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Three Observations on Global Energy and Climate

A Post-Copenhagen Analysis

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The Copenhagen COP-15 summit in December 2009 did not yield the significant outcome that it was intended to deliver. Although the Copenhagen Accord provided some tangible results, the question of whether an effective international regime on climate change can be established is becoming ever more urgent. This paper will analyze on several different levels the outcome of the Copenhagen negotiations and the prospects of international action on climate change.

First, the COP-15 summit is briefly reviewed in the context of previous efforts to address climate change. Second, attention is drawn to three interrelated developments in the world's energy system and energy-related emissions that should be recognized as critical signals regarding international action on climate change: (1) coal has been the fastest growing fossil fuel for the past 7 years; (2) the carbon intensity of the world's total primary energy supply has been increasing in the past decade; (3) previous emissions reduction efforts have fallen short and emissions have been (and still are) rising in almost all countries in the world. Third, a brief assessment is made of the domestic circumstances of the major players and their potential mitigation measures, followed by a discussion of general impediments to successful international climate policy.

The conclusions of the paper will evaluate the short-term prospects for internationally coordinated action on climate change.

Introduction

To assess the Copenhagen COP-15 summit in its proper context, it is worth recalling how internationally coordinated action on climate change has progressed over the past two decades. International climate change policy has never come easily. After the United Nations Framework Convention on Climate Change (hereafter UNFCCC) was signed at the Earth Summit of 1992, it took the Parties to the Convention another five years to arrive at the Kyoto Protocol, which was subsequently not ratified by the United States due to concerns over its economic impact and the potential loss of US competitiveness in comparison to that of emerging developing countries such as China and India.[1]

Although the Kyoto Protocol was signed in 1997, subsequent negotiations about the details of its implementation nearly stranded and were only concluded by the Marrakech Accords at the COP-7 summit in 2001.[2] Despite opposition from the United States, the Kyoto Protocol finally came into force in 2005—eight years after it was signed—the critical threshold having been reached by Russia's ratification of the Protocol.[3] Considering the major challenges that were overcome, the Kyoto Protocol has been a quite remarkable achievement and to this day stands out as the most significant milestone in the global response to climate change.

However, both the realization of the emission reduction commitments (by Annex-I parties) and the follow-up that would advance international action on climate change have proven to be very difficult. Taking strong action is politically complex, as measures aimed at reducing greenhouse gases necessarily involve an enormous range of issues such as energy security, energy prices, economic growth, industrial competitiveness, technological innovation and the environment. Moreover, at an international level there are very fundamental differences in the stakes that the major players perceive to have with respect to the negotiations on a climate change regime. Major dividing lines run between the developed and developing countries, exporters and importers of hydrocarbons, and finally amongst developed countries themselves, regarding the approach that an international climate change regime should take.[4]

In the two years following the COP-13 meeting in Bali in 2007 at which the Bali Roadmap was adopted, there was mounting political pressure to create a successor treaty to the Kyoto Protocol at

[1] U.S. Byrd Hagel Resolution, 105th Congress, S RES 98, July 25, 1997.
[2] Negotiations dealt with issues related to emissions accounting, the flexible mechanisms and methods on incorporating emissions/ removals from land use, land-use change and forestry. For a concise account see: Donald Goldberg and Katherine Silverthorne, 'The Marrakech Accords', *Sustainable Development, Ecosystems and Climate Change Committee Newsletter*, Vol. 5, No. 2, January 2002. Available online at: http://www.abanet.org/environ/committees/climatechange/newsletter/jan02/goldberg.html. See also: Suraje Dessai, *The Climate Regime from The Hague to Marrakech: Saving or Sinking the Kyoto Protocol?*, Tyndall Centre for Climate Change Research, Working Paper 12, December 2001.
[3] It is generally held that Russia ratified the Kyoto Protocol in exchange for EU support for Russia's accession bid to the World Trade Organization. Russia was easily able to meet its emission reduction commitment under Kyoto as a result of the economic downturn in the 1990s.
[4] Luc Werring, 'Negotiating a Robust Climate Policy', Clingendael International Energy Programme, Briefing Paper, November 2009; Stijn van den Heuvel and Stephan Slingerland, 'Energy and Climate: Bridging the Geopolitical Gaps', in: *Challenges in a Changing World: Clingendael Views on Global and Regional Issues*, December 2008; Coby van der Linde, Lucia van Geuns and Stephan Slingerland, 'Van zwarte naar groene energie: geopolitiek van mondiale energietransitie' ['From Black to Green Energy: Geopolitics of a Global Energy Transition'] (Dutch only), *Internationale Spectator*, 62(5), May 2008.

the COP-15 summit in Copenhagen. Two separate working groups set out to develop a framework that could be implemented after 2012, at which time the Kyoto Protocol commitment period ends.[5] Yet already in the lead-up to Copenhagen it became clear that it would be impossible to reach a legally binding treaty on further emissions reductions that would have a scope similar to that of the Kyoto Protocol.

The content of the Copenhagen Accord and other decisions that followed from the COP-15 meeting will be discussed in the next section. However, we can note here that the meeting made only very limited progress in bringing the various parties closer together and uniting them in an international framework on climate change, leaving many crucial issues to be resolved by further negotiations. In fact, the course of the negotiations and the procedural complexity of the meeting even led some to question the viability of the UNFCCC as a multilateral forum for reaching an international agreement to address climate change.[6]

Although negotiations have since continued, with a meeting in Bonn in June 2010 and the next UNFCCC Conference of the Parties (COP-16) scheduled for the end of 2010 in Cancún, Mexico, progress has practically halted for the moment. When the limited results of the COP-15 meeting and current international action on climate change are contrasted with several broad trends in energy use and emissions, the huge challenge that remains becomes apparent.

This, combined with the political circumstances of some of the nations that are crucial for addressing climate change, makes the outlook for a successful international climate change regime as bleak as ever. While recent mitigation commitments and some hopeful trends show that a transition to a more low-carbon energy system is underway, the speed of change is still very slow.[7] Given the current status and lack of progress on international climate policy, the stabilization scenarios expected to limit the global temperature increase to 2˚C will almost certainly not materialize.[8]

[5] The *Ad-Hoc Working Group on Long-term Cooperative Action* (AWG-LCA) included the United States as a Party to the UNFCCC; the *Ad-Hoc Working Group on Further Commitments of Annex-I Parties under the Kyoto Protocol* (AWG-KP) consisted of Parties that ratified the Kyoto Protocol and included the United States only as an observer.

[6] Katherine Michonski, Michael A. Levi, 'Harnessing International Institutions to Address Climate Change', Council on Foreign Relations, March 2010. Available at: http://www.cfr.org/content/publications/attachments/IIGG_WorkingPaper_2_ClimateChange.pdf.

[7] A broad and detailed study on climate change policy measures conducted by the *World Energy Council* concluded that "present policies to combat climate change are failing to rise to the scale of the challenge". World Energy Council, Energy and Climate Change, 2007, p. 125.

[8] UNEP Climate Pledges site, available at: http://www.unep.org/climatepledges/. Pre-Copenhagen analysis of latest (almost all) pledges: Niklas Höhne, Michiel Schaeffer, Claudine Chen, Bill Hare, Markus Hagemann and Christian Ellermann, 'Copenhagen Climate Deal: How to Close the Gap', Ecofys / Climate Analystics Briefing Paper, 15 December 2009. See also: World Resources Institute, 'Comparability of Annex-I Emission Reduction Pledges', Working Paper, February 2010. Available at: http://www.wri.org/publication/comparability-of-annexi-emission-reduction-pledges.

COP-15 and the Copenhagen Accord

The 15th Conference of the Parties at Copenhagen did not deliver a comprehensive treaty that could provide a follow-up to the Kyoto Protocol, as had been envisioned in the Bali Roadmap. That this objective was out of reach became clear during the course of 2009 and was officially acknowledged when President Obama of the United States endorsed a "one agreement, two steps" approach for Copenhagen at the Asia Pacific Economic Cooperation forum in Singapore in November 2009. Yet also when measured against the lowered expectations that were placed on it, the Copenhagen summit did not fulfill the objective of striking a political agreement that could be translated into a binding treaty in the near future.

Apart from the conclusions of the two Ad-hoc Working Groups to continue their work until COP-16 and decisions on some minor administrative issues, the only significant result was the Copenhagen Accord, which was negotiated in the final stages of the summit by the United States, Brazil, South Africa, India and China. We will briefly review its main content below.[9]

The only explicitly quantified target in the Copenhagen Accord is the goal of limiting a global temperature increase to a maximum of 2 degrees Celsius, this being recognized as a critical threshold conform the findings presented by the Intergovernmental Panel on Climate Change (IPCC). In effect, this simply meant the reaffirmation of a goal which had already been agreed upon by both the G8 and other major countries (including China, India, South Africa and Brazil) at the Major Economies Forum during the L'Aquila G8 summit in Italy in 2009.[10] At that same summit, the G8 nations already took further steps by calling for global emission reductions of 50% by 2050 and pledging to cut back emissions from developed countries by 80% in 2050, in line with IPCC suggestions.[11] Although the inclusion of these additional objectives in the Accord had been suggested during the negotiations, they were left out in the final version.

The important step of translating this goal for global temperature into a target regarding global emissions of greenhouse gases, both long-term (2050) and medium-term (2020), was not taken.[12]

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[9] See, for instance: Christian Egenhofer and Anton Georgiev, 'The Copenhagen Accord: A first stab at deciphering the implications for the EU', CEPS Commentary, 25 December 2009; Rob Fowler, 'An Initial Assessment of the Copenhagen Outcomes', University of South Australia, 20 December 2009.

[10] G8 Summit at L'Aquila, Italy, July 2009. *Declaration of the Leaders of the Major Economies Forum on Energy and Climate*, p. 1: "We recognize the scientific view that the increase in global average temperature above pre-industrial levels ought not to exceed 2 degrees C. In this regard and in the context of the ultimate objective of the Convention and the Bali Action Plan, we will work between now and Copenhagen, with each other and under the Convention, to identify a global goal for substantially reducing global emissions by 2050." Available online at: http://www.g8italia2009.it/static/G8_Allegato/MEF_Declarationl.pdf.

[11] *G8 Chair's Summary*, p. 4: "In the G8 session, leaders recognized the scientific view on the need to keep the global temperature rise below two degrees Celsius above pre-industrial levels and agreed on a long-term goal of reducing global emissions by at least 50% by 2050 and, as part of this, on an 80% or more reduction goal for developed countries by 2050. They also agreed on the need for significant mid-term targets consistent with the long-term goals and for global emissions to reach their peak as soon as possible." Available at: http://www.g8italia2009.it/static/G8_Allegato/Chair_Summary,1.pdf. For the IPCC burden sharing scenarios, see Box 13.7 in *Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change.* The notion that developing countries should substantially deviate from their baseline emissions trajectory is usually interpreted as aiming for 15% to 30% under business-as-usual (BAU).

[12] Let alone a rough burden-sharing agreement on how to divide the required cuts in emissions. Hence, on further steps debated but not taken at the G8 summit, such as specifying a base year in relation to the global emission cuts and the burden-sharing of global emission reductions, Copenhagen did not yield any progress.

This step would have been especially important in light of the increasing debate surrounding climate science, as it would have implied some judgement on what degree of emissions reductions would be required. An explicit target on the peaking of emissions was not included, either.[13] Instead, while endorsing the 2° Celsius limit, a bottom-up approach was chosen in which parties could list their mitigation goals in the appendices to the Accord. Appendix I lists the "quantified economy-wide emissions targets for 2020" for developed countries, while Appendix II consists of the "nationally appropriate mitigation actions of developing country Parties". At the end of this section, Figure 1 lists the pledges of the most important parties.

If there is one aspect in which the Copenhagen meeting is regarded by many to have provided some result of significance, it is finance. The United States pledged to contribute to the global goal of raising US$100bn annually for mitigation and adaptation measures in developing countries by 2020.[14] Furthermore, developed countries promised to jointly mobilize US$30bn in the next three years (2010-2012) for the Copenhagen Green Climate Fund. Preliminary information shows that the EU, Japan and the US will be large donors, but it is still not completely clear how such significant amounts of funds should be raised.[15] The Accord itself mentions that "[t]his funding will come from a variety of sources, public and private, bilateral and multilateral, including alternative sources of finance". In many cases, details on how the money should be distributed are yet to be decided upon.[16]

A small step was made with respect to transparency and the requirement for mitigation actions to be "measurable, reportable and verifiable" (MRV) as suggested by the Bali Action Plan. Mitigation actions by non- Annex-I parties that benefit from international support will be subject to international measurement, reporting and verification. Mitigation actions not receiving such support will be subject only to domestic measurement, reporting and verification, but should be reported through national communications every two years "with provisions for international consultations and analysis under clearly defined guidelines that will ensure that national sovereignty is respected".[17] The scope and content of these provisions and guidelines will still need to be determined.

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[13] The Accord mentions that "deep cuts in global emissions are required according to science", and that "we should cooperate in achieving the peaking of global and national emissions as soon as possible". Copenhagen Accord, article 2.
[14] This goal was inserted in the name of all developed countries in Article 8 of the Copenhagen Accord.
[15] As of July 2010, the pledged contribution by the EU totals €7.2bn (i.e. €2.4bn per year for the 3-year period), but neither a burden-sharing agreement between Member States nor an explicit statement concerning the additionality of the financing was made public *EurActiv*, 'EU clarifies climate aid plan', 7 June 2010; available online at: http://www.euractiv.com/en/climate-environment/eu-clarifies-climate-aid-plan-news-494940. The US ear-marked $1.3bn for 2010 and requested $1.9bn for 2011. Japan committed to ¥1,750bn (approx. US$15bn) over the three period under the "Hatoyama Initiative" in December 2009, however ¥1,300bn of publicly-funded money is conditional upon a political accord and "fair and effective framework with participation of all major emitting countries" being reached. An overview of financial pledges related to climate change can be found at: World Resources Institute, 'Summary of Climate Finance Pledges Put Forward by Developed Countries', 5 June 2010. Available at: http://www.wri.org/stories/2010/02/summary-climate-finance-pledges-put-forward-developed-countries and http://pdf.wri.org/climate_finance_pledges_2010-06-05.pdf (version 5 June 2010).
[16] At the Bonn climate talks of June 2010, parting UNFCCC Executive Secretary Yvo de Boer stressed that whether pledges on climate finance would be upheld will be vital for achieving any progress at the COP-16 in Cancún. Reuters, 'Climate Finance Key for Cancún Talks: U.N. Chief', 3 March 2010. Available at: http://www.reuters.com/article/idUSTRE6221BZ20100303; Reuters, 'Copenhagen Climate Accord Faces $30 Billion Aid Test', 25 January 2010. Available at: http://www.reuters.com/article/idUSTRE60O31020100125. Also see: Roberts, Stadelmann and Huq, 'Copenhagen's climate finance promise: six key questions', February 2010. Available online at: http://www.iied.org/pubs/pdfs/17071IIED.pdf.
[17] UNFCCC, *Copenhagen Accord,* 2009, Article 5.

The legal status of the Copenhagen Accord has been the subject of extensive discussion.[18] Due to the objections of a few countries, the Copenhagen Accord was not able to be endorsed unanimously and was only "noted" by the General Assembly of the Parties to the Convention at the conclusion of the conference. Consequently, the Accord does not hold the status of a UNFCCC decision; in fact, it is merely a political agreement between its signatories. This has cast doubts on the value of the pledges made. While targets declared within the context of the UNFCCC arguably hold more authority and political support than do the G8 pledges, they are nonetheless merely statements of intention and are not binding in any sense. From that perspective, the distinction between the different pledges by developed and developing countries listed in the two appendices is more a matter of form and intention. The developing countries have emphasized the voluntary nature of their proposed measures, while the matter of how pledges of both categories might be converted to legally binding commitments has been left open. This challenge of integrating the content of the Copenhagen Accord into the UNFCCC touches upon another very crucial point in the negotiations: the role of the Kyoto Protocol and the distinction between Annex-I and non-Annex-I countries in a future international climate change regime. While the United States maintains that the Kyoto Protocol will need to be substituted by a new framework, the developing countries are strongly against this. That an earlier paragraph mentioning a deadline in 2010 for agreeing upon a binding treaty was removed from the Accord can be interpreted as a signal concerning the short-term prospects of achieving a compromise on this critical issue.

All in all, it remains very uncertain whether the Accord provides enough common ground to make it a potential starting point for a new international framework on climate change. First, the negotiations made clear that there exists a very fundamental dispute on how to move forward from the broad goals (such as the 2˚C threshold) to more detailed arrangements that could spur effective measures addressing climate change. Arguably, this dispute has deepened rather than coming closer to a compromise. Compared to earlier efforts and agreements, in particular the Kyoto Protocol and the G8 meeting, the negotiations on climate change have "zoomed out", leaving many specific issues to be resolved in the future.[19] Yet if the experience of the Kyoto Protocol and the subsequent arduous task of agreeing on the Marrakech Accords make one thing clear, it is that these are exactly the details that determine whether any progress can be made on the implementation.[20]

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[18] Raj Bavishi, 'The Copenhagen Accord: A legal analysis', 28 January 2010.

[19] Ironically, the G8 pledges of July 2009 suddenly have gained extra significance, even while being widely dismissed as being too unambitious at the time. Fiona Harvey. 'Global Insight: Was G8 more than hot air?', *Financial Times,* 15 July 2009.

[20] Although the Copenhagen Accord claims to be "operational immediately", many necessary issues were left open, including (non-exhaustive): financial mechanism/operating entity for the distribution of funds in the Copenhagen Green Climate Fund, a Technology Mechanism, guidelines on international measurement, reporting and verification (MRV), provisions for international consultations and analysis, and a new mechanism for combating deforestation (REDD+). 'Old' issues such as what to do with the large amount of emission allowances in Russia and other Economies In Transition (under the Annex-I), whether to extend the scope of the Clean Development Mechanism, how to deal with emissions from international aviation and shipping, and how to improve emissions statistics reporting, did not progress much, if at all. See, for instance: *Euractiv*, 'Russian 'hot air' threatens UN climate deal', 22 October 2009. Available at: http://www.euractiv.com/en/climate-change/russian-hot-air-threatens-un-climate-deal/article-186633; M.C.J. den Elzen, M. Roelfsema, S. Slingerland, 'Too hot to handle? The emission surplus in the Copenhagen negotiations', Netherlands Environmental Assessment Agency, December 2009. Available at: http://www.rivm.nl/bibliotheek/rapporten/500114016.pdf; BBC News, 'Planes "threaten climate targets" ', 9 September 2009. Available at: http://news.bbc.co.uk/2/hi/science/nature/8243922.stm.

Second, the fact that the Copenhagen Accord lacks a legally binding status does raise the questions of whether the pledges will be upheld and what priority these goals will have for the Parties involved. Yet, as was already mentioned by President Obama in his remarks following the Copenhagen meeting, in the absence of an enforcing entity, international pledges and treaties are "only as strong as the countries' commitments to participate"[21]—an observation which also holds for the Kyoto Protocol, notwithstanding its legally binding status. Considering that at a fundamental level a perceived equivalence of benefits or reciprocity is necessary for an international agreement to be successful, globally coordinated action on climate change remains in essence a daunting task.[22] While the impact of climate change poses a shared threat, it still does not seem to be direct enough (or perceived to be direct enough) to incentivize strong action.

Third, when all the pledges are added up and compared to the emissions stabilization schemes proposed by the IPCC and other climate scientists, it should be recognized that the current efforts—even when implemented fully and successfully and using the highest ranges—will not be enough to have a 50% chance on limiting a global temperature rise to 2˚C. Current targets would amount to a 12% to 19% reduction of Annex-I country emissions by 2020 compared to 1990, in contrast with reductions of 25% to 40% recommended by the IPCC.[23] Even if followed up with stronger measures in the following decades, this would very likely put us on a path toward a temperature increase of at least 3˚C.[24] The *World Energy Outlook 2009* by the International Energy Agency indicated that the 450 ppm/2˚C stabilization scenario is practically out of reach and that mitigation pledges (in their highest range) are more in line with a 550 ppm/3˚C trajectory.[25]

[21] Remarks by Obama in his press conference following the negotiations on the Copenhagen Accord: "My response is that, A, that's why I think we should still drive towards something that is more binding than it is. But that was not achievable at this conference. And the second point that I'd make is that Kyoto was legally binding and everybody still fell short anyway. (…) Well, we don't have international government, and even treaties, as we saw in Kyoto, are only as strong as the countries' commitments to participate." Remarks by the President during press availability in Copenhagen, Bella Center, Copenhagen, 18 Dec 2009. Downloadable at: http://www.whitehouse.gov/the-press-office/remarks-president-during-press-availability-copenhagen.

[22] See Summary (p.9) and section 1.2 'Climate change, rational actors and reciprocity' in: H.C. de Coninck, *Technology Rules! Can Technology-oriented Agreements Help Address Climate Change?,* PhD Thesis/ECN Policy Studies Report, November 2009. Available online at: http://www.ecn.nl/publications/default.aspx?nr=ECN-B--09-017.

[23] World Resources Institute, 'Comparability of Annex-I Emission Reduction Pledges', Working Paper, February 2010. Available at: http://www.wri.org/publication/comparability-of-annexi-emission-reduction-pledges; UNEP Climate Pledges site, available at: http://www.unep.org/climatepledges/.

[24] Analysis of almost all pledges (as of 15 December 2009) gives a global emission trajectory the median chance of a temperature increase of about 3.2 - 3.5 ˚C. Niklas Höhne, Michiel Schaeffer, Claudine Chen, Bill Hare, Markus Hagemann and Christian Ellermann, 'Copenhagen Climate Deal: How to Close the Gap', Ecofys / Climate Analytics Briefing Paper, 15 December 2009. Also see: IEA, *WEO 2009*, pp. 175, 198.

[25] International Energy Agency, *WEO 2009*, p. 52: "A delay of just a few years would probably render that goal [i.e. moving onto the emissions path consistent with a 2˚C increase] completely out of reach"; p. 194: "An indicative guide, based on our results, is that for every year of delay before moving to a 450 ppm trajectory, an extra $500bn is added to the global bill of $10.5 trillion for mitigating climate change. This figure applies only to delays of one to three years; if further delay means that a 450 ppm trajectory becomes unattainable, the additional adaptation costs would be several times this figure." Also see: *WEO2009,* pp. 175, 192-194, 196, 198.

Copenhagen Accord, Appendix I – Quantified economy-wide emissions targets for 2020			
Country	**Reduction**	**Base year**	**Conditional upon**
Australia	-5% up to -15% or -25%	2000	-25%: "If the world agrees to an ambitious global deal capable of stabilising levels of greenhouse gases in the atmosphere at 450 ppm CO_2-eq or lower." -15%: "If there is a global agreement which falls short of securing atmospheric stabilisation at 450 ppm CO_2-eq and under which major developing economies commit to substantially restrain emissions and advanced economies take on commitments comparable to Australia's." -5%: "Unconditionally."
Canada	-17%	2005	"To be aligned with the final economy-wide emissions target of the United States in enacted legislation."
EU	-20% or -30%	1990	-30%: "Provided that other developed countries commit themselves to comparable emission reductions and that developing countries contribute adequately according to their responsibilities and respective capabilities."
Japan	-25%	1990	"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."
Russian Federation	-15% to -25%	1990	"The range of the GHG emission reductions will depend on the following conditions: - Appropriate accounting of the potential of Russia's forestry in frame of contribution in meeting the obligations of the anthropogenic emissions reduction; - Undertaking, by all major emitters the legally binding obligations to reduce anthropogenic GHG emissions."
United States	[in the range of] -17%	2005	"[In the range of 17%] 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."[1] ([1]): "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."

Copenhagen Accord, Appendix II – Nationally Appropriate Mitigation Actions of Developing Country Parties	
Country	**Mitigation Actions**
Brazil	36.1% to 38.9% below BAU (Business As Usual) levels
China	"China will endeavor to lower its carbon dioxide emissions per unit of GDP by 40-45% by 2020 compared to the 2005 level, increase the share of non-fossil fuels in primary energy consumption to around15% by 2020, and increase forest coverage by 40 million hectares and forest stock volume by 1.3 billion cubic meters by 2020 from the 2005 levels."
India	"India will endeavour to reduce the emissions* intensity of its GDP by 20-25% by 2020 in comparison to the 2005 level. [*: not taking agriculture emissions into account for the intensity target.]"
Indonesia	26% below BAU by 2020 (up to 46%, depending on international support)
South Africa	34% below BAU in 2020, 42% below BAU by 2025. Peaking between 2020 and 2025, plateau for approximately a decade and decline in absolute terms thereafter.

Figure 1. The pledges of several parties as enlisted in the Appendices I & II of the Copenhagen Accord. This list does not include all pledges. Source: UNFCCC, February 2010.[26]

[26] Available online at: http://unfccc.int/home/items/5264.php (Appendix I) and http://unfccc.int/home/items/5265.php (Appendix II). Accessed on 17 February 2010.

Energy and Climate: Three Sobering Observations

The previous two sections have discussed the context of international action on climate change and the outcome of the December 2009 Copenhagen summit. To place the discussions about the Copenhagen summit in an appropriate perspective, it is worthwhile to review some key longer-term global trends related to energy and emissions.

Three interrelated observations stand out.

Observation 1: Coal has been the fasting growing fossil fuel for the past 7 years.

According to the *BP Statistical Review of World Energy 2009*, global coal consumption increased by 3.1% in 2008, compared to an overall primary energy consumption growth of 1.4%. Although this was the slowest growth rate of coal demand in the past few years, it still made coal the fastest growing primary energy source (in comparison to oil, gas and hydropower) for the sixth consecutive year leading up to 2009. Even in 2009, when global primary energy consumption decreased by 1.1% due to the impact of the financial and economic crisis, coal demand remained resilient: while demand for oil and gas dropped by 1.7% and 2.1% respectively, coal demand stayed flat due to strong growth in the Asian Pacific region.[27]

Global coal production grew from 4.6 billion tonnes to 6.9 billion tonnes in the decade from 1999 to 2009. In many regions production techniques such as mountaintop removal and open pit mining have made a dramatic increase in production levels possible at lower costs.[28] China has been the main driver of global demand: Chinese coal demand more than doubled in the period from 1999 to 2009 and accounted for 74 percent of the growth in global coal consumption over the same period.[29] It is currently the largest producer (producing more than twice as much as the United States, which ranks second) and the largest consumer of coal, accounting for just over 45% of global production and demand.[30] With per capita primary energy consumption in China standing at one-third of OECD levels, the potential for increasing consumption levels is enormous.[31] The IEA projects that global coal consumption will increase by more than 50% by 2030 and that 97% of all global growth in coal consumption between now and 2030 will come from Asia, with the largest shares going to China (65%) and India (20%).[32]

The main demand for coal lies in electricity and heat generation. The share of coal used for these purposes compared to other fuels increased from 36% to 41% in between 1992 and 2007 globally and even more significantly—from 43% to 53%—for non-Annex-I countries to the Kyoto Protocol.

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[27] *BP Statistical Review of World Energy*, June 2010, p. 35.
[28] David G. Victor, Richard K. Morse, 'Living with Coal: Climate policy's most inconvenient truth', The Boston Review, September/October 2009. Available at: http://pesd.stanford.edu/publications/living_with_coal_climate_policys_most_inconvenient_truth/.
[29] *BP Statistical Review of World Energy*, June 2010, pp.5, 35 (and online historical database). China accounted for 85% of the global growth in coal consumption in 2008, and for 95% in 2009.
[30] *BP Statistical Review of World Energy*, June 2010, pp. 34, 35.
[31] Total primary energy supply per capita (in tonnes of oil equivalent per capita), for China: 1.48, OECD: 4.64, world average: 1.82, respectively. IEA, *Key World Energy Statistics 2009*, p. 49.
[32] IEA, *WEO2009*, pp. 89-90.

China, India and the United States all rely heavily on coal-fired power generation, with the share of coal in total generated electricity standing at 81%, 68% and 49% respectively.[33]

Worldwide proven reserves are still enormous, enough for another 119 more years at current rates of consumption (compared to 46 and 63 years for oil and gas, respectively).[34] This entails only proven reserves, which might be significantly enlarged.[35] According to current estimates, China and India hold the third and fifth largest proven reserves of coal in the world.[36]

Observation 2: The carbon intensity of the world's energy supply is increasing.

This observation may seem rather counterintuitive, given the major attention to climate change and low-carbon energy sources and their rapid growth. However, going directly against this low-carbon objective is the trend that the carbon intensity of our energy supply is actually increasing (see Figure 2).[37] Naturally, this is directly related to the second observation that coal is the fastest growing fossil fuel.

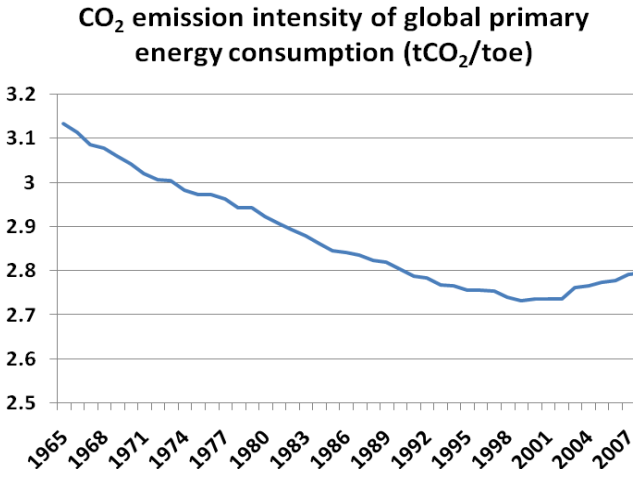

Figure 2. Emission intensity of global primary energy consumption. Source: BP, *Statistical Review of World Energy*, June 2009 (electronic version, including emissions statistics). Emissions are fossil-fuel related CO_2 emissions; toe: tonnes of oil equivalent.

Due to its high carbon content, coal emits about twice as much carbon dioxide as natural gas when combusted.[38] Hence, although coal provides only a quarter of the world's total primary energy supply (TPES), it accounts for 42% of CO_2 emissions—a share that is expected to steadily increase.[39] Renewable energy sources—in particular the 'new' non-hydro renewable energy sources such as wind and solar—have very high growth rates, especially when considering their increasing share in newly installed capacity in power generation.[40] However, their base is very small, and consequently their share in total

[33] Data obtained from: IEA, *CO_2 Emissions Highlights 2009*, p. 10; IEA, *WEO 2009,* pp. 629, 647, 649.
[34] *BP Statistical Review of World Energy*, June 2010, pp. 6, 22, 32, 35.
[35] IEA, *WEO2009*, pp. 90-91; David G. Victor, Richard K. Morse, 'Living with Coal: Climate policy's most inconvenient truth', The Boston Review, September/October 2009, pp. 7-8. BGR, *Annual Report 2009. Reserves, Resources and Availability of Energy Resources,* 2009.
[36] *BP Statistical Review of World Energy*, June 2009, p. 32.
[37] "In the 1980s, global energy-related CO_2 emissions rose more slowly than primary energy demand, but this decarbonisation of the energy sector started to slow and reverse in the 1990s, as the share of nuclear power fell back while that of coal rose. The Reference Scenario projects a continuation of this recarbonisation until after 2020, before energy demand growth once again outpaces emissions growth". IEA, *WEO2008*, p. 381.
[38] IEA, *CO_2 Emissions Highlights 2009*, p. 10. Gas: 15.3 t C/TJ, oil products: 16.8–27.5 t C/TJ, primary coal products 25.8-29.1 t C/TJ. Available online at: http://www.iea.org/co2highlights/CO2highlights.pdf.
[39] IEA, *CO_2 Emissions Highlights 2009*, p. 10. Projected share of coal in total global energy-related CO_2 emissions increases from 42% (2007) to 46% (2030). IEA, *WEO2009*, p. 623.
[40] E.g.: in the EU more wind power capacity was installed than any other type of electricity generation capacity in 2008 and 2009, accounting for more than one-third of total new capacity. European Wind Energy Association, www.ewea.org.

generated electricity is increasing much more slowly (see Figure 3). Moreover, electricity consumption is only part of the world's total energy use. Particularly for the purposes of heating and transport, fossil fuels still dominate the energy supply. As a consequence, the share of non-hydro modern renewable energy technologies (including wind, solar, geothermal, tide and wave energy) are projected to increase their share of total energy use only to slightly more than 2% in 2030—up from less than 1% today.[41]

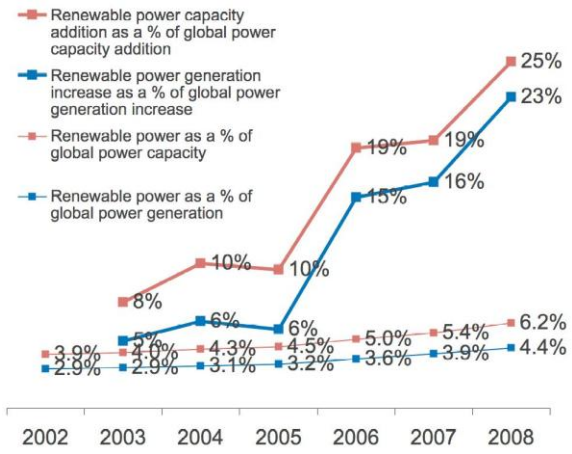

Figure 3. Increase of renewable energy sources (excl. large hydro) in global electricity generation. Source: New Energy Finance, *Global Trends in Sustainable Energy Investment 2009*, June 2009.

The growth of coal is complemented by a slow reduction of the share of hydropower—currently by far the most significant renewable energy source—because in many countries the technical potential for hydropower has already been largely utilized (e.g. in the United States, Europe and Japan; China will face this problem as well in one or two decades).[42] Nuclear power has historically played an important role in decreasing the carbon intensity of the global energy supply, yet its share in the global fuel mix is also declining.[43] Especially in Europe a whole generation of nuclear power plants will need to be decommissioned sooner or later: in the absence of a 'nuclear renaissance', the share of nuclear power is projected to drop significantly.[44] The growth of nuclear power outside the US and Europe does not compensate sufficiently to reverse this decline, even though especially China is implementing a ambitious nuclear programme, with about one-third of all nuclear plants under construction located in China.

Observation 3: Current efforts to curb greenhouse gas emissions are still falling short.

Up until the financial and economic crisis, global emissions of greenhouse gases had been accelerating, and they are expected to pick up the pace again soon.[45] Total emissions of

[41] Reference Scenario in IEA, *WEO2009*, p. 74. Fossil fuels are expected to maintain their share of circa 80% in TPES.
[42] IEA, *WEO2009*, p. 101.
[43] IEA, *WEO2009*, p. 224: "Historically, the carbon intensity of power generation (defined as CO_2 emission content per unit of generation) tended to fall only gradually with improvements in technology and efficiency, and the uptake of lower or zero-carbon technologies. In 1971, carbon intensity was above 600 grammes of CO_2 per KWh (gCO_2/kWh); it fell to around 510 gCO_2/kWh in the 1990s and then remained fairly stable. The reduction in carbon intensity before the 1990s was in large part due to significant expansion of nuclear capacity worldwide."
[44] IEA, *WEO 2009*, pp. 99-101. The Reference Scenarios foresees nuclear power capacity in Europe dropping from 132 GW to 103 GW by 2030 in the EU (its share in the electricity mix dropping from 28% to 19%), while the United States actually shows a slight increase in absolute figures, from 101 GW to 115 GW, given its renewed interest in nuclear power. New legislation promoting nuclear power (in the US and EU) might change these prospects. For more background analysis see: *Ernst&Young*, Nuclear Perspectives. Regional opportunities for a sector in renaissance, September 2009. Available online at: http://www.ey.com/Publication/vwLUAssets/Nuclear_perspectives:_regional_opportunities_for_a_sector_in_renaissance/$FILE/Nuclear_perspectives_Sep%2009.pdf.
[45] Michael R. Raupach et al., 'Global and Regional Drivers of Accelerating CO_2 Emissions', Proceedings of the National Academy of Sciences of the United States of America, Vol. 104, No. 24, 12 June 2007. Available at:

anthropogenic greenhouse gases increased from 24 billion tonnes of CO_2-equivalent (CO_2e) in 1970 to 33 billion tonnes in 1990 and 41 billion in 2005, with an average annual growth rate of about 1.2% over this quarter-century. Yet growth rates have been going up, with an increase of 3% in the five-year period between 1990 and 1995, 6% between 1995 and 2000 and 15% over the period 2000-2005.[46]

Annual growth rates from industrialized countries slowed between 1970 and 2005, while their emissions increased from 16 billion to 19 billion tonnes during the same period. However, emissions from developing countries almost tripled from 7 billion tonnes in 1970 to circa 21 billion in 2005. Carbon dioxide emissions (predominantly energy-related) grew by 18% over the period 2000-2005, even faster than most other greenhouse gases.[47]

The financial and economic crisis caused global energy consumption to drop significantly for the first time since 1980, and energy-related carbon dioxide emissions showed a decline of 1.1% in 2009 compared to the previous year.[48] This temporary reprieve has the unintended effect of helping some countries to meet their Kyoto Protocol commitments, yet the expectations are that despite the inclusion of 'green' and 'low carbon' investments in economic recovery packages around the world, the outlook for further growth of emissions has not fundamentally changed.[49]

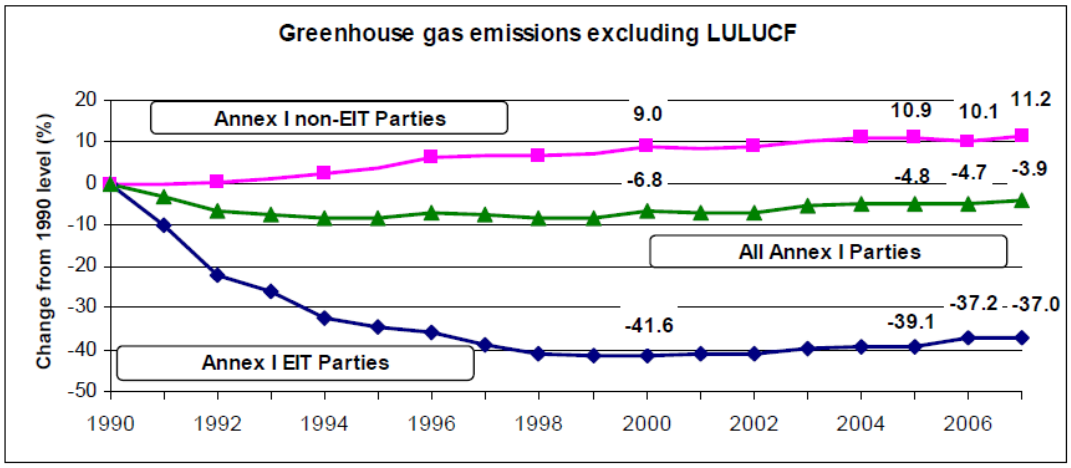

Figure 4. Annex-I greenhouse gas emissions excluding land use, land-use change and forestry (LULUCF).
Source**:** UNFCCC, *National GHG inventory data for the period 1990-2007*, 21 October 2009.

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http://www.pnas.org/content/104/24/10288.full.pdf+html; Netherlands Environmental Assessment Agency, 'Greenhouse Gas Emissions Growing Faster Since 2000: New data on worldwide emissions 1970-2005', May 2009.Available online at: http://www.pbl.nl/en/news/pressreleases/2009/20090526-Greenhouse-gas-emissions-growing-faster-since-2000_-new-data-on-worldwide-emissions-1970-2005.html.

[46] Netherlands Environmental Assessment Agency, 'Greenhouse gas emissions growing faster since 2000: new data on worldwide emissions 1970-2005', May 2009.

[47] Also anthropogenic emissions from methane and nitrous oxide grew considerably (by 11% and 6% over 2000-2005), while emissions of fluorinated greenhouse gases are shown to have increase by as much as 40%. While their volumes are much lower, the global warming potential of these gases is many times higher than that of carbon dioxide: methane (25), N_2O (298), fluorinated gases (1,430-22,800). Netherlands Environmental Assessment Agency, 'Greenhouse Gas Emissions Growing Faster Since 2000: New data on worldwide emissions 1970-2005', May 2009.

[48] *BP Statistical Review of World Energy*, June 2010, electronic version.

[49] IEA, *WEO 2009*, pp. 44-45; Luc Werring, 'Negotiating a Robust Climate Policy', Clingendael International Energy Programme, Briefing Paper, November 2009; D.P. Van Vuuren, A.F. Hof and M.C.J. den Elzen, *Meeting the 2°C Target: From climate objective to emission reduction measures*, Netherlands Environmental Assessment Agency, p. 25, Box 2.2. Available online at: http://www.rivm.nl/bibliotheek/rapporten/500114012.pdf.

Under the Kyoto Protocol, the industrialized Annex-I countries (including the United States) committed to a joint 5.2% reduction target for 2010 compared to 1990 levels. Currently aggregate Annex-I emissions reductions stand at 3.9% when excluding emissions/removals from land use, land-use change and forestry (LULUCF).[50] However, this can be attributed largely to the economic collapse of the Economies In Transition (EIT), among them Russia and Eastern European countries, whose emissions decreased by 37% compared to 1990 levels. In contrast, overall emissions from non-EIT Annex-I parties increased by 11.2% (Figure 4).[51] Figure 4 illustrates that emissions from the EIT countries are slowly growing again: e.g. Russian emissions in 2007 showed an 8% increase compared to 2000 levels.

Party	Total aggregate anthropogenic greenhouse gas emissions in million tonnes of CO_2e (CO_2, CH_4, N_2O, HFCs, PFCs and SF_6) excl. LULUCF			Change 1990-2007, including emissions/removals from LULUCF	Kyoto Protocol target
	1990	2007	Change 1990-2007		
Australia	416.2	541.2	+30.0%	+82%	+8%
Canada	591.8	747.0	+26.2%	+46.7%	-6%
European Community	4232.9	4052.0	-4.3%	-5.6%	-8%
Japan	1269.6	1374.3	+8.2%	+8.2%	-6%
Russian Federation	3319.3	2192.8	-33.9%	-40.3%	0%
Ukraine	926.0	436.0	-52.9%	-54.0%	0%
United States	6084.5	7107.2	+16.8%	+15.8%	(-7%)*

Figure 5. UNFCCC greenhouse gas inventory data for several Annex-I parties to the Kyoto Protocol for the period 1990-2007.
Data from: UNFCCC, *National GHG inventory data for the period 1990-2007*, Table 4 & 5, 21 October 2009.
(*): The United States signed but did not ratify the Kyoto Protocol, which included an emissions reduction target of -7%.

Figure 5 gives an overview of the greenhouse gas emissions over the period 1990-2007 of the major Annex-I parties. This includes the United States, which signed but did not ratify the Kyoto Protocol and was originally assigned a reduction target of -7% for the first commitment period (2008-2012).[52] Instead, emissions from the United States rose by 16.8% compared to 1990 levels. Yet also for Australia, Canada and Japan—Annex-I countries that all ratified the Kyoto Protocol—emissions have all increased and meeting the Kyoto target is practically out of reach.[53]

[50] This paper focuses on CO_2 emissions excluding emissions/removals from land use, land-use change and forestry (LULUCF), as there is a much larger uncertainty embedded in these (LULUCF) statistics. Instructive in this case are the revisions of total emissions including LULUCF for Australia and Sweden between 2008 and 2009 in: UNFCCC, *National GHG Inventory Data for the Period 1990-2007*, 2009 (p. 16) compared to UNFCCC, *National GHG Inventory Data for the Period 1990-2006*, 2008 (p. 16). For discussion, see: Florence Daviet *et al.*, 'Forests in the Balance Sheet: Lessons from Developed Country Land Use Change and Forestry Greenhouse Gas Accounting&Reporting', *World Resources Institute*, Working Paper, December 2009. Available at: http://pdf.wri.org/working_papers/forests_in_the_balance_sheet.pdf; Also see: Nicolas Stern, 'Action and Ambition for a Global Deal in Copenhagen', *UNEP*, 2009. Available at: http://www.unep.org/pdf/climatechange/ActionAndAmbitionForGlobalDealInCopenhagen.pdf.

[51] All Annex-I emissions statistics mentioned in this section are aggregate anthropogenic emissions of all greenhouse gases (CO_2, CH_4, N_2O, HFCs, PFCs and SF_6), excluding emissions/removals from land use, land-use change and forestry, taken from the UNCCC, National greenhouse gas inventory data for the period 1990-2007, 21 October 2009. Including LULUCF emissions/removals, the change over 1990 – 2007 for Annex-I emissions was -5.2%; for EIT countries -42.2% and for non-EIT countries +12.8%).

[52] The reduction target is supposed to be met when averaging the annual greenhouse gases over the period 2008-2012.

[53] Australia only ratified the Kyoto Protocol in 2007. Canada ratified in 2002, but the Harper government later rejected the target (see: Stephen Leahy, "Climate Change: Kyoto Gets a Slap in the Face from Canada", IPS News, 9 December 2009. Available at: http://ipsnews.net/news.asp?idnews=35785). Annex-I countries are allowed to meet their Kyoto targets by

The European Union is the only non-EIT Annex-I party to the Kyoto Protocol that is roughly on track to meet its emissions reduction target of -8% compared to 1990 levels. Current emissions from the EU-15 countries that originally signed the Kyoto Protocol now stand at -4.3% compared to 1990 levels,[54] while emissions of the EU-27 member states stand at -9.3%.[55] Again, the economic situation of the new (EU-12) member states contributed to this decrease.[56]

While some circumstances, such as several warm winters, helped cut emissions in Europe, this can still be considered an impressive achievement.[57] Apart from most new member states (EU-12) whose emissions are quite far below 1990 levels, some countries have made significant progress in reducing domestic emissions and are on track toward fulfilling their Kyoto targets.[58] However, also with respect to action on climate change and emissions reductions taken in the EU, it is important to note the following:

Emissions of carbon dioxide remained roughly constant in the EU-15 over the period 1990-2007.

This might appear quite remarkable given that the overall aggregate greenhouse gas emissions have decreased in the EU-15 and carbon dioxide is the main greenhouse gas, accounting for about 80% of greenhouse gas emissions globally.[59] Yet the greenhouse gas inventory of the EU-15 (excluding adjustments by carbon sinks/LULUCF), shows that the decrease in greenhouse gas emissions is caused by a drop in emissions of methane, N_2O and PFCs. Running counter to this effect is a strong growth in hydrofluorocarbons (HFCs) which have a huge global warming potential and serve as an alternative for the ozone-depleting gases (HCFCs) that have been capped under the Montreal Protocol.[60]

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making use of the flexible mechanism offered by the Kyoto Protocol, i.e. the Joint Implementation (JI) and Clean Development Mechanism (CDM), or they can purchase additional credits from other countries that are exceeding their targets, e.g. from the Annex-I EIT parties.

[54] And -5.0% compared to their respective base years, which are slightly different. See Table ES.3 in: European Environment Agency, *Annual European Community Greenhouse Gas Inventory 1990-2007 and Inventory Report 2009*, 27 May 2009, p. 15.

[55] Latest data over 2007: European Environment Agency (EEA), *Annual European Community Greenhouse gas Inventory 1990-2007 and Inventory Report 2009*, 27 May 2009. Full report available at: http://www.eea.europa.eu/publications/european-community-greenhouse-gas-inventory-2009/european-community-ghg-inventory-2014-full-report.pdf.

[56] European Environment Agency (EEA), *Greenhouse Gas Emission Trends and Projections in Europe 2009: Executive Summary*, 2009, p. 12. Available online at: http://www.eea.europa.eu/publications/eea_report_2009_9/ghg-trends-and-projections-2009-summary.pdf.

[57] The impact of warm weather requiring fewer heating days is indicated as a major contributing factor for lower emissions from households for the years in the period 2005-2007. See: EEA, *Annual European Community greenhouse gas inventory 1990-2007 and inventory report 2009– Executive Summary*, 2009, pp. 8-9; EEA, *Annual European Community greenhouse gas inventory 1990-2006 and inventory report 2008 – Executive Summary*, 2008, p. 10;EEA, *Annual European Community greenhouse gas inventory 1990-2005 and inventory report 2007 – Executive Summary*, 2007, p. 8.

[58] The EU-27 did not have a Kyoto target as a whole, now committed to a 20% reduction goal in 2020. Change in greenhouse gas emissions excluding LULUCF of the EU-15 countries compared to their Kyoto Protocol/EU burden-sharing target: Belgium -9.9% [Kyoto target -7.5%]; England -18% [-12.5%]; Germany -22.4% [-21%]; Sweden -9.3% [+4%]; France -5.8% [0%]; Denmark -3.9% [-21%]; the Netherlands -2.6% [-6%]; Luxembourg -1.9% [0%]; Italy +6.9% [-6%]; Finland +10.3% [0%]; Austria +11.3% [-13%]; Greece +23.2% [+25%]; Ireland +24.5% [13%]; Portugal +36.1% [+27%]; Spain +52.6% [+15%]. Table ES.3 from: EEA, *Annual European Community greenhouse gas inventory 1990-2007 and inventory report 2009*, 27 May 2009, p. 15. All EU-27 countries are expected to meet their Kyoto targets by using carbon sinks and the Kyoto flexible mechanisms (i.e. CDM/JI credits), with the exception of Austria, according to EEA, *Greenhouse gas emission trends and projections in Europe 2009 – Executive Summary*, 2009, pp. 11-12.

[59] For reference: the EU-15 CO_2 emissions account for 81% of the EU-27 CO_2 emissions (excl. LULUCF). For both the EU-15 and EU-27, CO_2 is the dominant greenhouse gas, accounting for 83-84% of total GHG emissions. EEA, *Annual European Community Greenhouse Gas Inventory 1990-2007 and Inventory Report 2009*, 27 May 2009, pp. 15-16.

[60] See Section 2.1 and 2.2 in: EEA, *Annual European Community greenhouse gas inventory 1990-2007 and inventory report 2009*, 2009, pp. 102-109.

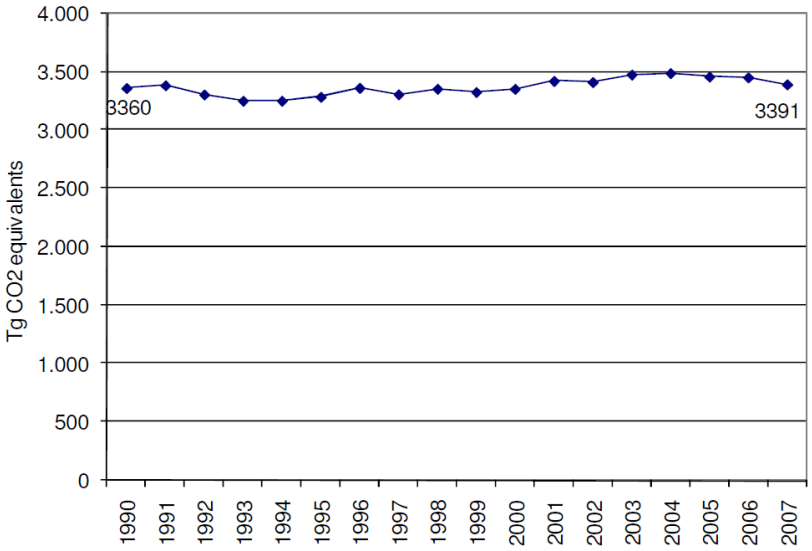

Figure 6. EU-15 emissions of CO_2 excluding emissions/removals from land use, land-use change and forestry (LULUCF) for the period 1990-2007. Source: European Environment Agency, *Annual European Community Greenhouse Gas Inventory 1990-2007 and Inventory Report 2009. Submission to the UNFCCC Secretariat,* 2009, p. 107.

Carbon dioxide emissions (excluding LULUCF) in the EU-15 were more of less flat from 1990 to 2007, increasing marginally from 3360 Tg CO_2-e (1990) to 3391 Tg CO_2-e (2007), as can be seen in Figure 6. Keeping carbon dioxide emissions constant while growing economically is of course already an achievement, but the underlying trends are worth analyzing. Growth of emissions caused by transport and public electricity and heat production has been quite significant, and this has been compensated mainly by emissions reductions in manufacturing industries and construction.[61]

The implications of this observation are important for evaluating European policy on climate change. By means of the EU Emission Trading Scheme (EU ETS) and the 20-20-20 targets, much of the European climate policy is directed at the energy sector and is aimed at reducing the use of fossil fuels by means of energy conservation, energy efficiency improvements or the promotion of renewable energy sources.[62] All these policies are designed to have an impact on the emissions of carbon dioxide in particular, but thus far have resulted in keeping emissions stable within the EU-15, not lowering them.

[61] European Environment Agency (EEA), *Annual European Community Greenhouse Gas Inventory 1990-2007 and Inventory Report 2009*, 27 May 2009, p. 107, Fig 2.3 and Fig 2.4. Full report available online at: http://www.eea.europa.eu/publications/european-community-greenhouse-gas-inventory-2009/european-community-ghg-inventory-2014-full-report.pdf.

[62] E.g.: Andris Piebalgs, 'How the European Union is Preparing for the "Third Industrial Energy Revolution" With an Innovative Energy Policy', EUI Working Paper RSCAS 2009/11, February 2009.

The Outlook for International Climate Policy

We will assess the prospects for an international framework dealing with climate change from two different levels. The first is by considering the chances of a successful follow-up of the Copenhagen Accord with the possible result of a new binding treaty on emissions reductions. For this, we will very briefly sketch the domestic situation of several of the countries that can be considered to be most important in the climate change debate. Second, we will raise some broader challenges that will need to be addressed in order to arrive at a successful international regime on climate change.

First of all, whether the **United States** will pass domestic legislation on emissions reductions will be critical for the fate of international action on climate change following from the Copenhagen Accord, at least in the short term. The *American Clean Energy and Security Act* has an intended objective of reducing American greenhouse gas emissions by 17% compared to 2005 levels by introducing a cap & trade system for emissions. As of July 2010, the bill is still pending approval from the US Senate, after passing the House of Representatives on 26 June 2009 with a narrow margin of 219 to 212 votes. The loss of the supermajority in the US Senate by the Democratic Party, however, has made the passage of this already troubled and controversial bill very unlikely. Modified bills have been proposed in the Senate, including the *Clean Energy Jobs and American Power Act* (S.1733) introduced in by Kerry and Lieberman in May 2010. Although this bill was originally intended to be tri-partisan and offers a compromise on the regulation of carbon emissions to accommodate economic concerns by the Republican Party, the level of support remains uncertain.[63] The impact of the oil spill in the Gulf of Mexico has further complicated matters. President Obama has attemped to use the disaster to garner broader support for a transformative energy bill, yet aspects of an energy bill that involve compromise, particularly on off-shore drilling, have become more delicate.[64] There is a serious chance that if legislation passes, the main focus will be on energy sector reform, though not so much on lowering greenhouse gas emissions by putting a price on carbon. Other options for regulating emissions are being pursued, most notably through the Environmental Protection Agency, but these routes are also sure to encounter strong political opposition.[65] More initiatives are being deployed at the state level, but public opinion in the United States does not seem to be very supportive or very much concerned with the progress of climate change legislation. According to a poll conducted in January 2010 by the Pew Center, global warming is ranked as the least important of all issues confronting the American people.[66] Moreover,

[63] Based on discussions with Ruth Greenspan Bell (World Resources Institute) and Chris Flavin (Worldwatch Institute) at the Clingendael International Energy Programme, spring 2010. Edward Luce, 'Options narrow for president on climate bill', *Financial Times,* 30 June 2010. A rather extensive account of progress climate change legislation in the U.S. up to April 2010 is given by: Patrick Tutwiler, 'Climate Change Legislation: Where Does It Stand?', April 27, 2010. Available online at: http://www.govtrackinsider.com/articles/2010-04-27/climate-change.

[64] John M. Broder, 'Oil Spill May Spur Action on Energy, Probably Not on Climate', *New York Times,* 12 June 2010. Available at: http://www.nytimes.com/2010/06/13/science/earth/13climate.html. Jonathan Weisman, 'Disaster Dims Odds of Energy Bill Compromise', *Wall Street Journal,* 5 May 2010. Available at: http://online.wsj.com/article/SB10001424052748704866204575224582701608508.html.

[65] Bradford Plumer, 'The Subsitute', *The New Republic,* 8 February 2010. Available at: http://www.tnr.com/article/politics/the-substitute. A proposal by Republican Senator Lisa Murkowski that would prohibit the EPA from regulating emissions under the Clean Air Act in June 2010 did not make it through the Senate. However, there is seems to be a quite general support for the idea that emissions should be regulated through Congress legislation, not the EPA. Democratic Senator Jay Rockefeller is reported to propose a two-year delay on EPA regulation on power plant emissions, which might receive broader support. *Reuters,* 'US Sen. Rockefeller seeks EPA carbon rule delay', 4 May 2010. Available at: http://www.alertnet.org/thenews/newsdesk/N04103058.htm.

[66] Pew Research Center for the People & the Press, 'Public's Priorities for 2010: Economy, Jobs, Terrorism', 25 January 2010. Available at: http://people-press.org/report/584/policy-priorities-2010.

an intensifying debate on climate science over leaked e-mails by climate scientists and errors in the IPCC reports have added to a trend of increasing confusion and disbelief concerning climate change in public opinion.[67] Amidst these circumstances and given the difficult economic position of the United States, it seems quite uncertain that a bill enforcing significant emissions reductions will be brought forward in the United States in the short term.

The **European Union** has commanded praise for its 20-20-20 policy and has tried to lead by example. Yet Copenhagen showed that it could not play a significant role in the final negotiations, and currently its policy options are quite limited. Having already committed to a unilateral 20% reduction target, basically its only options are to increase this reduction target to 30% and/or impose border taxes on imported goods from countries not implementing strict emissions reduction targets.[68] The former has been made conditional upon substantial commitments by other countries, while the latter would have significant implications for European businesses and global trade.[69] While there are some signs that the dispute concerning climate science is becoming more vigorous in Europe as well, it has still been rather subdued. However, concerns are increasingly voiced that the EU should not place itself in a frontrunner position on climate change, completely ahead of the other parties involved, as this would incur significant costs affecting industry and consumers.[70]

For **China** and **India** the targets in the Copenhagen Accord are voluntary and based upon domestic initiatives, which are assumed to be implemented regardless of the UNFCCC process. It is expected that China will incorporate its carbon intensity target into its 12th Five-Year Plan (2011-2015). As these carbon intensity targets express a goal of reducing emissions relative to the size of the economy, the measure of emissions reductions will depend largely on the growth of both countries' economies. India's target is considered to be relatively easy to meet, while the Chinese target is regarded as more ambitious. However, also the Chinese carbon intensity target is approximately in line with baseline projections that have incorporated the country's progressive policies on energy efficiency and its strong promotion of renewable energy sources and nuclear energy. [71] According to such projections, emissions will rise even if the carbon intensity of the economy decreases, and they

[67] Pew Research Center for the People & the Press, 'Fewer Americans See Solid Evidence of Global Warming', 22 October 2009. Available at: http://people-press.org/report/556/global-warming; Elisabeth Rosenthal, 'Skeptics Find Fault With U.N. Climate Panel', *New York Times*, 8 February 2010; Thomas Friedman, 'Global Weirding Is Here', *New York Times*, 17 February 2010. Available at: http://www.nytimes.com/2010/02/17/opinion/17friedman.html.

[68] Christian Egenhofer, Anton Georgiev, 'The Copenhagen Accord. A first stab at deciphering the implications for the EU', CEPS Commentary, 25 December 2009; Christian Egenhofer, Anton Georgiev, 'Why the transatlantic climate change partnership matters more than ever', CEPS Commentary, 210 January 2009.

[69] The option of a 'carbon border tax' has been used both as a means for creating leverage in negotiating stronger commitments by other countries and for protecting European domestic (energy-intensive) industry against unfair competition.See for (non)-compatibility between carbon border taxes and the WTO: Nicole Ahner, 'Final Instance: World Trade Organization—Unilateral Trade Measures in EU Climate Change Legislation', EUI Working Paper, RSCAS 2009/58, November 2009.

[70] *Euractiv,* 'Hedegaard backtracks on EU climate goals', 27 May 2010 (updated 2 June 2010). Ed Crooks, 'Resources: The Power Bill Arrives', *Financial Times*, 2 January 2010.

[71] For China, the *World Energy Outlook 2009* of the IEA projected a decline in carbon intensity in CO_2/GDP of 37 percent over the period 2007-2020 in its Reference Scenario (p. 183). The *International Energy Outlook 2009* of the U.S. Energy Information Administration, published May 2009, estimated a decline of 44% between 2006 and 2020 (p. 148). On the discussion on the level of effort, see, for instance: David I. Stern and Frank Jotzo, 'How Feasible are Emissions Intensity Targets for China, India and other Developing Countries? An Econometric Analysis', February 2010; Michael A. Levi, 'Assessing China's Carbon-Cutting Proposal', (U.S.) Council on Foreign Relations, 30 November 2009. Available at: http://www.cfr.org/publication/20862/assessing_chinas_carboncutting_proposal.html. Also see: *China, Copenhagen and Beyond,* Clingendael International Energy Programme, September 2009.

might very well double before 2025.[72] In fact, Chinese emissions have accelerated since 2003 up to the economic and financial crisis, and emissions growth has been seriously underestimated in the past.[73] Moreover, in terms of negotiating a new framework, China and India are very strongly committed to preserving the central position of the Kyoto Protocol.[74]

The commitment of **Japan** received an unexpected boost with the election of the Democratic Party of Japan, which put forward a 25% reduction pledge by 2020 compared to 1990 levels. While this reduction goal is in line with IPCC suggestions for developed countries, there are two major concerns. First, this goal has not yet been translated into nationally legislated measures, which might pose quite a difficult problem as there is a strong opposition to these targets from Japanese industry.[75] Second, it is still quite unclear as to how Japan aims to fulfill this target, as Japan is significantly off-track from meeting its Kyoto goal of an emissions reduction of -6% compared to 1990 levels by the first commitment period (2008-2012). Emissions in 2007 stood at +8.2% (see Figure 5).[76]

Emissions from **Russia** are still far below its assigned Kyoto target that had been set equal to 1990 levels. As a consequence, Russia can meet its Kyoto target even if emissions continue to grow as they did in the past decade (Figure 4&5). In fact, even the most ambitious pledges for 2020 translate to targets that are above current levels, so they still leave some room for emissions growth. As climate change is perceived by some to have positive effects for Russia as well, it remains rather unlikely that Russia will push for stringent greenhouse gas emissions reductions unless this has significant positive side-effects.[77] As an illustration, Russia is planning to build about 40 to 50 GW of

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[72] According to business-as-usual projections by the IEA, EIA and Chinese sources (e.g. Jiang Kejun *et al*, 中国2050年低碳情景和低碳发展之路 [Low Carbon Scenarios and a Low Carbon Development Path up to 2050 for China], Energy Research Institute, 2009. Available at: http://www.eri.org.cn/manage/upload/uploadimages/eri2009630132954.pdf (Chinese only)). It is hard to envision a low-carbon growth trajectory for China without the large-scale deployment of carbon capture and storage (CCS) technology (e.g. Tao Wang and Jim Watson, *Carbon Emissions Scenarios for China to 2100*, Tyndall Centre for Climate Change Research, Working Paper 121, September 2008). However, prospects of such large-scale deployment of CCS in China in the coming few decades are not very positive. *China, Copenhagen and Beyond,* Clingendael International Energy Programme, September 2009, pp. 70-72; Zhang, Zhongxiang, 'In What Format and under What Time Frame Would China Take on Climate Commitments? A Roadmap to 2050', June 2009, p. 10; Richard K. Morse, Varun Rai, Gang He, *Real Drivers of Carbon Capture and Storage in China and Implications for Climate Policy*, Stanford Program on Energy and Sustainable Development, Working Paper no. 88, August 2009. Available at: http://iis-db.stanford.edu/pubs/22621/WP_88_Morse_He_Rai_CCS_in_China.pdf.

[73] As an example, prior estimates of Chinese emissions for 2030 by the IEA have been revised upwards by 70% in the course of only 5 years' time. Mark Levine, Nathaniel Aden, 'Global Carbon Emissions in the Coming Decades: The Case of China', Ernest Orlando Lawrence Berkeley National Laboratory, May 2008; Ch. 2 in: *China, Copenhagen and Beyond,* Clingendael International Energy Programme, September 2009.

[74] China's Special Representative for Climate Change Negotiations, Yu Qingtai, has indicated that he sees little hope of overcoming key disagreements. *Reuters/China5e.com*, 'China Envoy Says Deep Divides Threaten Climate Talks', 25 February 2010. Available at: http://www.china5e.com/show.php?contentid=78792. *Euractiv,* 'We Can't Ditch Kyoto Protocol, Says Indian Ambassador', 9 February 2010. Available at: http://www.euractiv.com/en/climate-environment/we-can-t-ditch-kyoto-protocol-says-indian-ambassador.

[75] Alexandru Luta, 'Climate Sudoku. Japan's Bumpy Ride Towards a Post-2012 Target', Finnish Institute of International Affairs (FIIA), Briefing Paper 36, 24 June 2009; Llewelyn Hughes, 'Climate Change and Japan's Post-Copenhagen Challenge', *Brookings Commentary,* December 2009. Available at: http://www.brookings.edu/opinions/2009/12_japan_climate_hughes.aspx.

[76] An energy and climate bill that has been under discussion in spring 2010 aims to implement a mandatory emissions trading system and to raise the share of renewable energy sources to 10 percent of the primary energy supply by 2020. However, voting on the bill has been delayed due to elections and the content might be watered down. *Reuters,* 'Japan aims to pass climate bill by year-end U.N. talks', 15 June 2010, available at: http://www.reuters.com/article/idUSTRE65E0F620100615; James Murray, 'Concerns mount over vague Japanese climate bill', *BusinessGreen,* 8 March 2010. Available at: http://www.businessgreen.com/business-green/news/2259063/concerns-mount-vague-japanese.

[77] Anna Korppoo, 'Russia and the Post-2012 Climate Regime: Foreign Rather Than Environmental Policy', FIIA Briefing Paper 23, 24 November 2008; 'The Russian Debate on Climate Doctrine. Emerging Issues on the Road to Copenhagen', FIIA Briefing

coal-fired power between now and 2020, which might increase coal demand from 130m tonnes to 326m tonnes by 2020 according to one scenario, in order to reduce gas consumption in the power sector with the aim of making more gas supplies available for export.[78] Prior to the crisis coal consumption jumped by 9.1% from 2007 to 2008.[79]

Indonesia and **Brazil** are very important for global emissions reductions when deforestation is taken into account.[80] According to a World Bank report they rank number 3 and 4 in terms of global emissions when adjusting for deforestation and carbon sink removal.[81] Whether these 'emissions' will be curbed depends very much on the successful implementation of an enhanced Reducing Emissions from Deforestation and Forest Degradation (REDD+) system that was discussed at the COP-15 meeting. Little progress has been made to date, however, although some of the pledged funding at COP-15 has been explicitly earmarked for combating deforestation.[82]

When reviewing these national circumstances, it is important to realize that many emissions reduction pledges that were submitted for inclusion in the appendices of the Copenhagen Accord are conditional upon a significant, fair and effective global deal being reached in the near future. Yet the pledge submitted by the United States to be listed in Appendix I of the Copenhagen Accord was made conditional upon domestic legislation. Without a solid goal by the United States—still accounting for about one-fifth of global emissions—any emissions reduction framework will not be very meaningful, which would almost certainly mean that other countries (e.g. the EU, Canada, Japan, Australia, Russia and others) would withdraw or scale down their pledges (cf. Figure 1).

Second, the aftermath of the financial and economic crisis has left many countries in a difficult and uncertain situation. This limits the political viability of strong action on climate change goals which might incur costs on society. Moreover, due to the drop in energy demand caused by the crisis, energy prices have (partly) decreased as well, in particular the price of coal and LNG.[83] In the short term, this might widen the competitive gap between renewables and fossil fuels, making promotion schemes such as feed-in tariffs more expensive and less sustainable.[84] This is of particular relevance given the massive expansion of renewables that is required to achieve the stabilization scenarios.[85]

Paper 33, 5 June 2009; Christof van Agt, 'Van Moskou naar Kopenhagen: Russische vergezichten op klimaatverandering' ["From Moscow to Copenhagen: Russian views on climate change"], Internationale Spectator 63(11), November 2009.

[78] Reuters, 'Russian Coal Exports to Start Falling', 6 June, 2007.

[79] *BP Statistical Review of World Energy*, June 2009, p. 35.

[80] Globally, deforestation is estimated to account for circa one-sixth of total anthropogenic greenhouse gas 'emissions'. See: Fig SPM.3 in IPCC, *Climate Change 2007: Synthesis Report. Summary for Policymakers, 2007;* Chapter 9 in IPCC, *Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, 2007;* Lord Nicolas Stern, *Stern Review: The Economics of Climate Change. Executive Summary*, 2006, p. xxv. Also see: Florence Daviet *et al.*, 'Forests in the Balance Sheet: Lessons from Developed Country Land Use Change and Forestry Greenhouse Gas Accounting & Reporting', *World Resources Institute*, Working Paper, December 2009.

[81] World Bank/PEACE, *Indonesia and Climate Charge: Current Status and Policies*, 2007, p. 2. Available online at: http://siteresources.worldbank.org/INTINDONESIA/Resources/Environment/ClimateChange_Full_EN.pdf .

[82] Rob Fowler, 'An Initial Assessment of the Copenhagen Outcomes', University of South Australia, 20 December 2009, pp. 6-8; *Bloomberg,* 'U.S. Pledges $1 Billion Toward $3.5 Billion Deforestation Fund', 16 December 2009. Available at: http://www.bloomberg.com/apps/news?pid=20601081&sid=aIp5RvRvc16A.

[83] IEA, *WEO2009*, pp. 51, 63-68.

[84] IEA, *WEO2009*, p. 262; Mark Mulligan, 'Spain pressed over solar tariff cuts', *Financial Times,* 23 June 2010; *Reuters,* 'EU, US clean energy support under threat – HSBC', 21 June 2010. Available at: http://af.reuters.com/article/energyOilNews/idAFLDE65K11Y20100621?pageNumber=2&virtualBrandChannel=0&sp=true.

[85] Discussions at *Smart EU Energy Policy Conference*, Wilton Park, December 2009.

Some broader challenges

Perhaps the most fundamental problem underlying climate change mitigation is that in the coming decades most of the energy consumption growth and almost all of the growth in greenhouse gas emissions will take place in developing countries.[86] In 2008, primary energy demand from non-OECD countries exceeded that of the OECD for the first time. All net growth in energy consumption came from non-OECD countries, with China alone accounting for nearly three-quarters.[87] Supplying low carbon energy to China's and India's massive populations will be crucial in achieving any greenhouse gas stabilization scheme, especially since both economies rely heavily on coal.

Currently the Clean Development Mechanism (CDM) is the largest international mechanism which mobilizes funds for mitigation purposes in developing countries.[88] Under this mechanism, credits are issued for 'avoided emissions'. Yet despite its very rapid growth, the total volume of credits—and hence the impact—is still quite small. A key question for future effective action on climate change is whether there will be political willingness to significantly expand CDM or a similar mechanism in order to spur mitigation measures in developing countries. This does not seem likely. First, the mechanism suffers from fundamental problems, such as how to prove the additionality of a project in order to assure that emissions were actually avoided.[89] This relates to the problem of determining what business-as-usual is and, therefore, what exactly constitutes a business-as-usual scenario—something which becomes especially difficult when countries are already taking action to mitigate emissions.[90] In fact, this problem underlies any assessment of the effort embodied by mitigation actions by developing countries under the Copenhagen Accord.[91] Second, to transfer large amounts of money to developing countries for climate change mitigation measures will be politically very difficult in developed countries. Another way of trying to compel other (developing) countries to take stronger action on climate change might be by trade measures such as carbon border tariffs, but whether this will lead to significant—let alone sufficient—reductions in emissions is very uncertain. As long as countries do not judge emissions reduction measures to be in their own interest and the impact of climate change is still perceived to be distant or manageable, only limited progress can be expected.[92]

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[86] According to the Reference Scenario of the IEA, energy-related CO_2 emissions are set to increase by 11 Gt between now and 2030, with key growth areas being China (6 Gt), India (2 Gt) and the Middle East (1 Gt). IEA, *WEO2009*, p. 44. For an excellent discussion on the necessity of engaging developing countries, see: David G. Victor, *Global Warming Policy After Kyoto: Rethinking Engagement with Developing Countries,* Stanford Program on Energy and Sustainable Development, Working Paper no. 82, January 2009.

[87] *BP Statistical Review of World Energy*, June 2009, p.1.

[88] The flexible mechanisms under the Kyoto Protocol have been designed to serve a double purpose: first, to assure that based on a market mechanism the economically most advantageous emissions reductions are realized first, and second, to create a mechanism that allows developed countries to assist less developed or developing countries in taking mitigation measures.

[89] Michael Wara, *Measuring the Clean Development Mechanism's Performance and Potential*, Stanford Program on Energy and Sustainable Development, Working Paper no. 56, July 2006; Michael Wara and David G. Victor, *A Realistic Policy on International Carbon Offsets*, Stanford Program on Energy and Sustainable Development, Working Paper no. 74, April 2008. Available at: http://iis-db.stanford.edu/pubs/22157/WP74_final_final.pdf.

[90] Benito Müller, *Additionality in the Clean Development Mechanism*, Oxford Institute for Energy Studies, EV 44, March 2009. Available at: http://www.oxfordenergy.org/pdfs/EV44.pdf; Nicolas Stern, 'Action and Ambition for a Global Deal in Copenhagen', *UNEP*, 6 December 2009, pp. 4,7-8. Available at: http://www.unep.org/pdf/climatechange/ActionAndAmbitionForGlobalDealInCopenhagen.pdf.

[91] In particular when targets are measured against a business-as-usual scenario.

[92] David G. Victor, *Global Warming Policy After Kyoto: Rethinking Engagement with Developing Countries*, Stanford Program on Energy and Sustainable Development, Working Paper no. 82, January 2009. The controversy surrounding climate financing

A second major challenge is to start taking long-term mitigation requirements into account:

First of all, since the emissions of developed countries are expected to peak before global emissions do, a gradual shift from offsetting to more actual emissions reductions is required. The EU-15 is currently projected to use offsets obtained by the Kyoto mechanisms to cover approximately 27% of the total emissions reductions required by its Kyoto Protocol commitment, translating to 2.2% of the 8% reduction target.[93] The *American Clean Energy and Security Act* (or *Waxman-Markey Bill*), which has been passed in the US House of Representatives, allows the use of international offsets to such a degree that the US could meet 70 percent of its emissions reduction task by 2020 with the use of international offsets.[94]

Suggested scenarios to limit a temperature increase to 2˚ C furthermore envisage increasingly steep emissions cuts towards 2050.[95] Of course, different emissions pathways can be proposed since the cumulative emissions over a certain period determine the concentration levels of greenhouse gases in the atmosphere, not annual emissions at a certain point in time. In fact, the *450 Scenario* by the International Energy Agency in its *World Energy Outlook 2009* already foresees an overshoot of concentration levels (greenhouse gas concentration levels peaking at 510 ppm of CO_2-equivalent in 2035) and hence requires an extra steep decline afterwards.[96] Such an acceleration of emissions reductions will be necessary to stay within any stabilization scenario, yet it can be argued that—running counter to this goal—incremental reductions will get harder over time as 'low hanging fruit' will have been reaped.[97] Taking industry for instance, the International Energy Agency estimates that significant reductions in terms of emissions (12%-23%) can be achieved by the global dissemination of best available technologies.[98] Yet further reductions can only be achieved if a wide range of new technologies are commercialized. In fact, merely deploying the best available

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for China at Copenhagen and CDM support for Chinese wind projects is also interesting in this respect. See: Gang He and Richard K. Morse, *Making Carbon Offsets Work in the Developing World: Lessons from the Chinese Wind Controversy*, Stanford Program on Energy and Sustainable Development, Working Paper no. 90, March 2010. Available at: http://iis-db.stanford.edu/pubs/22867/WP_90,_Morse_and_He,_Making_Offsets_Work_Lessons_From_China_CDM_Wind.pdf.

[93] EEA, *Greenhouse Gas Emission Trends and Projections in Europe 2009: Tracking progress towards Kyoto targets. Annex: Additional information on greenhouse gas emission trends and projections*, 2009, p. 90. Available at: http://www.eea.europa.eu/publications/eea_report_2009_9/annex-additional-information-on-greenhouse-gas-emission-trends-and-projections.pdf. Also see IEA, *WEO2009*, p. 182 on how banked allowances and offsets might influence the EU ETS up to 2020.

[94] Craig Windram, 'Some of the Numbers Behind the Waxman-Markey Bill', *Think Carbon*, 25 June 2009. Available at: http://thinkcarbon.wordpress.com/2009/06/25/the-numbers-behind-the-waxman-markey-bill/; Craig Windram, 'Comparison of Waxman-Markey, EU ETS and CPRS Emissions Trading Schemes', *Think Carbon*, 11 July 2009. Of course, this is a theoretical case assuming a maximal demand for international offsets and a sufficient supply. In addition to this discussion: Japan has also signalled that overseas emissions reductions would need to play an important role for meeting its 25% reduction target, possibly covering up to 40 percent. *Reuters,* 'Japan to include overseas cuts in 2020 carbon goal', 22 June 2010. Available at: http://uk.reuters.com/article/idUKTRE65L37620100622.

[95] The *Fourth Assessment Report* by the IPCC estimates that global emissions reductions of 50% to 85% below 2000 levels in 2050 are necessary for a 445-490 ppm scenario. IPCC, *Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the IPCC - Summary for Policymakers*, 2007, p. 15 (Table SPM.5).

[96] IEA, *WEO2009*, p. 199.

[97] See, for instance, the work of McKinsey on abatement cost curves for greenhouse gas emissions reductions beyond business-as-usual up to 2030. McKinsey & Company, 'A Cost Curve for Greenhouse Gas Reduction', *McKinsey Quarterly,* February 2007. Of course this cost curve will further develop over time as technologies mature.

[98] IEA, *Energy Technology Transitions for Industry*, 2009, pp. 23, 29. Industry accounts for nearly one-third of global energy demand and almost 40% of global CO_2 emissions.

technologies will be "nowhere near enough" to offset anticipated growth in demand.[99] Transport is another example: while raising fuel efficiency standards might go some way in reducing emissions from transport, a major transformation of petroleum-based transport will be necessary to meet the suggested longer-term emissions reduction requirements, especially since transportation is expected to grow substantially worldwide.[100] This also points to the importance of technology in addressing climate change. While it is impossible to predict the technological developments that might take place in the coming decades, it appears that significant breakthroughs in technology and/or associated costs are necessary in order to be able to meet the steep emissions reductions that are associated with a 2˚ C stabilization scenario.

Increasing energy efficiency and energy conservation is another critical component.[101] In general, it will be preferable and more cost-effective to reduce emissions by lowering energy consumption, as this has additional benefits, such as reducing fuel costs and increasing energy security. Many scenarios assert that large gains can be made by energy efficiency improvements, yet it remains difficult to implement the right incentives and reap the full potential.[102] In the end, prices of both energy and carbon will be crucial, since they determine whether financial incentives are in place to make a transition to a sustainable energy system.

[99] IEA, *Energy Technology Transitions for Industry*, 2009, pp. 24, 29.
[100] Because of this reason, the IEA projects that the most incremental investment for achieving their *450 Scenario* will be needed in the transport sector: about three times as much as for buildings (ranking second) and more than three times as much as for the power generation sector (ranking third). Mentioned is the estimated cumulative investment for the period 2010-2020. IEA, *WEO2009*, p. 263, Fig. 7.2.
[101] Andris Piebalgs, 'How the European Union is Preparing for the "Third Industrial Energy Revolution" With an Innovative Energy Policy', EUI Working Paper RSCAS 2009/11, February 2009, pp. 3-4.
[102] The IEA *450 Scenario* asserts that 57% of the required emissions reduction for 2050 should be derived from energy efficiency improvements. IEA, *WEO2009*, p. 323. According to McKinsey, global energy demand growth—which has stood at an average of 1.7% per year since 1986 and is projected to be 2.2% per year until 2020—can be cut in half to less than 1% annually due to improvements in energy productivity. McKinsey&Company, *Curbing Global Energy Demand Growth: The Energy Productivity Opportunity*, May 2007.

Conclusions

Instead of zooming in on the details of the COP-15 summit, this paper aimed to zoom out and place Copenhagen against the backdrop of global energy and emissions trends and earlier attempts to coordinate international action on climate change. From this broader perspective a rather sobering picture emerges. Despite the fact that global emissions might have been significantly higher without the mitigation efforts taken to date, it is manifest that the current approach and measures are having only very limited success.

The negotiating process at the COP-15 meeting made it clear that the Copenhagen Accord represents the limit of what could be achieved in the given circumstances—this being, in a sense, the limit of shared political will. After the negotiations seemed on the verge of concluding without any concrete result, the Copenhagen Accord was received by many with a sense of relief. It was argued that the Accord is better than no agreement at all, and it at least prevented the negotiations from failing completely and ending in a deadlock similar to the Doha rounds of the WTO. Even so, the negotiating process in the lead-up to Copenhagen and during the summit itself demonstrated the limits of a fully multilateral approach under the UNFCCC.

That many developing countries have made voluntary mitigation pledges for the first time is an important step, and their contributions can be significant in lowering emissions to levels below the business-as-usual projections. Furthermore, the medium-term targets for 2020 submitted by developed countries go at least part way towards meeting the requirements of suggested stabilization scenarios.

Yet as they stand, the current pledges—even at their highest level, and assuming they are fully achieved—will very likely not suffice to keep the temperature rise below even 3˚ C. There is of course always the possibility that targets might be strengthened over time, but this is quite unlikely given the difficulty of meeting them. The experience of the United States illustrates how difficult it is to compensate for a delay in taking action: whereas its original Kyoto reduction target that was dismissed stood at -7% for 2008-2012, its most ambitious target currently considered for legislation aims at a reduction of -3% to -4% compared to 1990 levels by 2020. The clause in the Copenhagen Accord which considers a review in 2015 of required emissions reductions for a maximum temperature increase of 1.5˚ C can therefore be said to be rather theoretical.

The broad trends outlined in this paper show that over the past decade the world has been moving towards a more coal-based energy system, with huge potential consequences for emissions and climate change. Given the large inertia of both the global energy system and the climate system itself, climate change mitigation efforts are facing an extremely difficult challenge. A brief discussion has outlined the major impediments to effective climate policy and the outlook for following up on the Copenhagen summit. Up to now, the impact resulting from policy on climate change has been rather limited. The lack of progress in Copenhagen and the bleak prospects of an effective deal emerging from it in the short term give little reason for optimism on achieving any shift in this trend.

Without a doubt, change is underway and initiatives are being deployed to move towards a sustainable energy system. However, both the speed and scale of progress are insufficient to meet the challenge. If the carbon content of the global energy supply is any measure to go by, the world is still heading in the wrong direction.