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GHG mitigation targets and potentials in large emerging economies

Comparison of pledges and estimated potentials

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1. Introduction

The outcome of the UN climate change negotiations at the COP15 in December 2009 was the non-binding Copenhagen Accord stating that the countries signing the agreement will commit themselves to limiting global temperature increase to 2 degrees. Countries have then had the possibility to submit their intended mitigation actions, simply referred to as "pledges". If the accord is not to become empty politics, the total emission reductions resulting from these pledges should amount the required reductions necessary to limit the temperature increase to 2 degrees; taking into account that there may be different long-term emission paths compatible with the target. However, the pledges do not necessarily amount to what is needed, and this is the background for this presentation. It is important to note, however, that 2020 is a short time horizon when talking about the two degree target, and reductions of much larger scale than pledged for this year will be needed in the long term. Political decisions and policies relevant for the short term are however important, especially perhaps in order to stimulate technological development.

Furthermore, much has been discussed regarding whether the proposed pledges are "sufficient" and whether they are "fair", and several studies have been made on the countries' potentials for the GHG-emission reductions and associated costs. A lot of attention is given in particular to large emerging economies, and their role. These countries are of special interest as their economies and emissions are predicted to grow rapidly in the coming years and also because their pledges are formulated in ways that make assessments difficult. On this background this paper analyses the pledges made by large emerging economies regarding their GHG-emission reductions in 2020 in light of their estimated potentials and costs for the same, both looking at existing national and international literature and presenting new results from the global ETSAP-TIMES Integrated Assessment Model (TIAM). Though the focus of this paper are the large emerging economies, this is not to say that other countries, in particular industrial countries, are not important – there is no doubt that they have a large responsibility for past emissions, and also will have to commit to large reductions in the future. This paper does not in any way intend to prescribe which countries should pay for reductions and impacts of climate change – it merely intends to analyse what has been put on the table, and also to analyse reduction potentials of the countries in energy-economic models.

In the Copenhagen Accord, the countries agree to work to limit the increase in global temperature to 2°C. According to the UN's Intergovernmental Panel on Climate Change (IPCC), to stay within this limit will require greenhouse gas (GHG) emission reductions of between 50 and 85% in 2050 (Metz et al., 2007). There is no common agreement between scientists and practitioners on what levels of emissions in 2020 are compatible with this temperature target, as several emission trajectories could be followed. Recently, there have been several studies analysing the pledges of the Copenhagen Accord, and the results from some are summarised in Figure 1. The studies vary in their estimated levels of emissions in 2020; in their calculated "business as usual" (BAU) scenarios, their calculated emissions under the low and high levels of pledges, and also in their claims on what emission levels are compatible with the 2 degree target.

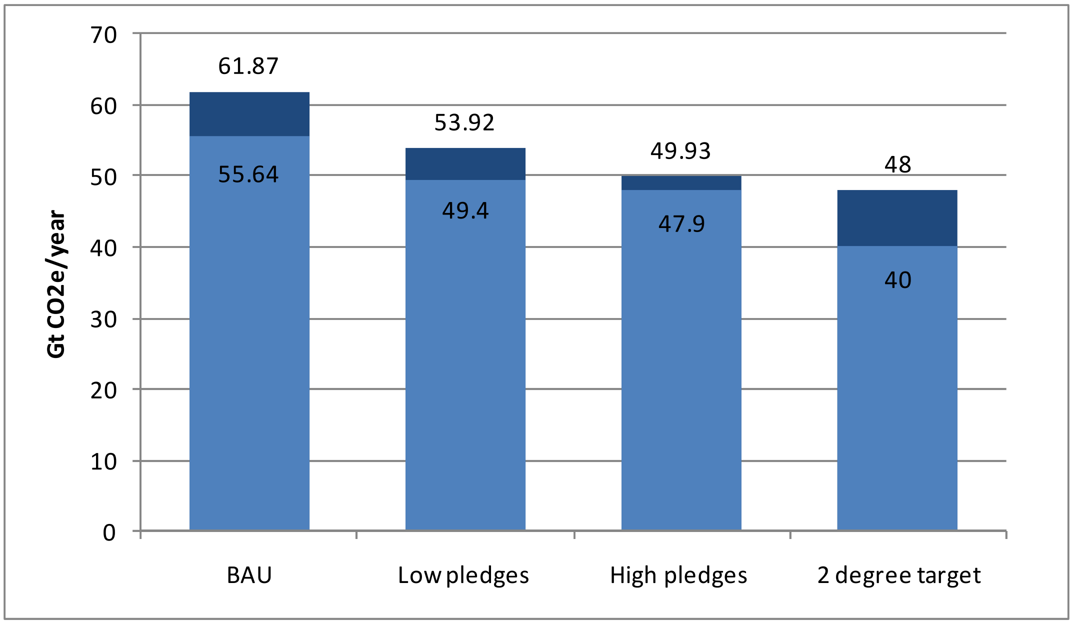

Figure 1. Recent studies on GHG emissions in 2020: BAU, pledges and 2°C target. Sources: Lowe et al. (2010), climateinteractive.org/scoreboard, Stern and Taylor (2010), Houser (2010), Climate Works Foundation and European Climate Foundation (2010; Project Catalyst), Rogelj et al. (2010), Elzen et al. (2010).

The estimated BAU emissions in these particular studies vary between 56 Gt and 62 Gt CO_2e in 2020, and the emission levels that are assumed to be compatible with the 2 degree target vary between 40 and 48 Gt in the same studies. Furthermore, the resulting emissions calculated from the pledges vary between 49 and 54 Gt and between 48 and 50 Gt for the low and high pledges respectively. Despite the fact that from this figure it might look like the 2 degree target can be reached under the high pledges, no single study comes to this conclusion. The large variation in calculated emissions in the different scenarios is due to how the different studies treat several difficult uncertainty factors, for instance the role of emissions from land use, land use change and forestry (LULUCF). The difference in methods applied also makes comparison between the studies difficult.

This paper will focus on the countries in the so-called BASIC group – Brazil, South Africa, India, and China. The participation and commitment of these countries, as well as other emerging economies, are crucially important for any climate mitigation work. Firstly, as can be seen from Figure 2, these countries account for substantial shares of the world's population, GDP and GHG emissions GHG emissions, and the shares are expected to increase in the coming years. Secondly, the rapid emission growth in these countries, especially in China, will make mitigation efforts Annex-I (industrialised) countries futile on their own. This was illustrated by the EMF 22 International Scenarios, where none of the 10 participating models could solve for a strict 2 degree – or 450 ppm – scenario if mitigation action in non-Annex I countries are delayed. Finally, global mitigation costs increase significantly when action is delayed in non-Annex I countries. The effort made by the BASIC countries to combat climate change will therefore be of high importance, as the ambitious goal of staying below 2 degrees is impossible without severe reductions also by these countries.

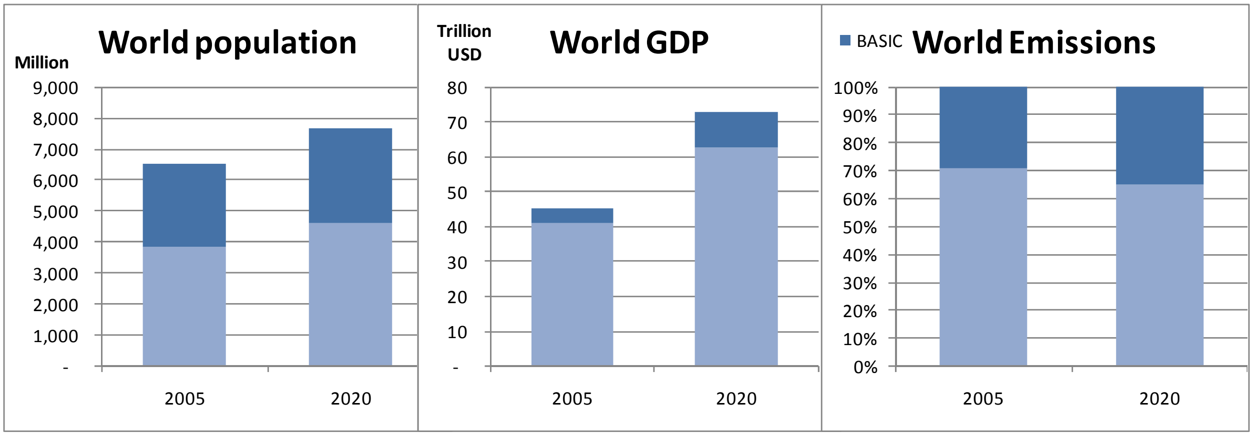

Figure 2. BASIC shares (dark blue) of world population, GDP and GHG emissions. Source: Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, World Population Prospects: The 2008 Revision; UNSTATS; ETSAP-TIAM; Lowe et al. (2010); Climate Works Foundation and European Climate Foundation (2010; Project Catalyst); Stern and Taylor (2010).

This paper is based on the DTU Climate Centre's (DKC) initial work regarding GHG mitigation targets and potentials in large emerging economies, which will be elaborated in coming research projects. The results and analyses presented here are preliminary and should be considered as work in progress.

2. Methods

This paper takes its offset in the official letters from the BASIC countries to the UNFCCC secretariat at the end of January 2010, stating their intentions regarding GHG emission targets for 2020. The intentions regarding GHG emissions are not stated in a fixed manner such as "X% reduction from year XXXX", but rather in the way of emission intensities or reductions relative to "business as usual" pathways. It is therefore unsure what the actual emissions will be like, and it is thus important to analyse the pledges and find potential ranges of the emissions, in order to get a clearer picture of what the world's total GHG emissions will look like in 2020. This analysis is based on both a literature review of other studies which have performed such analysis, and scenario analysis made in the ETSAP-TIAM model regarding the emissions on the global level as well as in China and India. The second part of the analysis is a literature review of national and international sources analysing the mitigation potentials and costs in the BASIC countries. Finally the pledges of the BASIC countries will be compared to their potentials.

2.1.ETSAP-TIAM model description

TIAM is a detailed, technology-rich global TIMES model. The structure and data come from the MARKAL-based SAGE model developed by the US Department of Energy's Energy Information Administration. Detailed information about the development of TIAM, its structure, existing databases and application can be found in Loulou and Labriet (2008), Loulou (2008), Loulou et al. (2009), or obtained from ETSAP[1] or KanORS[2].

TIAM is a partial equilibrium model, where equilibrium on energy markets is found via maximization of total surplus, using linear programming. It is a model of the global energy system including the entire energy system, i.e. from primary resource extraction to end-use (thus also including upstream energy use and emission from mining of the fuels). Many relations which are normally exogenous to energy system models are treated within TIAM, e.g. the mining and trade with fuels and fuel prices are modelled endogenously. This is very important when making long-term global scenarios, while investments in the global energy sector influence the markets for oil, coal, gas etc. The main structure of the energy system is similar to the structure of many ETSAP-TIMES models, with additional focus on the energy resources in the up-stream sector, in which the global regions are divided into OPEC and non-OPEC countries.

Important for this paper is the fact that TIAM includes climate equations calculating greenhouse gas (GHG) concentration levels in the atmosphere and oceans, consequential change in radiative forcing and change in global mean temperature. Thus, the model and hence the energy system can be optimised for various climate targets.

In the current version of TIAM the world is divided into 16 regions (where China and India each are separate regions) and the time horizon is 2100, which is needed for long-term climate mitigation policies.

3. Results

3.1. Target emissions in 2020

In the Copenhagen Accord, the countries agree to work to limit the increase in global temperature to 2°C above pre-industrial levels. According to IPCC, to stay within this limit will require greenhouse gas (GHG) emission reductions of between 50 and 85% in 2050 compared to 2000 levels, and emissions will have to peak between 2000 and 2015. (Metz et al. 2007), see Table 1.

[1] Energy Technology Systems Analysis Programme. See www.etsap.org for the related documentation.
[2] KanORS Consultants. Visit www.kanors.com for more details.

Category	Additional radiative forcing (W/m^2)	CO_2 concentration (ppm)	CO_2-eq concentration (ppm)	Global mean temperature increase above pre-industrial at equilibrium, using "best estimate" climate sensitivity[a], [b] (°C)	Peaking year for CO_2 emissions[c]	Change in global CO_2 emissions in 2050 (% of 2000 emissions)[c]	No. of assessed scenarios
I	2.5-3.0	350-400	445-490	2.0-2.4	2000 - 2015	-85 to -50	6
II	3.0-3.5	400-440	490-535	2.4-2.8	2000 - 2020	-60 to -30	18
III	3.5-4.0	440-485	535-590	2.8-3.2	2010 - 2030	-30 to +5	21
IV	4.0-5.0	485-570	590-710	3.2-4.0	2020 - 2060	+10 to +60	118
V	5.0-6.0	570-660	710-855	4.0-4.9	2050 - 2080	+25 to +85	9
VI	6.0-7.5	660-790	855-1130	4.9-6.1	2060 - 2090	+90 to +140	5
						Total	177

Notes:

a) Note that global mean temperature at equilibrium is different from expected global mean temperatures in 2100 due to the inertia of the climate system.

b) The simple relationships $T_{eq} = T_{2\times CO2} \times \ln([CO_2]/278)/\ln(2)$ and $\Delta Q = 5.35 \times \ln([CO_2]/278)$ are used. Non-linearities in the feedbacks (including e.g., ice cover and carbon cycle) may cause time dependence of the effective climate sensitivity, as well as leading to larger uncertainties for greater warming levels. The best-estimate climate sensitivity (3 °C) refers to the most likely value, that is, the mode of the climate sensitivity PDF consistent with the WGI assessment of climate sensitivity and drawn from additional consideration of Box 10.2, Figure 2, in the WGI AR4.

c) Ranges correspond to the 15th to 85th percentile of the Post-Third Assessment Report (TAR) scenario distribution. CO_2 emissions are shown, so multi-gas scenarios can be compared with CO_2-only scenarios.

Note that the classification needs to be used with care. Each category includes a range of studies going from the upper to the lower boundary. The classification of studies was done on the basis of the reported targets (thus including modelling uncertainties). In addition, the relationship that was used to relate different stabilization metrics is also subject to uncertainty (see Figure 3.16).

Table 1 IPCC stabilisation scenarios. Metz et al. (2007), table TS.2.

When the Fourth Assessment Report (AR4) of the IPCC was published in 2007, only six scenarios in category I had been assessed, and the emission pathways of these scenarios are illustrated in Figure 3.

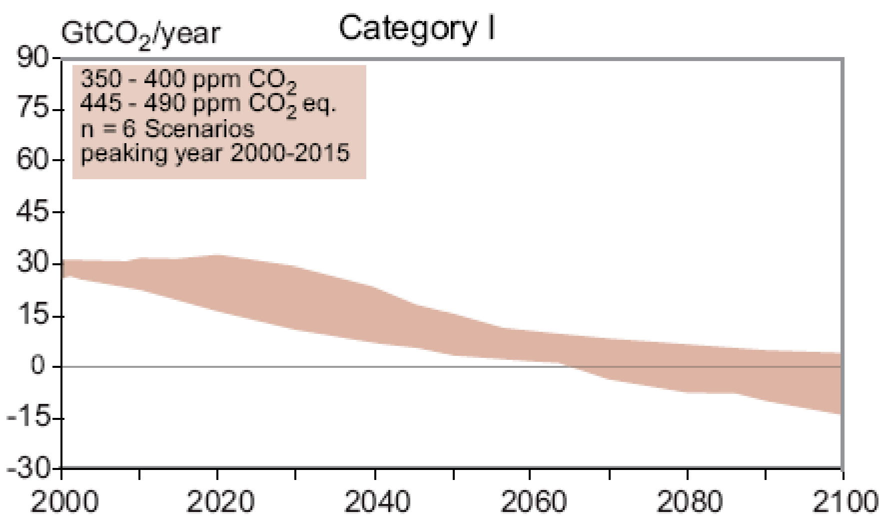

Figure 3 Emission pathways of mitigation scenarios in Category I of Table 1. Metz et al. (2007).

According to Stern (2009) the optimal global emissions in 2020 – taking into consideration a 50-50 chance of staying below 2 degrees Celsius warming as well as economic considerations – is about 44 Gt CO_2e (excluding emissions from peat of around 2 Gt), which is above the scenarios assessed in AR4. This recommendation is derived from an analysis of several emissions pathways in Bowen and Ranger (2009). In this policy paper, it is estimated that the emissions in 2020 should be between 40 and 54 Gt if aerosol emissions remain high, or between 40 and 48 Gt if aerosol emissions are low, in order to have a 50% chance of limiting global temperature rise to two degrees. Correspondingly emissions in 2050 would need to be between 6 and 17 Gt or 14 and 17 Gt. Note that those pathways lying in the high levels in 2020 would need to be among the low in 2050.

UNEP (2010) summarises the findings from four different studies assessing emissions pathways which would leave a chance of staying below a 2°C increase. The required emission caps in 2020 range from 40 to 54 Gt CO_2e.

3.2. BASIC countries

In contrast to Annex-I countries' pledges, the BASIC countries' pledges are not formulated as reductions from a specified reference year, and they do not give very firm sizes of emissions in 2020. For instance, Brazil and South Africa pledge reductions compared to BAU emissions. Thus, calculated emissions, as well as the evaluation of the real effort in 2020, depend completely on calculated BAU emissions. India and China, on the other hand, pledge reductions in emission intensities compared to 2005, and thus calculated emissions in 2020 depend exclusively on assumed GDP-growth.

In its communication to the UNFCCC secretariat dated January 29th 2010, Brazil indicates that it intends to take NAMAs resulting in a reduction of between 36.1 and 38.9% below its projected emissions. South Africa declares in their letter to UNFCCC of January 29th 2010 that it is committed to take NAMAs corresponding to 34% reduction of emissions compared to baseline in 2020 and 43% below BAU in 2025. In its communication to the UNFCCC secretariat dated January 30th 2010, India indicates that it intends to reduce its CO_2-emission intensity (units CO_2 per unit GDP) by 20-25% in 2020 compared to its 2005 level (not including agriculture in the emissions intensity calculation). China indicates in its communication dated January 28th 2010 that it intends to reduce its CO_2-emission intensity (units CO_2 per unit GDP) by 40-45% in 2020 compared to its 2005 level.

The pledges of the BASIC countries are summarised in Table 2. The third column summarises the resulting emissions in 2020, as calculated by various other studies, and the fourth column summarises the resulting emissions in 2020 from calculations in ETSAP-TIAM. The numbers in parenthesis represent the percentage deviation from the BAU or reference emissions. As with the global emissions, the calculated BASIC emissions vary greatly between studies. It is difficult to make a complete comparison between studies because they often do not report all core assumptions, such as GDP growth and BAU emissions. In ETSAP-TIAM, Brazil and South Africa are not represented as separate regions, but are aggregated together with other countries into larger entities, and thus in the following, focus will be on China and India.

	Copenhagen Accord pledge	**Emissions in 2020, Gt (% deviation from BAU/Ref)**	
		Other studies	Own calculation, based on ETSAP-TIAM
Brazil	Reductions of 974-1051 Mt CO_2e in 2020, or 36.1-38.9% below BAU. Several specified NAMAs, incl. reduced deforestation.	1.5-2.2	N/A

South Africa	Reductions of 34% below BAU in 2020 and 42% in 2025, depending on provision of financial resources, technology transfers and capacity development support	0.4-0.5	N/A
India	Emission intensity reduction of 20-25% by 2020 compared to 2005. Emissions from agriculture not included in assessment of the intensity.	2.7-3.8 (-19 to 0%)	2.8-3 (+8 to +15%)
China	Emission intensity reduction of 40-45% by 2020 compared to 2005. Share of non-fossil fuels in primary energy consumption to be increased to around 15%, increase in forest coverage by 40 mill. hectares and forest stock volume by 1.3 bill. m^3 compared to 2005.	11.4-13 (-13 to -2%)	9.5-10.3 (-4 to +5%)

Table 2 BASIC countries' pledges. Data sources: Lowe et al. 2010, Stern and Taylor (2010), Houser (2010), Climate Works Foundation and European Climate Foundation (2010; Project Catalyst), Elzen et al. 2010, ETSAP-TIAM.

Looking at India, our calculations of pledged absolute emissions are within the range of the other studies, but relative to the reference scenario they differ. Indian reference emissions in TIAM are relatively low, and thus pledges result in higher emissions. For China on the other hand, the calculations of pledged emissions relative to BAU emissions based on TIAM runs are more on level with other studies, but absolute emissions are lower than any of the other.

In order to put the pledges made by China and India into perspective, the resulting emissions in 2020 are compared with their emissions under an optimised climate policy. Originally, the intention was to analyse the distribution of emissions under a radiative forcing target of 2.6W/m^2 corresponding to the 2 degree target. However, this target was not obtainable in ETSAP-TIAM in its current configuration. Thus, we have run the model with a 3.5 w/m^2 constraint, in order to investigate China and India's role in an optimised global energy system with a climate constraint. Note that TIAM optimises the energy system so that the marginal emission reduction costs are equalised across regions, i.e. assuming full trading of emission allowances, and no assumptions are made regarding who will actually pay for the reductions.

Table 3 summarises the Indian and Chinese GHG emissions in 2020 relative to reference case, under their pledges and in the climate constrained scenario respectively. The conclusion from this work is that China's high pledges seem to be close to the optimal for the 3.5 constraint, but as we know, this is too high for the 2 degree target. India's emissions under pledges are way above what they ought to, and emissions in the reference case are closer to the target.

	Pledged emissions	**Emissions in climate scenario (3.5 W/m^2)**
India	8-15% above reference case in 2020	6% below reference case in 2020
China	4% below to 5% above reference case in 2020	5% below reference case in 2020

Table 3. Indian and Chinese GHG emissions in 2020 relative to reference case. Calculations in ETSAP-TIAM.

Figure 4 shows the relative emissions compared to reference emissions in 2020, for China, India, and the rest of the world (RoW[3]). It is clear from the figure that China and India's emissions under pledges, relative to the reference emissions, are high compared to the pledges in RoW. Reductions in the RoW in the climate scenario should be 91 % compared to Ref, with China and India's at 94 and 95% respectively. Given the assumptions made and the calculated reference emissions in TIAM, the high pledges proposed by the rest of the world would – in total – seem to reach beyond the level of reductions required to meet the 3.5 W/m^2 constraint.

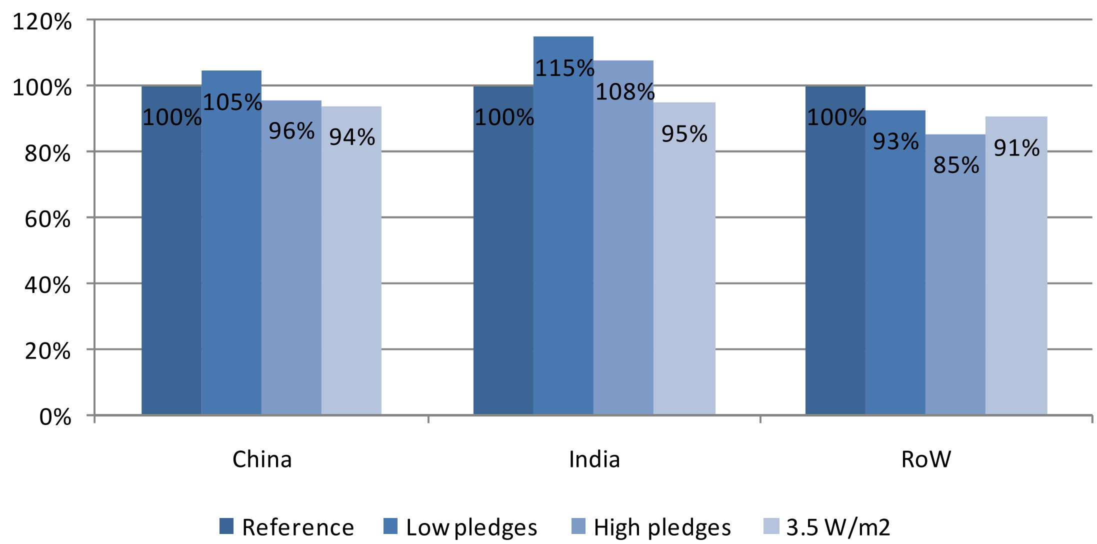

Figure 4. Relative emissions in four scenarios in 2020. Own calculations; reference and 3.5W/m^2 emissions based on runs in ETSAP-TIAM.

Figure 5 depicts the additional total discounted system costs of the climate constrained scenario compared to the reference scenario, on the time horizon until 2100. In India and China the discounted system costs increase by 8 and 10 % respectively, while they increase by only 3 % in the RoW. Optimisation in a climate scenario in TIAM takes the approach that marginal abatement costs are equalised across regions. When costs increase relatively more in China and India than in the RoW, it is an indication of the fact that there are large amounts of reductions available in these countries, at a relatively low price. Here it is important to notice that the costs are allocated to the regions based on where the reductions take place, and this does not say anything about who should or will pay – and though this is an important and interesting topic in itself, this is not a topic for this paper.

[3] Calculated emissions in the reference and climate scenarios are here the aggregated emissions in the 14 other regions of TIAM. The RoW emissions under pledges are here based on several simplifying assumptions, due to the fact that TIAM regions and countries with pledged reductions do not match one-to-one.

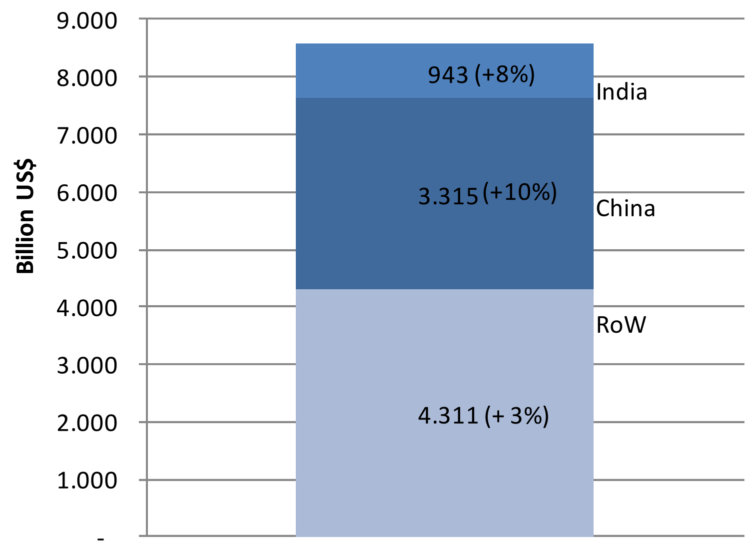

Figure 5. Additional system costs of 3.5 W/m^2 compared to reference (total discounted system costs 2005-2100). ETSAP-TIAM.

Figure 6 shows the primary energy consumption by fuel in China and India, and how it changes over the coming century; from the figure one can see how the countries' energy systems change in the climate constrained scenario compared to the reference. Firstly, the overall trends in the fuel composition of primary energy seem to be more or less the same in China and India. Until 2020 the changes between the reference and the climate scenario are not large, but in the long run the changes are radical, and gas and renewables come to play huge roles.

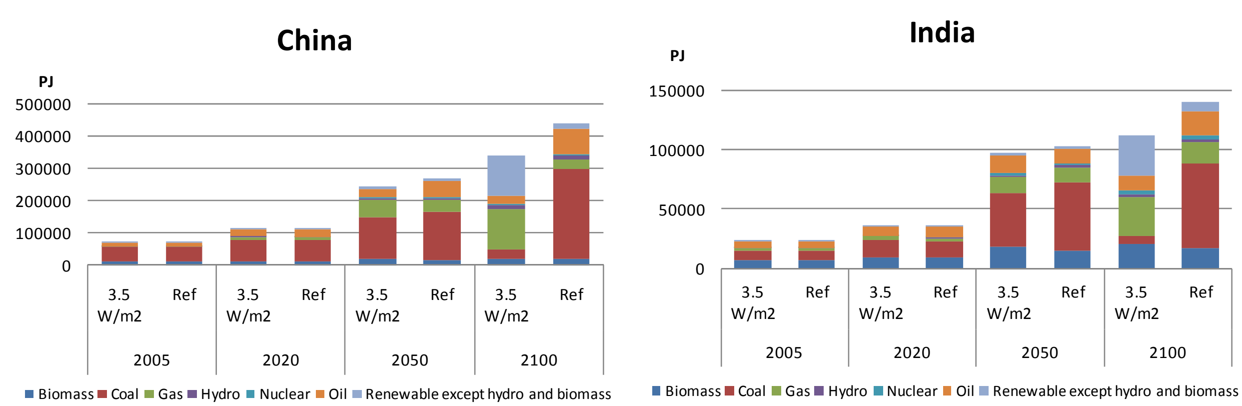

Figure 6 Primary energy consumption by fuel in China and India. ETSAP-TIAM.

Figure 7 shows the composition of the electricity production in China and India over the coming century, and again the trends are similar in China and India. Until 2020 the changes between the reference and the climate scenario are not large, but again, in the long run, they are absolutely radical, and CCS and solar play huge roles.

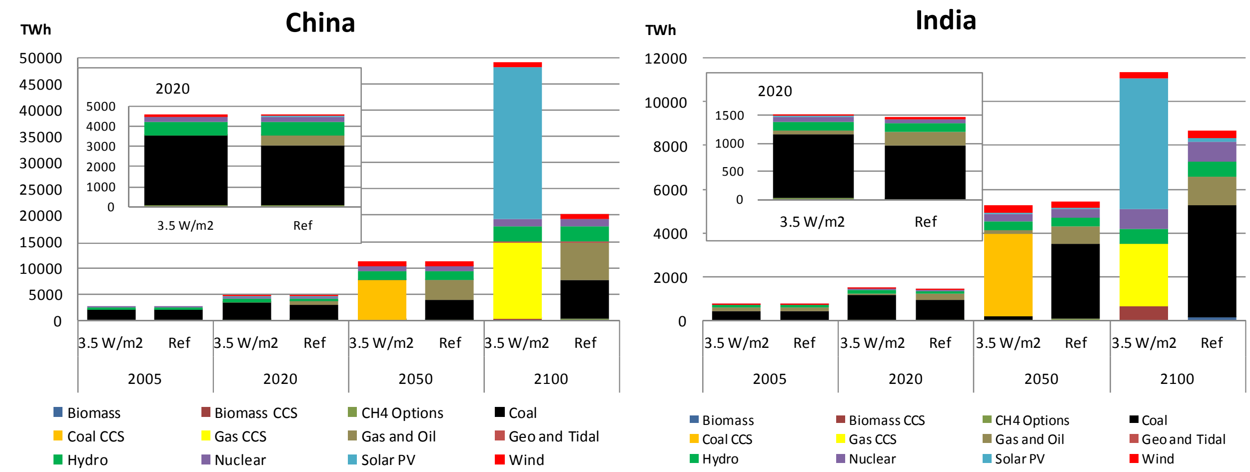

Figure 7. Electricity production by fuel in China and India. ETSAP-TIAM.

For all of the BASIC countries, both national and international studies have looked at their national mitigation potentials. Table 4 summarises some of the findings of these studies. Note here that the reported maximum mitigation potentials are not absolute maximums as such, but rather the maximum modelled or calculated in the studies; for instance some studies only assess options with negative or small costs, and some assess particular reduction targets, and the potentials reported are given these constraints.

Study	Mitigation target	Mitigation potential with cost < $20/ tCO2	Total max emission reduction potential, % rel. to BAU (2020)	Modelling Approach	Comments
Brazil					
CCAP[1]	In steps to all feasible mitigation options	80.1	20.7%	Macroeconomic with bottom up model (MAED and MESSAGE)	
EcoFys[2]	Three alternative mitigation scenarios	>104	14%	Bottom up model	GHG, not only CO2
IEA[3]	Options with net economic benefit	62	(16.9% in 2030)	Energy simulation model	
South Africa					
LTMS[4]	-30 to -40% from 2003 level		30%	MARKAL energy optimisation model	Accumulated emission reduction over the whole period. Most of the results compared to Growth without Constrains scenario
EcoFys[2]	Three alternative mitigation scenarios	57 – 110 MtCO2 eq.	35%	Bottom up model	GHG, not only CO2
National SA[5]	Four alternative policy cases		7%	MARKAL	

India					
IIAM[6]	550 PPM scenario		8.7%	Partial equilibrium model linked to macroeconomic assumptions	Includes energy and industry
TERI[7]	Options with cost below $10/ tCO2	390		MARKAL energy optimization model	Includes energy and industry
EcoFys[2]	Three alternative mitigation scenarios	420	38%	Bottom up model	GHG emissions and not only CO2
IEA[8]	Options with net economic benefit	490	(27.1% in 2030)	Energy simulation model	
MiniCam[9]	Stabilization at 450, 550,650PPM		10%	Macroeconomic model	
MIT[10]	Reduction targets of 10% to 40% in 2010	400	(30%, year not specified)	Bottom up model linked to macroecnomic model	Results are given for 2010
China					
ERI[11]	Alternative policy scenario with 11% reduction from baseline in 2020		11 %	IPAC	High emphasis on more efficient coal power and industry
GCCI[12]	Reduction targets of 5% to 45%	302	45%	MARKAL-MACRO	
EcoFys[2]	Three alternative mitigation scenarios	777	32%	Bottom up model	GHG emissions, not only CO2
IEA[8]	Options with net economic benefit	1555	(22.5 % in 2030)	Energy simulation model	
McKinsey[13]	Max. abatement potential	2200-4500	(46.2 % in 2030)	Bottom up	Results are given primarily for 2030
MIT[10]	Reduction targets of 1% to 50% in 2010	1000		Bottom up model linked to macroeconomic model	Results are given for 2010

Table 4 Mitigation potentials in BASIC countries. Sources: 1) CCAP and Centro Clima (2006); 2) Ecofys and Wuppertal Institute (2008); 3) IEA (2006); 4) ERC (2007); 5) Winkler et al. (2007); 6) Shukla et al. (2007); 7) CCAP and TERI (2006); 8) IEA (2007); 9) Edmonds et al. (2008); 10) Morris et al. (2008); 11) Jiang et al. (2007); 12) Chen (2005); 13) McKinsey (2009).

Comparing these studies and the calculated potentials with the countries' pledges, it seems that Brazil has pledged quite large relative reductions compared to the potentials reported here; however, this is likely to mainly be the consequence of the fact that mitigation options in LULUCF are not included in these studies. When it comes to South Africa it seems that the country's pledges are close to the potentials found by both the national LTMS and EcoFys studies. In contrast, both India and China's potentials seem much larger than the pledged reductions calculated based on TIAM data, corresponding to the results from the climate constrained scenario.

4. Discussion

This paper has shown that the 2°C target agreed upon in the Copenhagen Accord will be very difficult to reach, as well as to model, and that it will be more or less impossible without early participation of large emerging economies. The future mitigation efforts of the BASIC countries are thus of great importance and interest, and this paper has looked closer at their pledged efforts and compared them with estimated emission reduction potentials for the same countries.

The 2020 pledges by China and India are close to their BAU/reference emissions, and appear to be small compared to estimated potentials. Contrastingly, Brazil and South Africa have pledged large reductions from BAU, and their pledges appear close to estimated potentials.

According to the current assumptions and data in TIAM, even in a non-constrained world it would actually be optimal that China by 2020 develops an energy system with lower emissions than its low pledges amount to, and the same is true for India's both low and high pledges. The potentials for large, relatively cheap reductions in China and India are also reflected in the total discounted system costs in the climate scenario, where large shares of the additional costs take place in China and India. The conclusion is thus that, for the world as a whole, it is optimal to do large reductions in these countries. However, this is not to say that China and India should necessarily pay for all these reductions by themselves; the reduction may require large amounts of financial transfers and an international agreement on who should pay, as well as on technology transfer, but this topic is outside the scope of this paper.

From this, it is clear that the BASIC countries play a large and increasing role in regard to energy consumption and GHG emissions, and it is hugely important that they are involved in any future mitigation efforts. However, it is important for these countries that mitigation efforts do not conflict with their development objectives, and if they do, this will most certainly limit their interest in participating in the efforts. One of the main concerns for developing countries in general, when it comes to emission reduction targets, seems to be that they may have to lower their ambitions for economic development. However, research shows that policies and strategies taking into account both sustainable development priorities and GHG emission targets may achieve climate targets effectively, and that such integrated policies may be cheaper and more sustainable than traditional climate focused policies alone (see e.g. Shukla et al., 2009). Furthermore, some studies even show that with this approach, policies to reduce GHG emissions may actually improve sustainable development in other areas, through changes in energy efficiencies, resource use, urban and land use planning, transportation systems and behaviour etc. Thus, an integrated approach to climate change and development is necessary.

The work presented in this paper is the preliminary result of DTU Climate Centre's first work on climate change mitigation and sustainable development in China and India, and the Centre is just starting up a joint project with the Basque Centre on Climate Change, the Indian Institute of Management in Ahmedabad and the Energy Research Institute in China on these issues.

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