementation of the Global Climate Change Alliance, and to mobilising a sufficient level of financial resources to combat the negative impact of climate change.

EU Heads of State and Government confirmed in June 2008 their commitments regarding increased official development assistance (ODA) targets for 2010 and 2015 (to 0.56 per cent of GNI in 2010 and 0.7 per cent in 2015). Clearly mainstreaming climate resilience considerations into programmes for poverty eradication will lead to increased efforts. However, the G77 and China is proposing that climate support including adaptation should be

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91 At the spring 2008 Joint Development Committee of the World Bank and IMF, it was agreed that climate finance should be additional to existing ODA spending. The substance of this agreement was also agreed in the UNFCCC Articles 4.3 and 4.4, and most recently in the Bali Action Plan.

over and above ODA commitments, the proposal argue for a particular share of GDP like 0.5-1% above the 0.7 %. It is clear that ODA alone will not be sufficient to cover the climate adaptation needs. Innovative financing mechanisms should therefore be explored.

In this respect, the carbon market also offers new opportunities in terms of raising public revenues for such contributions in Europe. As agreed in the Directive of the European Parliament and of the Council amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emission allowance trading system of the Community foresees that at least 50% of the revenues generated from the auctioning of allowances should be used for climate actions[92]. One option to scale up European efforts could be that Member States earmark a certain part of these revenues to the GCCA.

At the international level, an option, which could have the advantage of complementing European contributions, would be to auction or sell a share of the Assigned Amount Units (AAUs), which could bring predictable finance at a high scale. Adaptation Fund should be sourced from share of proceeds on CDM and then in addition a 2% share of AAUs sold at the international level. The mechanisms could be reviewed for adequacy on a regular basis.

Another option would be a compliance scheme where countries would pay compensation for missing reduction targets, which could be paid into the Adaptation Fund at initially, e.g. 150€ per ton.

Option for spending modalities and delivery channels

Any new revenues raised for climate adaptation in developing countries could be used to increase the funding of existing initiatives including the GCCA, or could be channelled through multilateral institutions (like WB, GEF or UNDP). The existing adaptation fund could be enhanced to support adaptation action based on NAPAs, first on the basis of pilot and demonstration projects to gain experience and "best practice". Support should focus on LDCs and SIDS.

The Adaptation Fund (AF) agreed in Bali in December 2007 and to be managed by the Global Environment Facility (GEF) is financed by a 2% levy on CERs and will finance adaptation projects in all developing country parties to the Kyoto Protocol particularly vulnerable to climate change. The Adaptation Fund has however not yet shown to be fully operational, which might argue for an advantage in the shorter term in rather funding the GCCA as a joint European initiative. The GCCA does not compete with the AF, which is likely to function as a global project financing mechanism working through (UN) implementing agencies. It intends to work in a complementary fashion to the AF, providing the majority of GCCA funding directly to governments through general or sector budget support. In the longer term, beyond 2012, the Adaptation Fund might equally move away from project-based funding towards a more strategic approach of integrating financing into national development programmes

[92] This concerns actions in developed and developing countries and includes for instance contributions to the Global Energy Efficiency and Renewable Energy Fund and to the Adaptation Fund,, measures to avoid deforestation and increase afforestation and reforestation in developing countries that have ratified the future international agreement, to transfer technologies and to facilitate adaptation to the adverse effects of climate change in developing these countries, and for the environmentally safe CCS, including in third countries. Under Directive 2008/101/EC, all auction revenues from aviation should be used for these purposes;

(budget support). The experience gained through the GCCA would then be very useful for extending the scope of the Adaptation Fund.

Other options to be further explored urgently are insurance mechanisms to reduce the economic risks from climate related disasters. For example, this mechanism could partly finance insurance premiums, maybe coupled to planned adaptation and risk reduction strategies paid from the Adaptation Fund. Insurance co-finance could be differentiated according to respective capabilities of developing countries.

22.7. Conclusions – Catalytic role of the UNFCCC

A variety of actors and processes are already engaged in actions that are relevant to adapting to climate change. This will require coordinated efforts on many fronts. Governments have an important role to give incentives to public and private stakeholders to engage in adaptation actions, e.g. putting in place the right enabling environment to reduce the operational risk to the private sector and other organisations engaging in adaptation.

It is therefore likely that the bulk of adaptation action will not happen through the UNFCCC, but rather across the board, through many different stakeholders.

A key element of the FAA, is to foster the catalytic role of the UNFCCC, to encourage the actions of other relevant organisations, private and public actors and strive for consistency and synergies between relevant processes.

22.8. Monitoring and review effectiveness of measures

Monitoring would need to be applied for both the efficiency of actions proposed under the UNFCCC, and to the resilience of economies and societies to climate change. It is of a different nature and has a different scope than MRV applied to mitigation. As the bulk of adaptation actions will need to happen through mainstreaming, notably via tools such as budget support, any attempt at monitoring and reviewing the effectiveness of adaptation measures will be based, essentially, on qualitative reporting.

23. ANNEX 23: OPTION FOR MEETING URGENT AND IMMEDIATE CLIMATE-RELATED NEEDS: THE GLOBAL CLIMATE FINANCING MECHANISM

This annex further explores one of the proposals presented in the Communication regarding the establishment of a Global Climate Financing Mechanism (GCFM) to accelerate finance for climate change needs in poorest and most vulnerable developing countries. This is in accordance with the Council's invitation to consider innovative means of financing and to work inter alia on this Commission's proposal. This option is proposed as a specific and targeted initiative with a limited time frame. Whereas the financing solutions proposed for the broader post-2012 financial framework to ensure predictable funding on a long term horizon, the GCFM would ensure an immediate increase in public financing to specifically support priority adaptation and, to a lesser extent, mitigation needs in poor and climate-vulnerable developing countries.

Concept

Similar to the International Finance Facility for Immunization (IFFIm[93]), the GCFM would frontload finance through capital markets based on donors' guarantees of repayments at a later stage. The two main features of the proposed GCFM are:

– raising funds from the international capital markets by issuing bonds allowing spending immediately on priority climate-related actions in poorest developing countries most vulnerable to climate change, and

– making legally binding pledges for repayment of the bonds over a longer time period.

The GCFM has a temporary nature. It is conceived as a transitory instrument to deliver substantial funding in favour of poor and vulnerable developing countries. The GCFM could be used as a bridging initiative to fill the gap during the five years from 2010 to 2014, leaving time (i) for already decided instruments (mainly the Adaptation Fund) to function at a sufficient scale and (ii) for the new post-2012 finance architecture with long term and predictable financial solutions to be decided and turned into effect, ensuring sustainability of the scaling-up induced by the GCFM. The GCFM is therefore short term and focused. It would be followed by relevant instruments to be agreed upon in the post 2012 financial framework.

The GCFM does not intend to establish a new "Fund". The EC, as others, has been advocating against the proliferation of funds and aid fragmentation in the area of climate change and it is not its intention to create a new one. The GCFM is a fund raising mechanism, allowing new and quick sourcing of funds at affordable costs. New sources should not mean new delivery mechanisms. Funds raised through the GCFM would be used to complement existing instruments with their proper ways of delivering. Analysis of comparative advantages of different instruments (EU GCCA, UN, WB) using various criteria such as efficiency, effectiveness, coordination and coherence, support to approaches which integrates climate change into national planning processes and budget, Paris Declaration principles application

[93] The International Finance Facility for Immunisation (IFFIm) was created to accelerate the availability and predictability of funds for immunisation (see also: http://www.iff-immunisation.org/index.html).

as well as absorption capacity could be used in a second stage to allocate the funds amongst existing instruments.

Justification

It would allow rapidly reducing the current gap between the limited availability of funding and the needs to tackle priority investments in most vulnerable countries with additional money. It is expected that costs will rise over time as climate impacts will worsen before effects of mitigation are felt and temperatures are stabilized. Delaying interventions in adaptation actions risks putting in danger investments already done to reach development objectives. Postponing interventions will result in higher adaptation costs in the future. Infrastructure that is not climate proof risks being damaged or destroyed by extreme weather events. It is likely that rising sea levels and increased incidence of climate related disasters will multiply adaptation costs in the future. One clear example justifying early intervention in adaptation is disaster risk reduction (DRR). Evidence shows that investment in DRR has a high ratio of benefits to costs. Studies reveal that for each dollar invested in DRR, benefits between two and four dollars can be expected in terms of avoided or reduced social and economic impact of natural disaster. Funds for a big push will therefore be needed shortly. Synergies with mitigation actions can also be promoted from the start (see below).

Secondly, the GCFM could be a feasible short term option which would send a powerful signal to the developing countries in the run up to the December 2009 Copenhagen climate conference. As such, the decision on an EU financial mechanism to support climate change action in developing countries may have a great importance for the success of the climate change negotiations. Being an EU initiative of significant size, this signal would be much stronger than smaller individual member states initiatives.

Illustration of possible costs and structure

The GCFM could aim to raise some €5 billon over 5 years (2010 – 2014) by issuing bonds sold to investors.

Repayment of such bonds would be secured by legally binding commitments from Member States, possibly using revenues linked to the carbon market, such as derived from the auctioning of carbon credits through the Emission Trading Scheme. Rough estimate indicates annual repayments in the range of $480 million/year over 20 years assuming 5 per cent interest rate.

Different options could be further studied to set up a GCFM. In particular, the specific legal entity created for the purpose of legally issuing the bonds backed by commitments from Member States would be either a fully staffed organisation responsible for handling the bond issue and the financial management or a light vehicle, whose management and tasks would be entrusted to an existing institution. In the latter case, the options of entrusting the EIB or the Commission with this task could be further explored.

Interest rate on bonds would be based on the funding rates of the supporting governments[94] plus a margin to allow for additional institutional credit risk, compared with straight sovereign

[94] The cost of bonds will thus depend on the long term debt ratings of the supporting governments. However, this link is not arithmetical. For example, IFFIm is rated AAA, on the basis of the triple A of its major supporters (France and UK), while some of them (Italy and South Africa) have lower ratings.

bonds. For the first bond issued by the IFFIm, this margin was around 0.5% over the cost of US Treasury bonds for the same maturities.

The ethical investment argument linked to "climate" bonds may permit to reduce interest costs but it is unlikely that it could allow lowering costs down to the cost of sovereign bonds. The ethical investment argument also requires a sound marketing and information strategy, which may be costly.

Provisional simulation of total costs for contributing donors has been calculated on that basis. Annual costs to be shared between participating donors would rise progressively from the first year (only start up costs) to reach a constant level of around 401 M€ in year 6 (2015) up to the end of the period (2034).

The below estimation of the annual costs of the GCFM is based on the following assumptions: 5% interest rate, 20 years reimbursement period for each of the 1 billion tranche (this period could vary), 4% cost for the management of the mechanism (initial estimation made by the EIB in case it would act as the financial institution to perform the financial management tasks) and 5 billion € bonds emission hypothesis:

Table 9 Annual costs related to the GCFM

Interest rate: 5,00%
Amounts in current million EUR

	Set-up Cost	Bond issue proceeds	4% running costs (financial institution in charge)	Total cost for donors (interests+ repayments)
2009	-2			**-2**
2010		1000	-40	**-40**
2011		1000	-40	**-120**
2012		1000	-40	**-200**
2013		1000	-40	**-281**
2014		1000	-40	**-361**
2015				**-401**
2016				**-401**
2017				**-401**
2018				**-401**
2019				**-401**
2020				**-401**
2021				**-401**
2022				**-401**
2023				**-401**
2024				**-401**
2025				**-401**
2026				**-401**
2027				**-401**
2028				**-401**
2029				**-401**
2030				**-401**

Most EU 15 Member States are rated triple A (except Greece, Italy and Belgium). Instead, the ratings of the new Member States vary between BB+ (Romania) and A + (except Slovenia AA). Hence, their support to the mechanism might marginally increase the cost of the bonds.

2031				**-321**
2032				**-241**
2033				**-160**
2034				**-80**
Total		**5000**	**-200**	**-8226**

In current euros, total disbursements of supporting governments would amount 8.2 billion € over the 20 year period, for 5 billion € bonds issued over the first 5 years. Comparison of present values gives a better view of the incremental cost of the mechanism: 4.97 billion € for the present value of governments contributions against 4.39 billion € for the present value of bonds, i.e. a 13% incremental cost.

Annual payments to be done by sponsoring countries could come from the revenues generated from the auctioning of allowances in the EU emission trading system, as referred to in the energy and climate package agreed by the European Council in December 2008. As a matter of comparison, it is estimated that revenues from auctioning could progressively increase from 2013 to reach 30 billion € or more in 2020 (assuming a carbon price of €30/ton), so that roughly 1.3% of these funds would be sufficient to cover the extra budgetary cost of annual repayments.

Member States participation to the mechanism would be voluntary. However, a commitment of all EU Member States to the initiative would provide the relevant visibility of EU engagement and leadership in the context of an international agreement and should therefore be encouraged as such.

For a shared effort, Member States could agree on a burden sharing of the global costs between themselves, based on simple distribution keys, as for example the CO2 emissions of each country, possibly also taking into account the "ability to pay".

ODA Accounting

According to DAC's rules, annual payments by participating member States to the institution in charge of issuing bonds would be annually accounted for as multilateral ODA along the period (and not the initial global commitment at the start of the period), provided that the bond issuer is recognised by the DAC as a multilateral development institution (which is the case for the IFFIm). However, this operation can be seen differently as traditional voluntary contributions to replenish multilateral funds and a different treatment in that case could be further explored, if it would be of interest of some Member States to account for the initial global commitment at the start of the period.

Use of funds

The existing estimates of adaptation funding needs in developing countries vary widely. The United Nations Framework Convention on Climate Change (UNFCCC) estimates that annual financial flows to developing countries should be between € 23-54 billion per year in 2030 to finance adaptation. It is estimated that public financial assistance in support of developing countries' adaptation efforts should be stepped up to € 5 billion in 2013 and further raised to € 10 billion by 2020 focussing especially on the poorest and most vulnerable developing countries. Additional work is being undertaken to clarify what is meant behind figures[95].

[95] Further work on the costs of adaptation is being currently undertaken by the World Bank, the UK and the Netherlands.

Those figures, although to be fine-tuned at country level, reveal the magnitude of what is at stake, compared to annual ODA disbursements of around 105 billion US$.

Various mechanisms are already in place or are being built to finance adaptation actions in developing countries. Adaptation specific instruments include the UNFCCC funds (Global Environment Facility, Least Developed Country Fund, Special Climate Change Fund and the recently operationalised Kyoto Protocol Adaptation Fund financed from a 2% levy on Clean Developments Mechanism projects), the World Bank Pilot Programme for Climate Resilience, the EU Global Climate Change Alliance and other bilateral initiatives. Overview of current funding level of those instruments reveals that, at their current level, they are not able to meet the required financing for adaptation and therefore, they need to be amended or complemented by additional mechanisms. Getting the global figure right is not therefore the main issue. The key issue is that instruments of support are currently unlikely to generate the (even lowest estimation of) required level of funding and that additional and innovative resources are needed to help developing countries adapt to the adverse impacts of climate change. Globally, what is needed is an adequate global policy and finance architecture with predictable financial flows for mitigation and adaptation.

The funds would be used in priority to allow spending on climate-related investments in poorer and most vulnerable developing countries. Specific areas of adaptation where the use of frontloaded funding can be highly cost-effective include the following:

- Disaster risk management and prevention, including flood, drought & cyclone early warning and prevention; risk insurance provision; and overall provision of improved information and communication systems;

- Agriculture, including changes in agricultural practices (e.g. reduced or no tillage, etc); changes in crop mix; increase of storage for irrigation (e.g. small and large scale storage for supplemental or primary irrigation); improved soil management and erosion control; marketing systems;

- Water, including ensuring safe water supply; water reuse technologies; increased integrated basin management; storage for irrigation and hydropower; protection of groundwater and improving recharge; rainwater harvesting; water policy reform and creation of incentives for efficient water use (mitigation and adaptation synergy);

- Health, increased geographical coverage of malaria projects and vector monitoring; increased funding for clean water supply and sanitation to prevent the spread of diseases, especially after floods (expected to increase in frequency and intensity);

- Sustainable natural resource management, ecosystems management, including sustainable land management; coastal zone management; protection of coral reefs; addressing livelihoods of fishery communities affected by climate change;

In addition, given the importance of early mitigation activities in some LDC/SIDS, a share of the funds could be allocated to mitigation activities. Areas of intervention in mitigation could be:

- Avoided deforestation, reforestation and afforestation;

- Energy efficiency, development and installation of cleaner and more efficient technologies (no regret option), renewable energy;

- Improved waste management (with co-benefits in sanitation area).

Areas involving synergies between adaptation and mitigation would be particularly opportune. In particular, avoided deforestation is a good example of synergies between mitigation and adaptation that could be attractive and provide interesting results.

Given that the poorest and most vulnerable developing countries would be targeted, grants should be the main financing modality. However, in order to increase the financial leverage, an additional option for mitigation could be blending with loans from European development financial institutions having experience in this field (EIB, KFW, AfD, etc).

Conditions for a successful GCFM

First, the absorption capacity in beneficiary countries must be sufficient to allow the frontloading of funds.

Further work is needed to better quantify at country level the detailed investment needs for mitigation and adaptation. Presently 39 out of the 50 LDCs have a National Adaptation Programme of Action (NAPA) describing their priority adaptation needs. The value of what is set out in the NAPAs already completed so far is estimated at around USD 1,5 billion (Source: LDCF/GEF). It should be recognised that NAPAs have been produced in a rather narrow context in order to identify priority activities in response to urgent and immediate adaptation needs and do not represent a comprehensive analysis of the expected impacts of climate change on the economy and of global adaptation action to address these. NAPAs nevertheless provide a good indication of the sectors in which priority investments will have to be made and actions identified in NAPAs should be the starting point. To handle adaptation more comprehensively, NAPAs should be expanded into cross-sectoral policy approaches to adaptation. The major challenge lies in a comprehensive integration of adaptation in the national development strategies, and there is an urgent need to support developing countries in that effort. This can be done in particular through capacity building in beneficiary countries and the use of appropriate support instruments.

Furthermore, the implementation modality should learn from development aid experience and programmatic approaches (sector budget support in particular with a focus on results could be an effective way of absorbing those funds at country level, in line with the Paris declaration principles). This approach is being tested by the Global Climate Change Alliance that was recently launched by the EU and is being implemented in some pilot countries.

The second necessary condition would be the provision of a legally binding and irrevocable payment commitment from each of the participating EU Member States. Such a secured financial base was made in the IFFIm by the UK, France, Italy, Spain, Sweden and other donors.

The third condition is that financial markets are sufficiently attracted and are ready to buy the bonds. If we look at the IFFIm experience, capital raising operations took place smoothly and the issuance the IFF bonds for vaccination can be considered as a success. There was sufficient interest from the investors in the interest rate, sufficient financial guarantee in the

triple A rating that was obtained, based on the overall high credit ratings of supportive countries and the legally binding nature of their commitments, and certain ethical interest in investing for the expected human results. The overall investment climate would surely be the most determinant factor in such an operation to secure a successful take up by the financial markets. While conditions on financial market are now substantially different from those that prevailed when the IFFIm bonds were issued, it seems that there is considerable interest in low-risk investment opportunities which should allow a smooth issuance of GCFM bonds also under current circumstances on financial markets.

Governance

A strategic methodology to allocate the funds to different existing instruments, based on selected criteria (proven efficiency, effectiveness, priority for adaptation, LDC/SISD, etc…) should be further developed if interest is shown in the concept.

The governance structure would be as light as possible. A management committee composed of the sponsors of the mechanism and the Commission would annually decide on the allocation of funds between implementing institutions, based on the proposed methodology, and would annually supervise the implementation.

24. ANNEX 24: COMPLIANCE AND ENFORCEMENT

The current compliance system

The Kyoto Protocol compliance mechanism is designed to strengthen the Protocol's environmental integrity, support the carbon market's credibility and ensure transparency of accounting by Parties. Its objective is to facilitate, promote and enforce compliance with the commitments under the Protocol. It is among the most comprehensive and rigorous systems of compliance for a multilateral environmental agreement. A strong and effective compliance mechanism is key to the success of the implementation of the Protocol.

The Compliance Committee is made up of two branches: a facilitative branch and an enforcement branch. As their names suggest, the facilitative branch aims to provide advice and assistance to Parties in order to promote compliance, whereas the enforcement branch has the responsibility to determine consequences for Parties not meeting their commitments. Both branches are composed of 10 members, including one representative from each of the five official UN regions (Africa, Asia, Latin America and the Caribbean, Central and Eastern Europe, and Western Europe and Others), one from the small island developing States, and two each from Annex I and non-Annex I Parties. The Committee also meets in a plenary composed of members of both branches, and a bureau, made up of the chairperson and vice-chairperson of each branch, supports its work. Decisions of the plenary and the facilitative branch may be taken by a three-quarters majority, while decisions of the enforcement branch require, in addition, a double majority of both Annex I and non-Annex I Parties.

Through its branches, the Committee considers questions of implementation which can be raised by expert review teams under Article 8 of the Protocol, any Party with respect to itself, or a Party with respect to another Party (supported by corroborating information). The bureau of the Committee allocates a question of implementation to the appropriate branch, based on their mandates.

The enforcement branch is responsible for determining whether a Party included in Annex I (Annex I Party) is not in compliance with its emissions targets, the methodological and reporting requirements for greenhouse gas inventories, and the eligibility requirements under the mechanisms. The mandate of the facilitative branch is to provide advice and facilitation to Parties in implementing the Protocol, and to promote compliance by Parties with their Kyoto commitments.

In the case of the enforcement branch, each type of non-compliance requires a specific course of action. For instance, where the enforcement branch has determined that the emissions of a Party have exceeded its assigned amount, it must declare that that Party is in non-compliance and require the Party to make up the difference between its emissions and its assigned amount during the second commitment period, plus an additional deduction of 30%. In addition, it shall require the Party to submit a compliance action plan and suspend the eligibility of the Party to make transfers under emissions trading until the Party is reinstated.

No such correspondence exists in the case of the facilitative branch, which can decide to provide advice and facilitation of assistance to individual Parties regarding the implementation of the Protocol, facilitate financial and technical assistance to any Party concerned, including technology transfer and capacity building and/or formulate recommendations to the Party concerned.

The branches of the Compliance Committee will base their deliberations on reports from expert review teams, the subsidiary bodies, Parties and other official sources. Competent intergovernmental and non-governmental organizations may submit relevant factual and technical information to the relevant branch after the preliminary examination.

The future compliance system

Any future climate regime will need to build upon the existing system which has already proven its effectiveness in the first non-compliance cases brought before the Committee. The wealth of experience developed over the last years, in particular in the interaction between the UNFCCC Secretariat, expert review teams and the Compliance Committee, offers a solid basis to adjust the current compliance system to the needs of the future regime. While a number of technical and substantial adjustments can be expected, the overall structure should largely be kept. In particular, in relation to mitigation action and reporting obligations of developed countries, the present system should be maintained.

In relation to new elements of the Copenhagen agreement concerning measurable, reportable and verifiable action by developing countries and financial and technical support by developed countries, the present compliance system has the potential to offer useful support. For instance, the UNFCCC Secretariat, expert review teams, and the Compliance Committee (e.g. through its facilitative branch) could play an active role in a system aimed at measuring, reporting and verifying domestic action as well as technical and financial support for it.