EN

EUROPEAN COMMISSION

Brussels, 26.5.2010
SEC(2010) 650

COMMISSION STAFF WORKING DOCUMENT

accompanying the

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

Analysis of options to move beyond 20% greenhouse gas emission reductions and assessing the risk of carbon leakage

Background information and analysis

Part II

{COM(2010) 265 final}

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1. Introduction

Following the Communication "International climate policy post-Copenhagen: Acting now to reinvigorate global action on climate change"[1], and in line with the Council conclusions of 15 March 2010[2], this staff working paper assesses the potential impacts of stepping up the EU's ambition level from 20 to 30%. It does so taking into account the outcome of the 15th Conference of the Parties to the UNFCCC, last year in Copenhagen.

Furthermore, this paper responds to the mandate given in the Emissions Trading Directive[3] (EU ETS directive, Article 10b) to the Commission to submit by end of June 2010 an analytical report assessing the situation of energy-intensive sectors that have been determined to be exposed to significant risks of carbon leakage in the light of the international negotiations. Finally, the ETS Directive (Article 10b (1) letter c) asked the analytical report to include an assessment of the impact of carbon leakage on Member States' energy security, in particular where electricity connections with the rest of the Union are insufficient and where there are electricity connections with third countries.

This paper responds to the above requests. It has the following structure. Section 2 assesses the pledges under the Copenhagen Accord and the extent to which they can be expected to lead to significant emission reductions and how they compare to the expectations of the EU. Section 3 describes the new baseline and reference scenario (reflecting the Climate and Energy Package agreed in 2009) and assesses the impact of the economic crisis on the implementation costs. Section 4 puts the near term reductions in a 2050 perspective. Section 5 examines the costs and benefits of stepping up the ambition level to 30% in 2020. Section 6 reports on the expected implications for the energy intensive sectors deemed to be exposed to carbon leakage. Section 7 evaluates the impact of carbon leakage on Member States' energy security, in particular where electricity connections with the rest of the Union are insufficient and electricity connections with third parties exist. Section 8 assesses the legal form for a post-2012 agreement and the impact of the EU's own legislation. Section 9 concludes.

2. Analysis of the Copenhagen Outcome

The 15th Conference of the Parties to the UNFCCC (COP 15) did not lead to a legally binding agreement but a representative group of 29 Heads of State and Government did agree on the "Copenhagen Accord". The Accord anchors the EU's objective to limit global warming to below 2°C above pre-industrial levels. It requested developed countries to put forward their emission reduction targets and invited developing countries to put forward their actions, all by 31 January 2010.

On 21 May 2010, 125 parties (including the EU and its Member States) had officially associated themselves to the Copenhagen Accord[4] and required to be listed in its chapeau. The countries that support the accord represent more than 80% of global GHG emissions[5].

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1 COM(2010) 86 final
2 3002nd Environment Council meeting, Brussels, 15 March 2010
3 Directive 2009/29/EC
4 For more information, see http://www.unfccc.int/
5 Based on the EDGAR database, http://edgar.jrc.ec.europa.eu/index.php

Many of them have submitted targets or actions. These include all Annex I Parties, with the exception of Turkey and all BASIC countries (Brazil, South Africa, India and China).

This section will assess to what extent these pledges can be expected to lead to significant emission reductions and how they compare to the expectations of the EU. The assessment focuses on the developed countries, the BASIC countries, Indonesia, Mexico and South Korea, representing 75% of global emissions.

Analysing the pledges put forward by the various countries, and drawing conclusions as to what they mean in terms of compatibility with the 2ºC objective, is not straightforward. Most pledges pose a number of interpretation issues and uncertainties. This relates to issues such as base year or baseline, emissions covered (which sectors of the economy, which gases), how one will account for targets or action, conditionality on support and how pledges relate to the carbon market.

The following assessment of the pledges highlights the most important issues. This can also inform the ongoing international negotiations which will ultimately benefit from more clarity on the real ambition level of any eventual legally binding agreement.

Section 2.1 addresses in a qualitative manner the pledged targets by developed countries. Section 2.2 looks at the problems with existing accounting rules under the Kyoto Protocol, specifically surplus AAUs and LULUCF accounting. Section 2.3 looks in a qualitative manner at the developing country pledges. Section 2.4 analyzes the extent to which the potential reductions are compatible with a 2ºC trajectory. Section 2.5 finally looks at a quantitative assessment of how targets compare to each other using the POLES model.

2.1. Economy wide emission reduction targets by developed countries

The pledges made by Annex I countries in the context of the Copenhagen Accord add up to a reduction target by 2020 of 12% below 1990 for the low end of the pledges and to 18% for the high end of the pledges (see Table 1).

This is far below the range drawn from the IPCC's 4th Assessment Report as being necessary to stay on a 2ºC trajectory (-25% to -40% below 1990 levels by 2020).

These targets could lead to be undermined if surplus AAUs from the first commitment period (2008-2012) would be allowed to stay in the system after 2012 and if lenient accounting rules would be applied for LULUCF activities.

Uncertainty remains on the legal status of many of these pledges, given that they often are conditional on the outcome of the international negotiations or on further implementation of national legislation. At present the EU is the only large emitter within this group of countries that has translated its pledge of -20% compared to 1990 into domestic legislation.

Table 1: Targets pledged by developed countries under the Copenhagen Accord

	Emissions (Mt $CO_{2\text{-eq}}$)	Emissions (Mt $CO_{2\text{-eq}}$)	Target (low pledge)		Target (high pledge)	
	1990	**2005**	**from 1990**	**from 2005**	**from 1990**	**from 2005**
Australia	416 214	524 635	12.9%	-10.4%	-10.8%	-29.3%
Canada	591 793	730 967	2.5%	-17.0%	2.5%	-17.0%
Croatia[1]	31 374	30 433	5.6%	8.9%	5.6%	8.9%
EU 27[1]	**5 572 506**	**5 119 476**	**-20.0%**	**-12.9%**	**-30.0%**	**-23.8%**
Iceland	3 400	3 694	-30.0%	-35.6%	-30.0%	-35.6%
Japan	1 269 657	1 357 844	-25.0%	-29.9%	-25.0%	-29.9%
New Zealand	61 853	77 175	-10.0%	-27.9%	-20.0%	-35.9%
Norway	49 695	53 701	-30.0%	-35.2%	-40.0%	-44.5%
Russian Federation	3 319 327	2 117 821	-15.0%	33.2%	-25.0%	17.5%
Switzerland	52 709	53 665	-20.0%	-21.4%	-30.0%	-31.2%
Ukraine	926 033	417 529	-20.0%	77.4%	-20.0%	77.4%
United States	6 084 490	7 082 213	-3.4%	-17.0%	-3.4%	-17.0%
Annex I total (including US)	**18 379 050**	**17 569 153**	**-12%**	**-8%**	**-18%**	**-14%**

[1] The Croatian submission mentions a -5% reduction vs 1990, but they use the base year calculation according to Decision 7/CP.12 under the UNFCCC. This represents actually a 6% increase from 1990 level.
[2] This calculation excludes emissions from international aviation. The EU target compared to 2005 would be higher if emissions from international aviation would be included.

Sources: UNFCCC, submissions provided by Parties in the context of the Copenhagen Accord and of the AWG-KP (all data are excluding LULUCF).

EU27

The EU has a conditional pledge of -30% against 1990 levels by 2020 in the context of a sufficiently ambitious international agreement, next to an unconditional pledge of -20% against 1990 levels that is already translated into binding legislation through the Climate and Energy Package[6]. It is the only large developed country emitter that already has such binding legal instruments in place for the period after 2012.

Its accounting rules for this post 2012 target are more stringent than the current rules under the Kyoto Protocol:

– A single 1990 base-year is used, not allowing for different base years for F-gases or Economies In Transition as under the Kyoto Protocol.

[6] Relevant parts of the package are Decision No 406/2009/EC 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, Directive 2009/29/EC amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emission allowance trading scheme of the Community.

– It does not recognise surplus AAUs from the first commitment period of the Kyoto Protocol.

– Emissions from international aviation are included in the target and the legislation foresees the need to include international maritime emissions, if no progress is achieved at the international level to include these.

– Emissions and removals from LULUCF are at present not included in the achievement of the reduction target, but may be at a later stage given the legislation foresees already that accounting rules should ensure permanence and environmental integrity.

United States

The US has pledged emission reductions *of "-17% with respect to 2005, in conformity with anticipated U.S. energy and climate legislation, recognizing that the final target will be reported to the Secretariat in light of enacted legislation".* The text of the US pledge also notes that "*the pathway set forth in pending legislation would entail a 30% reduction in 2025 and a 42% reduction in 2030, in line with the goal to reduce emissions 83% by 2050*." With respect to 1990 emission levels, the pledge corresponds to -3% in 2020.

A reduction of -17% vs 2005 is less than the EU's high end pledge (-24%[7] vs 2005). This is not in line with the expectations following the list set of criteria set forward by the EU to differentiate efforts between developed countries in the run-up to Copenhagen[8]. The US has a higher capability to pay, has done less domestic early action and is more greenhouse gas intensive than the EU.

The main uncertainty is that the pledge is not yet supported by domestic legislation, which is pending in Congress, and the lack of clarity on the accounting rules that will be applied within this domestic legislation. Some of the legislative proposals foresee ample use of both international and domestic offsets (agriculture and forestry), with allowed amounts that are significantly higher than those foreseen in the EU legislation (which at present does not include LULUCF activities) and with potentially not all sectors covered.

The real ambition level of any US actions will in the end depend to a large extent on how these accounting rules are defined.

Japan

Japan has offered a 25% reduction with respect to 1990, "*which is premised on the establishment of a fair and effective international framework in which all major economies participate and on agreement by those economies on ambitious targets*".

Japan's pledge of a 25% reduction target vs. 1990 is ambitious and in line with EU's comparability criteria. But LULUCF accounting rules remain unclear and should not give credits for actions that are not additional as is the case at present under the first commitment period of the Kyoto Protocol[9].

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7 Reduction excluding international aviation. Including international aviation the EU high end pledge is even more ambitious compared to 2005.

8 Environmental Council Conclusions, 9 March 2009

9 The Marrakech Accords allow Japan to issue emission rights (RMUs) for forest management activities equal to a yearly issuance of around 3% of Japan's 1990 emissions (excluding LULUCF).

Japan's pledge is fully conditional on the outcome of an international framework. It is not clear what the lower end pledge would be in case this framework is not considered satisfactory for Japan.

Russian Federation

Russia has pledged a 15% to 25% reduction with respect to 1990. The range is conditional on an international agreement and depends on the "appropriate accounting of the potential of Russia's forestry". This is actually less ambitious than the Russian pledge made before the Copenhagen conference (-20% to -25%).

It is unclear what the reference to appropriate accounting for forestry means. This is important given that the Russian forests are net sinks under business-as-usual already and they potentially represent removals equal to more than 10% of Russia's 1990 emissions (excluding LULUCF). To ensure environmental integrity these should not be rewarded as long as they do not represent real additional action (see also Annex 10.2). Under the Kyoto Protocol the Russian target for 2008 to 2012 was already watered down by the recognition of a large amount of reductions through forest management representing little to no real new additional activities[10].

The Russian pledge itself, even without recognition of LULUCF activities, has a very low ambition level, potentially none at all. Compared to 2005 the target it represents an increase of emissions of 18% to 25%. Compared with many baseline projections, the high end of Russia's target range (-25% with respect to 1990) could maybe be in line with BAU[11]. The low end pledge seems clearly to have little or no ambition level at all.

In the situation outlined above, within the context of a mere amendment to Annex B of the Kyoto Protocol, the pledge would additionally be weakened because surplus AAUs would continue to be generated from the beginning of the post 2012 period, to come on top of the already very large amount of surplus AAUs that are expected to be banked from the period 2008-2012 into the post 2012 period. Estimates put this potentially at around 6.2 billion AAUs[12].

Australia

Australia has a conditional offer of -25% vs 2000 levels by 2020 in the context of an international agreement in line with stabilisation of GHG concentrations at 450 ppm $CO_{2\text{-eq}}$ or lower. Unconditionally it will reduce emissions -5% vs 2000, and up to -15% if there is a global agreement which falls short of the high ambition level. Excluding LULUCF, the high pledge is 11% below 1990 levels. It may be assumed that it covers all sectors as listed under the Kyoto Protocol (which does not include international bunker fuels) but it is unclear which

10 The Marrakech Accords allow Russia (Decision 12/CP.7) to issue emission rights (RMUs) for forest management activities equal to a further 600 million $CO_{2\text{-eq}}$ for the period 2008-2012, or yearly a bit more than 3.5% of 1990 emissions (excluding LULUCF).

11 The recent IEA baseline in its World Energy Outlook 2009 for CO_2 from energy only, projects emissions at -21% compared to 1990 in 2020. The POLES baseline developed by JRC, IPTS projects -36% compared to 1990 in 2020 for all GHG.

12 This calculation is based on the reported 2007 emissions, excluding LULUCF, as a proxy for emissions in the period 2008-2012, adding to that the impact of forest management credits issued under Decision 12/CP.7.

accounting rules would be used for LULUCF. These are important given that they can have significant impacts on the ambition of any Australian pledge (see also Annex 10.2).

Canada

Canada pledged emission reductions of 17% with respect to 2005, "*to be aligned with the final economy-wide emissions target of the United States in enacted legislation*". This is a lower pledge than the one they first had introduced in the negotiations under the Kyoto Protocol (-20% in relation to 2006). It is not clear if all sectors are covered, given the reference to the alignment with the yet unknown US legislation which potentially covers fewer sectors. Furthermore the use of LULUCF accounting rules is unclear but could have significant impacts on the ambition level of Canada's pledge (see also Annex 10.2).

New Zealand

New Zealand's pledge is between 10% and 20% below 1990 levels by 2020, but is conditional on a global agreement. LULUCF accounting rules can have great impact on the real ambition level for New Zealand. Given the very high importance of the LULUCF sector to the total New Zealand emissions, uncertainty remains on the ambition level (see also Annex 10.2).

Norway

Norway has pledged a 30% to 40% reduction with respect to 1990. "*As part of a global and comprehensive agreement for the period beyond 2012 where major emitting Parties agree on emissions reductions in line with the 2 degrees Celsius target, Norway will move to a level of 40% reduction for 2020*" As such, Norway goes beyond the EU's high end pledge.

Switzerland

Echoing the EU27 pledge, Switzerland has offered to reduce economy-wide emissions by 20% to 30% with respect to 1990 by 2020. The -30% reduction would be part of a global and comprehensive agreement for the period beyond 2012.

Ukraine

Ukraine has pledged an emission reduction of 20% vs 1990 by 2020. This pledge is conditional to it maintaining the status of "economy in transition", as recognised under the UNFCCC and the Kyoto Protocol, and on the possibility to bank surplus AAUs (reference to Article 3.13 of the Kyoto Protocol).

Such a level of emissions is equivalent to a 77% increase with respect to realized emissions in 2005. Even more than in the Russian case, such a pledge offers large scope for the continued generation of excess surplus AAUs on top of the existing ones (estimated at around 2.4 billion AAUs[13]).

Croatia

Croatia has pledged an emission reduction of 5% vs 1990 based on a base year calculation according to Decision 7/CP.12 under the UNFCCC. Taking this into account, the Croatian target allows rather for an increase of emissions by 6% compared to 1990. The target is temporary and shall be replaced upon accession to the EU.

Iceland

13 This calculation is based on the reported 2007 emissions, excluding LULUCF, as a proxy for emissions in the period 2008-2012.

Iceland has pledged a *"30% reduction with respect 1990, in a joint effort with the European Union "*. The -30% pledge, like the EU one, is conditional on comparable efforts by other countries. Iceland has a unilateral target (adopted in 2009) of -15% compared to 1990 levels.

2.2. Potential impact on developed country targets from surplus AAUs and LULUCF accounting rules

The pledges made by developed countries add up to a reduction target by 2020 of 12% to 18% below 1990. But if banking of surplus AAUs from the first commitment period (2008-2012) would be allowed this combined target would be weakened.

Using the reported 2007 emissions under the UNFCCC, excluding LULUCF, as a proxy for emissions in the period 2008-2012, the amount of banking into the post 2012 period could be well above 10 billion AAUs[14].

Figure 1 below represents the potential impact of banking these 10 billion AAUs into the 8 year period 2013-2020, assuming that 1/8th of these banked amounts would be available for compliance purposes in 2020. This would reduce the ambition level of the 2020 pledges to a range of around -6% to -11% below 1990 levels. Ambition levels would actually be even further loosened if some Parties were allowed to continue to issue surplus AAUs in the period after 2012, but this is not taken into account into the figure.

A mere amendment of Annex B of the Kyoto Protocol, without any other amendments to the protocol and with the pledges as they stand at present, would de facto result in a situation of banking of surplus AAUs and continued issuance of surplus AAUs post 2012.

If LULUCF accounting rules would remain as they are under the present Kyoto Protocol rules, using historic LULUCF data as a proxy, Parties would be allowed to issue an amount of emission rights (RMUs) for LULUCF activities equal to around 1% of 1990 emission levels[15], further reducing the real ambition level of the pledges to around -5% to -10% below 1990 levels.

If lenient accounting rules would be used that reward business-as-usual in the forest management sector rather then real additional action that depart from business-as-usual activities, the ambition level would be further reduced, in the extreme case by 8%[16]. This implies a real ambition level of the pledges of +3% to -2% below 1990 levels.

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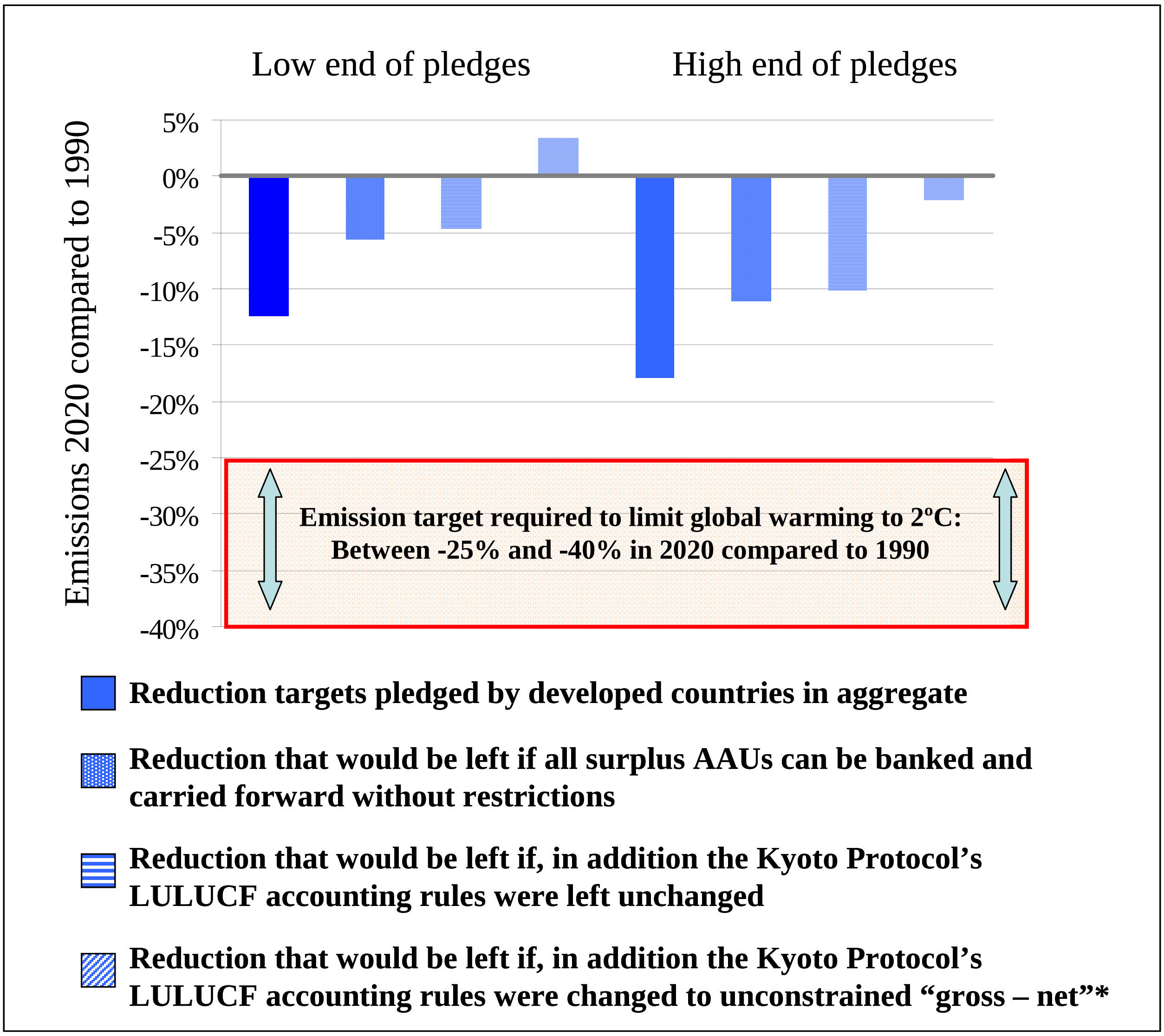
14 Potential surplus of AAUs: Russia 5.6 billion, Ukraine 2.4, EU member states with surplus 2.6 billion. Additional to that it is expected that Russia can bank additionally 600 million emission rights because it is expected to issue RMUs for forest management activities following Decision 12/CP.7. The eventual amount of banking is reduced if AAUs are transferred to other Parties with a deficit of AAUs for compliance purposes over the period 2008-2012, but it is increased if Parties rather use CDM credits for compliance over the period 2008-2012 than AAUs.

15 See table in annex 10.2, column with 'option 0'.

16 See table in annex 10.2 column with 'options 1', 0% discounting for Forest Management.

Figure 1: Potential impact surplus AAUs and LULUCF accounting rules on targets developed countries



* Gross net would allow countries that have emission removals from LULUCF already in baseline, without additional effort, to account for them fully.

2.3. Mitigation actions by developing countries

The pledges made by developing countries concerning (nationally appropriate) mitigation actions in the context of the Copenhagen Accord are very diverse. Many submissions include qualitative descriptions of Nationally Appropriate Mitigation Actions (NAMAs) to be undertaken. Some submissions do include quantitative pledges (Brazil, China, India, Indonesia, Maldives, Marshall Islands, Moldova, Mexico, South Korea, Singapore, South Africa), but their ambition levels are often hard to assess.

The following sections discuss the pledges of the BASIC countries, Indonesia, Mexico and South Korea. For an overview of the other developing country pledges, see Annex 10.

China

China has pledged to lower the carbon intensity of its GDP by 40% to 45% with respect to 2005 by 2020. In addition it intends to increase the non-fossil fuel share of primary energy consumption to 15% and increase forest coverage by 40 Million hectares and forest stock by 1.3 billion m^3.

These are voluntary measures but reference is made to the principles and conditions of Art 4.7 of the UNFCCC, which mentions the need of developed countries to foresee finance and technology transfer. It is unclear to what extent China sees this as a condition.

Assessing the stringency of the carbon intensity objective is very difficult due to the nature of the indicator, which depends on both GDP and emissions growth. Substantial uncertainties also remain on the accounting of the indicator.

One uncertainty is the method for GDP accounting: using nominal prices or constant real prices, using local currency or market exchange rates or exchange rates expressed in purchasing power parity (PPP). The pledge would not make sense and have no ambition level at all if expressed in nominal terms because of the impact of inflation. Furthermore, GDP measured in local currency may result in a lower ambition level than measured in PPP.

Also the coverage of emissions is not clear. Carbon probably only relates to CO_2. But it is not yet clear whether it covers only emissions from the energy sector or also includes process emissions and emissions from LULUCF.

China's pledge so far has not been sufficiently defined in detail and accounting interpretations could have impacts on the ambition level of the pledge. So far Chinese academics have indicated that the pledge does not include LULUCF, would be limited to energy CO_2 emissions and GDP measured in local real currency.

By definition, an intensity objective allows for a lot of flexibility. Assessing the ambition level depends to a large extent also on expected GDP growth. High GDP growth typically goes together with faster restructuring and productivity growth, as such making the achievement of the objective easier but also leads to higher absolute emissions. If real GDP growth of 8-9% per year is assumed, which seems to be China's development goal for the period 2005-2020, the adopted pledge range is consistent with a potential increase of CO_2 emissions between 72 and 118% with respect to 2005 levels. Certainly a 118% increase seems incompatible with global emission projection scenarios in line with a 2ºC compatible trajectory.

Baseline projections for China vary considerably. Some model projections estimate the pledge as binding, others estimate it as baseline or below. The International Energy Agency's World Energy Outlook 2009 (IEA, WEO 2009) projected in its reference scenario a 39% reduction in CO_2 emission intensity, suggesting that the lower end of the pledge would be in line with the reference case while the upper end of -45% would represent a 9 to 10% emission reduction over the reference scenario. All models used in this Staff Working Paper project the high end pledge as binding compared to baseline (TIMER/IMAGE, POLES, GEM E3, E3MG) thus leading to additional emission reductions. For the low end pledge, only the POLES and GEM E3 models project this to be binding compared to baseline[17]. POLES

[17] TIMER/IMAGE projects GDP at market exchange rates. But when projecting GDP at PPP, the TIMER/IMAGE model would also project the Chinese low end pledge as binding.

assumes a relatively low GDP growth and a CO_2 intensity improvement of 35.5% in the baseline, making also the low end pledge binding. Also the extent to which recent developments have been incorporated in the baseline projections has an impact on the projected distance from baseline. For instance the Chinese Energy Research Institute (ERI) of the National Development and Reform Commission (NDRC) is very ambitious in its reference, projecting a scenario that achieves even the upper end of the pledge. Clearly for other models this scenario is not baseline and thus likely to have more measures included already.[18]

Similar uncertainties exist for the measurement of the non-fossil fuel objective, which actually is a nuclear & renewable energy objective. It is unclear if it includes non-commercial biomass use, still a significant energy source in rural China. The accounting method for renewable energy and nuclear also matters. For instance the inclusion of non-commercial biomass and accounting of renewable energy such as hydro, wind and solar in power generation using the substitution method[19] would severely diminish the ambition level of this pledge[20]. The current pledge is less ambitious than objectives set out by the Chinese authorities before Copenhagen, such as a 15% 'renewable energy only' objective in addition to an ambitious programme for nuclear capacity expansions.

Overall it is difficult to assess the real ambition level of the Chinese pledge but most models indicate that certainly the high end pledge is significant, but disagreement exists on the low end pledge. Before 2002 CO_2 intensity improvements measured on the basis of IEA emission and GDP statistical data were higher than the current pledges but this trend reversed since 2002 when CO_2 intensity actually started to increase. Achieving the pledged intensity objective by 2020 would certainly require again a significant reverse of the most recent trend.

It is also unclear to what extent China sees carbon market mechanisms, such as reductions through CDM, as part of the instruments to achieve these internal objectives. Given the nature of the main action, an intensity objective, it could be that they expect any reductions achieved via the CDM to contribute to their own intensity objective. When assessing impacts on global reductions this needs to be taken into account to avoid double counting. It is clear that the objective would be more ambitious if emission reductions from CDM would not be taken into account when determining the CO_2 intensity improvements.

Brazil

Brazil has pledged emission reductions of 36.1% to 38.9% with respect to baseline. This is broken down into quantified measures with associated estimated reductions in 2020:

– Reduction in Amazon deforestation (estimated reduction: 564 Mt $CO_{2\text{-eq}}$ in 2020);

– Reduction in "Cerrado" deforestation (estimated reduction: 104 Mt $CO_{2\text{-eq}}$);

– Restoration of grazing land (estimated reduction: 83 to 104 Mt $CO_{2\text{-eq}}$);

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18 Jiang Kejun et al., NRDC, 2009.

19 See annex 10.3 for an explanation what the substitution method means.

20 For instance the POLES model projects a non fossil fuel penetration of 15.4% in baseline when applying the substitution method for renewable energy.

– Integrated crop-livestock system (estimated reduction: 18 to 22 Mt $CO_{2\text{-eq}}$);

– No-till farming (range of estimated reduction: 16 to 20 Mt $CO_{2\text{-eq}}$ in 2020);

– Biological N2 fixation (range of estimated reduction: 16 to 20 Mt $CO_{2\text{-eq}}$ in 2020);

– Energy efficiency (range of estimated reduction: 12 to 15 Mt $CO_{2\text{-eq}}$ in 2020);

– Increase in the use of biofuels (range of estimated reduction: 48 to 60 Mt $CO_{2\text{-eq}}$);

– Increase in the energy supply by hydroelectric power plants (range of estimated reduction: 79 to 99 Mt $CO_{2\text{-eq}}$);

– Alternative energy sources (range of estimated reduction: 83 to 104 Mt $CO_{2\text{-eq}}$);

– Iron and steel: replacement of charcoal from deforestation with charcoal from planted forests (range of estimated reduction: 8 to 10 Mt $CO_{2\text{-eq}}$).

These measures are voluntary and will be implemented in accordance to the principles of the UNFCCC Articles 4, 10 and 12 (including references to financing and technology transfer from developed countries). It is unclear to what extent Brazil sees this as a conditionality.

The Brazilian pledge does not refer to any (sectoral) baselines, even though they are expressed as reduction compared to baseline. As such, there will be accounting issues on how to measure if a pledge is achieved or not. For instance for the largest pledges, those that relate to LULUCF activities, there are large uncertainties on the accounting of emissions.. Pledges would be lower (higher) in ambition if accounting methods are used that increase (decrease) the total amount of emissions for a given amount of deforestation. As such it will be difficult to assess ex post the achievement of pledges if there is not more clarity beforehand on the accounting principles applied.

Even though not submitted under the Copenhagen Accord, baselines produced by the Brazilian government do exist[21]. Applying the pledged reductions to these Brazilian projections, the emissions would decrease by some 11.5-15% compared to 2005.

Even though accounting uncertainty exists, it is clear that the proposed reductions in deforestation can be considered as very positive. Things however may be different on the energy side. Brazil's own baseline projection for 2020 indicate emissions equal to 900 $MtCO_{2\text{-eq}}$ for the energy sector. This is significantly higher than the reference emissions scenario by the IEA (WEO 2009) or the POLES model[22]. Using the Brazilian baseline, pledges would not result in emissions much lower than baseline projections of other institutions without pledges.

Brazil is more explicit than China on the use of CDM, which it sees as contributing also to its own pledge. When assessing global emission scenarios this should be taken into account to

[21] See, for instance, the presentation given by Dilma Vana Roussef, Brazilian Minister Chief of staff, in November 2009 in Copenhagen, on *Brazilian mitigation actions*. Following the information contained in this presentation it can be deducted that projected emissions are about 2.7 Gt $CO_{2\text{-eq}}$ in the baseline by 2020.

[22] It should be noted that Brazil assumes higher GDP growth than these other models.

ensure no double counting happens from large deforestation reductions that also lead to significant carbon credit generation.

India

India has pledged to reduce by 2020 the emissions intensity of its GDP by 20-25% with respect to 2005 levels. The pledge is voluntary in nature. At the same time the reference made to Articles in the UNFCCC that relate to the provision of financial resources and technology transfer from developed countries makes it unclear to what extent India sees this as a conditionality.

The Indian pledge presents the same interpretation challenges already seen for China's, as well as similar difficulties in the assessment of its level of ambition. Even though agricultural emissions are not included, it is unclear if the pledge relates to all GHGs or only CO_2. Furthermore, sectoral coverage remains unclear: if agriculture is not in, what is then assumed about other sectors such as LULUCF activities?

About the intensity target itself, the IEA WEO 2009 projections for CO_2 suggest that a 20-25% intensity reduction is less than what would happen in its reference scenario (which assumes continuation of implemented policies). Results from four out of five climate modelling studies (the models are TERI-Poznan, McKinsey, Teri-MoEF, IRADe-AA, and NCAER-CGE) presented at the India Climate Modelling Forum (September 2009) indicate higher emission intensity reductions than the pledged ones, in scenarios with no new GHG limitation policies[23]. These studies would then suggest that the Indian pledge is not "additional" with respect to baseline developments. Similarly the E3MG model and the TIMER/IMAGE model give results that put the pledge at baseline. Instead the POLES model and the GEM E3 model show some effort compared to baseline [24].

India issued in 2008 a National Action Plan on Climate Change covering eight so-called "Missions", but has not submitted this plan in its pledges under the Copenhagen Accord. Some of these missions seem relatively more ambitious than the overall economy wide objective to improve emission intensity. For instance the Solar Mission plans for 20 GW installed PV and solar-thermal generation capacity by 2020. This clearly is not projected in the baseline of most model projections. Emissions reductions estimated by the Indian government would be around 42 Mt CO_2 by 2020.

The Mission on Enhanced Energy Efficiency proposes among other measures the introduction of a market for energy efficiency certificates covering most energy intensive industries. The impact of these measures is not easy to independently verify (Indian government estimates refer to 100 Mt CO_2/year or about 3.3% of India's current emissions). Other plans for instance on new supercritical coal or nuclear plants are also difficult to assess given that it is unclear to what extent these plans are actually implemented.

India starts from a very low level of per capita GHG emissions compared to other developing countries: about one fourth the level of China and even lower than Brazil's per capita

[23] See "*India's GHG emissions profile – Results of five Climate Modelling Studies*", Climate Modelling Forum, India, September 2009.

[24] TIMER/IMAGE projects GDP at market exchange rates. But when projecting GDP at PPP, the TIMER/IMAGE model would also project the Indian pledge as better than baseline.

emissions. India's GHG emission intensity per unit of GDP, while lower than China's, is higher than in the US and about twice as high as in the EU27. According to IEA statistics, this indicator has only been going down slightly since 1995.

South Africa

South Africa pledged a 34% reduction with respect to baseline by 2020 and a 42% reduction below BAU by 2025. The South African pledge under the Copenhagen Accord is conditional on financial resources, capacity building support and technology transfer.

The pledge makes reference to a study that calculated the baseline and the reduction potential that exist. This is most probably the Long Term Mitigation Scenarios (LTMS) report[25]. As such there is more clarity on the overall ambition level of the South African pledge than on other pledges. The LTMS study has an Unconstrained Growth Scenario projection with emissions at around 800 Mt $CO_{2\text{-eq}}$ in 2020, which seem at the very high end of projections[26].

The estimated reduction potential is clearly large. The LTMS study indicates that cost efficient action would represent about 30% reduction from 2020 baseline projections. But regarding the concrete measures South Africa wants to implement, and the support this will require, the pledge is not explicit. Furthermore, no clarity exists as to the extent carbon market mechanisms such as CDM are included or not in the pledge.

Indonesia

Indonesia has pledged a 26% voluntary reduction by 2020. The submission omits to mention with respect to what level or base year the reduction applies. It is also unclear to which extent this pledge is conditional on support and whether the use of carbon market mechanisms such as CDM are included within the pledge.

Previous announcements had put the reduction at -26% to -41% with respect to 2005 levels, the -41% option being conditional on availability of international support. The target is to be achieved, among others, through measures in: sustainable peat land management; reduction of the rate of deforestation and land degradation, development of carbon sequestration projects in forestry and agriculture; promotion of energy efficiency; development of alternative and renewable energy sources; reduction in solid and liquid waste; shifting to low emission transportation mode. This implies that the pledge includes LULUCF emissions.

Currently deforestation is the source of 80% of Indonesia's carbon emissions, and when these emissions are included in the nation's total it is in the top ten global emitters. Slowing deforestation in the nation could reduce emissions well below the 2005 emission level.

Mexico

Mexico, a Member of the OECD, has pledged to reduce emissions by 30% with respect to BAU by 2020 subject to the provision of adequate financial and technological support from developed countries as part of a global agreement. The pledge also mentions the adoption in

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25 Winkler H.(ed), 2007

26 For instance the TIMER/IMAGE model projects emission increases only up to around 600 Mtons $CO_{2\text{-eq}}$, due to lower GDP growth projections and higher energy efficiency improvements.

2009 of the Special Climate Change Program 2009 - 2012, which already includes a set of NAMAs whose full implementation will achieve a reduction in total annual emissions of 51 Mt $CO_{2\text{-eq}}$ by 2012, with respect to the business as usual scenario.

The pledge does not clarify the baseline, thus making it problematic to assess its ambition level. Should this refer to the projections contained in the Special Climate Change Program itself[27], a document referred to in the pledge, then baseline emissions in 2020 would be equal to 882 Mt $CO_{2\text{-eq}}$, and 1089 Mt in 2050. Should the full pledge be achieved, this would bring Mexican emissions by 2020 below the level of 2000.

Assessing the Mexican pledge and particularly comparing the Mexican Government baseline projections with independent projections is complicated by the fact that many models (such as for instance the IEA WEO, POLES and GEM-E3) do not include the agriculture and land use emissions, hence figures are not directly comparable. However the pledge seems in most projections to lead by 2020 to absolute reductions with respect to current levels. As such, achievement of the pledge, with emissions in 2020 below 2000 levels would certainly represent significant additional action.

There is so far no clarity on what extent carbon market mechanisms such as CDM are included or not in the pledge.

South Korea

South Korea, also a member of OECD, has also pledged a 30% emissions reduction target with respect projected baseline emissions by 2020. The pledge does not seem to have explicit conditions attached but neither refers to which baseline is used.

Announcements and statements done by government officials in the run-up to Copenhagen, indicate that they expect the pledge to lead to a reduction of 4% compared to 2005, but this is not confirmed in the Copenhagen Accord submission. The target is going to be achieved mainly through energy efficiency, increased use of renewable energy and nuclear power.

Once again, assessing such a pledge in the absence of details on the national baseline scenario is not straightforward. But applying the same target to the recent IEA WEO or the POLES projections (which only include emissions for the energy sector), would indeed result in a slight decrease with respect to 2005 emission levels.

2.4. Quantitative assessment of pledges: distance to the 2° C target?

A quantitative analysis of the reduction pledges of the developed and developing countries submitted to the Copenhagen Accord has been carried out by Netherlands Environmental Assessment Agency (PBL[28]) using the calculated reductions from the submitted actions and targets and baseline emissions from their TIMER/IMAGE model[29]. Both low and high pledges were analysed and the impact of the uncertainties related to these pledges, to

27 See "Programa Especial de Cambio Climático 2009-2012" Comisión intersectorial de Cambio climático, DOF 28/08/2009. 28 August 2009, page 15.

28 Planbureau voor de Leefomgeving

29 Den Elzen et al. 2010a

determine how far away emissions in 2020 will be from a pathway compatible with the 2°C objective. A number of assumptions had to be made.

The first assumption concerned the maximum level of emissions by 2020 that would be compatible with the 2ºC objective to limit temperature increase. The benchmark for this analysis is the level that scientists would consider capable of providing a better than 50% chance to remain within the 2°C temperature limit. Existing climate analyses point at a broad range of figures, from 40 to 48.3 billion or Giga tonnes of carbon dioxide equivalent ($GtCO_{2-eq}$) and include other conditions such as a peak year between 2015 and 2021 and a decrease in global emissions by 40-84% with respect to 1990 by 2050[30]. Higher levels of emissions by 2020 can theoretically be compensated by even higher reductions after 2020 to remain on a 2ºC compatible track. But at some point this becomes technically difficult[31]. The analysis used 44 Gt CO_{2-eq} as a best estimate for the necessary reduction with an additional range of 42 to 46 Gt CO_{2-eq} noting that emission levels above 44 Gt CO_{2-eq} depend on increasingly fast reductions after 2020[32]. This increases the uncertainty on the achievability of such reductions. Also note that the higher the emission level in 2020, the larger the overshoot of the concentration levels of GHG in the atmosphere above 450 ppmv which has additional negative feedback effects.

The second assumption was that all pledges for emissions reductions are implemented domestically or, in case of achieving the targets via carbon markets, those countries who are net sellers into the carbon market would reduce emissions beyond their pledges.

The third assumption was to exclude surplus AAUs from the first Kyoto commitment period and not allow for any further creation of new surplus AAUs in the period post 2012 that could be used for compliance with pledges in 2020. This was done by assuming the pledged emission level as the lowest of projected baseline emissions by the TIMER/IMAGE model or the pledge itself. For countries like Russia, Ukraine and Belarus this meant setting the low pledge at baseline emissions levels and in some cases also the high pledge. Similarly, for developing countries, whenever the pledge put forward was considered as leading to a higher emission level than baseline emissions, the latter was used as the pledge.

Figure 2 shows the reductions (expressed in the graph as wedges of different colours) provided by Annex I and Non Annex I countries under the favourable assumptions given above. Going down from the estimated baseline emissions of 55.9 Gt CO_{2-eq}, the two upper wedges (low ambition) show the potential impact of the low pledges of developed and developing countries. The last two wedges show the further impact of high pledges. The dark blue area represents remaining emissions. The graph includes, besides the estimated emissions of all GHG gases from energy related and industrial processes, the emissions from agriculture and forestry and international bunkers.

Figure 2: Emission gap to 2°C with current pledges

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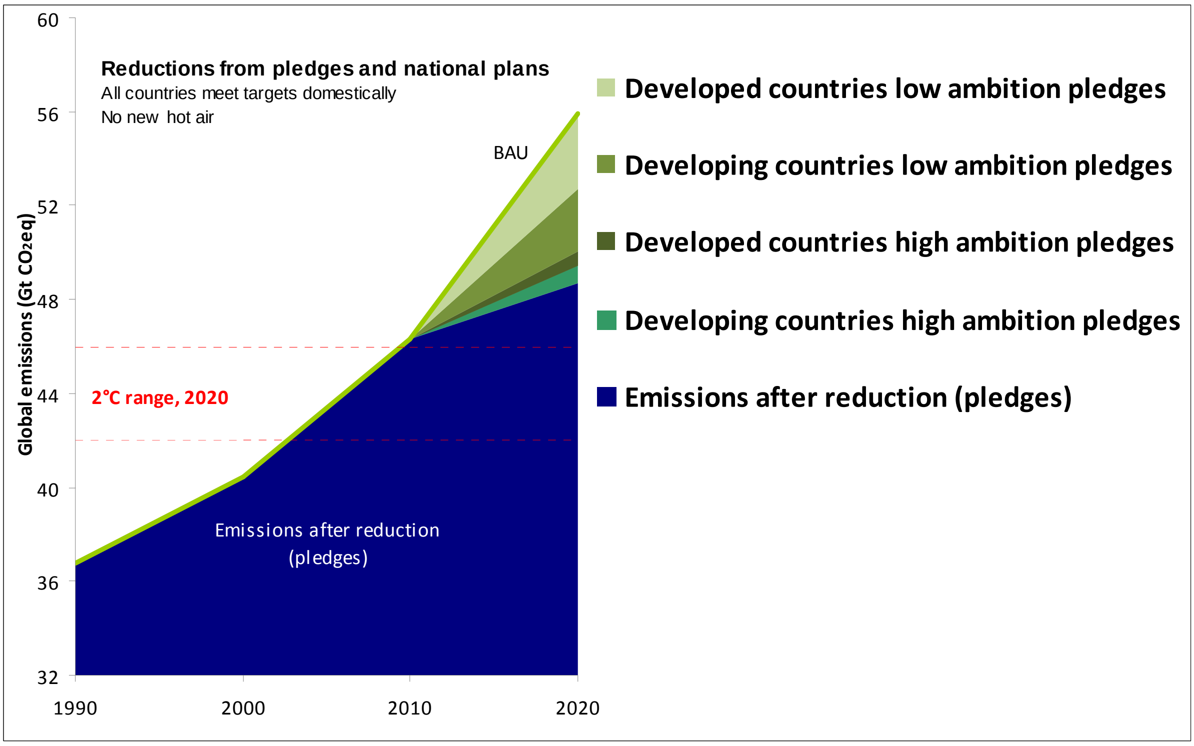
30 UNEP: "How Close Are We to the Two Degree Limit?" Information Note prepared by the Chief Scientists Office, UNEP, on Occasion of the UNEP Governing Council Meeting on 24-26 February 2010 in Bali, Indonesia.

31 Den Elzen et al. 2010b

32 Rogeli Joeri et al. 2010. The Authors argue that emission levels of 48 Gt by 2020 require a decade of emission reduction rates of -5%/year after 2020 in order to be compliant with the 2°C target, which they see as problematic and conclude that emission levels above 44 $GtCO_{2-eq}$ should come with a warning label.



Source: PBL

The graph shows that under the favourable assumptions of fully implemented pledges, the low end of pledges would bring emissions down to 50 Gt $CO_{2\text{-eq}}$. After implementation of the high end of the pledges, remaining emissions are 48.7 Gt $CO_{2\text{-eq}}$. in 2020, more than 7 Gt $CO_{2\text{-eq}}$. below baseline. This implies that more than half of the gap towards a 2ºC range is bridged. A further reduction of 4.7 Gt $CO_{2\text{-eq}}$. would be required to bring emissions to 44 Gt $CO_{2\text{-eq}}$. by 2020.

It is uncertain that, given the current pledges and state of international negotiations, this emission level will be met. Many uncertainties remain that could lead to less favourable emission projections than assumed in the above analysis:

– Only amending Annex B of the Kyoto Protocol would not prevent the banking of surplus AAUs from the first commitment period into the post 2012 period, used for compliance in the second commitment period. Furthermore, it would lead to continued generation of surplus AAUs after 2012 given relative low starting point in 2013 or weak 2020 pledges for some developed country Parties.

– Lenient accounting rules for LULUCF activities in developed countries could allow for the issue of credits even if no real actions are undertaken beyond baseline.

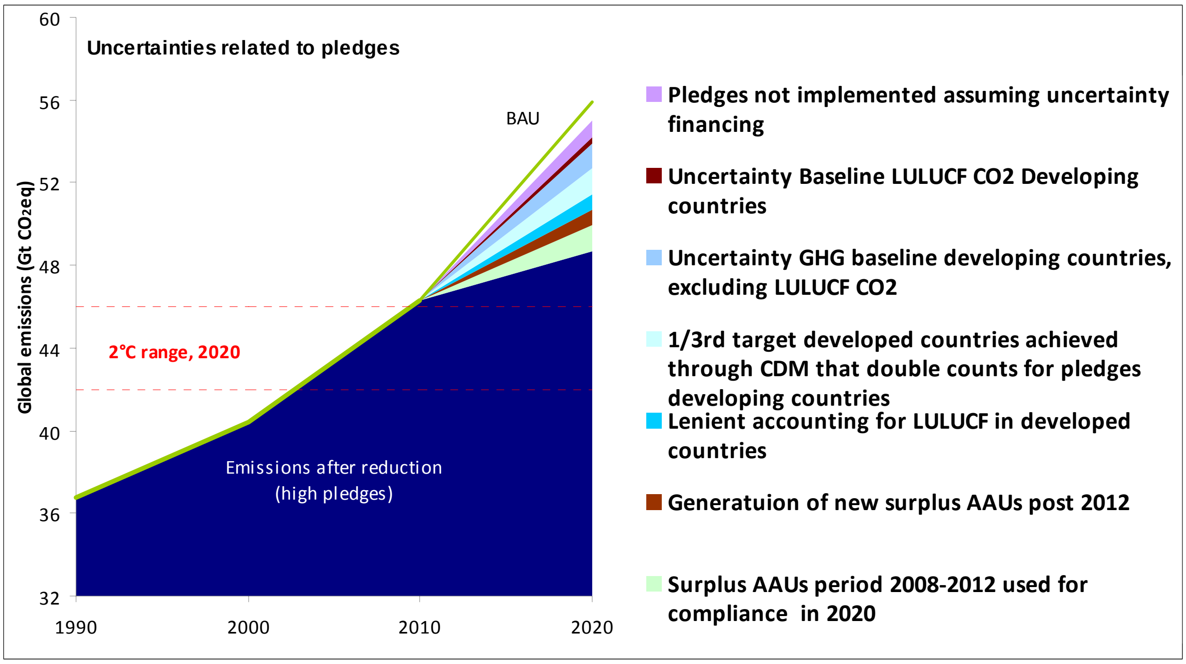
– Actions in developing countries could be double counted if credits generated through crediting mechanisms such as CDM would be used both for compliance purposes by developed country, as well as being taken into account as actions that can contribute to meeting the pledges by developing countries;

– Several of the pledges remain conditional on financial support which makes their implementation dependent on the matching of such support with actions;

– Baseline emissions in developing countries could be higher than expected, leading to less reduction than expected. For China and India the emissions in 2020 resulting from intensity reduction targets, also depend on the assumed economic growth. A higher economic growth leads to higher emissions.

Figure 3 shows the impact of the uncertainties on the ambition level of the pledges on a global scale. It is clear that when such uncertainties are taken into account, emissions might be much higher than one would expect, even when looking at the high end pledges in isolation. In the most extreme interpretation this leads to almost no reductions globally compared to baseline. Therefore it is absolutely key from an environmental integrity perspective to tackle these uncertainties or risks.

Figure 3: Potential to water down the high pledges



Source: PBL

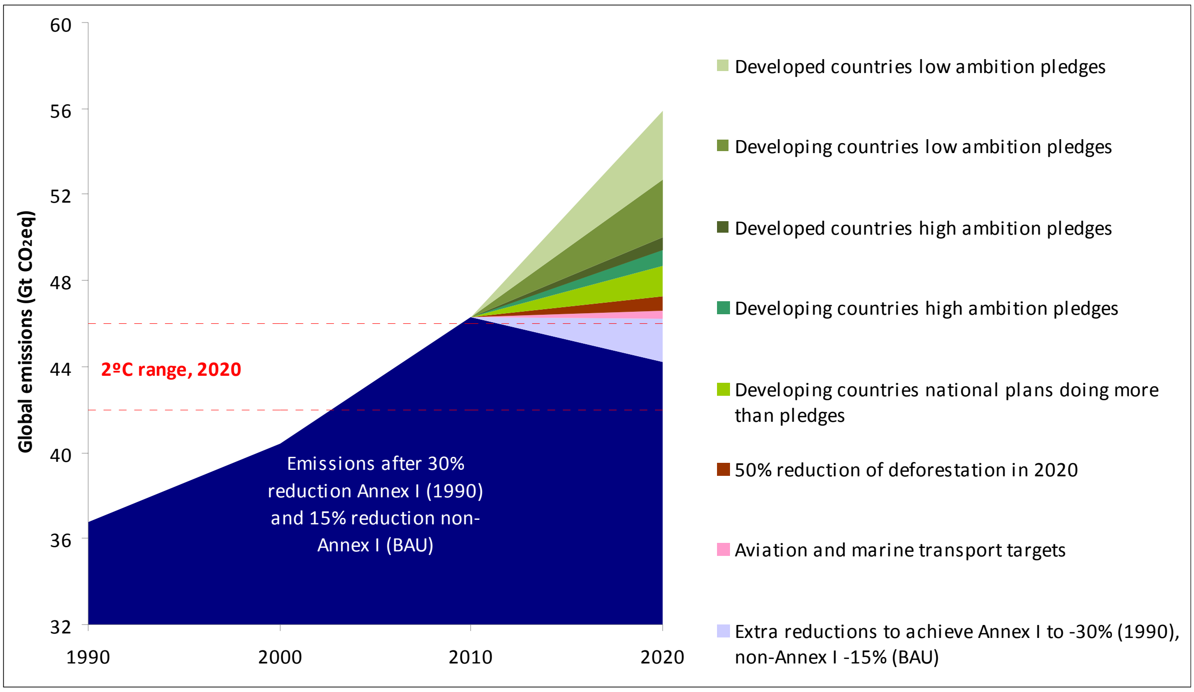
In order to be with more certainty on a 2ºC compatible emission path, higher reduction pledges should be brought forward in the coming years. One way could be to look in more detail at national action plans to see if they are able to achieve reductions beyond the given pledges under the Copenhagen Accord. These potential overshoots of pledges were not incorporated in the above analysis. For instance India has engaged itself to a list of Missions which seem in some respect more ambitious than the Indian pledge which is rather close to the baseline.

Furthermore, the actions to Reduce Emissions from Deforestation and Forest Degradation (REDD) in Developing Countries in the submissions will not decrease the gross emissions from deforestation by 50% by 2020 - (the objective supported by the EU). If this objective could be met, without leading to credits that would be double counted towards developed country targets, then emissions would further reduce. This would probably require support.

Finally, also emissions from bunker fuels could contribute, for instance through a cap and trade approach limiting emissions below 2005 levels. Adding these additional pledges and actions could reduce emissions to around 46 Gt $CO_{2\text{-eq}}$ and ensure peaking of global emissions before 2020 (see Figure 4).

Getting down to 44.2 Gt $CO_{2\text{-eq}}$ by 2020 could be achieved if developed countries decided to upgrade their combined pledges to -30% with respect to 1990, which was the EU's objective, while developing countries as a group upgraded theirs to a -15% with respect to baseline.

Figure 4: Additional pledges and actions that would ensure an emission pathway compatible with 2ºC



Source: PBL

2.5. Quantitative assessment on how to compare targets of the Copenhagen Accord

The POLES model was used to assess relative comparability of targets. For the developed countries the targets as pledged under the Copenhagen Accord were used (see Table 2) assuming that they apply to all sectors of the economy, except LULUCF and agriculture. These two sectors are not represented in the POLES model.

The pledges of the BASIC countries were modelled, with the exception of South Africa which is not a separate region in the POLES model. Also for South Korea and Mexico a pledge was assumed. For Brazil an interpretation was made on the potential ambition level of the measures related to the energy and industry sectors compared to the POLES baseline, given that only a small part of the actions pledged by Brazil relate to the energy and industry sectors and given that the POLES baseline for Brazil projects much lower emissions already than the baseline by Brazil. The intensity targets for India and China were applied on the total basket of gases. Furthermore, it should be noted that POLES is a model that is conservative on the intensity development in baseline for China and India, resulting in binding low and high end pledges.

The modelling was carried out to get information on comparability of efforts. As such the modelling is set up in a stylised manner, trying to see how efforts compare while assuming countries implement the pledges to a reasonable extent internally and assuming all the uncertainties regarding accounting could be eliminated.

It was assumed that no surplus AAUs are allowed to be banked into the period post 2012 and also no new surplus AAUs are generated for the years up to 2020. For the year 2020 itself any existence of surplus AAUs is taken into account if targets are less ambitious than baseline emissions in 2020 itself.

Furthermore, two different scenarios are modelled: one with access to the international carbon market and one without access. In case of access to the international carbon market a maximum of on third of the distance between pledge and baseline would be met via the acquisition of credits through the carbon market. Only those countries with a pledge would participate in the carbon market and generation of credits for the carbon market would come from reductions on top of reductions made to meet the pledges themselves.

The mitigation scenarios in the POLES model implement energy efficiency policies, similar to the ones presented for the Staff Working Document[33] accompanying the Communication "Towards a comprehensive climate change agreement in Copenhagen". Carbon prices are introduced in all sectors to meet any pledges. In the baseline all developed countries have a moderate carbon price already in their power and industrial sector to simulate the impact of expectations of industry of forthcoming climate regulation, at €7 [34]. This principle applies also in the baseline of the more advanced developing countries, be it with a lower carbon price. The baseline for the EU is calibrated on the EU PRIMES baseline and policy scenarios in POLES are by GHG targets. As such, it is not automatically assumed by the model that the EU 20% renewable energy target is met in the policy scenarios for the EU.

Table 2: Pledges modelled in POLES

Region	Pledge (base year)	
	Developed Countries	
	Low	High
EU	-20% (1990)	-30% (1990)
US	-17% (2005)	-17% (2005)
Japan	-25% (1990)	-25% (1990)
Russia	-20% (1990)	-25% (1990)
Australia and NZ	+12% (1990)	-10% (2005)
	Developing Countries	
	Low	High
Brazil	-2.7% (baseline)	-8% (baseline)
China	-40% (CO_2/GDP)	-45% (CO_2/GDP)
India	-20% (CO_2/GDP)	-25% (CO_2/GDP)

In the low pledge case, with full achievements of targets internally, most carbon prices are similar in developed countries, ranging from €32 in the US to €45 in Australia & New

33 SEC(2009) 101

34 For the EU the carbon price in its EU ETS is higher already in baseline, €26.5, due to the need to comply with the ETS target under the energy and climate change package (simulation is based on the same emissions profile as the one for the new PRIMES baseline).

Zealand. The only exceptions are Japan, with a high carbon price of €136 and Russia with a carbon price equal to baseline, thus representing a pledge that is less ambitious than baseline.

In the high pledge case, carbon prices increase significantly in the EU and Australia & New Zealand, much more than prices in the US and Canada where pledges remain constant. Even with the introduction of access to carbon markets, this picture does not change. Furthermore the price difference between EU, Japan and Australia and New Zealand becomes relatively small. Russia is the only large developed country that would be a net seller in the case with carbon markets.

Indications are that in the low end pledge, Japan has the highest ambition level. This picture becomes much more balanced in case of the high pledges, taking into account access to carbon market, with the exception of USA and Canada that would experience lower carbon prices.

Carbon prices in the international carbon market are estimated in the case of the low end pledges at €14. With high end pledges they increase to €25. Carbon prices in developed countries with ambitious targets remain higher than the international carbon price due to the acquisition limit, not allowing for equalisation of prices. With no limits on acquisition the carbon price could increase because demand would increase but, on the other hand, global carbon prices would lower if countries without a pledge would also be allowed to supply the international carbon market which was not assumed for this modelling. Furthermore when credits could be generated for reductions that fall within the pledges themselves, then carbon prices would further reduce and global emissions would increase.

This type of assessment only looks at one type of comparability criteria, i.e. the potential to reduce emissions and the subsequent necessary carbon price signal and emission reductions. It does not address the other 3 criteria the EU put forward as important criteria to set targets that should lead to a more balanced and political acceptable target than mere cost efficiency concerns. These were the capability to pay for domestic emission reductions and to purchase emission reduction credits from developing countries, the domestic early action to reduce GHG emissions and population trends and total GHG emissions.

Based on these criteria, one actually would expect Russia to take relatively less action because of its large early action and lower capacity to pay, however not to the extent that it would imply no action at all, as the current pledge does. Similarly, the US and Canada, with their higher capacity to act, larger remaining reduction potential and less early action could have been expected to do more. For a more in depth example of possible distribution of targets, see also sections 5.1 and 6.2 of the Staff Working Document[35] accompanying the Communication "Towards a comprehensive climate change agreement in Copenhagen".

Table 3: Impact pledges modelled in POLES

	Low pledges				High pledges			
	No access to carbon market		Access to carbon market		No access to carbon market		Access to carbon market	
	Carbon price €	GHG vs 2005	Carbon price €	GHG vs 2005	Carbon price €	GHG vs 2005	Carbon price €	GHG vs 2005

[35] SEC(2009) 101

EU	34	-15%	29	-14%	69	-26%	52	-20%
US	32	-19%	22	-14%	33	-19%	25	-15%
Japan	136	-37%	58	-29%	138	-37%	59	-29%
Russia	/	-16%	14	-21%	/	-16%	25	-27%
Canada	39	-18%	27	-12%	39	-18%	28	-12%
Australia and NZ	45	-21%	28	-11%	92	-37%	47	-22%
	Carbon price	GHG vs baseline	Carbon price	GHG vs baseline	Carbon price	GHG vs baseline	Carbon price	GHG vs baseline
Brazil	5	-3%	14	-10%	11	-8%	25	-15%
China	12	-9%	14	-10%	23	-16%	25	-17%
India	6	-8%	14	-16%	12	-14%	25	-23%

Source: POLES, JRC

The three BASIC countries require a carbon price signal to achieve their pledge. All are net suppliers in case of a carbon market. But China is so only to a very marginal extent with a quantity of around 1% of its baseline emissions, indicating that China has a relatively more ambitious pledge than both Brazil and India. Of course it should be underlined that this understates Brazil's real expected effort because this analysis does not look at the LULUCF and agricultural sectors, the key sectors in which Brazil is expected to do large efforts.

3. IMPLEMENTATION OF THE CLIMATE AND ENERGY PACKAGE

3.1. Introduction

In January 2008 the Commission presented the Impact Assessment for its proposal on a Climate and Energy package, based on a set of model based projections[36].

This impacts assessment based its projections to a large extent on the 2007 PRIMES baseline[37]. Since then the world has considerably changed. First and foremost the economic situation has changed radically compared to the expectations in 2008. In addition, the latest projections take into account higher oil and gas prices assumptions reflecting recent developments and the inclusion of a range of energy efficiency measures agreed and put into law in the EU during 2008 and 2009.

This section will describe the new updated baseline and the reference scenario which reflects the full implementation of the Climate and Energy Package as agreed in 2009. It will also assess the impact of the economic crisis on the implementation costs.

36 SEC(2008) 85/3

37 European Commission, DG Energy and Transport: European Energy ad Transport, trends to 2030 – Update 2007, 2008, ISBN 978-92-79-07620-6, http://ec.europa.eu/dgs/energy_transport/figures/trends_2030_update_2007/energy_transport_trends_2030_update_2007_en.pdf

3.2. The new 2009 baseline: impact of already implemented policies

The baseline scenario projects CO_2 and non-CO_2 greenhouse gas emissions from 2005 to 2030 at EU27 and Member State level based on the PRIMES energy system model for CO_2 emissions and the GAINS emissions model for non-CO_2 emissions, supported by the CAPRI agricultural model[38]. Consultations were organised with Member States concerning all these results.

The 2009 baseline scenario builds on macro projections of GDP and population which are exogenous to the models used (and remain stable between scenarios). They reflect the recent economic downturn, followed by sustained economic growth resuming after 2010. GDP projections for the short term (2009-2010) mirror economic forecasts from the European Commission, DG Economic and Financial Affairs (European Economy, May 2009)[39], which complement the up to date statistics for 2005-2008 from Eurostat. The medium and long term growth projections follow the "baseline" scenario of the 2009 Ageing Report (European Economy, April 2009)[40].

The baseline assumes that the recent economic crisis has long lasting effects leading to a permanent loss in GDP. The recovery from the crisis is not expected to be so vigorous that the current GDP losses will be compensated. Modelled growth prospects for 2011 and 2012 are also subdued in line with these trends at around 1% per year. However, economic recovery enables higher productivity gains, allowing somewhat faster growth rates from 2013 to 2015. After 2015, GDP growth rates mirror those of the 2009 Ageing Report. Hence the pattern of the baseline scenario is consistent with the intermediate scenario 2 "sluggish recovery" presented in the Europe 2020 strategy[41]. However, given the recent juncture characterized by the financial and economic crisis, there remains uncertainty concerning the medium-term economic developments. The average EU-27 growth rate for the period 2000-2010 is now only 1.2% per year, while the projected rate for 2010-2020 is recovering to 2.2%, similar to the historical average growth rate between 1990 and 2000. GDP in 2020 is thus significantly lower than assumed in the 2007 baseline (see Table 4).

The population projections for EU27 are based on the EUROPOP2008 convergence scenario (EUROpean POpulation Projections, base year 2008) from Eurostat, which is also the basis for the 2009 Ageing Report. Population projections are higher compared to the 2007 PRIMES baseline due to different migration assumptions.

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38 The main drivers of non-CO_2 greenhouse gas emissions from agriculture are animal numbers and fertiliser use. Future trends of these drivers have been estimated with the CAPRI model. For a description of the PRIMES, CAPRI and GAINS models see Annex 10.4.

39 European Commission, DG Economic and Financial Affairs: Economic Forecast Spring 2009. EUROPEAN ECONOMY 3|2009, http://ec.europa.eu/economy_finance/publications/publication15048_en.pdf

40 European Commission, DG Economic and Financial Affairs: 2009 Ageing Report: Economic and budgetary projections for the EU-27 Member States (2008-2060). EUROPEAN ECONOMY 2|2009, http://ec.europa.eu/economy_finance/publications/publication14992_en.pdf. The "baseline" scenario of this report has been established by the DG Economic and Financial Affairs, the Economic Policy Committee, with the support of Member States experts, and has been endorsed by the ECOFIN Council.

41 Communication from the Commission: Europe 2020. A strategy for smart, sustainable and inclusive growth. COM(2010)2020, Brussels, 3.3.2010.

Oil, gas and coal prices are significantly higher than in the 2007 baseline, reaching by 2020 $88, $62 and $26 (2008 prices) per barrel oil equivalent instead of $66, $50 and $16 in 2007[42]. They are based on the stochastic PROMETHEUS world energy market model and are comparable with the assumptions of the IEA World Energy Outlook 2009. Table 4 compares current and projected values for both baselines.

Table 4: Comparison of macro assumptions of 2007 and 2009 baselines

Relevant EU 27drivers	2005	2020 Baseline 2009	2020 Baseline 2007
Population	489.2 million	513.8 million	496.4 million
Gross Domestic Product	11 687 bn €$_{2008}$	14 963 bn €$_{2008}$	16 572 bn €$_{2008}$
Crude oil import price	59.4 $\$_{08}$/barrel	88.4 $\$_{08}$/barrel	66 $\$_{08}$/barrel
Coal EU import price	14.0 $\$_{08}$/boe	25.8 $\$_{08}$/boe	16 $\$_{08}$/boe
Gas EU import prices	39.7 $\$_{08}$/boe	62.1 $\$_{08}$/boe	50 $\$_{08}$/boe

Source: PRIMES, Eurostat and European Commission

The baseline scenario further reflects implemented policy measures at EU and national level as of spring 2009 to show how far the EU has got with the implementation of the Climate and Energy Package and other relevant measures. At EU level, the main new measures covered compared to the 2007 baseline are the following[43]:

- The Directive that improved and extended the EU Emissions Trading System

- The Regulation on CO_2 emissions of new passenger cars

- The implementing measures of the Eco-Design and Labelling Directives (e.g. energy services, stand-by, lighting)

- CCS demonstration plants which are part of the European Energy Programme for Recovery (EEPR)

- The 2008 "Health Check" of the Common Agricultural Policy.

Only effectively implemented national policies are modelled. Achievement of national reduction targets for the sectors not covered by the ETS (Effort Sharing Decision)[44] or renewable energy targets[45] is not assumed, but progress in the baseline depends on the extent to which legislation and other measures have been put in place by Member States and the EU to achieve these targets effectively.

The projected results for greenhouse gas emissions are summarised in Table 5 below. Total EU GHG emissions (including international aviation) with existing policy measures in 2020 are 7.1% lower than 2005 and 13.8% lower than 1990. This decrease is much stronger than it was in the old 2007 baseline used for the package analysis that saw all GHG emissions in 2020 only at -1.5% compared to 1990. Unlike in the 2007 baseline, the combination of

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42 Oil: 61.1 $05/barrel, coal 14.7 $05/boe, gas 46.4 $05/boe, see European Commission, DG Energy and Transport: European Energy ad Transport, trends to 2030 – Update 2007, 2008, ISBN 978-92-79-07620-6.

43 Directives 2009/29/EC, 2006/32/EC, Regulations (EC) No 72-74/2009, 443/2009, 663/2009.

44 Decision 406-2009-EC

45 Directive 2009/28/EC

economic crisis, higher oil prices, reviewed ETS and efficiency measures avoids a further increase of total primary energy use between 2005 and 2020.

Gross electricity generation increases now only by around 15% in the same period, compared to 25% in the baseline 2007. This comes along with significant decreases of the energy intensity and carbon intensity of the economy by annually 1.7% and 2.5% respectively over the projection period. Hence the EU overcomes the weak improvement rates of the period 2000-2010.

With implemented national legislation in place early 2009 taken into account, renewable energy reaches a share of 15% in gross final energy consumption in 2020, compared to 8.5% 2005. In the 2007 baseline this was projected to be 12.5% in 2020. Import dependency will nevertheless increase to 60% in 2020, but less than in the 2007 baseline (64%).

Table 5: EU 27 internal GHG emission reductions in the baseline

EU27 baseline scenario	Total GHG	ETS sector	non-ETS sectors
CO_2 emissions 2005-2020	-6%	-9.5%	-1.5%
Non-CO_2 emissions 2005-2020	-13%	-75%	-8%
Total GHG emissions 2005-2020	**-7%**	**-11%**	**-3.5%**
Total GHG emissions 1990-2020	-14%		

Source: Calculations based on PRIMES, GAINS

The figure below represents the projected evolution of the ETS in baseline. The lighter red line represents the total yearly allocated allowances in the ETS. This is actually the estimated cap for emissions in the ETS. In 2013 this cap increases because of extension of the scope, e.g. including further industrial CO_2 process emissions and some N_2O and PFC industrial process emissions, and the aviation sector in the ETS[46].

The darker blue line with squares is a stylised representation of the actual yearly emissions in the ETS, which also increases in 2013 because of the extension of the scope[47].

The bars represent the total amount of unused, potential international credits in the system and the impact of banking of allowances, or "buffer", in the ETS. The amount of allowed international credits for the whole period 2008 to 2020 is assumed to be 1.6 billion[48].

Over the whole period 2008-2012 emissions are well below cap, leading to a significant amount of banking and a build up of potential international credits and banked allowances by 2013 worth more than 2.3 Gt $CO_{2\text{-eq}}$. Only from 2015 onwards this buffer starts to decrease, when emissions become higher than the cap itself.

Between 2013 and 2020 and despite the linear reduction of the ETS cap, no absolute emission reductions in the ETS need to take place due to the availability of a large buffer of allowances from the period 2008 – 2012 and unused international credits. Nevertheless, by 2020 there is still a large amount of unused allowances and international credits in the system, worth a bit

46 Given that PRIMES models 5 year period, the aviation sector is included only from 2013, instead of 2012, as foreseen in the legislation.

47 Note that this is an interpolation based on the 5 year periods modelled by the PRIMES model.

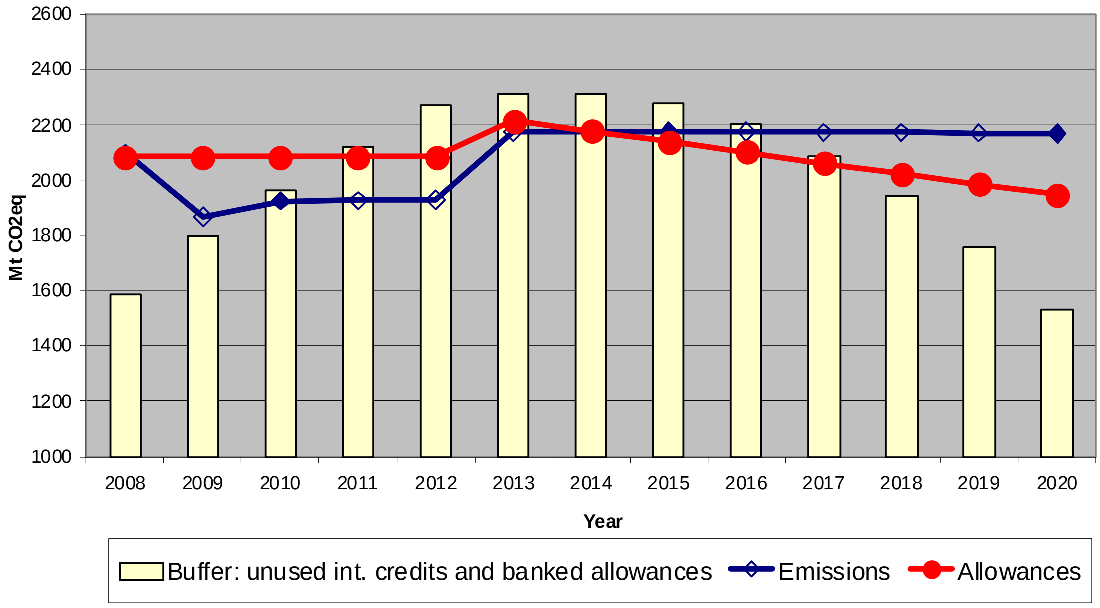
48 One allowance and one credit represent 1 tonne of $CO_{2\text{-eq}}$.

less than 1.6 Gt $CO_{2\text{-eq}}$. But this is decreasing rapidly by then, indicating that after 2020 efforts to reduce emissions increase significantly to comply with the post-2020 ETS caps.

Carbon prices are low in the beginning at €14.5 per tonne CO_2 (in 2008 prices) and increase to €25 by 2020, indicating that keeping emissions flat in the ETS between 2013 and 2020 is certainly not effortless.

Nevertheless one can conclude that the main impact of the economic crisis is the build up of a significant buffer of banked allowances by 2012, giving little incentives to reduce emissions further soon afterwards and still a large amount of unused international credits and banked allowances in the system up to 2020. In part lower carbon prices also result from the fact that there are more energy efficiency measures implemented in the system than in the old 2007 baseline.

Figure 5: ETS baseline emissions and allowances over time



Source: Calculations based on PRIMES, GAINS

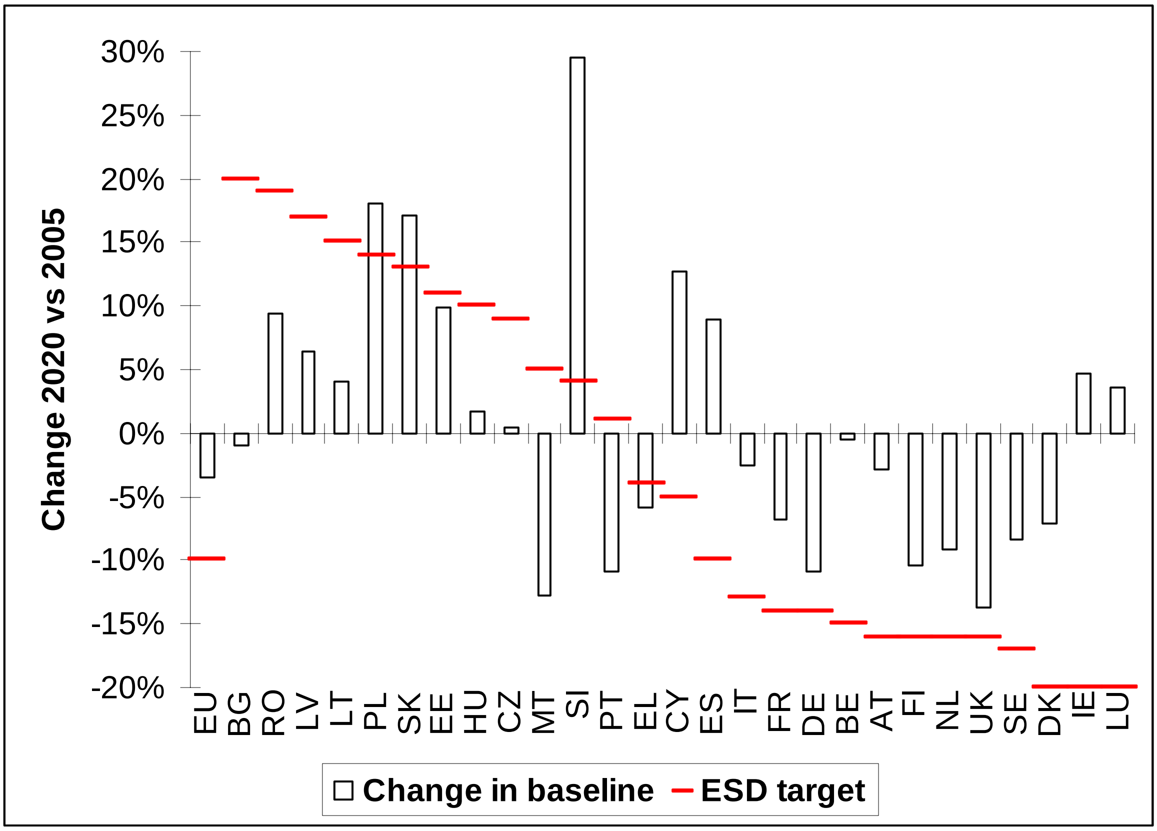
Total non-ETS GHG emissions decrease by 3.5% between 2005 and 2020 in baseline. This is a significant decrease compared to the 2007 baseline where emissions still saw an increase by more than 2%. This decrease is mainly driven by non-CO_2 emissions reductions of around 8% and a stabilisation of CO_2 emissions, which see a decrease of around 1% whereas in the 2007 baseline there was still a projected increase of around 7% of CO_2 in the non-ETS. After 2020, the non-CO_2 emission decreases tend to fade out in baseline.

As expected, the EU level non-ETS target of around -10% is not achieved, but the distance to target is significantly less than in the 2007 baseline. Figure 6 shows the 2020 targets in the non-ETS per country compared to 2005 and the projected emissions in 2020 compared 2005 in baseline in the form of a bar. When the bar is below the target, then the country already complies in baseline with its target.

10 Member States are projected to meet their non-ETS target already in baseline. 8 of them overachieve their targets significantly in baseline, with emissions at least 8% below target. This is a significant change with the 2007 baseline where this level of overachievement did not exist.

The countries that overachieve tend to be those that got targets that allowed for an increase in emissions by 2020 compared to 2005. On average projected non-ETS emissions for 2020 decreased by 5% compared to the 2007 baseline.

Figure 6: Progress towards the effort sharing target in baseline



Source: Calculations based on PRIMES, GAINS

3.3. The reference scenario: full implementation of the Climate and Energy Package

The baseline scenario is a conservative estimate of what happens if no new national or EU policies would have been put in place since spring 2009. However, this does not reflect the Climate and Energy Package, because Member States committed there to put policies in place to reach national non-ETS and renewable energy targets (RES targets). Starting from the baseline scenario, a reference scenario has been constructed which assumes the full national implementation of the package, including the non-ETS and renewable energy targets being reached in 2020[49]. Given that both policies are not defined beyond 2020, it is further assumed

49 The results used in this assessment are based on the draft version of the reference scenario, still under review by the European Commission services, but characterised by stable EU level results. The final version, to be published by the European Commission, may hence vary slightly from the reference scenario results used in this assessment.

that the stringency of the non-ETS policy remains stable after 2020 and comparable considerations apply for renewable energy policies. It also includes some further EU legislation adopted between spring and end of 2009 to reflect further eco-design implementation standards and the recast of the Directive on Energy Performance of Buildings.

Non-ETS and renewable energy legislations give considerable freedom to Member States on how they can achieve their targets, allowing for transfers between Member States if some overachieve the national targets. For the achievement of the non-ETS targets, it is assumed that this flexibility is fully used. Consequently, a uniform non-ETS carbon value across the EU is used. But for the achievement of the renewable energy targets, only limited trade is assumed for those Member States that have indicated that they plan to make use of the so called co-operation mechanisms that allows for such transfers to achieve the renewable energy targets.

National support measures are assumed to be of similar level in all renewable energy sectors within a country, provided that the transport specific target is met. For reaching the targets, on average a renewable energy incentive of around €50 per MWh and a biofuel support of €55 per MWh in 2020 is necessary, with considerable differences between countries. These values are slightly higher than in the 2007 analysis. However, at the same time the economic crisis has reduced energy demand which reduces the needed volume of renewable energy in order to reach the 20% target. With a 20% average renewable energy share for the EU as a whole, average shares are around 32% in the electricity sector, 20% in heating and cooling and 10% in transport.

A major difference with the projections for the analysis under the Climate and Energy Package[50] is that the achievement of the renewables targets will go a longer way towards reaching the GHG reduction targets outside the EU ETS than originally modelled and there are much less additional carbon price incentives necessary to reduce GHG emissions so that the 2020 climate targets are reached. The lower economic growth forecast has made achievement of the GHG reduction targets easier whereas it does help less for the achievement of the renewables target, and the latter therefore dominates the efforts needed for target fulfilment as projected. It should be noted that this modelling result assumes different economic incentives for renewables and GHG reduction and does not prejudge the question which concrete policy instruments could be used to provide these incentives. For example, carbon related pricing in non-ETS sectors can in itself be an important contribution to achieving the renewables targets (for heating and transport).

The ETS emissions profile changes considerably, given that the renewable energy targets induces actors to reduce emissions already by 2020 even when ETS carbon prices actually reduce in comparison with the baseline. Instead of a carbon price of €25 by 2020 (as in the baseline), the carbon price reduces to around €16 in 2020. Emissions even reduce by -19% compared to 2005 instead of only -11% in baseline.

This also has profound implications for the potential use of credits from third countries. Emission levels in the ETS stay below target until 2016, increasing the total amount of unused international credits and banked allowances up to 2016. Even though some of this is consumed in the period 2017-2020 because of emissions higher than target, there are still

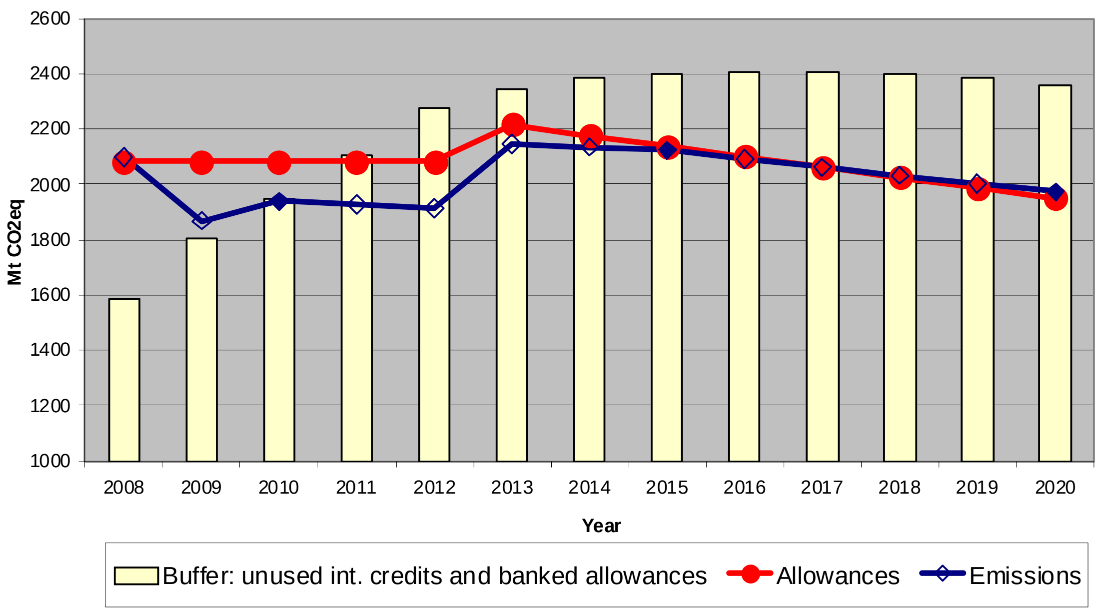
[50] SEC(2008) 85/3

around 2.4 Gt $CO_{2\text{-eq}}$ of banked allowances and unused international credits in the system by 2020, much more than in baseline (see figure below).

Whereas in the baseline pressure was building up to reduce emissions after 2020 in the ETS through increased carbon prices, in the reference case there are much lower incentives to continue to reduce emissions in the ETS after 2020. The resulting ETS carbon price for 2030, at around €20, is even below the carbon price of baseline in 2020. ETS emissions are rather stagnating after 2020, with the increasing use of unused international credits and banked allowances after 2020 to establish compliance in the ETS.

This has also important implications for the development of CCS. In the baseline there is still some introduction of CCS plants beyond the foreseen demonstration plants, while in reference this expansion of CCS investments does not take place anymore.

Figure 7: ETS emissions and allowances in the reference scenario over time



Source: Calculations based on PRIMES, GAINS

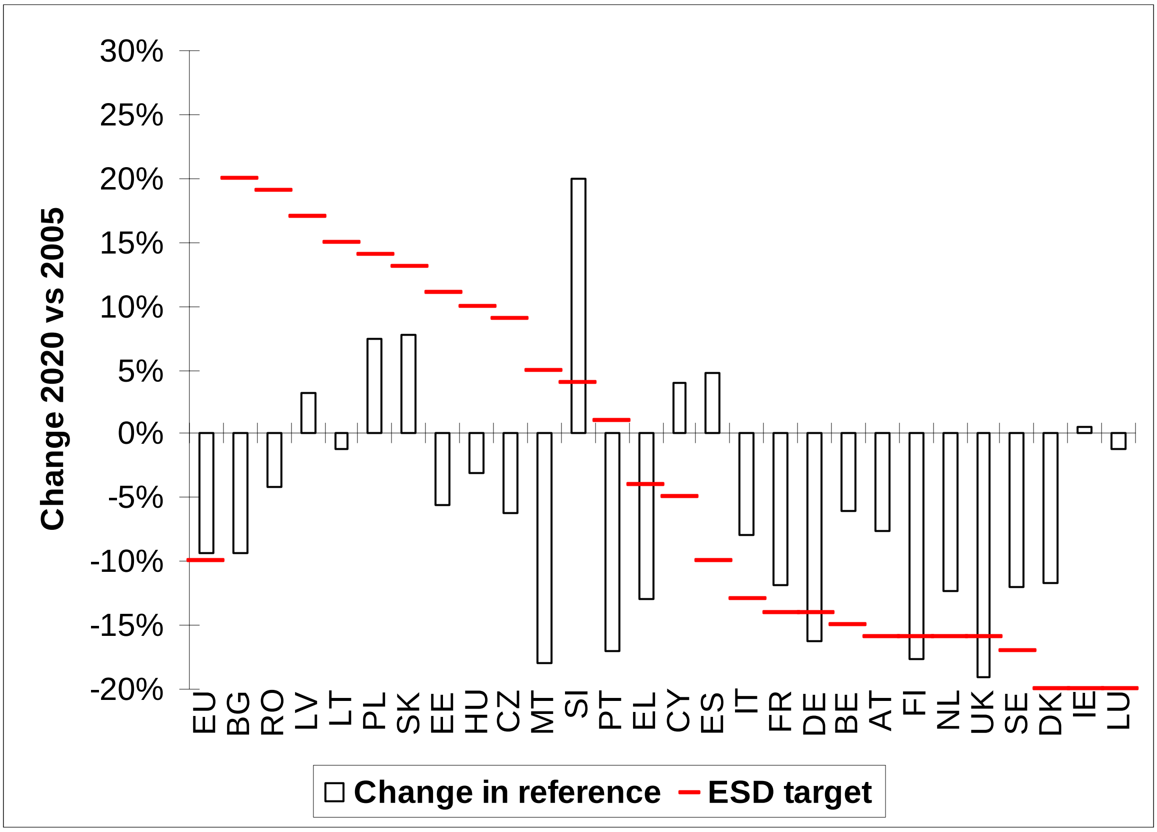
Achieving the renewable energy targets reduces also emissions in the non-ETS considerably. Only a moderate effort in addition to the achievement of renewable targets would be needed to achieve the GHG reduction targets outside the ETS. Actually at an additional carbon price of €4 to €5 the non-ETS target would basically be achieved internally. There does not appear to be any need for the use of international credits, given that these tend to be more expensive.

Most of the additional reductions due to this low carbon price is projected to come from cheap mitigation options for non-CO_2 emissions, e.g. in waste and wastewater management, reduction of gas transmission losses and manure management.

This result of a significantly lower non-ETS than ETS carbon value might seem counter intuitive, given that the distribution of efforts between ETS and non-ETS in the package was mainly decided based on cost-efficiency considerations. This result shows how significant the economic and policy changes between the two analyses have been. Main contributors to alleviate the carbon price burden more significantly for non-ETS than for ETS sectors are higher oil prices and their impact on household and industry fuel demand and the energy efficiency measures which significantly impact on non-ETS sectors, in particular the recast Energy Performance of Buildings Directive and the CO_2 and Cars Regulation.

All but one Member State that has targets in the non-ETS that allow for an increase compared to 2005, comply with those targets internally in the reference scenario. But also in the group of Member States that need to reduce emissions compared to 2005.

Figure 8: Progress towards the effort sharing target in the reference scenario



Source: Calculations based on PRIMES, GAINS

The projected results for greenhouse gas emissions in the reference scenario are summarised in Table 6 below. It shows that the EU will reach the -20% GHG reduction targets of the Climate and Energy Package. Not only the non-ETS sectors fulfil their target as assumed in the year 2020, but despite banking also the ETS (including aviation). Over the period 2013-2020 there is in principle no shortage of allowances that would require the use of international credits.

Table 6: EU27 internal GHG emission reductions in the reference scenario

EU27 reference scenario	Total GHG	ETS sector	non-ETS sectors
CO_2 emissions 2005-2020	-12.5%	-18%	-6%
Non-CO_2 emissions 2005-2020	-21%	-75%	-17%
Total GHG emissions 2005-2020	**-14%**	**-19%**	**-9.5%**
Total GHG emissions 1990-2020	-20%		

Source: Calculations based on PRIMES, GAINS

3.4. Has the Climate and Energy Package become cheaper due to the economic crisis?

Greenhouse gas emissions have reduced since 2005. This was not only due to the economic crisis. In 2005 EU greenhouse gas emissions, including emissions from international aviation, were 7% below 1990 levels[51]. In 2007, before the crisis started, emissions had further reduced to -8% compared to 1990 and in 2008, a year which still recorded positive but smaller GDP growth for the EU, emissions had decreased to -10% compared to 1990[52]. This indicates that policies to mitigate greenhouse gases and higher energy prices were having a real impact on emissions before the crisis started.

But the full force of the economic crisis in 2009 had a significant impact on emissions in the short term, with preliminary estimates putting the emission reduction in 2009 at around -14% compared to 1990 levels. Emissions are expected to rebound in the short term when GDP growth rates recover to pre-crisis values, but overall GDP levels by 2020 are projected to remain lower than expected before the crisis (see Table 4). This together with the continued impact of higher than expected energy prices, the decrease in investments in the years around the economic downturn due to a higher risk premium, the implementation of newly adopted energy efficiency measures and the price signal in the ETS to be compliant with the ETS target result in emission projections in baseline back to -14% in 2020 compared to 1990. This is significantly lower than for the 2007 baseline, which projected GHG emissions in 2020 only to be 1.5% below 1990 levels[53].

While it is not possible to make a perfect estimate of how much the implementation of the package has become cheaper due to the crisis, as not only GDP but also demographical data, energy prices and other baseline assumptions have changed, it is possible to make an approximation. In doing so, the Commission has taken a conservative approach, in particular by also taking into account costs that are in the baseline itself and that are linked to the implementation of the package (ETS and energy efficiency measures).

The assessment uses the same methodology to calculate costs as the one used for the impact assessment of the climate and energy package. This methodology is based on the PRIMES and GAINS models. The PRIMES model calculates the total cost of energy as a measurement of how much the rest of the economy has to pay in order to get the required services from energy. The cost covers all types of costs incurred in energy demand and supply sectors for all energy purposes, including energy savings, the purchasing of high performance appliances, household utility losses due to changed energy services, etc. These total costs also include

51 SEC(2008) 85/3, footnote 7.

52 EU greenhouse gas inventory submission to UNFCCC, 15.04.2010

53 SEC(2008) 85, Vol. II, Annex to the impact assessment, table 1

costs for buying auctioned ETS allowances, revenues from the latter have to be deducted from the direct energy system costs, because they are recycled back into the economy by the government and hence do not represent a net direct additional cost to society[54]. Furthermore costs of reducing non-CO_2 mitigation costs are estimated using marginal cost curves estimated using the GAINS model and are added to the projected costs by the PRIMES model[55].

The approximation of costs first assesses the costs related to measures incorporated in the 2009 baseline that contribute to the achievement of the Climate and Energy package.

For the 2009 baseline, compliance costs are estimated for the revised ETS target because in baseline it is assumed the ETS target is achieved. Furthermore, costs are taken into account related to higher energy efficiency measures implemented in the 2009 baseline.

ETS emissions are significantly lower in 2020 in the 2009 baseline than in the 2007 baseline, but the ETS target is not met through domestic emission reductions. Emissions are projected to be higher than the target by around 200 million ton $CO_{2\text{-eq}}$. In order to be compliant with the ETS target, entities in the ETS will need to consume part of the buffer of banked allowances and unused international credits (see description in section 3.2). The consumption of this buffer, valued at €25 per allowance or credit, for compliance purposes represents a cost of around €5 billion.

Furthermore costs related to higher energy efficiency measures in the 2009 baseline are estimated to be around €7 billion. Together these represent an approximation of costs of € 12 billion related to measures in the baseline that contribute to the achievement of the climate change and energy package.

But in the baseline only the ETS target is met, not the renewable energy targets, neither the non-ETS targets. These targets are achieved in the reference scenario, through higher carbon prices in the non-ETS, increased incentives for renewable energy through the increased renewable energy values and additional energy efficiency measures. The additional policies in reference case to achieve these targets, come at an estimated net increase of costs compared to baseline of €36 billion.

Combined total cost to achieve the Climate and Energy Package, using the 2009 baseline framework, is estimated to be around €48 billion (€ 12 billion related to costs in baseline + €36 billion related to costs to achieve the reference on top of baseline).

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54 For more details on how PRIMES calculates costs in relation to auctioning in the electricity sectors see section 3.8 of Capros et al (2008). In PRIMES auctioned ETS allowances are a true cost element in power generation and so electricity prices are affected directly. Power producers will mostly pass through to consumers true emission abatement costs induced by the scarcity of emission allowances. With free allocation, the degree of passing through to consumer prices of the opportunity costs associated with the carbon price of the EU ETS depends on the market power of participants in the electricity market. In a well functioning market, as it is assumed in the PRIMES model projections, power producers will mostly pass through to consumers true emission abatement costs induced by the scarcity of emission allowances and are less able to pass through the opportunity cost associated with grandfathered emission allowances. So the model simulates different impacts on electricity prices of auctioning versus grandfathering regimes.

55 For detailed results on the non-CO_2 cost curves see Lena Höglund-Isaksson, Wilfried Winiwarter, Fabian Wagner, Zbigniew Klimont, Markus Amann: Potentials and costs for mitigation of non-CO_2 greenhouse gas emissions in the European Union until 2030. Report to DG Climate Action, IIASA.

This results in a net cost to achieve the Climate and Energy Package equal to 0.32% of GDP. This compares with costs in the package to achieve the package of 0.45% of GDP when one allowed for the use of international credits, and 0.61% when no such credits were used and the -20% target was implemented fully internally. Using this method costs per unit of GDP of implementing the package are estimated to have fallen between 30 and 50%.

3.5. Concluding remarks

Since the impact assessment for the climate and energy package in early 2008[56] and today there have been important changes. The economic crisis has unexpectedly reduced short-term growth rates. At the same time the average level of energy prices is significantly higher. Both elements have led and will lead to lower greenhouse gas emissions than projected for the 2007 baseline.

Main impacts are lower ETS carbon price projections for 2020 to comply with the ETS target under the climate and energy package and unexpectedly significant levels of banking early on, giving little incentives to reduce emissions further after 2012, and still a large amount of unused international credits and banked allowances in the system up to 2020.

Higher energy prices and the economic crisis but also measures to reduce emissions such as the CO_2 and Cars Regulation and the further implementation of energy efficiency regulations, have reduced emissions in the non-ETS sectors. For example, ten Member States are projected to meet their non-ETS target already in baseline. The countries that overachieve tend to be those that got targets that allowed for an increase in emissions by 2020 compared to 2005 in the non-ETS.

However, as the comparison between baseline and reference scenario shows, additional measures still need to be taken to achieve overall the renewable energy targets and the non-ETS targets. In the reference scenario with additional national policies in line with the commitments under the climate and energy package, the EU will reach the -20% GHG reduction targets of the Climate and Energy Package internally without a need for significant amount of international credits both in the ETS and non-ETS.

An approximation of the costs of the package puts the estimated costs in the context of the new 2009 baseline framework at €48 billion in 2020, or 0.3% of GDP. This is a reduction of costs per GDP between 30% and 50%.

4. NEAR TERM GHG REDUCTIONS IN A 2050 PERSPECTIVE

In order to assess the type of emission reductions necessary in the EU in the short to mid term that are consistent with a 2ºC emission pathway, a scenario was considered with the POLES model that projects a global reduction of emissions in the order of -50% compared to 1990 by 2050[57]. An important feature of the reduction scenario is the development of an international carbon market with increasing and gradual participation by developing countries and not

[56] SEC(2008) 85/3

[57] The reduction case for agriculture and LULUCF emissions is the same as those used for the Staff Working Document accompanying Communication " Towards a comprehensive climate change agreement in Copenhagen", part 1, section 6.10 (SEC(2009) 101).

immediate and perfect carbon prices on a global scale. By 2050, most world regions are fully integrated in the world carbon market, experiencing similar carbon prices, with the exception of the least developed countries, which experience still substantially lower carbon prices.

The Baseline scenario projects an overall increase in emissions by 2050 of 94% with respect to 1990, with a total of 68.8 Gt $CO_{2\text{-eq}}$ emissions in 2050. The emission growth is projected to take place entirely in developing countries. On the other hand the 2ºC scenario achieves an emissions level of around -50% globally with respect to 1990 by 2050. This result could be reached thanks to the contribution of non-fossil fuels in total primary energy supply (above 50% by 2050) and contributions from CCS technologies, including some CCS & biomass technologies. It should be noted that assumptions about the technical options and related costs are not certain on such long term horizons, which could have impact on the projected results.

In the 2ºC scenario, by 2050 internal reductions in developed countries' energy and industrial sectors are in the order of 76% compared to 1990, indicating that the international carbon market still has a role to play in achieving the reduction target of -80 to -95%[58].

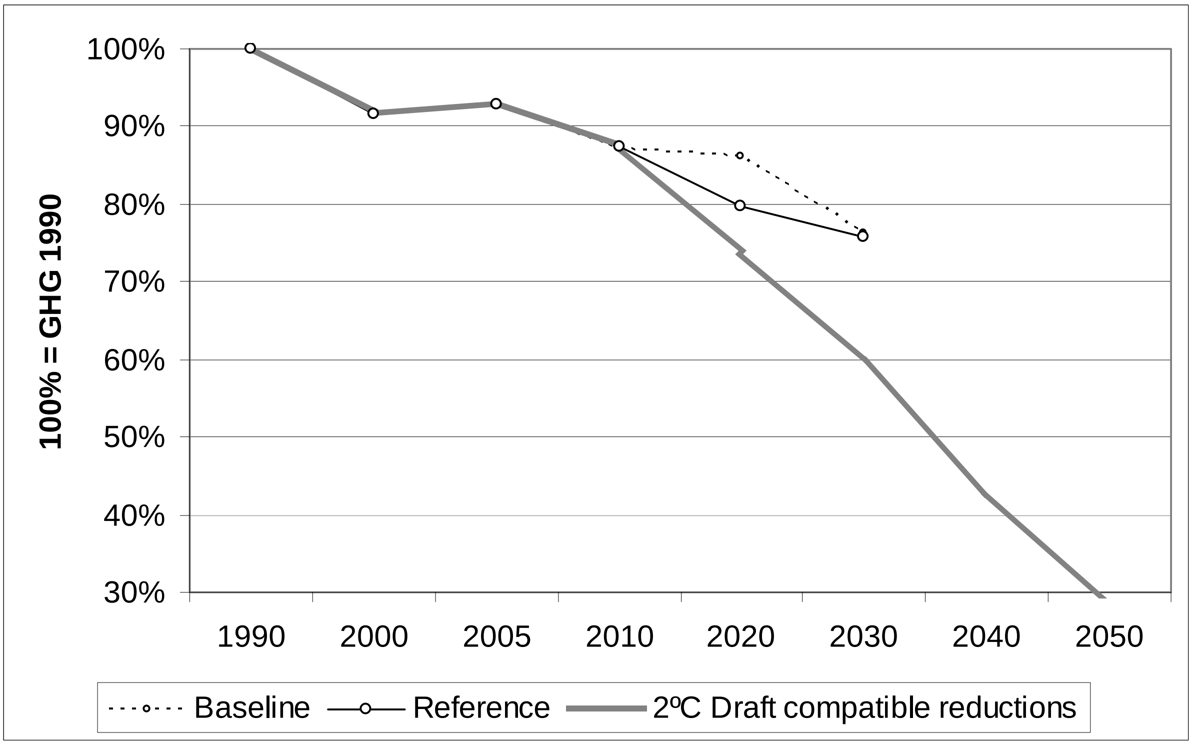
For the EU this translates into a domestic reduction of GHG (both CO_2 and non-CO_2) from energy and the industrial sectors of 26% by 2020, of 41% by 2030, and 75% by 2050. When including agricultural non-CO_2 emissions, taken from the updated GAINS model[59], emissions in the EU would be overall around 26%, 40% and 72% below 1990 in 2020, 2030 and 2050.

The figure below compares this 2ºC compatible internal emission trajectory for the EU with the emissions projected in baseline and reference case with the PRIMES/GAINS model set-up (see sections 3.2 and 3.3). Neither the baseline nor the reference case is compatible with a 2ºC trajectory. Even in the reference case, when emissions are at -20% in 2020 internally in the EU, there is still a gap with respect the 2ºC compatible emission profile which would require emissions internally rather to be at around -25% compared to 1990 by 2020. This gap increases significantly after 2020, when there are lower incentives in the reference case to reduce emissions in the EU. By 2030, reductions in the reference and baseline do not go beyond -25% whereas -40% internal reductions would be more appropriate for a 2ºC compatible scenario.

Figure 9: Short term EU emission profile compared to 2ºC compatible long term internal reduction trajectory

[58] Also most studies that the IPCC refers to on the high end of ambition levels assume that part of the developed country targets is met through carbon market mechanisms that pay for higher reduction in third countries.

[59] GAINS results only go up to 2030. For agricultural emissions and mitigation options these are extrapolated to 2050.

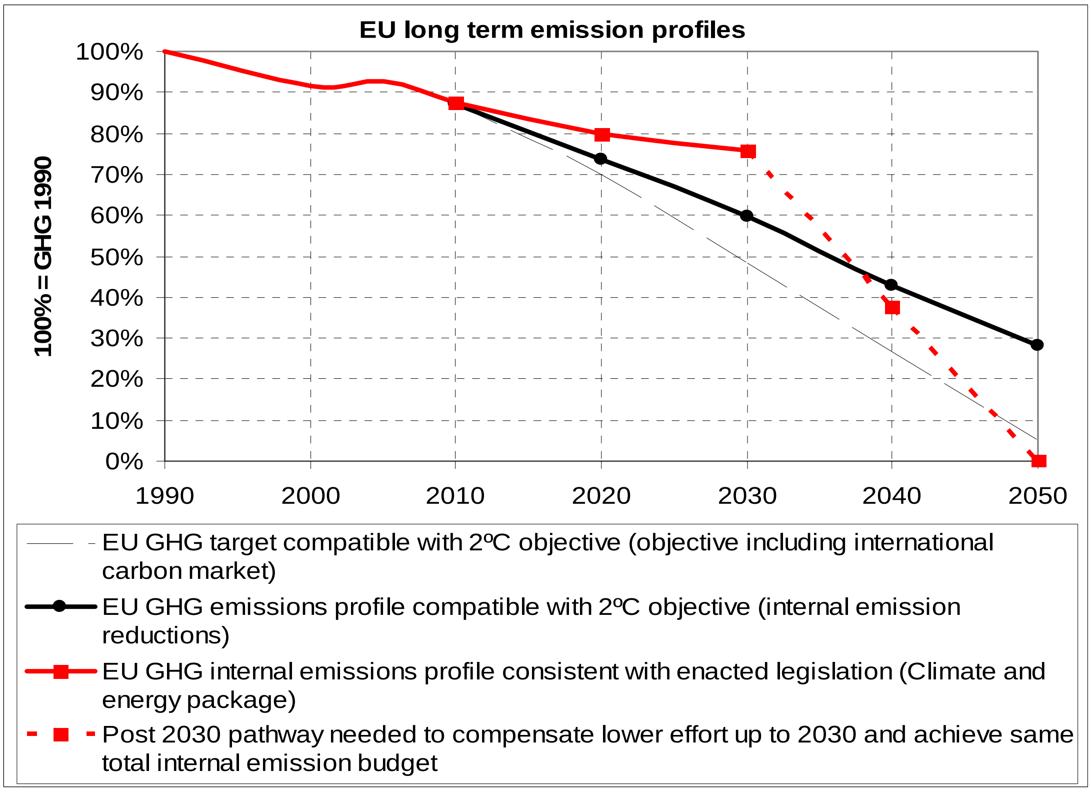


Source: POLES, PRIMES, GAINS.

A further strengthening of EU greenhouse gas target, that could deliver internal reductions by 2020 at a higher level than the reference case (which achieves the -20% target internally) is more in line with a 2ºC compatible scenario. This would also maintain incentives for further innovation in low carbon technologies beyond renewable energy (e.g. efficiency technologies, CCS etc.).

It needs to be stressed that only internal emissions are considered in the above figure. Emission targets for developed countries need to be rather in the order of -80% to -95% to be compatible with a 2ºC compatible pathway. Figure 10 gives the example of a target pathway for the EU of -95% by 2050 compared to 1990 and thus gives an indication of the resulting use of international crediting mechanisms is taken into account. Furthermore it also demonstrates the type of increased reductions that would be necessary after 2030 if present legislation is not adapted and the EU's internal reductions would need to catch up only after 2030.

Figure 10: Short term EU emission profile compared to 2ºC compatible long term target



Source: POLES, PRIMES, GAINS

5. Costs and benefits of stepping up to -30% and implications for policy instruments

5.1. Introduction

The European Council has repeatedly confirmed the willingness to step up the EU GHG emission target to 30% in 2020 compared to 1990 if the conditions are right[60]. The reference scenario has shown that already the present policy measures and commitments under the Climate and Energy Package can lead to an EU internal emission reduction of -20% in 2020, without the need to use credits from third countries to comply with its low end pledge, but with a reduced incentive to continue to reduce emissions after 2020.

As section 4 explains, this emission path is not consistent with the EU long term climate targets. This section assesses costs and benefits of a move to 30%. First, the direct efforts needed to increase the GHG reduction to 30% are assessed. Also the potential of land use, land use change and forestry to contribute is assessed. Finally, the macroeconomic impacts for the EU are summarized and co-benefits of a move to 30% are discussed.

60 The European Council in December 2008 confirmed "the European Union's commitment to increasing this reduction to 30 % within the framework of an ambitious and comprehensive global agreement in Copenhagen on climate change for the period after 2012 on condition that the other developed countries undertake to achieve comparable emission reductions and that the economically more advanced developing countries make a contribution commensurate with their respective responsibilities and capabilities."

5.2. Direct costs of stepping up to -30% and implications for ETS and non-ETS

In line with the EU commitment, the analysis of the direct costs of stepping up to 30% follows a target-based approach. However, it is not sufficient to only focus on the emission targets to be reached in one year (2020), as the temporal emission dynamics of the reference scenario due to the crisis and the flexibility provided by the ETS and non-ETS to adapt to this have shown. An indicative emission target for 2030 has been assumed to account for such dynamic effects without predefining a specific policy instrument design. If the EU wants to reach -80 to -95% GHG emission reductions by 2050, as confirmed by the European Council[61], internal emission reductions by 2030 may need to be significantly higher than in the reference scenario. Correspondingly, a -40% internal reduction in 2030 is assumed for further analysis in the policy scenarios[62].

To analyse the impact of a 30% reduction, the same modelling framework is applied as for the baseline and reference scenario. The PRIMES model delivers energy-related costs and CO_2 emissions, and the GAINS model delivers marginal cost curves for additional reduction of non-CO_2 emissions[63]. The starting point is the reference scenario which includes the full achievement of the GHG and renewable energy targets. For example, the start is from the 20% renewable energy target and 10% renewable energy in transport target in 2020 and it is assumed that the specific renewable energy policy support as applied in the reference scenario remains in place to ensure meeting of the targets.

For the further analysis, the same approach as in the economic analysis of the package is followed, in order to come as close as possible to the Council request of an update of the package analysis[64]. The reduction scenarios are cost efficient, by using economic instruments directly related to GHG emission reductions (modelled as carbon values) across the economy as the only additional instrument. This also implies that additional renewable energy in the policy scenarios are induced by carbon values.

As in the analysis for the package, the start is a policy target scenario (-30% internal reductions) in which all additional reduction efforts are made domestically, to analyse which would be the economically optimal distribution of efforts between ETS sectors and non-ETS sectors. Then a policy target scenario with 25% internal reductions is analysed, in which the remaining 5% reductions is achieved through the access to credits from third countries and the use of banked allowances. This "30% with flexibility" scenario would actually be closest to a 2ºC compatible trajectory as presented in section 4.

The main drivers of both reduction scenarios are presented and compared to the reference scenario in Table 7.

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61 European Council, Brussels, 29/30 October 2009, Presidency conclusions. 15265/1/09 REV 1.

62 A sensitivity analysis was conducted with a -35% domestic target for 2030. It showed that in such a scenario the results for 2020, which are the focus of the present analysis, remained practically unchanged.

63 For detailed results on the non-CO_2 cost curves see Lena Höglund-Isaksson, Wilfried Winiwarter, Fabian Wagner, Zbigniew Klimont, Markus Amann: Potentials and costs for mitigation of non-CO_2 greenhouse gas emissions in the European Union until 2030. Report to DG Climate Action, IIASA

64 Council conclusions on Climate change. 3002nd ENVIRONMENT Council meeting, Brussels, 15 March 2010.

Table 7: Comparison of policy scenarios and its drivers

EU 27 results for 2020	*Reference*	*30% with flexibility (25% internal)*	*30% internal*
Carbon Value ETS (€$_{08}$/tCO_2)	16.5	30	55
Carbon Value non-ETS (€$_{08}$/tCO_2)	4	30	55
Renewable energy value average (€$_{08}$/MWh)	50	50	50
Renewable energy share in gross final energy demand	20.0%	20.7%	21.4%
Gross energy consumption (Gtoe)	1.78	1.72	1.67
% change gross energy consumption compared to reference scenario		-3.5%	-6.5%
Import dependence energy demand (in %)	56.9%	56.2%	56.0%

Source: PRIMES

The carbon value needed to achieve -25% in 2020 domestically is €30 across all sectors, and hence lower than expected in the analysis for the Climate and Energy package for reaching the -20% target internally[65] for which the carbon price across sectors was estimated at €41[66].

For reaching -30% internally at least additional cost, the projected carbon value across sectors would increase to €55. Besides the climate mitigation effects, the 30% domestic target scenario would lead to an additional 1.4% increase compared to the reference scenario of the renewable energy share and nearly a 7% further reduction of energy consumption by 2020. It would thus also significantly contribute to move towards the -20% energy efficiency target, yielding -15% reduction in energy consumption compared to the 2007 baseline. For the scenario in which emissions reduce by 25%, the trend of the results is similar but, of course, the absolute magnitude smaller.

The lower carbon value in the non-ETS sector needed in the reference scenario to comply with the Climate and Energy package, for reasons explained in section 3.3, leaves relatively cheap mitigation options, which would be profitable at carbon incentives between €4 and the ETS value of €16 and are in the ETS already used as part of the reference scenario, in the non-ETS sector unused. For reaching -25% cost-effectively across sectors, these options will be used first and then all further available options across sectors until the target is reached. As consequence of this pattern, the increase in carbon values in the non-ETS sector compared to the reference scenario is higher than in the ETS sector.

Nevertheless overall mitigation potential compared to 2005 remains lower in the non-ETS compared to the ETS. The scenarios show that in a cost-effective policy design both sectors should contribute to a move to 30% (see Table 8). As under the package, the ETS should continue to provide about the double percentage point reduction compared to 2005 compared to the non-ETS sector. The ratio remains stable for both policy target scenarios. Compared to 2005, 34% should be provided by the ETS sectors (including aviation), and 16% compared to 2005 should be provided by the non-ETS sectors. In the non-ETS sectors, reduction potentials compared to current effort sharing targets continue to be higher in the poorer Member States.

65 SEC(2008) 85/3
66 €39 in 2005 prices, see SEC(2008) 85/3

Table 8 Sectoral greenhouse gas emissions

EU27 emissions in 2020	*Reference*	*30% with flexibility (25% internal)*	*30% internal*
Reduction compared to 2005			
% GHG reduction compared to 2005	-14%	-19%	-24%
% reduction ETS compared to 2005	**-19%**[67]	**-26%**	**-34%**
% reduction non-ETS compared to 2005	**-9.5%**	**-13%**	**-16%**
Reduction compared to reference case			
GHG reduction (Mt $CO_{2\text{-eq}}$)		-258	-531
% of additional emission reduction ETS		-7%	-15%
% of additional emission reduction non-ETS		-3.5%	-6.5%
Sectoral energy-related CO_2 emissions 2020			
Contribution of economic sectors compared to reference case			
% change Power and Distr. Steam		-13%	-26%
% change other sectors		-3%	-6%
Sectoral non-CO_2 emissions 2020			
% change energy non-CO_2 emissions		-4%	-6%
% change agricultural non-CO_2 emissions		-6%	-9%
% change other non-CO_2 emissions		-3%	-8%

Source: Calculations based on PRIMES, GAINS

When looking at the contribution of different economic sectors, the analysis shown in the table above contains a key insight: The energy supply sector is the one sector which contributes far above average compared to the reference scenario to reach a 30% greenhouse gas emission target at the same marginal costs across sectors, i.e. at lowest possible costs. This is mainly due to its high share in CO_2 emissions, which are the largest part of total GHG emissions.

For CO_2 emissions, the power sector has currently the highest relative share (35% of all CO_2 emissions in 2005, see also Table 9 below). It reduces 13% in the 30% case with flexibility case (and 26% in the 30% internal case) compared to the reference scenario by means of a more efficient, carbon free production of electricity, whereas the final demand sectors reduce only by 3.5% (and 6.5% respectively). For the power sector, this implies in the 30% with flexibility case a net reduction of 30% compared to 2005 levels and 25% compared to the baseline.

For non-CO_2 emissions the share of energy emissions is rather small. In the 30% with flexibility, energy-related non-CO_2 emissions decrease by further 4% compared to the reference scenario, after having seen a larger reduction from baseline to reference. Agricultural emissions, which are about half of the total non-CO_2 emissions, contribute 6% emission decreases compared to the reference scenario, induced by the rise of non-ETS carbon values from 4 to 30 euro, whereas their contribution from baseline to reference was limited. It should be noted that for non-CO_2 emissions the relative contribution of the agricultural sector to the 30% is sensitive to the exact non-ETS carbon price in the reference scenario, because a relatively large amount of reduction options in this sector can be achieved

[67] For stationary sources and aviation combined.

at carbon prices between €3 and €8. The remaining sectors only reduce non-CO_2 with around 3% in case of a 30% target compared to reference.

Nevertheless, also the direct contribution of industry, residential, tertiary and agriculture, and transport remain important, as the table below with further details on sectoral CO_2 emissions shows. Industry, residential and tertiary sectors all reduce their direct emissions of CO_2 from energy by around 20% compared to 2005 levels. The only notable exception is transport whose direct emissions are actually flat compared to 2005. Of course, transport emissions would have been even higher in 2020 if the CO_2 and Cars Regulation would not apply.

Table 9: Energy related CO_2 emissions per sector

	2005	2020			
Compared to total 2005 (=100%)		Baseline	Reference	-30% with flexibility	-30% internally
Total CO_2 emissions (energy related)	**100%**	**94%**	**86%**	**81%**	**75%**
Power generation/District heating	35%	33%	28%	24%	21%
Energy branch	5%	4%	3%	3%	3%
Industry	15%	12%	12%	11%	11%
Residential	12%	11%	11%	10%	9%
Tertiary and agriculture	7%	6%	6%	5%	5%
Transport	27%	28%	27%	27%	26%

Source: PRIMES (sectors not always exactly add up to the total for a given scenario due to rounding)

The reference scenario is characterised by a majority of new power capacity investments going to renewable energy (see Table 10). Going to higher levels of greenhouse gas emission reductions than -20% through an increase in carbon prices does increase the share of renewable energy only moderately beyond the 20% RES target agreed under the climate and energy package.

In the reference scenario new coal investment retains a 10% share in new power capacities in both 2020 and 2030 and remain very emission intensive, given that CCS does not become economically viable until 2030 given the low projected carbon prices after 2020 (see section 3.3, low carbon prices after 2020 due the remaining unused international credits in the system and banked allowances). These new investments in coal without CCS represent a significant lock in of carbon intensive production technologies.

Moving beyond 20% sees the share of coal decrease, whereas the other types of power production remain stable (total demand decreases because of mainly energy efficiency improvements in households and tertiary services).

With high carbon prices new coal investments become dependent on CCS use and therefore coal investments up to 2020 decrease by more than 6 GW_{net} compared with the reference scenario (see Table 10). But after 2020, increased reductions of 25% or more also make CCS competitive with carbon prices continuing to increase well above €30.

Hence in the 30% scenarios after 2020 significant investment into coal based CCS takes place and by 2030 already 40% of the operational coal power plants have CCS.

Table 10: Power sector investments 2015-2020

Net investment in power	Reference	-30% with	-30%

generation capacity 2015-2020 (in GW_{net})		flexibility	internally
Nuclear energy	9.3	9.7	10.2
Coal and lignite	16.2	10.1	9.5
Petroleum products	4.5	3.7	3.5
Gas (including derived gases)	8.4	6.9	6.4
Biomass & waste	16.4	16.9	16.9
Hydro	3.4	3.4	3.3
Wind	76.4	82.8	84.2
Solar.	20.9	26	27.9
Geothermal, tidal and other	3	3.6	3.6

Source: PRIMES

Costs

The economic analysis shows that the direct energy system and non-CO_2 mitigation costs of stepping up to 30% (while staying on track for the 2ºC trajectory) are moderate. The -25% internal scenario would lead to additional domestic costs of €25 billion compared to the reference scenario.

If the remaining 5% reduction can be delivered via emission credits from third countries or the consumption of banked allowances, and if these are available at the (opportunity) price of €30, then total net cost of moving to 30%, which already includes the reduced bill for energy due to energy savings, would be around €33 billion compared to the reference scenario. This is an additional cost of around 0.2% of GDP in 2020.

These additional costs are relatively low. The economic crisis, combined with the implementation of efficiency legislation and the Renewable Energy Directive, led to low ETS carbon prices of €16 and even lower non-ETS carbon values of €4 in 2020, significantly lower as in pre-package analyses. Hence there is still room for using relative cheap mitigation options both for CO_2 emissions in the energy sector as well for non-CO_2 emissions across sectors other than renewable energy related measures, before the marginal emission reductions at a projected uniform carbon value of €30 are reached. Moreover, as described, ETS auctioning revenues are significantly higher than in the reference scenario.

Reducing emissions fully to -30% internally in 2020 could be done for €13 billion more than in the case with use of international credits from third countries. The additional costs mainly stem from the substantially higher carbon price of €55 needed to bring about these additional emission reductions. This scenario results in very high auctioning revenues and substantial energy saving brought about by the higher carbon and electricity prices.

Table 11: Additional costs compared to the reference scenario

EU 27 (costs for 2020 in $€_{08}$)	*30% with flexibility (25% internal)*	*30% internal*
Carbon price per ton CO_2 (€)	30	55
Additional direct costs in 2020 (billion €)	25	46
Emission credit costs for reaching 30% (billion €/year)	8	
Total additional cost (including credits) in 2020 (billion €)	33	46
Total additional cost (including credits) (% of GDP)	0.22%	0.31%

Source: Calculations based on PRIMES, GAINS

Table 11 gives the additional costs of going to 30% when compared to the case in which we implement the climate and energy package targets. Total costs including those costs to do energy efficiency measures and other measures to comply with the ETS, non-ETS and renewable energy targets already in baseline and reference are higher. Table 12 summarises these total costs which are in total around €81 billion to achieve the -30% target allowing for access to the international carbon market.

Table 12: Additional costs including costs in baseline and reference scenarios

EU27 **(costs for 2020 in €2008, billion)**	**Baseline** **ETS target package**	**Reference** **non-ETS + renewable energy target package**	**-30% with flexibility** **-25% internally**	**-30% internally**
Direct costs in 2020	7	48	73	94
International credits and banked allowances	5		8	
Total cost	**12**	**48**	**81**	**94**
Total cost (% of GDP)	**0.08%**	**0.32%**	**0.54%**	**0.63%**

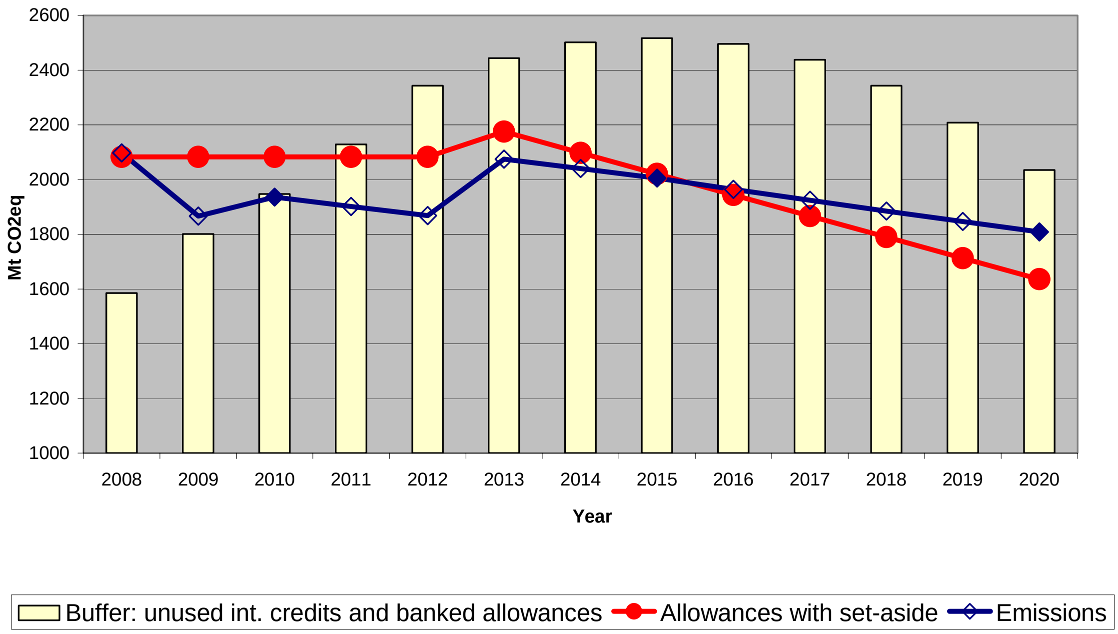
Source: Calculations based on PRIMES, GAINS

Implementing the ETS target

Specifically for the ETS, increasing the target can be achieved for instance by setting aside part of the allowances for auctioning in the period up to 2020 as an auctioning set-aside. Such a set-aside should build up gradually and reach an equivalent of around 1.4 billion tonnes in 2020, in order to simulate the -30% cost efficient split between the ETS and the non-ETS. In such a case projected emissions levels would be similar to the scenario that achieves -25% internally (see Figure 11: ETS with an auctioning set-aside). This reduces emissions substantially in the ETS compared to the reference case and actually allows for the maintenance of a significant buffer of unused international credits and banked allowances up to 2020, equal to a level between those projected in the baseline and the reference case (see Figure 5 and Figure 7).

Nevertheless, unlike in the baseline, emissions would continue to decrease up to 2020 and unlike in the reference scenario the buffer would start to decrease from 2015 and continued efforts to reduce are necessary, also after 2020. This would be compatible with longer term trajectories to meet the 2ºC objective. The total amount of auctioned allowances would reduce. Nevertheless, the carbon price increases from €16 in the reference case to €30, allowing total revenues from auctioning in 2020 to increase from €21 billion in reference to €29 billion with the auctioning set-aside.

Figure 11: ETS with an auctioning set-aside



Source: Calculations based on PRIMES, GAINS

5.3. Possible contribution of land use, land use change and forestry

This section summarizes the current state of an assessment made on land use, land use change and forestry (LULUCF) emissions and removals and their potential in the EU27 towards meeting GHG targets. This assessment has not yet been finalised.

Two different model set-ups are used to assess the impacts from forest management and afforestation/reforestation: one using the G4M + EUFASOM models combined and another one using the EFISCEN + EUFASOM models combined. Both model set-ups use largely the same input data but work at different scales and level of aggregation.

Table 13 summarises the results of the baseline projections for LULUCF for EU-27. It shows the projected changes in removals and emissions, i.e. the effects of accounting rules are not considered. This baseline is consistent with the PRIMES energy baseline (see section 3.2) in terms of the expected demand for energy from biomass and biofuels.

Net removals from the sector (i.e. LULUCF acting as a sink) will decrease significantly between 2005 and 2020 using the G4M + EUFASOM model set-up, from 175 Mt $CO_{2\text{-eq}}$ in 2005 down to 134 Mt in 2030, and beyond. The second model combination, EFISCEN + EUFASOM, suggests the sector sink to remain more or less stable until 2030. Results are preliminary pending comments from Member States and final calibration with data submitted to the UNFCCC. Nevertheless, it is clear that considerable uncertainty on baseline projections will remain, more so at the Member State level than at the EU level.

Clearly, afforestation (considered as forest established since 1990 to date) will increase, as it represent an ever increasing area. Deforestation emissions are projected to decrease slowly over the period and projections of forest management suggest that removals will decrease but the order of magnitude varies significantly between the models. Cropland emissions are projected to be slightly lower in 2020 compared to 2005 and removals on grasslands are expected to stay relatively stable.

Overall the trends in forest management are driven by both age class effects and increases in wood demand (for energy and non-energy use) resulting in a decline in the forest sink. The decline in removals from forest management is only partly offset by an increasing sink in new forests and a reduced rate of deforestation. Forest management will, however, remain the most significant activity in Europe's LULUCF carbon budget.

Table 13. EU-27 projected emissions from land use, land use change and forestry 2005-2030[a], Mt $CO_{2\text{-eq}}$

		2005	2010	2015	2020	2025	2030
Aff/Reforestation[b]	*Results from G4M*	-7.0	-16.8	-29.8	-44.7	-60.5	-76.5
	Results from EFISCEN	n/a	n/a	-69.1	-81.0	-100.3	-120.7
Deforestation	G4M	28.8	24.4	21.5	20.2	18.6	16.9
Forest management[b]	*Results from G4M*	-246.3	-209.6	-180.5	-160.6	-137.5	-114.0
	Results from EFISCEN	n/a	n/a	-328.3	-329.7	-316.7	-279.6
Cropland management	EUFASOM	69.1	67.9	64.3	61.9	61.9	61.2
Grazing land management	EUFASOM	-19.3	-20.2	-20.5	-20.8	-20.9	-21.4
SUM	*Results G4M+EUFASOM*	-174.9	-154.3	-145.0	-144.0	-138.0	-133.7
	Results EFISCEN+EUFASOM	n/a	n/a	-332.1	-349.4	-357.4	-343.6

Notes:
a. In accordance with the IPCC Guidance, for reporting purposes, the signs for removals are always negative (-) and for emissions positive (+)
b. For Forest management and afforestation/reforestation results exist from two different models (G4M and EFISCEN). They use largely the same input data but work at different scales and level of aggregation.
c. Preliminary numbers, process ongoing for peer review by country experts.

Uncertainties in terms of GHG fluxes and mitigation potential are significant and the impact of changes in the demand for bio-energy that may result from increase in renewable use beyond those in the baseline needs further analysis. GHG dynamics in the LULUCF sector involve a number of vegetation and soil carbon pools and often a complex web of GHG emissions and removals, as well as transfers between pools. The estimation of a GHG inventory for the LULUCF sector requires the net exchange (emission or removal) of GHGs with the atmosphere to be estimated with reasonable accuracy. This is difficult to achieve in practice and the uncertainties at EU15 level are in the range of 30% to 50% for forest land and even higher for other land uses[68]. Limitations in understanding of processes driving GHG dynamics in vegetation and soil can introduce significant uncertainties in projections of the responses to changes in land use and land management. The observed differences in baseline results (around a factor 2 between model combinations) can be interpreted as a proxy for the uncertainty associated with the use of different methods, although it should be stressed that these results are preliminary and that a higher degree of convergence can be expected in the

68 Draft GHG inventory 2010 for EU-15, forthcoming results from JRC (2010).

final results, especially at the EU27 level[69]. Also extreme weather events or disease related incidents can have short term impacts on the emissions and removals of this sector.

Because of the generally long time lag between the undertaking of mitigation measures and the effect on removals in the LULUCF sector, the mitigation potential through sinks is more limited in 2020 compared to the longer term up to 2030.

However, some actions may deliver significant short term benefits. For example, reductions in deforestation (conversion of forest to other land use) does not affect major areas in the EU but has relatively large impacts given the high carbon density of existing forests. This impact is larger on the short term than that of afforestation on similar areas of land, which takes many year to rebuild their carbon stock. Similarly, actions that reduce the conversion of grassland (e.g. to cropland) and the cultivation and drainage of organic soils could potentially represent an effective strategy to reduce emissions given that these represent the bulk of soil carbon emissions despite the relatively small area affected.

A proposal to include LULUCF in the EU greenhouse gas reduction commitment needs to ensure permanence and the environmental integrity of the sector's contribution as well as accurate monitoring and accounting[70].

Concluding:

- The preliminary results show a range within which the EU27 LULUCF total net sink (all activities) might decline or remain at current levels over the period leading up to 2020 and beyond.

- Real potential remains uncertain, due to the inherent complexity of GHG fluxes in the LULUCF sector and the uncertainty on assumptions on key parameters used in projections.

- Some activities in the LULUCF sector offers immediate GHG benefits. But in general there is a long time lag between the undertaking of mitigation measures and the effect on removals. This means that the mitigation potential relative to the baseline in 2020 is limited and the potential will be more pronounced in 2030. In other words, LULUCF must be viewed in a long term perspective. Macroeconomic impacts in the EU of stepping up to -30%.

5.4. Macroeconomic impacts in the EU of stepping up to -30%

5.4.1. Introduction: modelling set-up

This section assesses the macroeconomic impacts of the EU's reduction commitments for 2020 in the context of the pledges put forward in the Copenhagen Accord. The section focuses on the impact on the EU from the outcome of the Copenhagen Accord using a stylised modelling set-up. The reference case for comparing the impact of the Copenhagen Accord is the case where the EU implements unilaterally its low pledge (a reduction of -20% versus

69 Uncertainties of similar magnitude apply also to other sectors e.g. agricultural emissions (CH_4 and N_2O). These emissions are part of the reduction target for Non ETS sectors in the EU.

70 Decision 406/2009/EC of 23 April 2009, Articles 8 and 9.

1990 by 2020) and the rest of the world does not act beyond baseline. In this reference case the EU is assumed to also use international credits to comply with the -20% target.

This reference is compared with three stylized cases:

(1) The EU as well as those countries that pledged targets or action under the Copenhagen Accord implement their low pledges. This scenario is called **'Low Pledges'**.

(2) The EU goes towards it's high end pledge (-30% versus 1990) but the others remain at their low end pledges under the Copenhagen Accord. This scenario is called **'Mixed Pledges'**.

(3) The EU but also the other countries with pledges under the Copenhagen Accord go towards their high end pledges. This scenario is called **'High Pledges'**.

The E3MG and the GEM E3 models are both models that can assess macroeconomic effects. These are the direct effects of policy measures on sectors but also the indirect effects because of the interconnections between sectors. It also includes cross border direct and indirect effects given that trade is simulated in these models. Both models have the ability to assess policies in the areas of energy, environment and economic development.

E3MG (Energy Environment Economy Model at the Global level) is an econometric model while the GEM E3 model is an applied general equilibrium model. Both models where used to assess the impact of the Copenhagen Accord on the EU. See annex 10.4 for a short description of both models.

The accounting rules are stylised in a similar manner as the modelling with the POLES model (see section 2.5). As such the scenarios assessed can be regarded as the full implementation of the pledges under the Copenhagen Accord (see section 2), without uncertainties regarding the scope and the accounting rules for some of the pledges.

It was assumed that no surplus AAUs are allowed to be banked into the period post 2012 and also no new surplus AAUs are generated for the years up to 2020. For the year 2020 itself any existence of surplus AAUs is taken into account if targets for countries are less ambitious than baseline emissions in 2020.

Furthermore, two different scenarios are modelled: with access to the international carbon market and without access. In the case without international carbon market each country's pledge is met internally. With access to the international carbon market GEM E3 assumes that there is a limit on the amount of credits from third countries that can be used for compliance (set at 1/3rd of the distance between pledge and baseline) while the E3MG model does not assume any limit on this use. Only those countries with a pledge participate in the carbon market and generation of credits for the carbon market would come from reductions on top of reductions made to meet the pledges themselves. Developed countries are assumed not to be potential net sellers into the carbon market with the exception of economies in transition such as Russia and Ukraine. In E3MG the pledge covers all CO_2 emissions but does not include non-CO_2 greenhouse gases whereas in the GEM E3 model the pledge does also include these non-CO_2 emissions from agriculture.

In the reference scenario, the EU is assumed to implement the unilateral target (-20% compared to 1990 by 2020) through the agreed ETS and non-ETS targets, allowing for the use of credits from third parties as foreseen under the Climate and Energy Package. All scenarios are compared to this reference.

The allocation method for the allowances is in principle free allocation. In E3MG allowances are allocated for free to EU industries with the exception of auctioning for the EU power sector. Both GEM E3 and E3MG were used to assess variants of the allocation method in the EU for both ETS and non-ETS sectors.

In E3MG the recycling of revenues was done through reductions of social security contributions of employers (50%), subsidizing renewable energy (35%) and increasing R&D expenditures (15%). In GEM E3 revenues were fully used to reduce labour costs.

Table 14 summarizes the pledges simulated in the E3MG and GEM E3 scenarios for the key countries. The pledges for China and India are expressed as carbon intensity reductions compared to 2005. For some of the smaller regions differences may exist between the models given the different representation of regions in the two models.

Table 14. Pledges used in E3MG and GEM E3

Region	**Low (base year)**	**High (base year)**
US	-17% (2005)	-17%(2005)
Japan	-25% (1990)	-25%(1990)
EU27	-20% (1990)	-30%(1990)
Russia	-15% (1990)*	-25%(1990)
China	-40% (CO_2/GDP)	-45%(CO_2/GDP)
India	-20% (C/GDP)	-25%(C/GDP)
Brazil	-2.7%(BAU)	-8%(BAU)
** In GEM E3 the low end pledge for Russia was set at -20%*		

5.4.2. GDP Impacts

Table 15 shows the potential impact on GDP of the outcome of the Copenhagen Accord, if implemented in a manner that respects environmental integrity, as function of the ambition level of the pledges (see description stylised scenarios section 5.4.1).

Additional costs (measured as GDP loss) are very low in the EU in the Low case with access to the carbon market. This is logical given that it compares to a situation where the EU would implement anyway the low case unilaterally with access to the carbon market. Impacts in the low case with global carbon market remain negative for the EU since there is a slight global negative impact on GDP (affecting EU exports) and given that credits from third countries become relatively more expensive due to the increased demand from other countries for such credits.

Costs to move to -30% compared to a situation were the EU implements the -20% stay limited if there is access to the carbon market. Costs stay in both models around 0.5% of GDP. Without access to the carbon market costs would increase from 1 to 1.5%.

Table 15: Effects on GDP (% difference from the reference)

GEM E3	All pledges Internal			Access to international credits		
	Low	Mixed	High	Low	Mixed	High

EU27	-0.4	-1.0	-1.0	-0.2	-0.5	-0.6
US	-0.9	-0.9	-0.9	-0.5	-0.5	-0.6
Japan	-0.8	-0.8	-0.9	-0.4	-0.5	-0.5
Russia	-0.1	-0.2	-0.6	-0.9	-1.0	-1.9
China	-0.9	-0.9	-1.6	-0.7	-0.8	-1.8
Brazil	-0.4	-0.4	-0.2	-0.1	-0.1	0.1
India	-0.2	-0.2	-0.4	-0.6	-0.7	-1.5
E3MG	All pledges Internal			Access to international credits		
	Low	Mixed	High	Low	Mixed	High
EU	-0.5	-1.2	-1.5	-0.1	-0.2	-0.4
US	-0.4	-0.6	-0.6	-0.4	-0.4	-0.5
Japan	-0.3	-0.3	-0.3	-0.1	-0.2	-0.3
Russia	0	0.1	0.1	-0.1	-0.1	-0.1
China	0	0.2	-0.8	0	0.1	0.2
Brazil	-0.1	-0.1	-0.2	0	0	0
India	0	-0.3	-0.1	0	0	-0.1

Source: GEM E3, E3MGE

Table 15 presented costs assuming that all sectors in the EU would meet their targets through free allocation, except for the results with the E3MG model that assumed that the EU electricity sector would not get allowances allocated for free but through auctioning. Macroeconomic effects depend to some extent on how the allocation of allowances is done across sectors. To give insights into this, different allocation variants for the EU were simulated with both models.

In E3MG a variant was run of the scenarios with access to the international carbon market where on top of the auctioning for the electricity sector there would not be free allocation to the non-ETS sectors but a carbon tax[71]. Free allocation would remain for ETS sectors other than electricity. The tax revenues from the non-ETS sectors are used to reduce social security contributions paid by employers.

This results in a significant improvement of the overall GDP impacts due to the increased recycling of revenues that increases output in both labour intensive as well as other sectors.

Table 16: Impact of a carbon tax in the non-ETS on GDP compared to reference (E3MG)

	Access to International Credits			
	Low	**Mixed**	**High**	**High**
				+ Carbon Tax non-ETS
EU27	-0.1%	-0.2%	-0.4%	-0.1%

Source: E3MG

Similarly with the GEM E3 model 3 additional variants were run on top of the one that assumes free allocation for both the ETS and non-ETS sectors:

– Auctioning only for the power sector, free allocation other ETS, free allocation in the non-ETS

71 Note that from a modelling perspective, taxation and full auctioning give similar results.

– Auctioning for all ETS sectors, free allocation in the non-ETS

– Auctioning for all ETS sectors, tax non-ETS

Increased revenues are assumed to be used for reducing labour costs.

The result of the GEM E3 projections confirm that auctioning and taxation improve overall macroeconomic results given the way revenues are recycled. This even could lead to less negative or even positive GDP outcomes compared to a situation where the reductions are fully achieved with free allocation and no auctioning or tax at all.

Table 17: Impact of different allocation scheme on EU GDP compared to reference (GEM E3)

	Access to international credits			
ETS	Free allocation	Auctioning for Power	Auctioning all ETS sectors	Auctioning all ETS sectors
non-ETS	Free allocation	Free allocation	Free allocation	Tax
Low	-0.2%	-0.1%	0.1%	0.4%
Mixed	-0.5%	-0.3%	0.0%	0.6%
High	-0.6%	-0.3%	-0.1%	0.6%

Source: GEM E3

Of course the demonstrated increase of overall productivity in the economy depends also on how the revenue is recycled. Other recycling policies might have less beneficial impacts on GDP. Member States may place for instance a high priority in coming years on strengthening their public finances. But these results show how good and smart policy design could improve the impacts of any increase to higher GHG reductions.

5.4.3. Employment Impacts

When allowing access to the international carbon market, effects on employment from the full implementation of the Copenhagen Accord are generally modest for the EU compared to the reference case where the EU acts alone with access to the international carbon market (see Table 18). If the EU would move to 30% with access to the carbon market and other countries would stay at the low pledges, the effect on EU employment would be neutral or slightly negative (-0.3%) (note that access to the carbon market is limited in the GEM E3 runs, therefore having higher negative impacts). If all countries would opt for the high end of the pledges employment with access to international credits, employment effects might marginally decrease further to between -0.1% and -0.3%.

Table 18: Impacts for EU unemployment (% change compared to reference)

Impact EU employment compared to reference case						
	All pledges Internal			Access to International carbon market		
	Low	Mixed	High	Low	Mixed	High
E3MG	-0.1%	-0.4%	-0.4%	0.0%	0.0%	-0.1%
GEM E3	-0.2%	-0.6%	-0.6%	0.0%	-0.3%	-0.3%

Source: GEM E3, E3MG

E3MG assumes auctioning only for the EU electricity sector in all the projections used for Table 18. But employment effects are less striking or even positive if larger amounts of revenues can be recycled. Table 19 adds a variant that introduces also a tax in the non-ETS sectors that is used to reduce social security contributions paid by employers. This tax comes on top of the auctioning of allowances for the power sector in the ETS. This results [2]net employment increases by around 160 000 jobs by 2020.

Table 19: Impact of a carbon tax in the non-ETS on employment compared to reference (E3MG)

Impact EU employment compared to reference case				
	Access to international credits			
	Low	Mixed	High	High
				+ Carbon Tax non-ETS
EU27	0.0%	0.0%	-0.1%	0.1%

Source: E3MG

GEM E3 assumes free allocation to all sectors in all the projections used for Table 18. But similarly to the E3MG results of Table 19, employment effects are less or even positive compared to reference if larger amounts of revenues can be recycled to reduce labour costs. Table 20 gives the results of different allocation variants. The introduction of auctioning only for the power sector already has a positive impact compared to a situation that no auctioning or taxation at all is applied. The best impacts are achieved with the introduction of taxation in the non-ETS. The increase of employment with 0.7% implies that net employment increases with more than 1 million jobs in 2020.

Table 20: Impact of different allocation scheme on employment compared to reference (GEM E3)

	Access to international credits			
ETS	Free allocation	Auctioning for Power	Auctioning all ETS sectors	Auctioning all ETS sectors
non-ETS	Free allocation	Free allocation	Free allocation	Tax
Low	0.0%	0.1%	0.2%	0.5%
Mixed	-0.3%	-0.1%	0.1%	0.7%
High	-0.3%	-0.1%	0.1%	0.7%

Source: GEM E3

The same conclusion can be drawn as in sections 5.4.2. The demonstrated effects on employment depend on how the revenue is recycled. Positive impacts on labour costs could potentially be lower for recycle policies that focus less on labour costs reductions. Member States could for instance choose to strength their public finances.

5.4.4. Sectoral impacts on employment and economic activity

The conclusions from the economic modelling confirm the result from other studies that the macroeconomic impact of environmental and climate policy on economic activity and employment is generally small. The required expenditures result in a redirection of employment and activity as part of a process of structural change to limit climate change. The net effect consists of the creation of jobs (directly and indirectly) in certain sectors and the reduction of jobs in other sectors.

For the EU a reduction of GHG emissions from 20% to 30% is expected to create, in particular but not only, a further stimulus for employment in the renewable sector and in energy efficiency sectors. See for instance PRIMES result that show a reduction in energy consumption and an increase in renewable use of stepping up to 30% (see section 5.2). Evidence for 2005 on direct and indirect employment effects in the renewable sector shows that nearly 1.4 million people were employed in that sector. Direct employment related to investments, O&M expenditure and fuel costs was estimated at 775 000 jobs. The indirect jobs created through multiplier effects (increase in demand in other sectors) amounted to 606 000 resulting in a total of 1.381 million jobs (Table 21)[72]. Assuming that the total number of jobs depend on the volume of renewable energy (in Mtoe) allows estimating the number of direct and indirect jobs that will be created in the renewable sector when moving from 20 to 30% (see section 5.2 for projected increases in renewable use of stepping up to 30%). This is an overestimation since increases in labour productivity in this sector over time are ignored. In addition, it does not take into account the different employment impacts that might result from each type of renewable energy. Bearing that in mind, this implies that in the reference scenario (reflecting the climate & energy package and meeting a 20% renewable target) nearly 3.5 million people would be employed in the renewable energy sector in the EU: 0.9 million more than in the baseline. Moving from a 20% reduction to 25% (internally) would create 43 000 jobs in addition. Moving to 30% internally could create 65 000 (gross) jobs in addition only in the renewable sector. These findings are also fully in line with the EmployRES study[73].

Table 21: Potential additional direct and indirect employment effects in the renewable energy sector of a 30% reduction compared to a 20% reduction (the reference)

	2005	baseline	reference	25%	30%
Direct jobs	775 000	1 580 000	2 115 000	2 142 000	2 155 000
Indirect jobs	606 000	1 014 000	1 358 000	1 375 000	1 383 000
Total	1 381 000	2 594 000	3 473 000	3 516 000	3 538 000
Additional to baseline			879 000	922 000	944 000
Additional to reference				43 000	65 000

In addition, analysis done in the context of revision of the energy efficiency action plan indicates that energy efficiency increases employment. For every Mtoe energy saved; it might create 1 000 direct jobs. Since a step of 20 to 30% (doing 25% internally and 5% through international credits) is expected to save some 60 Mtoe around 60 000 jobs might be created directly. This is in line with other studies that suggest that 40 to 60 jobs are created per PJ of (primary) energy saved or around 2 000 jobs/Mtoe saved[74]. Analysis showed that a better implementation of the improved energy efficiency resulting from the energy in Buildings Directive could create directly 10 000 to 100 000 jobs[75]. This is confirmed by other studies

72 http://ec.europa.eu/energy/renewables/studies/doc/renewables/2009_employ_res_report.pdf

73 EmployRES : http://ec.europa.eu/energy/renewables/studies/doc/renewables/2009_employ_res_report.pdf, Ecofys, 2005.

74 See UNEP (2008) Green jobs: towards sustainable work in a low-carbon world. (http://www.unep.org/PDF/UNEPGreenJobs_report08.pdf). Worldwatch Institute, Washington, p 133.

75 See: http://www.euroace.org/EuroACE%20documents/060522%20Financing%20Building%20Energy%20Efficiency%20in%20the%20Enlarged%20European%20Union%20%5Bfinal%20report%5D.pdf

suggest that renovating the existing building stock in combination with energy efficiency improvements, in the 10 Member States that joined the EU in 2004, might create 50 000 to 185 000 new jobs directly[76]. A UNEP report suggests that a 20% reduction in energy consumption in the EU might create 1 million jobs[77]. The same report indicates that greening the building industry in the EU and US would create at least 2 million jobs. With a goal of 75% reduction in carbon emissions by 2030 even 2.5 million jobs might be created. Stepping up to 30% might thus create directly and indirectly a significant number of jobs in particular in sectors dealing with the renewable energy and energy efficiency.

Leading and being more innovative also allows benefiting from a rapidly growing world market for low carbon production technology, leading to further additional exports with subsequent positive impacts on employment. This is not unlikely. If the world would indeed put itself towards a 2ºC compatible pathway, then global renewable capacity could increase by 75% globally already between 2010 and 2020 (from 1 250 to 2 200 GW)[78]. Maintaining the strong position of EU companies in such rapid growing world market would give another boost to employment in Europe but is also a challenge given that other regions will start developing rapidly their own expertise and capacities. Lagging behind would imply that others might make use of the opportunities offered by a growing global market.

The result of the economic modelling in section 5.4.3 and empirical evidence confirms the impression from other studies that overall climate change policy will have a modest aggregate economic impact on job growth in the EU. As the modelling also shows, the nature of the policy measures to achieve the targets would be likely to have a significant impact. Recycling of tax or auctioning revenues into reducing labour taxes may have a significant positive impact on increasing employment resulting in net positive impacts on employment.

But while there are positive impacts on employment in some sectors, others can expect a reduction of employment due to reductions in fossil fuel consumption and reductions in investments in fossil fuel fired plants and by increases in energy costs. This points to need for restructuring. These may differ between sectors and regions. The extent of these differences have not been examined in this analysis.

The literature gives diverging views on the impacts of increasingly "green" jobs on the direction of job quality. With respect to the skills, there will be need for both, re-skilling and up-skilling, and education and trainings systems have to adapt to this challenges. It is important that the costs will be shared among various actors. The transition to a low-carbon economy is likely to be more beneficial to high-skilled workers in the initial phase as transitions to new activities call for the implementation of advanced technologies for which the high-skilled have better qualifications, with the introduction of new 'green' technologies increasing the demand for corresponding skills, and rendering obsolete others. However, it is expected that in the medium term and the faster these technologies mature, lower skilled workers will also be able to fill these jobs –provided they receive adequate training and education.[79] The Commission has already developed some initiatives in this field, notably the

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76 See http://www.ecofys.nl/com/publications/documents/EURIMA_Nov05.pdf, in the 10 new EU Member States by retrofitting the existing building stock (see page 67).

77 UNEP (2008) Green jobs: towards sustainable work in a low-carbon world. (http://www.unep.org/PDF/UNEPGreenJobs_report08.pdf). Worldwatch Institute, Washington.

78 DG JRC, POLES, results of model projections discussed in section 4.

79 Employment in Europe Report 2009.

initiative New Skills for New Jobs[80] that aims to facilitate better anticipation of skills need in the EU. Further to that, Flagship Initiative "An agenda for new skills and jobs" of the Europe 2020 Strategy outlined the importance of implementing specific measures to assist affected workers in this transition, to improve the quality of jobs and to help sectors to make the transition to new low carbon opportunities.

Pricing carbon emissions (be it in the ETS or non-ETS) can raise revenues and improve market efficiency and stability. Such new sources of finance can also contribute to more robust financial systems[81]. The generally more labour-intensive, high productivity nature of environment related activities implies that a shift towards a lower-carbon economy can be accompanied by an increase in employment. The current eco-industry employment trends and employment multipliers imply that this effect is likely to be spread across Member States rather independently of national income. The spread will be affected by existing structures of the economies, such as dependence on fossil fuels, and so different policies for different regions would help mitigate job losses. The empirical evidence confirms the result from modelling that moving from 20 to 30% may have positive impacts on employment in the EU. Taking into account the job losses in other sectors, well designed labour and carbon tax policy might ensure that the number of net jobs created (new jobs minus losses) outbalances higher the number of jobs lost.

5.5. Co-benefits: energy security and reduced air pollution.

The additional reduction in GHG emissions of stepping up to 30% compared to the reference scenario will further reduce air pollutant emissions and improve energy supply security. This is so because of the reduction in energy consumption and a shift in the pattern of energy use towards renewable energy sources. For this analysis the same methodology was employed using the GAINS model as in the Climate and Energy Package. The analysis permits a broad estimation of the changes in on air pollution impacts, including air pollution control costs and physical health impacts. This analysis indicates that reducing GHG emissions to -25% or -30% below 1990 by 2020 will further reduce emissions of particulate matter (PM), sulphur dioxide (SO_2) and nitrogen oxides (NO_x) in the EU by 4 to 9% (see Table 22). This will lower the costs associated with pollution abatement equipment required under the reference scenario. This can also be expected to further reduce the costs of the Thematic Strategy on Air Pollution of 2005[82].This reduction in air pollution control costs might be as large as a third of the additional costs of controlling the GHG emissions to reach the 30% target (see Table 22). The reduction of air pollution accompanying the reduction in greenhouse gas emissions will also reduce mortality and morbidity due to reductions in small particles and ground level ozone. Damage to materials, crops and sensitive ecosystems (due to acidification, excess nitrogen deposition and ground level ozone) will also be reduced. As such, climate change policies will contribute to the achievement of the health and environmental objectives of the 2005 Thematic Strategy on Air Pollution. Notwithstanding the reduced air pollutant emissions from a move to -30% GHG emissions, there will still remain a need to implement additional measures to ensure delivery of the Thematic Strategy's objectives.

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80 See http://ec.europa.eu/social/main.jsp?catId=822&langId=en.

81 See: http://ec.europa.eu/economy_finance/articles/international/documents/innovative_financing_global_level_sec2010_409en.pdf

82 COM (2005) 446

Table 22. Impacts on air pollution and air pollution control costs

Change compared to reference case		
	30% with flexibility (25% internal)	30% internal
SO_2 emissions (kt)	-199	-424
NO_X emissions (kt)	-171	-350
PM2.5 emissions (kt)	-27	-54
Air pollution reduction (% cf to the reference case in 2020 (sum SO_2, NO_X and PM2.5)	4	9
Reduction health damage compared to reference (€$_{08}$ billion/year)	3.5 to 8.1	7.3 to 16.7
Reduction Air pollution control costs (€$_{08}$ billion/year)	2.8	5.3

Note: based on GAINS model for emission, health impacts and air pollution control costs. Benefit valuation uses valuation of mortality used for the 2005 Thematic Strategy on Air Pollution and 2008 Climate and Energy package. Morbidity not included in health damage. Air pollution control cost estimates use a 4% social discount rate and would be higher with private discount rates used in PRIMES.[83]

In addition to these air pollution effects, a reduction in GHG emissions of 30% will reduce oil and gas imports compared to the reference scenario. These effects are included in the aggregate impacts reported from the modelling exercises in section 5.2. In case of a -25% reduction in GHG emission domestically oil imports would be reduced by around 11 Mtoe (1% lower than the reference in 2020). Gas imports would be 1% lower (10 Mtoe). A -30% reduction domestically would reduce oil imports by 2% or some 18 Mtoe. Gas imports would be 12 Mtoe or 3 % lower than the reference scenario in 2020.

Table 23 indicates that the reduction in oil and gas imports implies a reduction in the import bill of around €9 billion in 2020 in case of a -25% reduction domestically compared to the reference scenario. In case of a -30% reduction domestically in greenhouse gas emissions the EU would have to pay some €14 billion less to import oil and gas. The majority of the savings would come from a reduction in oil imports. The energy import dependency of the EU would be slightly reduced compared to the reference case, from nearly 57% to around 56%.

Table 23: Reduction in oil and gas imports (bn €2008).

Domestic GHG reductions vs 1990 by 2020	-25%	-30%
Oil	5.5	9.7
Gas	3.6	4.5
Sum	9.1	14.1

Source: PRIMES

Compared to the baseline, a 30% reduction internally would lower oil imports with 41 Mtoe and gas imports with 65 Mtoe. With flexibility (a 25% reduction internally) oil imports would be 33 Mtoe and gas imports 62 Mtoe lower. A 30% reduction internally reduces the oil and

[83] See Annex to SEC(2008) 85/3 i.e. page 77.

gas import bill of €45.5 billion in 2020. A 25% reduction in GHG in the EU reduces the import bill by €40.5 billion.

5.6. Emissions from international bunker fuels

5.6.1. International aviation

International aviation is a sector with rapidly increasing greenhouse gas emissions. These emissions are not monitored and accounted for as part of national policies, obligations and communications under the UNFCCC framework. For the EU27, international aviation emissions have increased by 110% between 1990 and 2007 and now amount to nearly 140 Mt CO_2.

To contribute towards providing a solution to this problem, the EU has included both domestic and international aviation emissions from flights departing from and arriving at EU airports into the EU ETS. From 2012 onwards, emissions will be capped at 97% of average 2004-2006 emissions, falling to 95% of 2004-2006 emissions from 2013. This enlarged scope of the EU ETS is reflected in the PRIMES energy system modelling based on Eurostat data[84]. Projected emissions, therefore, in the baseline, and the reference and policy scenarios used by the PRIMES model (see sections 3.2, 3.3 and 5.2) already include the EU-related contribution of this sector and the effect of its regulation by inclusion in the EU ETS.

5.6.2. International maritime transport

Accurate data about the level of GHG emissions from ships in international traffic are not publically available because there are no international requirements for ships to report fuel used or the resulting emissions. The majority of the climate impact of shipping is from the CO_2 emissions from the combustion of fossil fuels for propulsion and electricity/steam generation. Estimates are available based on fuel consumption combined with assumptions on fleet composition and shipping activity coming from the International Maritime Organisation (IMO)[85]. These estimate CO_2 emissions from international shipping at 870 million tonnes, or about 2.7% of the global emissions of in 2007. CO_2 emissions from international shipping amounted to 468 million tonnes in 1990, representing a growth of 86% over the period. The average yearly growth rate over the last 17 years has thus been of about 3.7%. Increases in emissions have been largely driven by the growth in world trade, 90% of which is carried by sea, and a trend towards larger, faster, more powerful vessels.

Figure 12: CO_2 emissions from shipping

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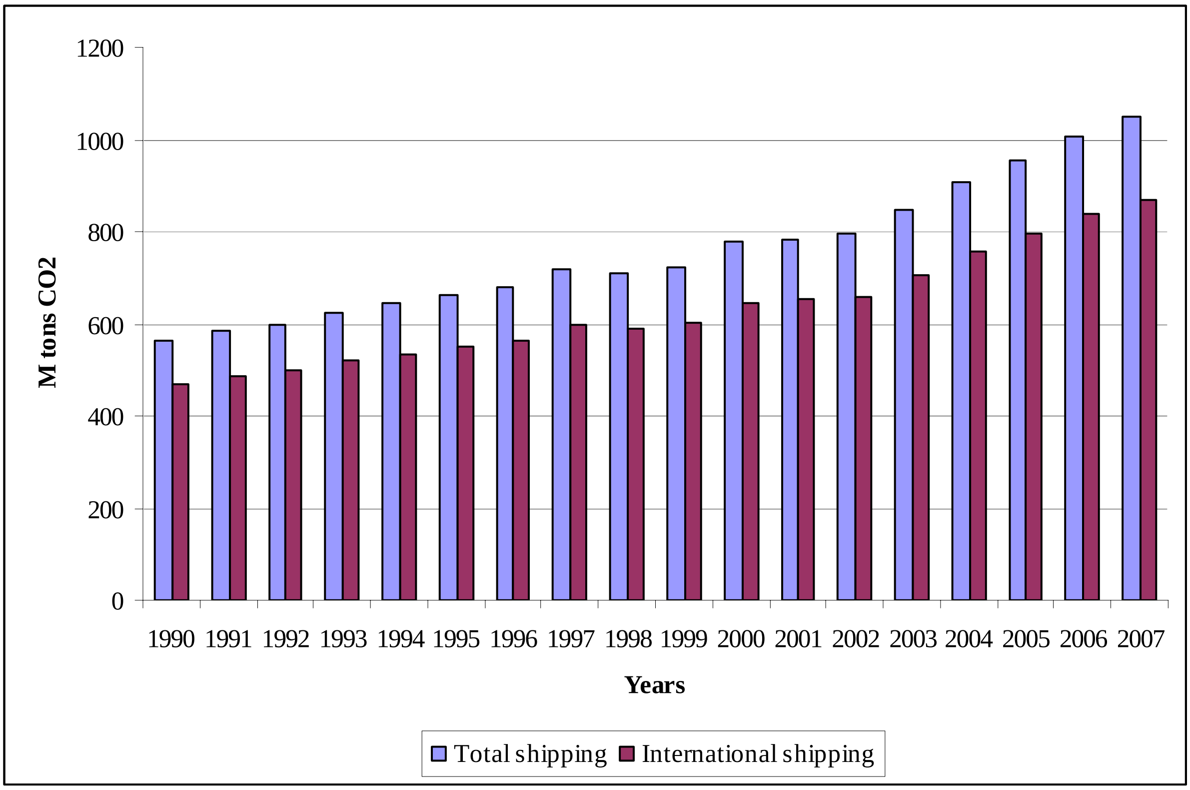
84 Eurostat and international data is based on fuels purchased and hence usually covers domestic and outgoing flights.

85 International Maritime Organization, 2009



Source: IMO 2009

Emissions from maritime bunkers are projected to continue growing fast until 2020 and beyond. According to estimates done with the POLES model, emissions from maritime transport could increase nearly 48% from 2005 to 2020 in a baseline scenario.

The vast majority of these emissions are from the largest ships. 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.

For the EU CO_2 emissions due to shipping from, to and within the EU have been estimated by CE Delft (Jasper et al., 2009)[86] at about 310 Million tonnes in 2006. This includes domestic and international shipping, both for cargo and for passenger transport, as well as for fishing boats. As the domestic part is already included in EU domestic emissions, the international part is a bit smaller. Based on information from Jasper et al. and IMO, it can be assumed that the international part of EU maritime CO_2 emissions was 70-80% or between 220 and 250 Million tonnes in 2006. This corresponds to about 26-30% of global international maritime emissions. Without policies or technical improvements EU emissions from ships might be 50% higher in 2020 and double by 2030.

Reduction potential and costs

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86 Jasper Faber, A. Markowska, D. Nelissen, M. Davidson, V. Eyring, I. Cionni, E. Selstad, P. Kageson, D. Lee, O. Buhaug, P. Roche, J. Graichen, W. Schwarz.: Technical support for European action to reducing Greenhouse Gas emissions from international maritime transport. Report for the EC. Tender DG ENV, C3/ATA/2008/0016. December 2009.

While emissions are rising fast, there is considerable potential for reductions using currently available technologies and techniques for both existing and new vessels. According to the IMO 2009 study, a significant potential for reduction of GHG through both technical and operational measures exist, many of which seem to be cost effective (although some nonfinancial barriers remain). Operational improvements for both new and existing vessels can deliver reductions from 10% to 50% in CO_2 emissions, while for new ships more efficient engines, improved design of hulls and propeller could deliver reductions of up to 50%[87]. 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 improve operational procedures and to stimulate technological developments and implementation. By 2030, CO_2 emissions from shipping could be reduced about 33% at negative marginal abatement costs, relative to a frozen technology baseline[88]. However due to market failures and barriers, only a fraction of this potential is likely to be implemented. At a cost of some €30/tCO_2 reductions of 35% or 160 to 180 Mt, might be possible in 2030. In conclusion, emissions from international maritime bunkers, also in the EU, offer scope for very cost effective reductions.

With the approval of the Climate and Energy Package, Council and Parliament noted that all sectors of the economy should contribute to achieving GHG emission reductions, including international maritime shipping and aviation[89]. Aviation is contributing to these reductions through its inclusion in the EU ETS. But Council and Parliament also requested that, in the event that no international agreement which includes international maritime emissions in its reduction targets through the International Maritime Organisation has been approved by the Member States or no such agreement through the UNFCCC has been approved by the Community by 31 December 2011, the Commission should make a proposal to include international maritime emissions according to harmonised modalities in the Community reduction commitment, with the aim of the proposed act entering into force by 2013.

6. IMPACTS ON ENERGY INTENSIVE SECTORS

6.1. Introduction

The ETS is central to the EU's commitment to address climate change, setting a cap on emissions and thereby providing a price signal to industry for reducing CO_2 emissions at the lowest cost. However, a risk of carbon leakage can arise in case installations competing in the same market are not confronted with the same carbon constraints as in the EU. This could lead to a loss of market share to installations outside the EU and an increase in greenhouse gas emissions, undermining the environmental integrity of actions by the EU.

87 IMO, 2009

88 These costs depend heavily on fuel prices: for the CE Delft study (Jasper et al., 2009) the underlying fuel price is 89.5$/bl oil by 2030.

89 Decision No 406/2009/EC and Directive 2009/29/EC

The direct impacts are most important for certain sectors where the pass-through of the cost of allowances into prices is difficult. The climate and energy package contains provisions to prevent the risk of carbon leakage in the amended ETS Directive which have been designed for a unilateral 20% reduction by the EU, where other countries do not commit to emission reductions.

This risk of carbon leakage would, however, decrease, with a proper global international regime on climate change, as industries in other world regions would face the same efforts of applying measures to reduce emissions. Therefore, the ETS Directive (Article 10b) mandates the Commission to submit by end of June 2010 an analytical report in the light of the outcome of the international negotiations assessing the situation of energy-intensive sectors that have been deemed to be exposed to significant risks of carbon leakage. This should be accompanied by any appropriate proposals, if necessary to prevent carbon leakage under the new situation in the light of Copenhagen. The ETS Directive states that proposals may include inter alia adjustment of the proportion of allowances received free of charge by sectors deemed to be exposed to a significant risk of carbon leakage, or inclusion into the EU system of importers from these sectors.

The following sections analyse the situation of energy-intensive industry in the light of the outcome of international negotiations, assessing the impact of low and high pledges in the Copenhagen Accord.

6.2. The situation of energy intensive sector half-way through phase 2 of the EU ETS

Member States have in their national allocation plans for phase 2 (2008 to 2012) allocated free allowances to major energy-intensive industry taking into account expected production levels. On top of such allocation at expected needs energy intensive industry are also allowed to use a certain amount of international emission credits which can be surrendered for compliance purposes.

The recession has produced a significant amount of "unintended over-allocation" to those industrial installations that were already under the scope of the ETS in phase 2. This can be witnessed in the significant drop of ETS emissions from 2008 to 2009. While electricity generators in aggregate show a deficit of free allowances in relation to emissions reported in 2009, emissions from industrial sectors show an aggregate surplus of allowances as high as 20 or 30 %[90]. Despite the gradual economic recovery, it is expected that the surplus for some of the most exposed energy intensive sectors will continue to grow over the remaining years of phase 2 (from 2008 to 2012). However, the crisis has hit different sectors differently.

6.3. Model projections to assess impacts on energy intensive sectors

Using the GEM E3, E3MG and PACE models the impact of the Copenhagen Accord on carbon leakage risk was assessed for the energy intensive industries, with the PACE model having more sectoral disaggregation than GEM E3 and E3MG.

90 Community Independent Transaction Log, Report on Verified emissions for 2008-2009 and allocations for 2008-2009: http://ec.europa.eu/environment/climat/emission/citl_en_phase_ii.htm

The scenarios assessed were the same model runs as presented in section 5.4. that compared three stylised cases to a reference case where only the EU implemented its low-end pledges and the others stayed at baseline.

(1) Low Pledges: One where all countries implement their low end pledges under the Copenhagen Accord.

(2) Mixed Pledges: One where the EU implements its high end pledge but the other countries only implement their low end pledges under the Copenhagen Accord.

(3) High Pledges: One where all countries implement their high end pledges under the Copenhagen Accord.

All projections presented in this section assume that there is access to international credits. The E3MG model projections do not assume any limit on this use, the GEM E3 and PACE do. In GEM E3 the use of credits from third countries for compliance is limited at a third of the distance between the pledge and baseline emissions. In PACE, each scenario assumes a CDM use in 2020 set at 42 percent of the reduction efforts of the Annex I regions besides EU27[91]. In PACE, for the EU27, a CDM use is set in the non-ETS sectors up to 3% of 2005 non-ETS emissions and in ETS sectors of up to 50% of the reduction requirements. Only those countries with a pledge participate in the carbon market and generation of credits for the carbon market would come from reductions on top of reductions made to meet the pledges themselves.

GEM-E3

The results of the GEM E3 scenarios compare the impact of the pledges of the Copenhagen Accord to a situation that the EU acts alone with a target of -20%, the so called reference case.

The main result of the GEM E3 projections is that the full implementation of the low pledges of the Copenhagen Accord would be beneficial for EU energy intensive industries compared to the situation that the EU acts alone and implements its low pledge unilaterally without action by others. Implementation of the low end pledges by others under the Copenhagen Accord would improve the relative competitive position of EU energy intensive industry compared to the situation where the EU acts alone and thus reduce carbon leakage.

If EU targets would be increased unilaterally to -30% this reverses compared to the reference case into a net reduction in production, with a maximum reduction of -1.2%, in case of access to the international carbon market for the chemical products sector, in addition to the output losses in the reference case. This relative loss reduces again, if other countries would also implement their high pledge.

Different impacts compared to baseline are notable for different regions when they implement their pledges. Brazil's energy intensive sectors would gain on average, even if they need to implement pledges, probably reflecting the fact that they become more competitive on a global scale now that all major partners act and the Brazilian economy is relatively CO_2 efficient and their abatement is mainly in non-industrial activities. Furthermore, emissions of

[91] The share of 42% is the equivalent to the rule applied in the EU-27 in the PACE scenarios.

India's energy intensive sectors are lower showing still large scope to supply credits into the international carbon market beyond their own pledges. This is not the case for the Chinese energy intensive industries, whose emissions mainly decline because of China's own pledge. Russia sees production decrease, due to a similar effect as India because they also supply the carbon market due to the low ambition in their pledge.

Table 24: Impact on the production of ferrous and non ferrous metals (GEM E3) compared to reference

Impact on the production of ferrous and non ferrous metals compared to reference			
	Access to international carbon market		
	Low	Mixed	High
EU	0.5%	-1.1%	-0.4%
US	-0.6%	-0.4%	0.2%
Japan	-2.2%	-2.1%	-1.3%
Russia	-5.7%	-4.4%	-7.7%
China	-1.8%	-2.0%	-7.0%
Brazil	-0.7%	-0.5%	3.2%
India	-5.0%	-5.1%	-8.9%

Source: GEM E3

Table 25: Impact on the production of chemical products (GEM E3) compared to reference

Impact on the production of chemical products compared to reference			
	Access to international carbon market		
	Low	Mixed	High
EU	0.3%	-1.2%	-0.9%
US	-1.8%	-1.6%	-1.1%
Japan	-2.5%	-2.2%	-1.3%
Russia	-6.1%	-5.2%	-10.6%
China	-0.8%	-0.6%	-3.6%
Brazil	0.3%	0.5%	1.8%
India	-1.6%	-1.5%	-3.4%

Source: GEM E3

Table 26: Impact on the production of other energy intensive industries (GEM E3) compared to reference

Impact on the production of other energy intensive industries compared to reference			
	Access to international carbon market		
	Low	Mixed	High
EU	0.4%	-1.0%	-0.6%
US	-0.5%	-0.4%	0.0%
Japan	-0.9%	-0.9%	-0.4%
Russia	-0.7%	0.2%	-0.2%

China	-3.5%	-3.7%	-8.6%
Brazil	1.0%	1.3%	4.3%
India	-6.7%	-6.8%	-12.6%

Source: GEM E3

GEM E3 assumes free allocation to all sectors in all the projections used for Table 24, Table 25 and Table 26[92]. To assess the impact of other allocation methods than free allocation, three additional variants were run that have limited free allocation in both the ETS and non-ETS sectors (simulated as auctioning and carbon taxes respectively). It was assumed that the revenue raised in each variant would be recycled to reduce labour costs. Almost all variants that introduce auctioning in the ETS have small beneficial effects on production in the energy intensive sectors due to the recycling of revenues. The introduction of a tax and the associated recycling in the non-ETS sectors also has beneficial effects for the production in the energy intensive sectors. This should be taken as an indicator that well designed policies that recycle revenue optimally, could lead to lower overall impacts.

Table 27: Impact of different allocation scheme on production in energy intensive industries (GEM E3)

		Access to international credits			
ETS		Free allocation	Auctioning for Power	Auctioning all ETS sectors	Auctioning all ETS sectors
non-ETS		Free allocation	Free allocation	Free allocation	Tax
ferrous and non ferrous metals	Low	0.5%	0.5%	0.5%	0.5%
	Mixed	-1.1%	-1.1%	-1.1%	-1.0%
	High	-0.4%	-0.5%	-0.4%	-0.4%
chemical products	Low	0.3%	0.4%	0.5%	0.7%
	Mixed	-1.2%	-1.1%	-0.9%	-0.5%
	High	-0.9%	-0.8%	-0.6%	-0.1%
other energy intensive industries	Low	0.4%	0.5%	0.6%	1.0%
	Mixed	-1.0%	-0.7%	-0.5%	0.1%
	High	-0.6%	-0.3%	-0.1%	0.5%

Source: GEM E3

E3MG

Also the E3MG scenarios compare the impact of the pledges of the Copenhagen Accord to a situation where the EU acts alone with a target of -20%, the so called reference case. The results with the E3MG model are in line with the results of the GEM E3 model. Moving to a 30% reduction in the EU leads to additional output losses of energy intensive industries in the EU, albeit below 0.5%. The highest output loss is expected in the rubber and plastic and the non-metallic minerals products sector.

[92] The free allocation in the scenarios in GEM E3 and E3MG to energy intensive industries is determined through what the cost effective level of emissions would be in the individual ETS sectors per sector if all reductions would have to be achieved internally in the ETS in a cost efficient manner without access to international credits. It should be recalled that the exact extent of free allocation to energy intensive industries is still to be determined based on benchmarks.

In the E3MG model industries seem to be more responsive to overall economic impacts and less to relative competitive positions. The increase in carbon price even in the high case with access to international credits is small compared to the reference, assuming no limits on the use for international credits. But output losses are in line with the reduction in GDP of the EU27 (see section 5.4.2 for GDP impacts), with also limited negative GDP impacts in other regions taking on their low end pledges. These are, therefore, more, but not only, related to the general reduction in GDP due to the higher costs of greenhouse gas abatement in all large regions and some shift of production to regions with less strict or no pledges (e.g. OPEC).

E3MG assumes auctioning only for the EU electricity sector in all the projections used for Table 28 with the exception of one variant that includes taxation in the non-ETS. This variant shows that a reduction in labour costs (resulting from recycling carbon tax revenues from a carbon tax in the non-ETS sector in the EU27) would further dampen the already small negative impact of the high pledges on the output of the energy intensive sectors. This is so since the reduction of labour costs would limit GDP loss in the EU (see section 5.4.2 for GDP impacts). This would more or less halve the marginal output loss of the energy intensive sectors.

Table 28. Change in output energy intensive industries EU in 2020 (% change from reference), E3MG

Access to International carbon market				
	Low	**Mixed**	**High**	**High**
				+ Tax non-ETS
Chemicals				
EU27	-0.1	-0.1	-0.2	-0.1
Outside EU27	-0.1	-0.1	-0.1	-0.1
Rubber & Plastics				
EU27	-0.4	-0.4	-0.5	-0.2
Outside EU27	-0.4	-0.4	-0.5	-0.5
Non-Metallic Mineral. Products				
EU27	-0.0	-0.1	-0.4	-0.2
Outside EU27	-0.1	-0.1	-0.1	0
Basic Metals				
EU27	-0.3	-0.3	-0.3	-0.2
Outside EU27	-0.2	-0.2	-0.1	-0.1

Source: E3MG

PACE

The PACE model was used in addition to the models mentioned above. PACE has a more detailed representation of the energy intensive sectors as much as possible in line with the level of disaggregation of the carbon leakage assessment (see also annex 10.4), as well as a methodology to determine the allocation of free allowances which is closer to the existing ETS provisions. Revenues from auctioning are not recycled through a reduction in labour costs but through a lump sum payment to households.

The PACE scenarios simulated two variants of the allocation of allowances in the ETS:

– Free allocation for the energy intensive sectors that receive 100% free allocation according to a benchmark, using an estimate that simulates more closely to the actual provisions of the ETS directive regarding benchmarks[93]. For the power sector only auctioning is applied and for the other sectors in the ETS a gradual shift towards auctioning is simulated as foreseen under the climate and energy package.

– This is compared to full auctioning for all sectors in the ETS

Table 29 shows the results for the EU. The same three scenarios as described above - low, mixed and high - were modelled and results were compared to a reference scenarios which includes the achievement of the energy and climate package with access to international credits[94]. Pledges for the non-EU countries were the same as those assessed for the GEM E3 and E3MG model (see Table 14). Additionally, this table includes the impact of the reference scenario, with the unilateral action of the EU's climate and energy package, compared to a business as usual scenario where the EU would not have a climate and energy package (2nd column). Furthermore a scenario is assessed where the EU would go to -30% without the others even implementing any pledge under the Copenhagen Accord (columns 6 and 10, with and without free allowances). Finally all these scenarios are assessed in two different variants, one with free allocation to the energy intensive sectors and one with also full auctioning in these sectors, in order to pick up the effects of free allocation.

Impacts discussed here are limited to EU energy intensive industries. The PACE scenarios also project the beneficial impact on EU energy intensive sectors of full implementation of the low pledges of the Copenhagen Accord compared to the situation that the EU acts alone. When EU targets would be increased unilaterally to -30%, with the others taking no action, a maximum reduction of -1.1% would occur for the sector 'chemicals, rubber and plastics (other)' on top of the -2.8% effect of the EU implementing the -20%, if free allocation and access to the international carbon market would be maintained.

Free allocation in the EU ETS for energy intensive sectors has an important positive impact on energy intensive sectors compared to the case with full auctioning.

Compared to the assessment done before the economic crisis for the climate and energy package[95], the impacts of implementing the package without others taking action are smaller, potentially due to the economic crisis and higher than expected energy prices.

Table 29: Change in output energy intensive industries EU in 2020, PACE

Sectoral output changes (% change in 2020)	**Reference: impacts package (-20%) vs business as usual**	**Additional impacts of pledges under the Copenhagen Accord (impacts compared to reference)**							
		EU ETS with free allocation				EU ETS with full auctioning			
		LOW	Mixed	HIGH	Unilateral -30%	LOW	Mixed	HIGH	Unilateral -30%
Mineral products	-0,3	0	-0,2	-0,2	-0,3	0,0	-0,4	-0,3	-0,5

93 The free allocation in the scenarios in GEM E3 and E3MG to energy intensive industries is determined through what the cost effective level of emissions would be in the individual ETS sectors per sector if all reductions would have to be achieved internally in the ETS in a cost efficient manner without access to international credits. It should be recalled that the exact extent of free allocation to energy intensive industries is still to be determined based on benchmarks.

94 It assumes that both the -20% emission reduction in 2020 is achieved as well as the increase in renewables in the power sector in line with the EU 20% renewables target.

95 SEC(2008) 85/3, vol II, annex to the impact assessment, table 19.

Iron and steel (further processing)	-0,5	0,3	-0,2	0,1	-0,5	0,0	-0,7	-0,5	-1,0
Non-ferrous metals	-0,5	0,3	-0,2	0,2	-0,6	0,2	-0,4	0,0	-0,7
Paper products, publishing	-0,1	0	-0,1	-0,1	-0,1	0,0	-0,1	-0,1	-0,1
Cement	-0,2	0	-0,2	-0,1	-0,2	-0,2	-0,5	-0,4	-0,5
Bricks, tiles and construction products	-0,3	0	-0,3	-0,2	-0,3	-0,2	-0,6	-0,6	-0,7
Iron and steel	-0,3	0,1	-0,2	0	-0,3	-0,4	-1,0	-0,9	-1,1
Aluminium	-0,5	0,3	-0,2	0,2	-0,5	0,1	-0,6	-0,3	-0,9
Fertilizers	-1,0	0,3	-0,2	-0,1	-0,6	0,1	-0,6	-0,5	-1,0
Organic chemicals	-0,8	0,3	-0,1	0	-0,5	0,1	-0,5	-0,5	-0,9
Inorganic chemicals	-1,0	0,4	-0,1	-0,1	-0,5	0,1	-0,5	-0,4	-0,8
Chemicals, rubber and plastics (other)	-2,8	0,4	-0,7	-0,6	-1,1	0,3	-0,8	-0,7	-1,2

Source: PACE (Zentrum für europäische Wirtschaftsforschung (ZEW), Mannheim)

Another additional element of the analysis with PACE was a comparison of scenarios with and without allowing for banking, with or without pledges by the BRIC countries[96] and with or without access to international credits. Table 30 underlines the positive impacts all three have on sectoral output. In comparison to table 29 it also underlines the positive impact of access to international credits.

Table 30: Selected simulation results for multilateral scenarios showing the effect of banking, action of BRIC countries and access to international credits for the HIGH scenario

Impact for the EU in 2020 of **high end pledges** compared to business as usual (Sectoral output changes in %) (for the EU this compares to a scenario without unilateral implementation of the package and with free allocation for energy intensive sectors)			
High end pledges developed countries	Yes	Yes	Yes
Pledges BRIC	No	Yes, high end	Yes, high end
Banking in EU ETS	No	Yes	Yes
Access to international credits	No	No	Yes
Mineral products	-0.9	-0.8	-0.5
Iron and steel (further processing)	-0.9	-0.8	-0.4
Non-ferrous metals	-1.2	-1.1	-0.3
Paper products, publishing	-0.4	-0.3	-0.2
Cement	-0.7	-0.6	-0.3
Bricks, tiles and construction products	-0.9	-0.8	-0.5
Iron and steel	-0.8	-0.7	-0.3
Aluminium	-1.1	-1	-0.3
Fertilizers	-1.8	-1.3	-1.1
Organic chemicals	-1.2	-0.8	-0.8

96 Brazil, Russia, India and China.

Inorganic chemicals	-1.7	-1.2	-1.1
Chemicals, rubber and plastics (other)	-5.4	-3.9	-3.4

Source: PACE (Zentrum für europäische Wirtschaftsforschung (ZEW), Mannheim)

Conclusion

The general picture that emerges from the modelling with the E3MG, GEM E3 and PACE models is that with access to international credits, banking of allowances and free allocation, output losses of energy intensive industries are limited.

6.4. Additional and alternative means to address the risk of carbon leakage

6.4.1. Inclusion of imports into the EU system

There has been broad discussion on the environmental and economic effectiveness of measures addressing the risk of carbon leakage, such as allocation of free allowances, financial compensation and border measures. It is clear that any of these are bound to be a second best option, with a properly global system with similar marginal costs for all emitters being the best solution.

The ETS Directive foresees to address the risk of carbon leakage by means of free allocation. Free allocation will be based on historical production and ambitious benchmarks.

According to Article 10b, the analysis in the light of the international negotiations, is to be accompanied by any appropriate proposals, which may include inclusion into the ETS of importers of products from sectors deemed to be exposed to a significant risk of carbon leakage. This would imply a requirement to buy and surrender allowances to cover the carbon content of goods imported, equivalent to the requirements placed on EU firms.

Border measures would make it easier for the EU companies to pass on their costs of emission allowances. This would make other measures to address the same issue, notably the free allocation, redundant. Hence, border measures should in principle work as an alternative measure to the free allocation. An accumulation of measures and inherent inefficiencies associated with them should be avoided.

At first sight, border measures seem intuitively attractive with two arguments generally used for motivating them: in addition to avoiding carbon leakage and levelling the playing field, to create incentives for major emitters to take on commitments in the international negotiations on a post-2012 climate regime.

However, several issues require careful consideration to avoid any unintended negative effects. The main question is the effectiveness of border measures in achieving these goals, followed by legal implications, in particular the WTO compatibility, their impact on relations with major trading partners, and design, implementation and enforcement challenges.

Effectiveness

Analyses indicate uncertainty about the ability of border measures to achieve the intended effect of avoiding this risk of carbon leakage[97]. The incentive effect which an inclusion of imports into the ETS and other border measures are likely to trigger is to increase exports to the EU of products made in installations that are more efficient, while the production for non-EU markets may be done in installations performing much worse. This would render the application of border measures ineffective in terms of overall carbon leakage.

Border measures could limit adverse competiveness impacts of unilateral policy on energy-intensive industries. However, there could also be impacts related to increased costs of imported inputs for EU manufacturers, outside the ETS which requires consideration[98]. Furthermore, higher cost of inputs that would emerge may cause problems for European producers further downstream in the production chain in sectors which are in the ETS but which are not covered by the border measures, potentially limiting any positive effects in terms of avoiding net carbon leakage and addressing competitiveness impacts[99]. For example, border measures applying only to a limited number of sectors and products (those deemed to be exposed to a significant risk of carbon leakage) would raise the price of steel as an input for EU manufacturers of cars. However, no corresponding measure would be applied on imports of cars, leaving domestic car manufacturers - who would now pay for embedded carbon in their steel input but compete against imported cars without such costs - at a competitive disadvantage than the situation faced before.

Even if border measures may reduce carbon leakage, they could imply potentially large costs of mitigation for participating countries and economic losses for non-participating countries, while not necessarily reducing the output losses by the industry in the imposing countries. OECD carried out an analysis for a scenario where the EU acted alone to reduce emissions (by 50% in 2050)[100]. Results indicated that border measures would have insignificant effects to prevent the output losses of the EU energy-intensive industries and would raise the cost of action in the EU as a whole from 1.5% of GDP to 1.8% of GDP in 2050. A number of factors contributed to offset the positive effects of the market share gains created by border measures on the output of these industries. These include costlier energy-intensive imported inputs, a slight increase in the carbon price, and the fact that energy-intensive industries still faced some competitiveness losses as a result of the indirect impact of the European carbon price on the price of their non-energy inputs.[101]

In order to use border measures in relation to a level playing field on export markets, it would be necessary for inclusion of importers to be supplemented by a border adjustment measure for exports. The equivalent for exporters would be to exempt them from surrendering allowances for emissions in the EU caused by producing goods for exports, diminishing the environmental effect of the EU's policies within the EU and complicating as well as

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[97] See i.a. "The Economics of Climate Change Mitigation", OECD, 2009 and Meyer-Ohlendorf N. and Gerstetter C.: "Trade and Climate Change", Berlin, 2009.

[98] Alexeeva-Talebi, V. et al.: "Alleviating Adverse Implications of EU Climate Policy on Competitiveness: The Case for Border Tax Adjustments or the Clean Development Mechanism?", ZEW, 2008/095

[99] See e.g. Houser et al: "Levelling the carbon playing field", Peterson Institute for International Economics and World Resources Institute, Washington DC, 2008.

[100] It applied a border measure equal to the local carbon price to each tonne of carbon used in the production of imported goods, both directly and indirectly via inputs, e.g. electricity.

[101] "The Economics of Climate Change Mitigation", OECD, 2009

undermining the functioning of the ETS. Furthermore, such a mechanism might again raise additional questions as regards WTO compatibility as well as practical implementation.

Impact on international negotiations and trade relations

On the one hand, border measures could give a new impulse to the international climate negotiations as a new negotiating tool. On the other hand, the introduction of border measures may also trigger retaliatory measures and even hinder the international negotiations. According to some analyses, as a unilateral measure, they risk hostile reactions from trade partners and may, therefore, not improve the chances of reaching a global climate deal[102] - generally recognised as the best option to avoid the risk of carbon leakage. A number of emerging economies as well as developed countries have already signalled their concerns related to this issue.

Legal questions

The WTO has signalled that there may not be a problem of principle, based on Article XX of GATT. However, the modalities seem to matter significantly. According to the WTO/UNEP report, there are two central challenges in implementing border measures: providing a clear rationale (i.e. accurately assessing carbon leakage and competitiveness losses) and determining a “fair” price to be imposed on imported products to bring their prices in line with the domestic cost of compliance with an emissions trading scheme.[103] Similarly, other analyses conclude that although for some sectors border measures could be made WTO compliant, they are potentially complex, and practical and legal issues may severely constrain what border measures could be implemented.[104]

Design, implementation and enforcement questions

Effective border measures, which cannot be circumvented, would be difficult to design, implement and enforce. It would be challenging to determine which imports from which countries or sources the system would apply to. There would be practical difficulties to set the right level of allowances to be surrendered by importers.

Even if a flat rate was adopted, e.g. where the amount of allowances to be surrendered by the importer would be the same for every importer irrespective of how the product was produced, determining the flat rate would be a challenge in itself. However, the work undertaken to establish benchmarks under the ETS could be a basis. A system could be envisaged where an EU average is used. Such an approach would probably need to introduce a moving target. In order to be WTO compatible, the approach would still have to allow for importers of products that are less emission intensive than the flat rate to surrender only the corresponding amount of allowances, e.g. by providing evidence of the lower carbon content of its products. Providing information on the carbon emitted during production would enable adjustments to reflect actual emissions, increasing effectiveness, and could provide incentives for cutting

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102 See e.g. "Tackling carbon leakage", Carbon Trust, 2010, and "Climate measures and Trade", Kommerskollegium, 2009

103 "Trade and Climate Change", WTO and UNEP, 2009

104 See e.g. Wooders P. et al.: "Border carbon adjustment and free allowances: responding to competitiveness and leakage concerns", OECD Roundtable on Sustainable Development, 2009/8, and "Tackling carbon leakage", Carbon Trust, 2010.

emissions[105]. However, it might only trigger incentives to cut emissions for production designated for exports to the EU.

This would require the emissions in installations in third countries to be monitored and reported according to ETS requirements. It would be difficult to enforce this and therefore, to detect potential violations. Monitoring of emissions entails a clear definition of a product, installation and process boundary, notably how far up and downstream the process should be covered, and decisions on an accounting protocol, e.g. what emission factors for fuels should be used. While monitoring such information in the EU, where robust monitoring capacity is put in place under the EU ETS rules, is already challenging, the same effort imposed on third, especially developing, countries may be unfeasible. Without a consistent highly sophisticated monitoring, reporting and verification system in place, there is considerable scope for potential gaming by different interpretations of all these elements. For example, depending on the definition of the installation boundaries, emissions associated with outsourced heat could be excluded resulting in lower emission intensity. Moreover, all the monitoring would not only have to be done at installation but also at product level in case an installation is producing multiple products.

As an alternative to current measures, the Commission continues to study the inclusion of imports into the EU ETS. The results of the implementation of any similar approaches should be closely monitored to see if this experience can be used in the case of EU ETS.

6.4.2. Other means to address the risk of carbon leakage

As mentioned above, the measures already foreseen in the revised ETS Directive are estimated to appropriately reduce the risk of carbon leakage for the sectors in the EU deemed to be exposed to such a risk. However, additional measures, compatible with the already decided measures, could further help to address the risk, in particular in case the EU would step up its commitments.

One way would be to introduce a more targeted approach to international credits. The recognition of CDM in the ETS reduces the risk of carbon leakage as it lowers the cost of compliance for the installations. However, industrial based CDM has also caused some concerns about possibly contributing to a risk of carbon leakage in certain sectors, as well as about the environmental integrity and cost-effectiveness of the projects.

In order to make continued use of the EU's demand-side leverage it could be considered to apply a multiplier to CDM projects or to replace CDM credits by sectoral crediting based on ambitious benchmarks and/or not accepting CDM credits from project in energy-intensive sectors deemed to be exposed to a significant risk of carbon leakage. However, such restrictions on access to lower-cost CDM credits could increase overall costs of meeting the EU target, if it had a significant impact on the price of the credits. In the overall context of a fair and ambitious deal it would also be difficult to accept CDM credits from countries which are not participating adequately in the international climate effort.

Box 1: The case of industrial gases

[105] "Tackling carbon leakage", Carbon Trust, 2010

HFC23 and N_2O projects create significant "windfall" profits generated for the plant operators – to a degree where the profits from the core business (of producing HCFC and adipic acid) are dwarfed by the corresponding CER revenues. With abatement costs of €0.50 per CER or even lower[106], and a generation of between 80 and 400 CERs per underlying product, at conservative secondary CER prices of €10 per tonne profits amount to between €800 and €3 400 per underlying product unit. Apart from the fact that using the CDM is an expensive way to finance these emission cuts[107], there are serious indications that production of HCFC-22 and adipic acid have been shifted from Annex 1 to non-Annex 1 countries in order to generate more CDM revenues. It also seems to often finance measures which can be appropriate for developing countries with sufficient capacities to undertake themselves as appropriate action to contribute to the mitigation of GHG emissions.

This is not a marginal problem, as HFC and N_2O projects make up by far the bulk of issued CERs to date. While HFC23 destruction projects represent 0.4% of all CDM projects under validation or registered, they account for 208 out of 385 million tonnes or 54% of all credits issued to date[108]. By 2012 this number is expected to still be 17%. This would increase further if HFC23 reductions could also be credited from new HCFC-22 production facilities – something that is not allowed today. The crediting of HFC-23 also increases the risk of slowing down the phase-out of HCFC-22 production under the Montreal Protocol. Similarly, the reduction of N_2O represents 1.4% of all projects under validation or registered, while accounting for 82 million tonnes or 21% of issued credits. By 2012 they will still account for 7% of all expected issued credits. The low costs for the generation of these credits hamper the evolution towards using the carbon market to incentivise cost-effective reductions in other areas and at sectoral level. It also contributes to the unequal geographical distribution of credits, as 80% of HFC and 60% of N_2O emission reductions come from China[109].

Apply a multiplier to these projects or setting a conservative sectoral benchmark would reduce these windfall profits and concerns for carbon leakage while generating mitigation action in developing countries. If for example, a multiplier of 2 is applied and a project reduces emissions by 20% from baseline (from 100 to 80), it means that 10 units would be credited while 10 units would be an own mitigation action triggered via European demand. If then 0.4 billion tonnes of the existing 1.6 billion tonnes of access to CDM credits would be replaced by new sectoral credits and a threshold mimicking a multiplier of 2 is applied, this would incentivise extra-territorial reductions of 0.4 billion tonnes.

In addition, the risk of carbon leakage can be decreased by reducing emissions through innovation and modernisation in the energy-intensive sectors. The Europe 2020 strategy connected to innovation includes the contribution of innovative incentive mechanisms linked to the carbon market. While the key incentive for innovation comes from the long-term effect of the carbon price, benchmarks used for free allocation could avoid the risk of carbon

106 N.serve Environmental Services: "Low hanging fruits: abatement costs and profitability of different project types", Nov 2009 www.nserve.net

107 To abate all developing-world HFC-23 emissions Wara (2006) estimates this would cost approximately $31 million per year. Instead, by means of a CDM subsidy the Annex B nations will likely pay between 250 and 750 million euro to abate 67% non-Annex B HFC-23 emissions. See: Wara (2006) *"Measuring the Clean Development Mechanism's Performance and Potential"*, Working Paper 56, Program on Energy and Sustainable Development at Stanford University.

108 Source: www.uneprisoe.org

109 www.newenergyfinance.com/Download/pressreleases/10/pdffile/

leakage by further incentivising the EU industry to innovate and implement new technologies. An innovation/technology accelerator in the ETS benchmarking system could thus be developed to reward companies that invest in top performing technology and make significant emission reductions or overachieve the benchmarks by giving those installations additional free allowances on top of what could be expected from a normal implementation of the benchmark rules.

Such an innovation/technology accelerator could be created by dedicating or monetising the allowances that are not distributed for free in line with general benchmarking rules, but which are within the "industry cap" (the maximum amount of free allowances to be distributed for free under Article 10a(5) of the ETS Directive), assuming that the benchmarks/allocation rules finally agreed lead to an amount of free allocation below this "industry cap". The allowances would be used to encourage investments in installations that commit to make major advances and/or significantly outperform the average of the relevant benchmark.

In principle eligibility would be limited to industrial installations eligible for free allocation under the revised ETS Directive. Eligibility for support could come by two means:

(1) Absolute value: installations which commit to outperforming the benchmark in x successive years by more than x %

(2) Relative improvement: installations which commit to achieving an improvement of at least x % of carbon intensity over y years

In terms of governance and operational implementation the European Investment Bank could play a similar role as for the demonstration programme for CCS and innovative renewable energy funded by 300 million allowances in the new entrant reserve.

In this way, implementation of the ETS could provide an extra technology push for top performing installations by giving them financial support on top of the free allowances allocated under a rigorous implementation of the benchmark rules specified in the ETS Directive. It would also support less performing installations when they need to make investments to improve greenhouse gas efficiency. Both these actions would contribute to creating a low carbon economy.

6.5. Consultation of interested parties

The Commission first consulted the stakeholders on the analytical report and its preliminary conclusions at an ad-hoc meeting of the European Climate Change Programme (ECCP) working group on emissions trading on 17 March 2010. Following the meeting, the Commission sent the stakeholders a set of consultation questions, inviting them to comment on this issue and on related issues, in order to allow all relevant stakeholders, including EU industry associations, trade unions, environmental NGOs and Member States, to effectively contribute to the report. Responses from stakeholders others than those directly invited to provide comments were taken into consideration as well.

Fifty five contributions were received, five of which were confidential. The results of the consultation confirmed the conclusion that although the outcome of Copenhagen is a significant step forward, the situation of the energy-intensive industry has not changed substantially in the light of international negotiations. A number of stakeholders therefore oppose a review of the list of sectors deemed to be exposed to a significant risk of carbon leakage. However, some stakeholders asked to use the latest research for a new carbon leakage assessment using different criteria as to those set in the ETS Directive. Some claim that the risk of carbon leakage does not appear to be dramatic or that as emissions are lower due to the economic crisis, the overall costs will be lower than projected. However, others pointed out that these lower emissions are also associated with lower economic activity. Some stakeholders highlighted that new information should be taken into account at the time of the revision of the list foreseen 2014, including the level of benchmarks.

Some stakeholders expressed the opinion that only an international agreement with equivalent emission reductions and that is legally binding would be a compelling new factor that would require a change of the level of free allocation. But also a number of other reasons were proposed by some stakeholders to revise this level. Notably some stakeholders propose to revise this level if there was evidence that (sub)sectors have capacity to pass on the costs of CO_2 to prices and thus achieving windfall profits, similar to those identified in the electricity sector.

Most stakeholders confirmed that that the measures included in the Directive, i.e. free allocation for direct emissions and state aid for additional costs passed through in electricity prices, should be the main methods to address the risk of carbon leakage in the sectors identified to be at risk. Some added that free allocation will prevent carbon leakage only if the benchmarks are set at a technically achievable level. In contrast, others mentioned that free allocation at the scale currently envisaged was not necessary to avoid carbon leakage.

Some stakeholders expressed the opinion that if other countries do not commit to reducing GHG emissions, the EU should consider as a last resort border adjustment measures on products from these countries. However, others believe that border measures could cause negative effects in other areas, risk retaliatory action by countries outside the EU and turn out to be an overly complicated approach.

As regards additional measures to address carbon leakage, the results of the consultation indicated that substantial boost in financial support for R&D, pilot and demonstration projects for carbon- and energy-efficient technologies in energy-intensive industries in Europe would be necessary.

Some stakeholders from the industry highlighted that the access to flexible mechanisms (Clean Development Mechanism – CDM and Joint Implementation - JI) must be improved, while other stakeholders believe that use of international credits in industrial projects potentially distorts competition and increase the risk of carbon leakage. While manufacturers in the EU are subject to a cap, manufacturers of potential competing products are able to generate emissions reductions credits for sale into the EU ETS via the CDM. Therefore, they recommend to fully restrict the use of CDM projects which distort competition.

Overall, broad stakeholder reactions appear to indicate there is no need to change the current approach to address the risk of carbon leakage in the light of the international negotiations. However, some argue there is the need to become stricter as regards the assessment criteria and measures foreseen, also taking into account the latest information and research. In contrast, others stress the need for additional, complementary measures for avoiding the risk of carbon leakage.

The results of the consultation are available on the Commission's website.[110]

6.6. Concluding remarks

The analyses made based on the modelling outlined in this section indicate that the targets and actions put forward by many major economic players in the Copenhagen Accord, if dully implemented, may have made the EU energy-intensive industry somewhat less exposed to the risk of carbon leakage compared to what the situation would have been if the Copenhagen Accord would not have been agreed upon. However, the analyses show that its impact is not significant enough to motivate a change in the measures to be used to address the risk of carbon leakage. Considering the uncertainties related to the implementation of the pledges, the conclusion is that the measures taken to protect energy intensive industries against the risk of carbon leakage (free allocationand access to international credits) should be maintained.

Considering the outcome of the international negotiations, additional measures are not needed. However, due to the related questions about their effectiveness to address the risk of carbon leakage and competitiveness concerns, implications as regards the international negotiations and trade relations, and other impacts on the wider economy, border measures remain an option of last resort. They should in principle work as an alternative measure to free allocation, as they would make it easier for EU companies to pass on their costs of emission allowances. This would make other measures to address the same issue, notably the free allocation, redundant. An accumulation of measures and inherent inefficiencies associated with them should be avoided. If the EU stepped up from 20 to 30% negative impacts on energy intensive industry would increase by around 1% or less compared to the case that all other countries keep their low pledges, given that international crediting mechanisms would be kept in place and with free allocation applied to the energy intensive sectors.

However, in terms of carbon leakage, if both the EU and the rest of the world step up their pledges one should not only consider the absolute change in output for the EU industry, but the relative change in output in the EU compared to the rest of the world, as this demonstrates the changes in market shares The analysis made shows that the relative loss for EU energy intensive industry in case EU steps up to 30% and the rest of the world makes high pledges is that EU's relative position would be largely unchanged or even slightly improved compared to the case the EU only implements its low end targets on its own.

7. CARBON LEAKAGE AND ENERGY SECURITY

7.1. Background

Pursuant to Article 10b(1) letter (c) of the revised EU ETS Directive, this Staff Working Document includes an:

"assessment of the impact of carbon leakage on Member States' energy security, in particular where the electricity connections with the rest of the Union are insufficient and where there are electricity connections with third countries, and appropriate measures in this regard".

110 http://ec.europa.eu/environment/climat/emission/carbon_en.htm

7.2. Identification and analysis of Member States concerned

The Commission's assessment identified ten Member States that have interconnections with electricity networks in countries outside of the EU:

(1) Greece, Slovenia, Slovakia, Hungary, Bulgaria, and Romania have interconnections with Ukraine and with South-Eastern European States, all of them are Member States/observers of the Energy Community[111].

(2) Spain has a small electricity connection with Morocco (double circuit connection), which due to its size is not further considered. In addition, a number of Member States operate electricity connections with EEA countries, which, however, are fully integrated in the ENTSO-E[112] network and for this reason not further considered.

(3) Latvia, Lithuania, Estonia and Finland have connections with, among others, Belarus and/or Russia.

The findings accruing from this assessment show that due to their history, the electricity systems of the Baltic EU Member States are still characterised by a number of specific features that are outstanding and create a unique situation:

- The Baltic EU Member States are still operated in an integrated manner with the electricity systems of adjacent countries, i.e. Russia and Belarus (North Western Russian Ring). As a consequence, their supply and demand balance is at least partly maintained by Russia, which then acts as a provider of balancing energy;

- There is only one electricity interconnection between the three Baltic EU Member States and other EU Member States, Estlink, a subsea cable between Estonia and Finland. Latvia and Lithuania do not dispose of any electricity connection to a non-Baltic EU Member State.

- As can be seen from the table below, the relation between domestic generation capacities and import capacities to non-EU countries is very high in the case of the three Baltic EU Member States and very low or not existent with respect to import capacities to non-Baltic EU Member States.

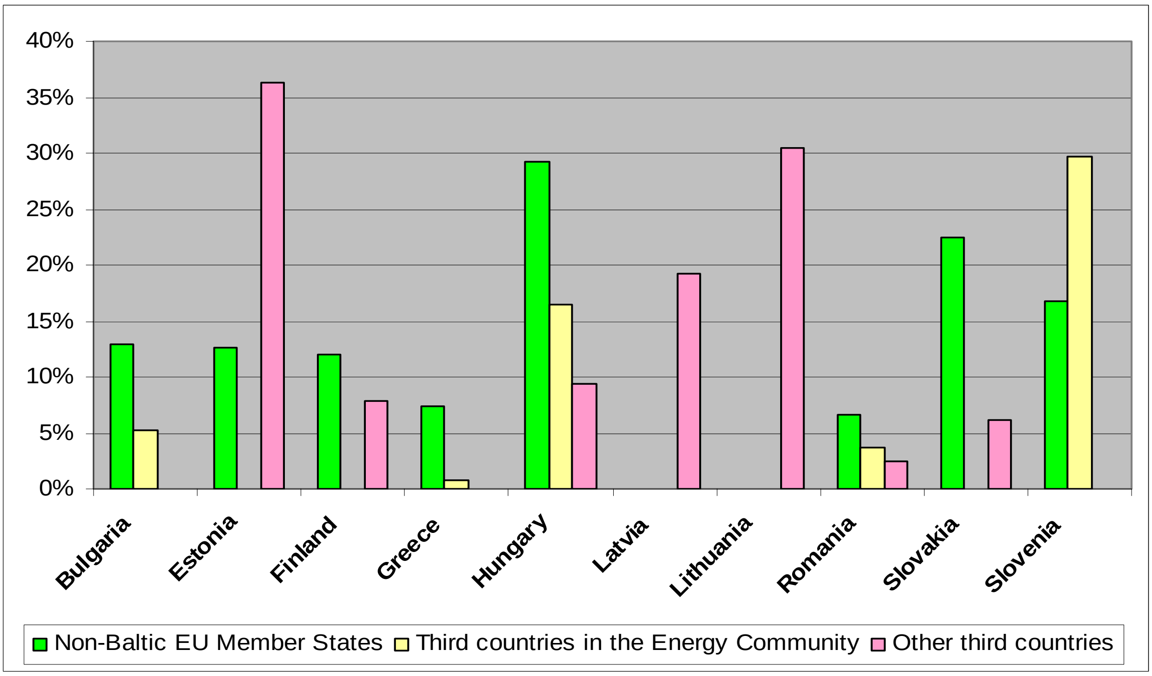
Against this background and in the light of the provision of Article 10b(1) letter (c) of the revised EU ETS Directive, the impact of carbon leakage on the energy security of the three Baltic EU Member States should be further analysed, as their electricity connections with the

[111] In October 2005 the European Community and Albania, Bosnia and Herzegovina, Bulgaria (since 2007 Member State of the EU), Croatia, Montenegro, the Former Yugoslav Republic of Macedonia, Romania (since 2007 Member State of the EU), Serbia and UNMIK on behalf of Kosovo signed the Treaty establishing the Energy Community. The Treaty requires the Contracting Parties to implement important parts of the acquis communautaire, provides for the creation of a single energy market and the mechanism for the operation of network markets. By this, it extends the single European energy (electricity and gas) market to the countries that have signed the Treaty establishing the Energy Community. Therefore, they can be considered part of the internal energy market of the EU. Ukraine enjoys an observer status in the Energy Community.

[112] European network of transmission system operators for electricity

rest of the Union should be considered insufficient, while on the other hand there are significant electricity connections with third countries.

Table 31: Share of import capacities in relation to generation capacities



Source: Eurostat Database 2007, ENTSO-E Indicative values for net transfer capacities in Europe, 2007

7.3. Analysis of the impact of carbon leakage on the energy security of Baltic EU Member States

In the given context, energy security is meant to mean security of electricity supply, which, in accordance with the Security of Electricity Supply Directive[113], may represent the ability of an electricity system to supply final customers with electricity. As can be seen from this Directive and the Internal Electricity Market Directives[114], there is a strong relation between security of electricity supply and a functioning internal market for electricity. The latter would entail a high level of security of electricity supply, which mainly accrues from the possibility to choose and change the supplier of electricity freely. In this respect, sufficient levels of interconnections are crucial, but not necessarily sufficient for both secure electricity supplies based on fair competition and the creation of a fully operational internal market for electricity. The impact of carbon leakage on energy security must therefore be seen against the background of a competitive market that will emerge from the implementation of relevant Community legislation such as Directive 2009/72/EC.

[113] Directive 2005/89/EC of the European Parliament and of the Council of 18 January 2006 concerning measures to safeguard security of electricity supply and infrastructure investment, OJ L33 of 4.2.2006, p 22

[114] Directive 2003/54/EC of the European Parliament and of the Council of 26 June 2003 concerning common rules for the internal market in electricity and repealing Directive 96/92/EC, OJ L176 of 15.7.2003, p 37 and Directive 2009/72/EC of the European Parliament and of the Council of 13 July 2009 concerning common rules for the internal market in electricity and repealing Directive 2003/54/EC, OJ L211 of 14.8.2009, p55

Currently, there is no or very little competition on the electricity markets of the Baltic States. The main reasons for this may be found in insufficient market opening and the persistence of regulated electricity prices in Estonia and Lithuania, although prices are mainly market-based in Latvia. Imports of electricity generated in third countries were also restricted in Estonia, and to a lesser extent in Lithuania. However, the regulatory environment allowing for competition may improve in the foreseeable future. Some of the measures planned in accordance with requirements of Community law can be described as follows:

- As from 1 April 2010, around 35% of the Estonian market will be open for competition, while full market opening is to be reached by 1 January 2013. Regulated prices will be removed for large consumers with consumption above 2 GWh and electricity imports from third countries will be allowed through a power exchange.

- While Latvian and Lithuanian markets should be open since 1 July 2007, real market opening today in Latvia is approximately 55% of final total electricity consumption. In Lithuania, the situation is the same as in Estonia, but further steps will follow to achieve full market opening by 2015.

- Transactions through power exchanges are limited today in the region. Lithuania has already established a day-ahead power exchange. In the medium-term, the Baltic States intend to partly use the Nordic spot power exchange Nordpool for their transactions. As from April 2010, Estonia plans to start using Nordpool spot to determine prices in the Estlink cable area only.

As a consequence, preconditions for competition may improve. However, due to missing or very limited connections with the EU integrated grid, enhanced competition, in the short and medium term, is not expected to come from other EU Member States, but from those countries which are well connected and which, at least temporarily, dispose of spare capacity to supply the Baltic electricity markets.

According to information submitted from Estonia and which is based on publications from Russian electricity generating companies and ENTSO-E, Russian electricity generators in the Northwestern part of Russia would dispose of an annual spare capacity of more than 67 000 GWh, out of which more than 87% can be generated at variable costs of 12 €/MWh, while the balance could be generated at 15 €/MWh. This compares to variable costs on the Estonian side of 25 €/MWh (at the start of the merit order) rising to 30 €/MWh to cover peak demand. Taking into account interconnectors with Finland (Estlink) and Latvia does not significantly change the situation for Estonia. Generation costs of thermal power plants in Latvia are said to be slightly below those of Estonia, while Lithuanian generation costs remain above those prevailing in Estonia.

Other indications from Baltic sources suggest that electricity generation costs from neighbouring non-EU countries might be more than one third below generation costs of new and highly efficient Combined Cycle Gas Turbine (CCGT) power plants in the Baltic States, even if CO_2 costs are included or excluded for both Baltic EU Member States and non-EU countries. In the case that CO_2 costs would only apply to Baltic EU Member States, the competitive advantage of non-EU Member States could rise to two thirds of the generation costs of Baltic EU Member States[115].

The figures demonstrate the potentially high exposure of the electricity market of Baltic Member States to competition from non-EU generators. For the time being, insufficient market opening in combination with regulated electricity prices for consumers provide a sort of protection from new entrants from non-EU countries, which, however, is planned to be gradually dismantled, as set out above.

Until 2012, allowances under the EU ETS in these Member States are allocated for free. This situation is, however, bound to change as from 2013, when full auctioning for electricity generation will be introduced. As a consequence, the competitive situation for electricity generation not subject to similar carbon constraints may further improve and emphasise the issue of fair competition.

Cheaper electricity supply from non-EU countries is likely to render maintaining security of electricity supply in the Baltic Member States more expensive, as idle (and non-competitive) capacities would need to be kept, in order to ensure the match of electricity supply and demand at any time. In addition, incentives to invest in low carbon electricity generation may be undermined, as generators without similar carbon constraints may well be able to undercut costs of electricity generation with carbon constraints. This way, the trend to import electricity may reinforce the above mentioned security of supply pattern. Potential short term benefits for consumers accruing from electricity supplied from non-EU Member States may be offset by higher costs for enjoying a certain level of security of electricity supply.

From an environmental point of view, it is important to highlight that electricity generated in non-EU Member States and finally consumed in EU Member States undermines the environmental integrity and the economic efficiency of the EU ETS for the following reasons:

- if electricity generated in non-EU states and exported for final consumption to EU Member States is not generated by entirely CO_2 free technologies, it may lead to an increase in global overall emissions, since the emissions entailed by its generation do not fall under the cap of the EU ETS, which would be the case if the electricity were generated in EU Member States. As a consequence, these emissions could be considered as additional to the overall quantity of emissions allowed under the EU cap and thus affect the environmental integrity of the EU ETS.

- depending on the scale of electricity imports, serving electricity consumption from imports of electricity rather than domestic generation may soften and thus distort the price signals emerging from the carbon price under the EU ETS across the EU, thus lowering the incentives from emission abatement.

Infrastructure developments, as envisaged under the Baltic Energy Market Interconnection Plan (BEMIP) and other EU policies related to infrastructure developments are designed to help improving the situation and providing alternative routes for supply (such as the cables NordBalt between Lithuania and Sweden planned for 2016, LitPol between Lithuania and Poland for 2015-2020 and possibly Estlink 2 between Estonia and Finland for which the decision should be made by the end of 2010). Any energy security risk is best addressed by a

[115] The underlying CO_2 price is 25 €/t.

full integration of the Baltic States into the EU electricity market (with more interconnections and a full synchronisation with the EU grid). However, these infrastructure developments can only be expected to be effective in the longer term. A certain level of uncertainty with respect to the timing of the relevant investment decisions and their implementation can not be ignored. They would, nevertheless, not address the issue of fair competition, i.e. competition between generators with and without carbon constraints.

7.4. Results/findings

The analysis showed that due to historical developments, there may be a risk for both energy security and a level playing field to allow fair and effective competition to develop on the electricity markets of the Baltic EU Member States. Since the interconnection capacities of the three Baltic Member States on the one hand and non-EU countries on the other hand, is, in relative and absolute terms much higher compared to other Member States, the potential for electricity imports from non-EU countries without carbon constraints for electricity generation is high. With full market opening and liberalisation of the electricity market reaching a more advanced stage by 2013, there is a certain probability that non-EU countries benefit from a competitive advantage on the EU internal market for electricity in terms of electricity generation, which may result in an increase in electricity exports to the Baltic Member States. This effect might be the more pronounced the more the electricity generation in a given Member State is CO_2 intensive.

The introduction of full auctioning, which is foreseen under the revised EU ETS Directive as from 2013, might make these risks even more pronounced.

While the fact of importing electricity from non-EU Member States should, in principle, not be a matter of concern, the following risks must be borne in mind:

- *Energy security risk:* Without enjoying sufficient connection to other Member States, increasing imports from non-EU countries could reduce economic incentives to provide for an adequate level of security of electricity supply domestically in the Baltic Member States. This could not only jeopardise their ability to match supply and demand under peak conditions, but could also jeopardise the economic incentives to ensure the desired investments in new generation capacities in the Baltic Member States and further increase their dependence on electricity imports. Both supply available for peak demand and investments in new generation capacities are crucial, in order to preserve the ability of the electricity systems concerned to supply final customers with electricity.

- *Competitiveness risk:* It is doubtful that a level playing field, where fair competition can evolve to the benefit of the consumers, will develop on the Baltic electricity market. Full auctioning of greenhouse gases allowances could increase the potential price differential that already exists between electricity imports from non-EU countries and electricity produced domestically in the Baltic EU Member States and thus undermines the Baltic energy companies' competitiveness.

- *Carbon leakage risk*: Electricity that is generated without similar carbon constraints and exported from non-EU countries to EU Member States for final consumption may alleviate the stringency of the cap set up by the EU ETS and may therefore have a detrimental effect on the environment, assuming that this electricity is not generated by employing entirely

CO_2-free electricity generation technologies. It may also affect an undistorted and clear carbon price signal.

The revised ETS Directive may offer potential measures (in particular, the use of Article 10c on derogation from full auctioning) to alleviate the burden on Baltic energy companies and partly address the competitiveness risk highlighted above. In order to provide realistic and effective incentives for the introduction of more carbon efficient electricity generating technologies, the use of this provision may also facilitate the transition to less CO_2-intensive electricity production in the Baltic region.

7.5. Concluding remarks

Against the background of the above, the following conclusions can be drawn:

(1) Due to historic developments, the Baltic Member States are put in a unique situation, which is characterised by insufficient electricity interconnection with other Member States on the one hand and integration in the electricity system of a non-EU country on the other hand.

(2) The specific situation of the Baltic EU Member States does, for the time being and subject to future developments, not allow consumers to benefit from competition on the internal electricity market of the EU.

(3) It cannot be excluded that, once liberalisation of the electricity market has reached a more advanced stage in the Baltic EU Member States, security of electricity supply may be put at risk. For Baltic Member States to fully benefit from the liberalisation and opening of their electricity markets also in terms of security of electricity supply, the full integration into the EU electricity market should be pursued.

(4) The revised ETS Directive is not designed to deal with issues relating to security of electricity supply or competition on the internal market for electricity and can therefore not provide an overall solution to the issues identified. It may, however, for a transitional period and in order to bridge the time required to develop overall solutions, offer options (in particular, Article 10c on derogation from full auctioning for the power sector) to alleviate the risks identified.

(5) The Commission should closely monitor the developments on electricity markets with interconnectors to third countries including infrastructure and market developments. In the light of these developments, it may take appropriate measures with a view to promoting security of supply and a level playing field for competition on the electricity markets concerned.

8. ASSESSMENT OF LEGAL FORM FOR A POST-2012 AGREEMENT AND THE IMPACT OF THE EU OWN LEGISLATION

8.1. Introduction

This section assesses the merits and drawbacks of alternative legal forms, including of a second commitment period under the Kyoto Protocol, as foreseen in the Commission's Communication "International climate policy post-Copenhagen: Acting now to reinvigorate global action on climate change"[116]. The EU has proposed in the international negotiations under the UNFCCC a single legally binding agreement incorporating the Kyoto essentials as the best way of securing the 2°C objective.

The EU clarified this position in the run-up to Copenhagen, underlining "the need for a legally binding agreement for the period starting 1 January 2013 that builds on the Kyoto Protocol and incorporates all its essentials", and that "a single legally binding instrument would provide the best basis for enhancing the implementation and ensuring consistency in the application of the international climate regime post-2012 and facilitating ratification by Parties and entry into force of the agreement with a view to achieving universal participation". The EU however also expressed "its willingness to an open discussion with other Parties on different options to the same ends"[117]. This position was reaffirmed in the conclusions of the March 2010 Environment Council, which expressed the EU's "openness to consider positively all proposals keeping the increase in global temperature below 2°C compared to pre-industrial level so as to ensure that the work in both tracks results in a comprehensive global legal framework which contains and preserves all the essential elements of the Kyoto Protocol"[118].

The EU's position is based on the essential concern for the environmental integrity of the agreement.

Environmental integrity includes the imperative to deliver the objective to remain below 2°C, requiring a broader participation, including the US and major emitters from the developing world, where the contribution of developing countries should be commensurate with their responsibilities and capabilities and may require support. In addition, as already emphasised in the Commission Communication of 9 March[119] and further described in section 2.2, an international agreement must provide for deeper reductions than the EU's current legislation, and serious weaknesses exist in the current Kyoto architecture which risk undermining the environmental integrity of an agreement, including the banking of surplus emission budgets (Assigned Amount Units or AAUs) from the Kyoto Protocol's 2008 to 2012 commitment period into future commitment periods, and the accounting rules for land use, land-use change and forestry (LULUCF) emissions from developed countries, both of which could significantly weaken the level of ambition of a future agreement. An international agreement also needs to address the emissions from international aviation and shipping.

8.2. The EU's domestic policy builds upon, reinforces and improves the Kyoto essentials

Some have been critical that the EU's proposal for a single legally binding agreement would threaten the achievements of the Kyoto Protocol while the EU has argued that a single agreement should incorporate core elements of the Kyoto Protocol.

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116 COM(2010)86 FINAL, adopted on 9 March 2010.

117 Paragraphs 59 and 60 of the Environment Council Conclusions on the EU position for the Copenhagen Climate Conference (7-18 December 2009), Luxembourg, 21 October 2009.

118 Paragraph 3 of the Environment Council Conclusions on the Follow-up to the Copenhagen Conference (7-19 December 2009), Brussels, 15 March 2010.

119 COM(2010) 86 final

A close look at the EU's climate and energy package reveals that the EU has already incorporated itself core elements of the Kyoto Protocol[120]:

– a continuation of the emissions budget approach, improved through legally binding annual limits which defines to the tonne precisely how much can be emitted between 2013 and 2020. And through the continuation of the linear reduction factor in the EU ETS after 2020, this emission budget approach stretches forward indefinitely;

– the monitoring, reporting, verification and compliance system;

– the continuation of the Kyoto Protocol's inspired market-based mechanisms.

The EU incorporates core elements of the Kyoto Protocol in its legislation, and has strengthened it internally. Firstly the EU has addressed some of the weaknesses regarding accounting in the Kyoto Protocol in its internal legislation. Secondly it further elaborated key elements of it in its internal legislation. Thirdly it addresses some of the gaps in the Kyoto Protocol framework.

Firstly: it addresses in its internal legislation some of the accounting weaknesses mentioned above:

– Surplus AAUs: the climate and energy package does not allow for the use of surplus AAUs for compliance purposes into the period post-2012 to comply with the GHG reduction targets. Under the climate and energy package only banking of allowances in the EU ETS exists from the period 2008-2012 into the post 2012 period. For all Member States, including those with surplus AAUs, targets in the ETS were set at environmentally ambitious and integer levels, setting clear, real reductions compared to historic, actual and projected levels at the point of defining the targets (e.g. the EU-wide cap for the period 2008-2012 was set at around 6.5% below 2005 levels, while expectations at that time where that emissions would rather increase above 2005 levels over the period[121]).

– LULUCF: at present the targets for post-2012 under the climate and energy package legislation do not include the possibility to account for absorptions or emissions from LULUCF activities. They can therefore not contribute to the compliance under the climate and energy package. LULUCF can be included in the future reduction effort provided that the permanence and the environmental integrity is ensured[122].

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120 Decision No 406/2009/EC and Directive 2009/29/EC

121 See for instance emission profile as estimated in 2007 regarding emissions in 2010: European Commission, DG Energy and Transport: European Energy ad Transport, trends to 2030 – Update 2007, 2008, ISBN 978-92-79-07620-6

122 Preambular paragraph 23 of the Decision 406/2009/EC of 23 April 2009 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 (Effort Sharing Decision) states that "In the event that no international agreement on climate change is approved by the Community by 31 December 2010, the Commission should make a proposal to include emissions and removals related to land use, land use change and forestry in the Community reduction commitment, in accordance with harmonised modalities, building on work carried out in the context of the UNFCCC, and ensure permanence and the environmental integrity of the contribution of land use, land use change and forestry as well as accurate monitoring and accounting, with the aim of the proposed act entering into force from 2013."

Secondly: EU internal legislation also further elaborates key elements of the Kyoto Protocol, notably compliance, supplementarity and base year:

– Compliance: Under the Kyoto Protocol, for every tonne a Party has emitted above its target at the end of the first commitment period, its emission budget for the next period will be reduced by a factor 1.3. This factor will however only be applied at the end of the reporting and compliance cycle, which will at the earliest be at the end of 2014. The EU has gone one step further and has applied an annual "abatement factor" of 1.08 under its Effort Sharing Decision, applying to Member States' non-ETS targets, which would foresee much faster, annual corrections applied if countries miss their target in the sectors not covered by the EU ETS. This comes in addition to the strong annual compliance regime under the EU ETS which has a €100 penalty[123] on top of the annual abatement factor of 1. These annual compliance cycles significantly strengthens incentives for EU Member States to ensure early reductions and provide for real early incentives to reduce emissions in case a Member State or companies under the ETS are not on track to meet their obligations.

– Internal real action: The Kyoto Protocol under its Marrakech Accords stipulates supplementarity as the need for domestic action to constitute a significant element of the effort made by each Party. The EU has gone a step further and, in its energy and climate legislation has put a numerical limit on the use of CDM and JI both for the targets in the ETS and non-ETS.

– A single baseline of 1990 is used for the EU's reduction commitments of -20% under the Climate and Energy Package and for the -30% offer, rather than a range of years from 1985 to 1995.

Thirdly: The EU addresses a number of important gaps in the Protocol's framework. These include addressing fast growing emissions from sectors not covered by the Kyoto Protocol and the ability to expand the international carbon market, both through enabling the linking with domestic emissions trading systems in countries that do not have a target under the Kyoto Protocol and through the development of new market-based mechanisms:

– Emissions from international aviation and shipping are recognised in the EU's reduction commitments. The EU's inclusion of aviation into the EU ETS provides an important expansion compared to the coverage provided under the Kyoto Protocol, whose targets do not cover international emissions from this sector. These are included in the EU's -20% target, thereby actually making the ambition level more ambitious for the other sectors due to the fact that the aviation sector is expected to be a net buyer of allowances. The climate and energy package provides that, in the event that no international agreement which includes international maritime emissions in its reduction targets has been approved by end 2011, the Commission should make a proposal to include international maritime in the Community reduction commitment. This comes in addition to any future action that the EU may decide to take to tackle emissions from international maritime transport, which are excluded from the Kyoto Protocol.

– The Kyoto Protocol limits international emissions trading to countries with a target under Annex B of the Protocol. Internal arrangements were put in place in the EU to address this limitation upon the EU accession of Cyprus and Malta, neither of which have a Kyoto

[123] This amount is regularly adjusted for increases with inflation.

target, but both of which are included in the EU ETS. Moreover, as the EU seeks to explore options to link the EU ETS with emissions trading systems outside the EU, including in countries that do not currently have a Kyoto target, such as potentially the United States, the current provisions of the Kyoto Protocol become an obstacle to ambitious further action. This obstacle has been cleared by explicitly allowing the EU ETS to link with trading systems in these countries[124].

– The EU has proposed the development of new sectoral carbon market mechanisms as an interim step towards the development of (multi-sectoral) cap and trade systems, in particular in the more advanced developing countries. These mechanisms can provide a more comprehensive price signal, generate credits on a greater scale and capture mitigation contributions by developing countries by crediting against appropriate emission thresholds set below projected emissions to ensure a net mitigation benefit that takes account of own appropriate action by developing countries. The introduction of such mechanisms is, however, also important to ensure sufficient access to environmentally integer offsets over the longer term and could avoid double counting of pledged action and targets under the Copenhagen Accord. The amended EU ETS legislation[125] allows to work together with interested developed and developing countries both bilaterally and multilaterally, even in case of no international agreement, to set up sectoral mechanisms, whose credits could then be recognized for use in the EU ETS and under the EU's Effort Sharing Decision containing Member State reduction commitments for the non-ETS.

– Finally EU legislation allows[126] applying measures to restrict the use of specific credits from project types and provide for ‘own contributions’ from third countries in terms of emission reductions. This allows improvement of the quality of credits from project-based mechanisms that enter the EU to ensure environmental integrity of the carbon market.

In conclusion, the EU has thus not only incorporated core elements of the Kyoto Protocol into its internal post-2012 legislation, but also taken many of these elements a step further. By doing so it has provided an important strengthening of the environmental integrity and scope compared to the Kyoto Protocol, providing the basis for a robust internal regulatory framework that can contribute to the design of an effective future international agreement.

8.3. Three main options for a post-2012 agreement

The various positions on the outcome of the international negotiations can be characterised in three broad categories:

(1) a single new international agreement, replacing the Kyoto Protocol but, to various degrees, incorporating its key elements;

(2) a 2nd commitment period under the Kyoto Protocol, together with a new legally binding agreement under the Convention; or

(3) a 2nd commitment period under the Kyoto Protocol, together with a set of decisions under the Convention.

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124 Directive 2003/87/EC, Article 25, as amended.

125 Articles 11a(5) of the EU ETS Directive 2009/29/EC and Article 5(2) of Decision No 406/2009/EC

126 Articles 11a(9) of the EU ETS Directive 2009/29/EC and Article 5(2) of Decision No 406/2009/EC

In informal discussions a hybrid of options 2) and 3) has also been proposed, combining a 2nd commitment period under the Kyoto Protocol with a legally binding agreement for developed countries under the Convention and a set of decisions covering developing country contributions.

The first option has been generally preferred by developed countries, with the EU being the strongest proponent of the incorporation of all essential elements of the Kyoto Protocol, and the US, as a non-Party to the Kyoto Protocol, opposing any link with the Kyoto Protocol. The 2nd and 3rd option have been supported by many developing countries, with more progressive countries supporting option 2 and others, including India and China, supporting option 3.

Option 1: a single new international agreement as a universal, consistent vehicle to apply common but differentiated responsibilities and respective capabilities*, building on Kyoto*

A single new international agreement, replacing the Kyoto Protocol and incorporating its essential elements, has thus far been the EU's preferred option. The advantage of this option is that it would bring all major emitters within a single legal framework, in accordance with their common but differentiated responsibilities and respective capabilities. A single legal framework would thus both facilitate sufficient environmental ambition and at the same time address competitiveness concerns. Importantly, it would also avoid important practical difficulties with linking the two agreements (for instance for carbon markets), avoid unnecessary duplications in obligations and negotiating time, and avoid difficulties with the timing of their entry into force. The concern has been raised that negotiating a new agreement rather than building on the existing Kyoto Protocol risks opening up and renegotiating key elements of the Protocol. The above has however shown the EU's commitment to the essential elements of the Kyoto Protocol, thus underlining the need for the EU to secure these in a future agreement, as well as the need to make fundamental changes to some of those elements. Whether this is negotiated as an amendment to the existing Kyoto Protocol or as part of a new agreement is unlikely to have a major impact.

Option 2: a 2nd commitment period under the Kyoto Protocol with a new legally binding agreement under the Convention

The main reason for countries to support this option is the wish of an important number of developing countries to maintain a "firewall" between developed country targets and developing country actions, as well as a fear to lose the achievements under the Kyoto Protocol and risk reopening what many see as a robust system with a danger of significantly watering it down.

Theoretically, a 2-treaty option is certainly possible. It would however need to ensure the comparability of all essential elements of the two agreements, in particular where this applies to developed countries under either instrument. It would also need to ensure cross-references between the two instruments to enable for instance a seamless carbon market, regardless of the instrument that a country is covered under.

In view of the need for comparability between the two instruments and the EU's need to make important changes to the current Kyoto architecture, it is hard to explain why pursuing a 2-treaty instrument justifies the practical difficulties of negotiating two instruments at the same time and ensuring a coordinated finalisation and entry into force of both instruments. Furthermore, agreements on a differential treatment between countries do not need separate instruments to reflect those agreements – what matters is the substance of commitments undertaken by countries, not the instrument under which those are taken. The EU should however remain open to consider a two-treaty solution, provided that such solution addresses the EU's fundamental concerns with the current Kyoto architecture and provide for the necessary comparability between obligations under both instruments.

Option 3: a 2nd commitment period under the Kyoto Protocol, together with a set of decisions under the Convention

Reasons for countries to support this option are very similar to those under option 2. The difference between supporting a set of decisions rather than a legally binding agreement under the Convention is mainly explained by the opposition to bring developing country contributions into an international legally binding framework, and a fear that this may lead to legally binding commitments for those countries.

The environmental imperative of broader coverage of at least all major emitters can theoretically be achieved through a set of decisions applying to some of those emitters, whereas others are covered by a legally binding agreement. The inclusion of targets and actions by major emitters in a single legally binding agreement, however, provides a stronger indication of the commitment to their implementation, and adherence to related obligations such as those on MRV. Moreover, comparability of both ambition and shape of commitments, including between developed countries (also those that did not ratify the Kyoto Protocol) is key to enable countries to step up their ambition and respond to domestic competitiveness concerns.

8.4. CDM will continue

One of the main arguments that has been made to call for a 2nd commitment period under the Kyoto Protocol is to ensure continuity for the 'international carbon market'. While the entry into force of a post-2012 agreement may be one way to achieve such continuity, the nature of the 'international carbon market' needs closer examination and the perception that the absence of such an agreement is a legal impediment for the continuity of this market is incorrect.

Even without a 2nd commitment period, the Kyoto Protocol remains in force, unless the Protocol is explicitly repealed by another agreement that enters into force or all 180+ Parties withdraw from it. At the end of 2012 the Kyoto Protocol's targets under its Annex B expire, not the Protocol itself. The same goes for the set of decisions implementing the CDM. This is, for instance, clear from paragraph 4 in Decision 3/CMP.1 (Modalities and procedures for a clean development mechanism as defined in Article 12 of the Kyoto Protocol). Rather than setting an end-date for the CDM, this decision explicitly provides for a review of these modalities and procedures "no later than one year after the end of the first commitment period", and that "further reviews shall be carried out periodically thereafter", thus clearly indicating its validity after 2012, unless it is explicitly repealed. Moreover, it is important to point out that COP 7 in November 2001, in its Decision 17/CP.7, provided for a "prompt start" for the CDM even before the Protocol entered into force, anchoring its operation in the Convention rather than the Protocol. Although not strictly necessary for the future of the CDM, it does set a clear precedent for securing the continuity of the CDM under the Convention rather than the Protocol, if politically desirable.

A further possible concern is the continuity post-2012 of the administrative and institutional support for the CDM, in absence of a 2nd commitment period under the Kyoto Protocol. Apart from the fact that the continuity of the legal framework on which the CDM is based is guaranteed post-2012, it should also be underlined that the CDM is self-funding through a charge on credits before they are issued to investors. The majority of this funding has come from charges on credits for which the end-user has been EU Member States or companies operating in the EU ETS. This means that the continuity of the institutions is not dependent on the political will of Parties to fund those institutions, but on the demand for credits.

In relation to the latter, one of the arguments made in the discussions on a 2nd Kyoto Protocol commitment period is that the absence of internationally agreed developed country targets means that there will be no demand for the CDM. This argument is not correct. Already today, demand for the CDM is mostly driven by domestic legislation. In May 2009 the World Bank reported that, for the third consecutive year, European buyers continued to dominate the CDM and JI markets for compliance, with a combined market share of over 80%, 90% of which comes from private contractors[127]. The vast majority of current demand is therefore driven through EU's domestically defined ETS legislation, not the EU's Kyoto targets.

Moreover, the EU climate and energy package has not only ensured the continuation of legally binding reduction targets post-2012, both under the EU ETS and for the non-ETS sectors, but also explicitly provides for the continuation of the use of CDM credits, even though the use of specific credits from project types can be restricted[128]. In addition, domestic emissions trading systems that are under development outside the EU also foresee the recognition of international credits. Demand for CDM credits, and other forms of international credits, is therefore first and foremost determined by domestic legislation, and in particular the level of ambition set within that legislation, rather than by the existence of binding targets under the Kyoto Protocol for the period after 2012.

8.5. Concluding remarks

The conclusion of this assessment of the merits and drawbacks of alternative legal forms for an international agreement for the period post-2012, including of a second commitment period under the Kyoto Protocol, should therefore be that an international legal framework which builds on the essential elements of the Kyoto Protocol should remain the EU's preferred outcome of the international negotiations. Although a second commitment period under the Kyoto Protocol should not be ruled out, there are a number of important issues, including the carry-over of surplus emission budgets and the accounting rules for land use, land-use change and forestry emissions from developed countries that must be addressed. The international framework should also address emissions from aviation and maritime emissions. Only this would enable the EU's participation in such a second commitment period, without it negatively affecting the integrity and ambition of EU legislation already in place. These concerns come in addition to the environmental imperative to ensure the participation of all key emitters in a future agreement in order to be able to deliver on the objective to remain below 2°C.

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[127] See page 33 of State and Trends of the Carbon Market 2009, World Bank, Washington, D.C., May 2009.

[128] Articles 11a(9) of the EU ETS Directive 2009/29/EC and Article 5(2) of Decision No 406/2009/EC

Importantly, the assessment also shows that the absence of an agreement on a second commitment period is not an obstacle for the continuation of the Clean Development Mechanism (CDM). As both the Kyoto Protocol and its implementing decisions elaborating the CDM remain in force after 2012, the legal foundations for the CDM stay intact. Administrative and institutional support for the CDM is provided post-2012, as the instrument is self-funding through a charge on credits before they are issued to investors. Most importantly, the absence of internationally agreed developed country targets is unlikely to affect the demand for the CDM, as already today this demand is mostly driven through domestic legislation. The EU climate and energy package has ensured the continued use of credits post-2012. Domestic emissions trading systems that are under development outside the EU also foresee the recognition of international credits. The level of ambition within those domestic systems, rather than the existence of international legally binding targets, will determine future demand.

9. CONCLUSIONS

This staff working paper assessed the potential impacts of stepping up the EU's ambition level from 20 to 30%. It did so taking into account the outcome of the 15th Conference of the Parties to the UNFCCC, last year in Copenhagen. Furthermore, this paper responded to the mandate given in the EU ETS Directive to the Commission to submit an analytical report assessing the situation of energy-intensive sectors that have been determined to be exposed to significant risks of carbon leakage in the light of the international negotiations. Finally, the ETS Directive also required the analytical report to include an assessment of the impact of carbon leakage on Member States' energy security, in particular where electricity connections with the rest of the Union are insufficient and where there are electricity connections with third countries.

Section 2 suggests the following conclusions:

- The pledges made by Annex I countries in the context of the Copenhagen Accord add up to reductions of 12% below 1990 2020 for the low end 18% for the high end of the pledges.

- These targets could lead to substantially less reductions if surplus AAUs from the first commitment period could be used after 2012 and lenient accounting rules would be applied for LULUCF activities. In the worst case the ambition level would not be better than the 1990 emission level.

- Pledges made by developing countries concerning national mitigation actions are very diverse. Many include qualitative descriptions of mitigation actions. Some include quantitative pledges (Brazil, China, India, Indonesia, Maldives, Marshall Islands, Moldova, Mexico, South Korea, Singapore, South Africa), but their ambition levels are often hard to assess.

- The pledges are still significantly below the range necessary to stay on a 2ºC trajectory. The low end brings emissions down to 50 Gt $CO_{2\text{-eq}}$ and the high end to 48.7 Gt in 2020. A further reduction of 4.7 Gt $CO_{2\text{-eq}}$ is required to bring emissions down to a level consistent with 2ºC: 44 Gt $CO_{2\text{-eq}}$ by 2020. Many uncertainties exist that could actually lead to significant less reductions. But it is possible to achieve the necessary reduction. This could be achieved if developed countries decided to upgrade their combined pledges to -30% with respect to 1990 while developing countries as a group upgraded theirs to a -15% with respect to baseline and the international maritime and aviation sector would contribute to the required effort.

- The POLES model was used to assess in a stylized way the comparability of targets for one criterion: the potential to reduce emissions and the necessary carbon price signal and emission reductions. The analysis indicated that for the low end pledges Japan has the highest ambition level. This picture becomes much more balanced in case of the high pledges. Russia's pledge seems not to be ambitious. Taking into account 3 other criteria the EU has proposed to compare targets, the US and Canada could have been expected to do more. The high end pledge of China seems more ambitious than India's and Brazil's unless one includes forests and agricultural efforts for Brazil.

Section 3 concludes that:

- In 2020 the EU's GHG emissions (incl. international aviation) in the baseline (that includes the full implementation of the ETS Directive but not the renewable and non-ETS targets) are expected to be 14% lower in 2020 than 1990.

- In the reference scenario (that also includes the 20% renewable target and the national non-ETS targets) the EU reaches the -20% GHG reduction targets of the Climate and Energy Package domestically. Both the ETS and the non-ETS sector fulfil their targets without the need to use credits from third countries.

- The economic crisis has lowered emission projections and costs to achieve the Climate and Energy package targets. Achieving the Climate and Energy package targets for RES and GHG now requires additional costs of €48 billion or 0.32% of GDP, 30 to 50% lower than estimates of costs per GDP made before the adoption of the Climate and Energy package.

Section 4 shows that neither the baseline, nor the fully implemented Climate and Energy package (the reference scenario) are compatible with a 2ºC trajectory. Emission reductions should be around 25% lower in 2020 than 1990 rather than 20%. This gap increases significantly after 2020. In 2030 reductions do not go beyond -25% whereas around -40% internal reductions would be more appropriate.

Section 5 assesses the additional costs and benefits of moving from 20 to 30% in 2020. The analysis shows that:

- Without extra CDM use the additional costs of a 30% reduction (compared to the reference case (the package as it is) would be €46 billion (or 0.31% of GDP) in 2020. If half of the additional reduction would come from credits the additional costs would be €33 billion (or 0.22% of GDP).

- If the 30% reduction would be part of an international accord using high pledges the GDP effect would vary around -0.4% to -0.6% in 2020 compare to the case that the EU implements the package with a -20% unilaterally. Depending on how policies would be implemented in particular with respect to the revenues from auctioning in the ETS and the possible use of carbon tax revenues in non-ETS sectors, this negative impact could actually be reversed into a net growth.

- With access to international credits, the impact on employment would be small: -0.3 to +0.7%. Increases in jobs in some sectors would partially be compensated by losses in other sectors. Net effects could be positive if auction and/or tax revenues would be use to reduce labour costs.

- Going from 20% to 30% GHG reductions with use of international credits would have significant co-benefits. Air pollution control costs are expected to be around €3 billion lower in 2020. In addition there are benefits on the health side that are valued at some €3.5 to 8 billion per year (in 2020). Finally, energy imports would decrease and energy security increase.

Section 6 analyzed the impact of stepping up to 30% on the energy intensive sectors and concludes:

- targets and actions put forward in the Copenhagen Accord may make the EU's energy-intensive industry slightly less exposed to the risk of carbon leakage compared to a situation without Copenhagen Accord

- The analyses shows that its impact is not significant enough to motivate a change in the measures now used to address the risk of carbon leakage. Considering the uncertainties related to the implementation of the pledges, the conclusion is that the measures taken to protect energy intensive industries against the risk of carbon leakage (free allocationand use of international credits) should be maintained.

- In the EU ETS, border measures, such as inclusion of imports into the EU ETS, are inconsistent with allocating allowances for free, since border measures would allow EU companies to pass on their costs of emission allowances. Considering the outcome of the international negotiations, additional measures that are incompatible with the already decided measures (free allocation) are not needed.

- If the EU stepped up to 30% while all other countries would keep their low pledges, this would not lead to significant impacts on energy intensive industry's output compared to other countries, if crediting mechanisms and free allocation are kept in place.

Section 7 evaluated the impact of carbon leakage on Member States' energy security, in particular where electricity connections with the rest of the Union are insufficient and electricity connections with 3rd parties exist. It suggests that:

- The Baltic Member States of the EU are in a unique situation, characterised by insufficient electricity interconnection with other Member States and integration in the electricity system of a non-EU country.

- Once liberalisation of the electricity market has reached a more advanced stage in the Baltic EU Member States, security of electricity supply may be put at risk. For Baltic Member States to fully benefit from liberalisation and opening of their electricity markets also in terms of security of electricity supply, the full integration into the EU electricity market should be pursued.

- The revised ETS Directive is not designed to deal with issues relating to security of electricity supply or competition on the internal market for electricity and can, therefore, not provide an overall solution to the issues identified. It may, however, for a transitional period and in order to bridge the time required to develop overall solutions, offer options (in particular, Article 10c on derogation from full auctioning for the power sector) to alleviate the risks identified.

- The Commission should closely monitor the developments on electricity markets with interconnectors to third countries including infrastructure and market developments. In the light of these developments, it may take appropriate measures with a view to promoting security of supply and a level playing field for competition on the electricity markets concerned.

Section 8 assesses the merits and drawbacks of alternative legal forms, including of a second commitment period under the Kyoto Protocol. It concludes that:

- an international legal framework that builds on the essential elements of the Kyoto Protocol should remain the EU's preferred outcome of the international negotiations. Although a second commitment period under the Kyoto Protocol should not be ruled out, there are a number of important issues, including the carry-over of surplus emission budgets and the accounting rules for land use, land-use change and forestry emissions from developed countries that must be addressed. These concerns come in addition to the imperative to ensure the participation of all key emitters in a future agreement in order to remain below 2°C. This includes the need to address emissions from international aviation and maritime transport.

- The existence of a second commitment period is neither necessary for the continuation of the Clean Development Mechanism (CDM). Demand is driven by countries that have implemented national legislation.

Table 32: GHG emission levels and main drivers for all scenarios

	Baseline	Reference	30% with flexibility (25% internal)	30% internal
Carbon price ETS (€/$CO_{2\text{-eq}}$)	25	16.5	30	55
Carbon price non-ETS (€/$CO_{2\text{-eq}}$)	0	4	30	55
Average renewable energy value (€/Mwh)	0	50	50	50
Reduction GHG (over 1990 %)	-14%	-20%	-25%	-30%
GHG reduction ETS sector including aviation (% over 2005)	-11%	-19%	-26%	-34%
GHG reduction non-ETS sector (% over 2005)	-3.5%	-9.5%	-13%	-16%
Renewable energy share in final Energy Consumption (%)	14.8%	20.0%	20.7%	21.4%
Total cost	12	48	81	94
Total cost (% of GDP)	0.08%	0.32%	0.54%	0.63%

Table 33: Costs and co benefits policy scenario to go to -30% compared to reference

Impacts compared to the reference scenario	30% with flexibility	30% internal

	(25% internal)	
Direct costs (% of GDP)	0.22%	0.31%
Energy system costs + non-CO_2 mitigation Costs + costs international credits and opportunity costs banked allowances (billion €)	33	46
Increase Average Electricity price (%)	5%	11%
Change in GDP in 2020(%) *assuming free allocation in ETS and no tax in the non-ETS*	-0.4% to -0.6%	-1.0% to -1.5%
Employment (% change) *assuming free allocation in ETS and no tax in the non-ETS*	0%	-0.1% to -0.2%
Gross Energy Consumption (% change compared to reference)	-3.5%	-6.5%
Reduced oil & gas imports (billion €)	-9.1	-14.1
Costs air pollution control (billion €)	-3	-5
Reduction health damage compared to reference (billion €)	3.5 to 8	7 to 17

10. ANNEXES

10.1. Association and pledges under the Copenhagen Accord

10.1.1. Association with the Copenhagen Accord

On 21 May April 2010, 125 Parties (including the EU and its Member States) have officially associated themselves to the Accord and are formally listed in its chapeau[129].

All Annex I Parties have associated themselves, except Turkey[130].

Among developing countries, all BASIC countries (Brazil, South Africa, India and China) have associated themselves with the Accord and have submitted national actions.

Cuba, Ecuador, Nicaragua, Kuwait, Nauru and Cook Islands officially notified their objection to the Copenhagen Accord.

129 When the COP15 report was issued, the chapeau of the Copenhagen Accord listed the following Parties agreeing to the Accord: Albania, Algeria, Armenia, Australia, Austria, Bahamas, Bangladesh, Belarus, Belgium, Benin, Bhutan, Bosnia and Herzegovina, Botswana, Brazil, Bulgaria, Burkina Faso, Cambodia, Canada, Central African Republic, Chile, China, Colombia, Congo, Costa Rica, Côte d'Ivoire, Croatia, Cyprus, Czech Republic, Democratic Republic of Congo, Denmark, Djibouti, Eritrea, Estonia, Ethiopia, European Union, Fiji, Finland, France, Gabon, Georgia, Germany, Ghana, Greece, Guatemala, Guinea, Guyana, Hungary, Iceland, India, Indonesia, Ireland, Israel, Italy, Japan, Jordan, Kazakhstan, Kiribati, Lao People's Democratic Republic, Latvia, Lesotho, Liechtenstein, Lithuania, Luxemburg, Madagascar, Malawi, Maldives, Mali, Malta, Marshall Islands, Mauritania, Mexico, Monaco, Mongolia, Montenegro, Morocco, Namibia, Nepal, Netherlands, New Zealand, Norway, Palau, Panama, Papua New Guinea, Peru, Poland, Portugal, Republic of Korea, Republic of Moldova, Romania, Russian Federation, Rwanda, Samoa, San Marino, Senegal, Serbia, Sierra Leone, Singapore, Slovakia, Slovenia, South Africa, Spain, Sweden, Swaziland, Switzerland, The Former Yugoslav Republic of Macedonia, Tonga, Trinidad and Tobago, Tunisia, United Arab Emirates, United Kingdom of Great Britain and Northern Ireland, United Republic of Tanzania, United States of America, Uruguay, Zambia. Since the issuance of the COP15 report, the Secretariat has received communications from the following Parties expressing their intention to be listed as agreeing to the Accord: Afghanistan, Barbados, Chad, Gambia, Jamaica, Mozambique, Uganda, Ukraine, Viet Nam.

130 Turkey is in a sui generis situation and an exception. Turkey is listed in Annex I, had not announced a pledge before Copenhagen, and has not associated itself with the Accord.

10.1.2. List of countries having officially expressed support for the Copenhagen Accord, and quantitative pledges put forward

The table below provides information on countries who have so far expressed support for the Copenhagen Accord, mentioning in each case in which way support has been expressed (generally through a letter to the UNFCCC, the date of which is specified). Most countries have asked to be listed in the chapeau of the Accord.

Annex I countries are identified in blue, and the table specifies which reduction target they have put forward, against which base year, how much this represents compared to 1990 levels, and whether a conditionality has been expressed.

The table also indicates, when applicable, the quantified objectives put forward by developing countries as part of their nationally appropriate mitigation actions. A number of developing countries have submitted mitigation contributions that are not quantified. These are not included in the table below[131].

Country	Date of letter, or other source	Reduction by 2020	Base year	Compared to 1990 levels	Conditionality
Afghanistan	22/03/2010	-	-	-	-
Albania	26/01/2010	-	-	-	-
Algeria	09/03/2010	-	-	-	-
Argentina[132]	15/02/2010	-	-	-	-
Armenia	29/01/2010	-	-	-	-

131 Complete documentation provided by Parties in the context of the Copenhagen Accord is available through http://www.unfccc.int.
132 Argentina did not ask to be listed in the chapeau of the Accord.

Country	Date of letter, or other source	Reduction by 2020	Base year	Compared to 1990 levels	Conditionality
Australia	27/01/2010	-5% up to -15% or -25%	2000	+13% to -11% (-15% to -33% including LULUCF)	5% unconditional 15% or 25% conditional on the extent of actions by others
Bahamas	01/02/2010	-	-	-	-
Bangladesh	25/01/2010	-	-	-	-
Barbados	20/04/2010	-	-	-	-
Belarus	02/02/2010	-5 to -10%	1990	-	Premised on the presence of and access of Belarus to the Kyoto flexible mechanisms, intensification of technology transfer, capacity-building and experience enhancement for Belarus taking into consideration the special conditions of economies in transition Annex I Parties, clarity in the use of new LULUCF rules and modalities.
Benin	08/02/2010	-	-	-	-

Country	Date of letter, or other source	Reduction by 2020	Base year	Compared to 1990 levels	Conditionality
Bosnia and Herzegovina	29/01/2010	-	-	-	-
Botswana	25/01/2010	-	-	-	-
Bhutan	05/02/2010	-	-	-	-
Brazil	BASIC statement 24/01/2010 + submission of NAMAs 01/02/2010	-36.1% to -38.9%	BAU	-	-
Burkina Faso	16/03/2010	-	-	-	-
Burundi	03/05/2010	-	-	-	-
Cambodia	29/01/2010	-	-	-	-
Canada	Press reports of speech, 30/01/2010	-17%	2005	+3%	-
Cape Verde	09/04/2010	-	-	-	-
Central African Republic	28/01/2010	-	-	-	-
Chad	30/03/2010	-	-	-	-
Chile	02/02/2010	-	-	-	-

Country	Date of letter, or other source	Reduction by 2020	Base year	Compared to 1990 levels	Conditionality
China	28/01/2010 Formal association: 09/03/2010	-40% to -45% of its carbon intensity, 15% non-fossil fuel share of primary energy consumption, Increase forest coverage by 40m hectares and forest stock with 1.3bn m^3	2005	-	Voluntary; referring to the principles and conditions of Art 4.7, which mentions the need of developed countries to foresee finance and technology transfer
Colombia	29/01/2010	-	-	-	-
Congo (Dem. Rep.of)	30/01/2010	-	-	-	-
Congo (Rep.of)	01/02/2010	-	-	-	-
Croatia	01/02/2010	-5%	1990	-	Temporary target until EU accession
Côte d'Ivoire	12/02/2010	-	-	-	-
Costa Rica	29/01/2010	-	-	-	-
Djibouti	02/02/2010	-	-	-	-
Eritrea	16/03/2010	-	-	-	-
Ethiopia	01/02/2010	-	-	-	-

Country	Date of letter, or other source	Reduction by 2020	Base year	Compared to 1990 levels	Conditionality
European Union	28/01/2010	-20% to -30%	1990	-	-20% unconditional -30% conditional upon comparable efforts from developed countries and adequate contribution from DCs
Fiji	30/01/2010	-	-	-	-
Gabon	22/02/2010	-	-	-	-
Gambia	14/02/2010	-	-	-	-
Georgia	01/02/2010	-	-	-	-
Ghana	13/01/2010	-	-	-	-
Guatemala	05/02/2010	-	-	-	-
Guinea	18/03/2010	-	-	-	-
Guyana	12/02/2010	-	-	-	-
Iceland	27/01/2010	-30%	1990	-	Comparable emissions reductions by developed countries and adequate contribution by DCs

Country	Date of letter, or other source	Reduction by 2020	Base year	Compared to 1990 levels	Conditionality
India	Ministry press note 30/01/2010 Formal association: 08/03/2010	Reduce the emissions intensity of its GDP by 20-25% (excluding agricultural emissions)	2005	-	Voluntary
Indonesia	30/01/2010	-26%	-[133]	+22% (including LULUCF)	Voluntary
Israel	01/02/2010	-	-	-	-
Jamaica	07/04/2010	-	-	-	-
Japan	26/01/2010	-25%	1990	-	Conditional on a fair, effective and global agreement
Jordan	01/02/2010	-	-	-	-
Kazakhstan[134]	01/02/2010	-15%	1992		-
Kiribati	26/02/2010	-	-	-	-

133 Not specified in the submission to the UNFCCC.

134 Kazakhstan is not an Annex 1 Party but has declared that it wishes to be bound by the commitments of Annex I Parties.

Country	Date of letter, or other source	Reduction by 2020	Base year	Compared to 1990 levels	Conditionality
Laos	12/02/2010	-	-	-	-
Lesotho	29/01/2010	-	-	-	-
Liechtenstein	27/01/2010	-20% to -30%	1990	-	-20% unconditional -30% conditional upon comparable efforts from developed countries and adequate contribution from DCs
Former Yugoslav Republic of Macedonia	25/01/2010	-	-	-	-
Madagascar	25/01/2010	-	-	-	-
Malawi	29/01/2010	-	-	-	-
Maldives	23/01/2010	Carbon neutrality	-	-	-
Mali	22/01/2010	-	-	-	-
Marshall Islands	27/01/2010	-40%	2009		Conditional on adequate international support
Mauritania	22/02/2010	-	-	-	-

Country	Date of letter, or other source	Reduction by 2020	Base year	Compared to 1990 levels	Conditionality
Mexico	31/01/2010	-30%	BAU	-	Provided the provision of adequate financial and technological support from developed countries as part of a global agreement
Moldova	01/02/2010	Min -25%	1990	-	-
Monaco	05/02/2010	-30% (carbon neutral by 2050)	1990	-	
Mongolia	28/01/2010	-	-	-	-
Montenegro	29/01/2010	-	-	-	-
Morocco	01/02/2010	-	-	-	-
Mozambique	06/04/2010	-	-	-	-
Namibia	28/01/2010	-	-	-	-
Nepal	31/01/2010	-	-	-	-
New Zealand	01/02/2010	-10% to -20%	1990	-	Conditional upon global agreement including 2°C target, comparable efforts by developed countries, actions by emerging DCs, inclusion of LULUCF and carbon market.

Country	Date of letter, or other source	Reduction by 2020	Base year	Compared to 1990 levels	Conditionality
Norway	25/01/2010	-30 to -40%	1990	-	-40% conditional upon a global and comprehensive agreement where major emitting Parties agree on emission reductions in line with the 2 degrees Celsius target
Palau	29/01/2010	-	-	-	-
Panama	30/01/2010	-	-	-	-
Papua New Guinea	23/12/2009	-	-	-	-
Peru	28/01/2010	-	-	-	-
Russian Federation	01/02/2010	-15% to -25%	1990	-	Level reductions depending on: - The appropriate account of potential of the Russian woods in a context of the contribution to performance of obligations on reduction of anthropogenic emissions; and - Acceptance of legally significant obligations on reduction of anthropogenic emissions of greenhouse gases by all largest emitters.

Country	Date of letter, or other source	Reduction by 2020	Base year	Compared to 1990 levels	Conditionality
Rwanda	29/01/2010	-	-	-	-
Samoa	20/01/2010	-	-	-	-
San Marino	18/02/2010	-	-	-	-
Senegal	02/03/2010	-	-	-	-
Serbia	29/01/2010	-	-	-	-
Sierra Leone	01/02/2010	-	-	-	-
Singapore	28/01/2010	-16%	BAU	-	Contingent upon a legally-binding global agreement, but domestic measures already to be implemented
South Africa	BASIC statement 24/01/2010+ submission NAMAs 01/02/2010	-34%	BAU	-	Contingent upon a global legally binding agreement providing capacity building support and technology transfer.
South Korea	30/12/2009	-30%	BAU	-	-

Country	Date of letter, or other source	Reduction by 2020	Base year	Compared to 1990 levels	Conditionality
Switzerland	26/02/2010	-20% to -30%	1990	-	-20% unconditional -30% conditional upon comparable efforts from developed countries and adequate contribution from DCs
Tanzania	03/02/2010	-	-	-	-
Trinidad and Tobago	29/01/2010	-	-	-	-
Togo[135]	16/02/2010	-	-	-	-
Tonga	18/03/2010	-	-	-	-
Tunisia	11/02/2010	-	-	-	-
Uganda	07/03/2010	-	-	-	-

135 Togo did not ask to be listed in the chapeau of the Accord.

Country	Date of letter, or other source	Reduction by 2020	Base year	Compared to 1990 levels	Conditionality
Ukraine	21/04/2010	- 20%	1990	-	- To have the agreed position of the developed countries on quantified emissions reduction targets of the Annex I countries; - To keep "economy in transition" status and relevant preferences arising from such status; - To keep the existing flexible mechanisms of the Kyoto Protocol; - To keep 1990 as the single base year for calculating Parties commitments; - To use provisions of Article 3.13 of the Kyoto Protocol for calculation of the quantified emissions reduction of the Annex I countries of the Kyoto Protocol for the relevant commitment period.
Uruguay	29/01/2010	-	-	--	-
United Arab Emirates	14/02/2010	-	-	-	-

Country	Date of letter, or other source	Reduction by 2020	Base year	Compared to 1990 levels	Conditionality
USA	28/01/2010	(in the range of) -17%[136]	2005	-3.4%	Final target in light of enacted legislation
Viet Nam	31/03/2010	-	-	-	-
Zambia	09/03/2010	-	-	-	-

136 The US submission includes a reference to the following: "The pathway set forth in pending legislation would entail a 30% reduction in 2025 and a 42% reduction in 2030, in line with the goal to reduce emissions 83% by 2050".

10.2. Impact of different options for LULUCF accounting rules on the reduction target of developed countries

The Staff Working Document accompanying the Communication "Towards a comprehensive climate change agreement in Copenhagen", (SEC(2009) 101) included a quantitative analysis of the impact of the different LULUCF accounting rules on the potential to account 'business as usual' (BAU) practices in the LULUCF as an emission or a removal. The potential to account it as an emission or removal was expressed as a % of 1990 emissions excluding LULUCF emissions or removals.

For this historic data of the years 2001-2005 were used as proxies for future BAU emissions in the LULUCF sectors over a five year commitment period. For more background information see sections 5.2 and 6.3 of Part One and Annex 10 of Part Two of the Staff Working Document (SEC(2009) 101).

The accounting options assessed are based on different proposals that have been tabled over the course of the international negotiations under the Kyoto Protocol. These are:

– **Option 0:** no changes to accounting rules and the forest management cap set at the same level as the one applied up to 2012. The optional sectors are accounted for in the same manner as countries have opted for at present.

– **Option 1:** option based on the current regime with no changes to accounting rules except an evolution by 2020 towards mandatory accounting for all activities, also for the Article 3.4 activities which are optional at present. For the forest management sector different discounts rates are applied instead of the present 'arbitrary' cap.

– **Option 2:** option based on the current regime but with net-net accounting for the forest management sector compared to a base period. There would also be an evolution towards mandatory accounting for all activities by 2020, also for the Article 3.4 activities which are optional at present.

– **Option 3:** option based on the current regime but the emission flux of the forest management sector would be compared to a forward looking baseline for forest management.

– **Option 4:** Full land based accounting as done at present under the UNFCCC inventories with net-net accounting.

All 4 options were assessed with the exception of option 3[137]. The table below shows the impact of the different options for accounting rules of LULUCF on the amount of emissions or absorptions accounted for, compared to 1990 emissions (excluding LULUCF). Negative values represent a carbon uptake while positive values represent a release of carbon into the atmosphere. In analysing the results put forward it is important to keep in mind that the data

137 Since the construction of this table for the assessment in 'SEC(2009) 101', Annex I parties (with the exception of the US, which is not a party to the Kyoto Protocol) have submitted estimates for a forward looking baseline for forest management, the so-called reference level for forest management, based on a number of agreed criteria.

supporting this assessment is historical. Hence, this analysis does not allow assessing the effect of planned policies in the LULUCF sector.

Table 34: Impact of different LULUCF accounting options on developed countries' targets

Net emissions: % compared to 1990 GHG without LULUCF (accounting period: 2001-2005)											
when relevant, net -net activities with→		1990 base year					1990-1999 base period				
Options →	**0** (KP rules)[1]	**1**[2,3]			**2**[2]	**4**	**1**[2,3]			**2**[2]	**4**
Discount for FM(%)		*100*	*85*	*0*			*100*	*85*	*0*		
Austria	-0,8	-0,5	-3,7	-22,1	-7,5	-5,3	-0,6	-3,8	-22,2	-2,7	-0,8
Belgium	0,0	0,0	-0,4	-2,4	-0,2	-0,2	0,0	-0,3	-2,3	-0,2	-0,2
Bulgaria	0,0	6,5	5,5	0,0	5,0	5,2	1,0	0,0	-5,5	0,3	0,3
Czech Republic	-0,6	-0,3	-0,8	-3,6	-1,1	-1,4	-0,1	-0,6	-3,3	0,7	0,6
Denmark	-2,1	-1,9	-2,5	-6,4	-2,3	-2,6	0,2	-0,5	-4,3	0,1	0,0
Estonia	0,0	0,0	-0,7	-4,6	8,0	8,2	0,0	-0,7	-4,6	4,6	4,7
Finland	-0,8	7,1	0,1	-39,9	-7,5	-11,7	6,6	-0,5	-40,5	-2,0	-6,0
France	-0,7	-0,5	-2,2	-11,5	-2,6	-4,0	-0,4	-2,0	-11,3	-1,9	-2,7
Germany	-0,6	-0,5	-1,4	-6,5	-0,5	-0,6	-0,4	-1,3	-6,4	-0,4	-0,4
Greece	-0,7	-0,3	-0,9	-3,9	-2,1	-2,1	-0,4	-0,9	-4,0	-1,7	-1,6
Hungary	-1,1	0,9	0,4	-2,5	0,9	0,8	0,7	0,2	-2,7	1,6	1,8
Ireland	-0,2	-0,1	-0,3	-1,2	0,7	-0,7	0,1	-0,1	-1,0	0,1	-0,7
Italy	-4,8	-3,7	-5,9	-18,4	-9,5	-6,9	-3,9	-6,1	-18,7	-6,3	-3,5
Latvia	-8,7	-4,4	-11,7	-53,0	18,4	23,9	-4,4	-11,7	-53,0	11,0	16,6
Lithuania	-4,4	-2,3	-4,5	-17,0	1,8	4,6	-2,3	-4,5	-17,0	-0,4	1,9
Luxembourg	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Netherlands	0,1	0,1	0,0	-0,9	0,2	0,0	0,1	0,0	-0,9	0,2	0,0
Poland	-0,9	-0,6	-1,7	-8,0	-1,6	-1,7	-0,5	-1,6	-8,0	-1,6	-1,5
Portugal	-1,3	0,9	0,1	-4,5	-5,6	-6,7	0,9	0,1	-4,5	2,2	1,3
Romania	-1,6	0,0	-2,2	-14,5	-0,5	-0,5	0,0	-2,2	-14,5	0,6	0,6
Slovakia	-0,2	-5,6	-6,4	-11,1	-5,0	-2,3	-4,3	-5,1	-9,8	-3,7	-1,8
Slovenia	-6,5	0,0	-4,0	-26,7	-11,0	-12,1	0,0	-4,0	-26,7	-5,2	-5,7
Spain	-2,8	-2,0	-3,4	-11,3	-2,0	-2,0	-2,0	-3,4	-11,3	-2,0	-1,5
Sweden	-4,0	-1,8	-5,2	-24,7	-14,0	-18,7	-2,2	-5,6	-25,1	8,0	4,6
UK	-0,3	-0,1	-0,4	-1,8	-0,3	-0,6	-0,1	-0,4	-1,9	-0,2	-0,3
EU	**-1,2**	**-0,6**	**-1,8**	**-8,7**	**-1,9**	**-1,9**	**-0,7**	**-1,9**	**-8,8**	**-1,0**	**-0,8**
Australia	8,4	8,4	7,8	4,6	10,2	-18,6	8,4	7,8	4,6	10,0	-5,3
Belarus	0,0	-0,3	-3,4	-20,9	-1,2	-2,4	-0,1	-3,2	-20,7	0,4	0,0
Canada	2,0	2,0	1,8	0,6	22,9	18,2	2,4	2,2	1,0	9,9	6,0
Croatia	0,0	0,0	-3,6	-24,3	-11,0	-10,7	0,0	-3,6	-24,3	1,3	1,3
Iceland	-2,6	-2,9	-3,0	-3,5	-3,1	-7,7	-2,8	-2,9	-3,4	-2,9	-5,6
Japan	-4,0	0,0	-1,1	-7,0	-1,0	-0,6	-0,1	-1,2	-7,1	-0,9	-0,6
Liechtenstein	-2,6	-2,6	-3,9	-11,0	-2,9	1,1	-2,6	-3,9	-11,0	-2,7	0,7
Monaco	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
New Zealand	4,7	4,7	-1,3	-35,5	-1,0	-2,2	4,7	-1,3	-35,5	-3,8	-6,4
Norway	-9,9	-7,5	-16,5	-67,6	-37,0	-34,5	-7,3	-16,3	-67,4	-38,6	-35,6
Russian Federation	-3,6	-0,4	-2,0	-11,5	-7,3	-7,5	2,7	1,0	-8,5	-0,8	-0,9
Switzerland	-3,5	0,7	0,2	-2,5	4,4	3,7	0,7	0,2	-2,5	4,8	4,2
Turkey	-0,3	-0,3	-4,8	-30,5	-4,7	-13,8	-0,3	-4,8	-30,5	-2,9	-4,8
Ukraine	-2,4	6,2	4,4	-5,6	7,5	3,0	4,0	2,2	-7,8	5,2	2,5
USA	0,0	0,0	-1,4	-9,7	-1,8	-1,5	0,0	-1,5	-9,7	-1,3	-1,1
Other AI	**-1,0**	**0,6**	**-0,9**	**-9,4**	**-1,3**	**-2,6**	**1,3**	**-0,2**	**-8,7**	**0,0**	**-0,7**
TOTAL AI	**-1,1**	**0,2**	**-1,2**	**-9,2**	**-1,5**	**-2,4**	**0,7**	**-0,7**	**-8,7**	**-0,3**	**-0,8**

[1] Only the 3.4 activities already selected by Parties for the 1st commitment period were included.
[2] All 3.4 activities were selected, not to prejudge which activities Parties will elect.
[3] For illustrative purposes, the full range (0-100%) of discount factors is shown. The eventual use of a discount factor will be subject to negotiations.

Source: JRC, IES

It is clear that different accounting options have a decisive impact on credits and debits generated by the sector and produce significantly different results for individual Parties, not because of changes in mitigation efforts but simply because different accounting methods are used.

10.3. Partial substitution method versus physical energy content method.

There are essentially two methods used to calculate the share of different type energy sources in a country's energy mix:

– partial substitution method

– physical energy content method.

They have an important impact on how renewable power production (wind, solar, hydro) is taken into account in this energy mix.

Both methods measure electricity production from fossil fuel similarly by measuring the physical energy content of the fossil fuel used in the power production itself. Note that the physical energy content of the fossil fuel is higher than that of the electricity really produced because of efficiency losses in a fossil fuel power plant.

But the two methods measures renewable power production (wind, solar, hydro) differently. The physical energy content method measures the caloric equivalent (860 kcal/kWh) of the electricity output that is generated by renewable energy while the partial substitution estimates the average heat content of the fossil fuels input that would have been needed if the electricity was not produced with renewable energy (somewhere between 2100 and 2600 kcal/kWh depending on the transformation efficiency of the plant).

Of course, using the physical energy content method results in relative shares of solar, hydro and wind in the energy mix that are about one third of the value computed with the partial substitution method.

Therefore, when looking at the percentages of various energy sources in total supply, it is important to understand the underlying conventions that were used to calculate the primary energy balances.

10.4. Economic modelling tools used for this assessment

<u>POLES:</u>

The POLES (Prospective Outlook for the Long term Energy System) model is a global sectoral simulation model for the development of energy scenarios until 2050. The dynamics of the model is based on a recursive (year by year) simulation process of energy demand and supply with lagged adjustments to prices and a feedback loop through international energy price. The model is developed in the framework of a hierarchical structure of interconnected modules at the international, regional and national level. It contains technologically-detailed modules for energy-intensive sectors, including power generation, iron and steel, the chemical sector, aluminium production, cement making, non-ferrous minerals and modal transportation sectors (including aviation).

The world is broken down into 47 regions, for which the model delivers detailed energy balances. Emissions of all Kyoto gases are calculated for the sectors covered by the model.

<u>PRIMES:</u>

Primes simulates the response of energy consumers and the energy supply systems to different pathways of economic development and exogenous constraints. It is a modelling system that simulates a market equilibrium solution in the European Union and its member states. The model determines the equilibrium by finding the prices of each energy form such that the quantity producers find best to supply match the quantity consumers wish to use. The equilibrium is static (within each time period) but repeated in a time-forward path, under dynamic relationships. The model is behavioural but also represent in an explicit and detailed way the available energy demand and supply technologies and pollution abatement technologies. The system reflects considerations about market economics, industry structure, energy /environmental policies and regulation. These are conceived so as to influence market behaviour of energy system agents. The modular structure of PRIMES reflects a distribution of decision making among agents that decide individually about their supply, demand, combined supply and demand, and prices. Then the market integrating part of PRIMES simulates market clearing. For further information see

http://www.e3mlab.ntua.gr/models_menu.php?title=primes.

CAPRI:

CAPRI models the response of the European agricultural system towards a range of policy interventions. It is a comparative static equilibrium global agricultural sector model with focus on EU27 and Norway. It is solved by iterating supply and market modules. Its supply module consists of separate, regional, non-linear programming models which cover about 250 regions (NUTS 2 level) or even up to six farm types for each region (in total 1000 farm-regional models). Its market module is a spatial, global multi-commodity model for agricultural products, 40 product, and 40 countries in 18 trade blocks. For further information see http://www.capri-model.org/.

GAINS:

The GAINS model explores cost-effective multi-pollutant emission control strategies that meet environmental objectives on air quality impacts (on human health and ecosystems) and greenhouse gases. It is an integrated assessment model that brings together information on the sources and impacts of air pollutant and greenhouse gas emissions and their interactions. GAINS brings together data on economic development, the structure, control potential and costs of emission sources, the formation and dispersion of pollutants in the atmosphere and an assessment of environmental impacts of pollution. For further information on the GAINS Europe model which has been used for this analysis, as well as access to background data, see http://gains.iiasa.ac.at/gains/EU/index.login?logout=1.

E3MG:

E3MG stands for Energy-Environment-Economy Model at the Global level. It is an econometric world model addressing developments and policies in the areas of economy, energy and environment. It is an estimated model that reflects both long-term behaviour as well as year-to-year fluctuations. National economies of several developed (USA, Canada, Australia, Japan, Russia e.g.) and developing countries (China, Brazil, India) are included as separate regions. It is similar in structure to the E3ME model that covers the EU only (see www.e3me.com for details).

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 21 World Regions. The regions are linked through endogenous bilateral trade flows. 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, tax revenue recycling scenarios, and environmental instruments (incl. international or national carbon market, emission tax, and permit auctioning). 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 current GEM-E3 version has been updated to the GTAP7 database (base year 2004).

PACE:

PACE is a multi-sector, multi region computable general equilibrium (CGE) model of global trade and energy use. A description of the model structure of the PACE bottom-up CGE model is given in Böhringer and Löschel (2006) and Böhringer et al. (2009). Climate policies are introduced via an additional constraint that sets an upper limit to permissible greenhouse gas emissions (in the current analysis we investigate ceilings to emissions only). The model solution provides a positive shadow price with a binding emission constraint which can be readily interpreted as the price of tradable emission permits.

A non-standard feature of the model version is the hybrid representation of production possibilities: The model features the technological explicitness of bottom-up (engineering) energy system models for the electricity sector while production technologies in other sectors are described in a conventional top-down aggregate manner, i.e. by means of CES (CET) functions. The discrete activity analysis of technology options within top-down CGE models is accommodated through the CGE model formulation as mixed complementarity problem (MCP) – a flexible mathematical representation of market equilibrium conditions which accommodates weak inequalities and complementary slackness (Rutherford 1995, Böhringer 1998, Böhringer and Löschel, 2006, Böhringer and Rutherford 2008).

It has bottom-up representation of energy technologies in the CGE framework, essential for distinguishing energy goods by CO2-intensity and the degree of substitutability. The model differentiates coal, crude oil, natural gas, refined oil products, and electricity. At the sectoral level the model captures details on sector-specific differences in factor intensities, degrees of factor substitutability and price elasticities of output demand in order to trace back the structural change in production induced by a policy regulation.

The model runs on GTAP 7 with an updated benchmark year 2004, it incorporates alternative projections on future GDP growth rates. The sectoral disaggregation of the GTAP7 data concerning energy-intensive industries (EII) has been extended, giving more sectoral disaggregation.

TIMER/IMAGE

The TIMER energy system simulation model describes the long-term dynamics of the production and consumption of about ten primary energy carriers for five end-use sectors in 26 world regions. The model's behaviour is mainly determined by substitution processes of various technologies based on long-term prices and fuel-preferences. These two factors drive investments into new energy production and consumption capacity. The demand for new capacity is limited by the assumption that capital is only replaced after the end of the technical lifetime. Technology development is determined by learning-curves or through exogenous assumptions. The model calculates the energy- and industry related emissions.

The TIMER model is part of an overall modelling framework IMAGE/FAIR/TIMER. The IMAGE model calculates the land-use related emissions. The policy tool FAIR uses the baseline emissions and marginal abatement costs of the IMAGE and TIMER model, and calculates the use of CDM, surplus AAUs and emissions trading to meet the reduction targets. All three models have been used in the calculations of the pledges.

11. GLOSSARY

- AAU: Assigned Amount Units, the Kyoto protocol sets an absolute emission cap at country level for developed countries (QELRO or Quantified Emission Limitation and Reduction Objective). This absolute cap gets translated into a total absolute amount of allowed emissions over the entire commitment period (2008-2012), called a country's Assigned Amount. This Assigned Amount is issued into a country's registry in individual Assigned Amount Units (AAUs), each representing 1 tonne of $CO_{2\text{-eq}}$ emissions. These are the emission rights that can be transferred under the Kyoto Protocol's emissions trading mechanism and these are also used to demonstrate compliance with a country's Kyoto Protocol target.– Adaptation - Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.

- Afforestation - Planting of new forests on lands that historically have not contained forests.

- Annex I Parties - The industrialized countries listed in this annex to the Convention which were committed return their greenhouse-gas emissions to 1990 levels by the year 2000 as per Article 4.2 (a) and (b). They have also accepted emissions targets for the period 2008-12 as per Article 3 and Annex B of the Kyoto Protocol. They include the 24 original OECD members, the European Union, and 14 countries with economies in transition.

- AWG-KP - Ad hoc Working Group on further commitments for Annex I Parties under the Kyoto Protocol. The AWG-KP was established by Parties to the Protocol in Montreal in 2005 to consider further commitments of industrialized countries under the Kyoto Protocol for the period beyond 2012, and is set to complete its work in Copenhagen in 2009.

- AWG-LCA - Ad hoc Working Group on Long-term Cooperative Action. The AWG-LCA was established in Bali in 2007 to conduct negotiations on a strengthened international deal on climate change, set to be concluded in Copenhagen in 2009.

- Cap and trade - Mechanisms that set a cap on emissions and allocated a number of emission rights to entities to cover for their emissions. Those entities can use the emission rights to demonstrate compliance and can trade these emission rights among them. Examples of cap and trade system are the one set up by the Kyoto Protocol for countries with a reduction target (Annex I countries) via the creation of Assigned Amount Units and possibility to trade them via the "Emissions Trading" mechanisms. The largest example at private entity level is the EU Emissions Trading System (EU ETS)

- Carbon Leakage - Portion of cuts in greenhouse gas emissions by countries trying to meet mandatory carbon limits that may reappear in other countries not bound by such limits, with less efficient production technologies, that increase global emissions. This causes a loss in market share for those countries imposing greenhouse gas limits. For example, multinational corporations may merely relocate production from countries subject to such constraints to escape restrictions on emissions.

- CCS – CO2 Capture and geological storage

- CDM - Clean Development Mechanism: a mechanism under the Kyoto Protocol through which developed countries may finance greenhouse-gas emission reduction or removal projects in developing countries, and receive credits for doing so which they may apply towards meeting mandatory limits on their own emissions.

- COP - Conference of the Parties: the supreme body of the UNFCC Convention. It currently meets once a year to review the Convention's progress. The word "conference" is not used here in the sense of "meeting" but rather of "association," which explains the seemingly redundant expression "fourth session of the Conference of the Parties."

- CMP - Conference of the Parties serving as the Meeting of the Parties: The UNFCCC's supreme body is the COP, which serves as the meeting of the Parties to the Kyoto Protocol. The sessions of the COP and the CMP are held during the same period to reduce costs and improve coordination between the Convention and the Protocol.

- Credits - Emission entitlements generated in offsetting or carbon crediting mechanisms that can be used for compliance in cap and trade systems at country or private sector level.

- Deforestation - Conversion of forest to non-forest.

- Emission rights - Emission entitlements generated in cap and trade systems. Two examples of emission rights generated through cap and trade systems are Assigned Amount Units (AAU) and EU Allowances (EUA)

- ETS - Emissions trading systems are cap and trade systems set up to regulate emissions at private entity level. At present the largest ETS is the EU ETS.

- EUA - EU Allowances: The EU Emissions Trading System sets an absolute emission cap for large point source emitters in the EU and allows for trade. The emission rights traded are called EU allowances.

- Flexible mechanisms - Generic terms for the 3 mechanisms under the Kyoto Protocol that allow for flexibility across borders to achieve reduction targets by Annex I parties. The 3 flexible mechanisms are 'Emissions Trading' between Parties, Joint Implementation (JI) and the Clean Development Mechanism (CDM)

- GEF - Global Environment Facility: an independent financial organization that provides grants to developing countries for projects that benefit the global environment and promote sustainable livelihoods in local communities. The Parties to the Convention assigned operation of the financial mechanism to the Global Environment Facility (GEF) on an on-going basis, subject to review every four years. The financial mechanism is accountable to the COP.

- GHGs - Greenhouse gases: the atmospheric gases responsible for causing global warming and climate change. The major GHGs are carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). Less prevalent - but very powerful - greenhouse gases are hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6).

- International carbon market - The sum of various distinct carbon markets including the EU's emissions trading system and the Clean Development Mechanism established under the Kyoto Protocol.

– GWP - Global warming potential

– ICAO - International Civil Aviation Organisation

– IEA - International Energy Agency

– IIASA - International Institute for Applied Systems Analysis

– IMF - International Monetary Fund

– IMO - International Maritime Organisation

– IPCC: Intergovernmental Panel on Climate Change - Established in 1988 by the World Meteorological Organization and the UN Environment Programme, the IPCC surveys world-wide scientific and technical literature and publishes assessment reports that are widely recognized as the most credible existing sources of information on climate change. The IPCC also works on methodologies and responds to specific requests from the Convention's subsidiary bodies. The IPCC is independent of the Convention.

– International carbon crediting mechanisms - Mechanisms that generate credits for emission reductions in countries or sectors that are not subject to a quantified emission reduction or limitation target. Like offsetting mechanisms, they allow for the transfer of these credits to other countries or private sectors entities in other countries for compliance with binding emission caps. More broadly than offsetting mechanisms, carbon crediting mechanisms include also those mechanisms that provide credits for emission reductions only beyond a certain target level that is more ambitious than business as usual. An example for such mechanisms is the so called "no-lose" target that rewards emission reductions below a crediting target, but does not require countries or sectors to acquire credits if the target is not met.

– JRC/IPTS - Joint Research Centre's Institute for Prospective Technological Studies, European Commission

– Kyoto Protocol - An international agreement standing on its own, and requiring separate ratification by governments, but linked to the UNFCCC. The Kyoto Protocol, among other things, sets binding targets for the reduction of greenhouse-gas emissions by industrialized countries.

– LULUCF - Land use, land-use change, and forestry. A greenhouse gas inventory sector that covers emissions and removals of greenhouse gases resulting from direct human-induced land use, land-use change and forestry activities.

– Marrakesh Accords: Agreements reached at COP-7 which set various rules for "operating" the more complex provisions of the Kyoto Protocol. Among other things, the accords include details for establishing a greenhouse-gas emissions trading system; implementing and monitoring the Protocol's Clean Development Mechanism; and setting up and operating three funds to support efforts to adapt to climate change.

– Mitigation - In the context of climate change, a human intervention to reduce the sources or enhance the sinks of greenhouse gases. Examples include using fossil fuels more efficiently for industrial processes or electricity generation, switching to solar energy or wind power, improving the insulation of buildings, and expanding forests and other "sinks" to remove greater amounts of carbon dioxide from the atmosphere.

- Net deforestation – difference between afforestation and deforestation & reforestation

- Non-Annex I Parties - Refers to countries that have ratified or acceded to the United Nations Framework Convention on Climate Change that are not included in Annex I of the Convention.

- non-ETS: Those sectors that are included in the EU Emissions Trading System.

- QELROs - Quantified Emissions Limitation and Reduction Commitments. Legally binding targets and timetables under the Kyoto Protocol for the limitation or reduction of greenhouse-gas emissions by developed countries.

- Offsetting mechanisms - Mechanisms that generate credits for emission reductions in countries or sectors that have themselves no emission cap and allow for the transfer of these credits to countries or sectors that have an emission cap under a cap and trade system in order to be used for compliance purposes. At present the only offsetting mechanism is the CDM that can be used by countries with a reduction target under the Kyoto Protocol for compliance and is also allowed within the EU ETS for compliance in the EU ETS. Also the proposals discussed in the US congress on a US ETS foresee offsetting mechanisms. But these also include internal ones in sectors not covered by the US ETS.

- Private carbon market - This covers a set of activities, i.e. the investment by the private sector in credit generating activities in offsetting mechanisms, the transfer of emission rights or credits as intermediates and the use of emission rights or credits for compliance purposes by private entities under an ETS.

- Public carbon market - The transfer of emission rights or credits that has the objective to be used for compliance purposes by public authorities, such as Annex I parties under the Kyoto Protocol.

- REDD - Emissions from deforestation and forest degradation

- RES target: abbreviation used to represent the EU 2020 renewable energy target of 20%

- Reforestation - Replanting of forests on lands that have previously contained forests but that have been converted to some other use.

- RMU - Removal unit: A Kyoto Protocol unit equal to 1 metric tonne of carbon dioxide equivalent. RMUs are generated in Annex I Parties by LULUCF activities that absorb carbon dioxide.

- SRES - Special Report on Emissions Scenarios: emissions scenarios used, among others, as a basis for the climate projections in the IPCC the Third and the Fourth Assessment Reports.

- Subsidiary Body for Implementation (SBI) :The SBI makes recommendations on policy and implementation issues to the COP and, if requested, to other bodies under the UNFCCC.

– Subsidiary Body for Scientific and Technological Advice (SBSTA): The SBSTA serves as a link between information and assessments provided by expert sources (such as the IPCC) and the COP, which focuses on setting policy.

– Technology transfer - A broad set of processes covering the flows of know-how, experience and equipment for mitigating and adapting to climate change among different stakeholders

– UNFCCC - United Nations Framework Convention on Climate Change.

– WEO – World Energy Outlook, yearly publication by the International Energy Agency on the outlook of the world energy system.

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