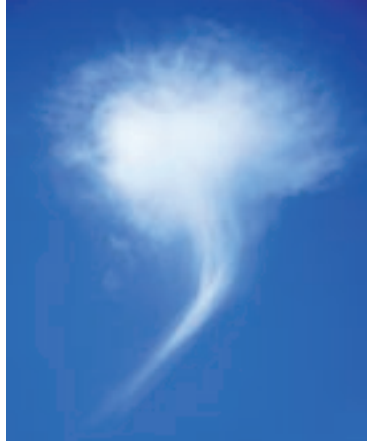


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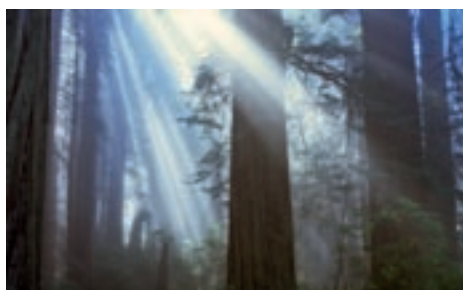


## Four policy scenarios for Copenhagen

*An analysis of four possible outcomes of  
the COP15 negotiations*



KÖPENHAMN  
(COPENHAGEN)



REGERINGSKANSLIET



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# Four policy scenarios for Copenhagen

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Följande skrifter har utkommit i Kommissionen för hållbar utvecklings skriftserie:

Hearing om klimatpolitikens vetenskapliga grunder april 2008  
Four policys scenarios for Copenhagen februari 2009

Skrifterna kan beställas av Åsa Dahlqvist på:  
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## *Preface*

In order to strengthen cooperation on and deepen analysis of issues related to sustainable development, the Swedish Government has set up an advisory Commission on Sustainable Development. The Commission serves as a forum for discussion, analysis and dialogue. It is chaired by the Prime Minister and consists of members from the business sector, non-government organisations, the research community and political life.

The Commission has adopted open working methods in the hope of encouraging broader dialogue in the community. The Commission may order studies and shorter reports from experts in Sweden or other countries. Such reports are published under the responsibility of the author(s).

Climate change is perhaps the most complicated issue facing the international community today. At the end of this year, governments from all countries of the world will gather in Copenhagen and try to negotiate a successor to the Kyoto protocol. The outcome of these negotiations is crucial in many respects.

With a view to stimulating discussion on the potential environmental and economic consequences, the Commission asked the company *Point Carbon* to analyse various possible outcomes of the negotiations. Point Carbon has long experience of carbon emission markets and has followed the international climate negotiations for many years. This analysis has been presented to the Commission by Kristian Tangen, Point Carbon. Point Carbon is solely responsible for the analysis, proposals and opinions presented in the report.

/ Joakim Sonnegård  
Head of the Secretariat  
Commission on Sustainable Development





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## *To the point*

**This report presents four scenarios for the outcome of the international negotiations in Copenhagen** where obligations adopted range from a marginal reduction compared to business-as-usual to a scenario where global emissions level out in the period 2015-2020.

**On the back of empirical observations, the study assumes that as countries take on deeper commitments** they will adopt more effective policy instruments, meaning that in the least ambitious scenario only 7 per cent of the cost effective potential is realized, while in the most ambitious scenario 48 per cent will be realized.

**As a consequence of the efficiency improvement, the average as well as the marginal costs of reducing emissions** are lower in the most ambitious scenario (18€/t and 36€/t, respectively) than in the scenario that gives the smallest emissions reductions (21€/t and 48€/t).

## *Point Carbon*



### *Introduction: Four policy scenarios for Copenhagen*


As expected, the international climate change negotiations in Poznan, December 2008, did not produce much in terms of concrete decisions. Since Poznan, the political signals from Washington indicate that the USA might play a different role in the upcoming negotiations than what they have been doing the past eight years. US President Obama has stated that the new administration would take on a “leadership” role and engage “vigorously” in the international negotiations. Domestically he aims to return the US emissions to its 1990-level by 2020.

Obama’s observer in Poznan, Senator Kerry, noted during the negotiations that he foresaw that the US could sign an agreement in Copenhagen, even in the event that a federal cap-and-trade scheme had not passed in the US Senate. Moreover, on January 15 the chair of the key House energy committee, Congressman Henry Waxman, said he hopes to pass a climate bill by 22 May this year.

Hence, apparently the US climate policy is changing, and this could significantly alter the course of the international negotiations. The purpose of this report, in light of the developments in the US, is to analyse how the negotiations in Copenhagen could unfold and what this might mean for future emissions and mitigation costs.

One pivotal question with regard to the development of the future negotiations is whether the US will participate in negotiations over legally binding emissions obligations. If the answer to this is yes, time appears too short to negotiate a legal instrument that would replace the Kyoto Protocol by December, remember the Kyoto Protocol took almost ten years to get in place. Rather, if the ambition is, as Senator Kerry hints, to get an agreement in place in the short run, the most realistic option seems to be to change the Kyoto Protocol so that the US could sign an amended version.

If the goal is to negotiate a new international agreement that would replace the Kyoto Protocol by December 2009, the most realistic option is probably an agreement that does not include legally



binding emissions obligations on an international level. This could for example be a framework agreement that would govern the linking of various national/regional trading schemes.

In our view, the course of action that is most consistent with exercising “leadership” would be negotiating in order to amend the Kyoto Protocol, including the aim to deepen commitments and broaden participation. Alternative US strategies are likely to either end up in prolonged negotiations where it is highly uncertain that the end-result will be anything better than the Kyoto Protocol, or alternative international agreements that will probably give less emission reduction than an amended Kyoto Protocol.

Hence, taking Obama’s leadership ambitions at face value we would expect that the US would engage in reforming the Kyoto Protocol so that it would be palatable in the US. The fact that the Obama administration appears to be loaded with individuals that were instrumental in bringing the Kyoto Protocol around in 1997 increases the probability of the US adopting such a negotiation strategy. We might get a clearer view of Obama’s strategy during the next round of negotiations in Bonn March 29 to April 8, which is the first time the new administration participates in formal negotiations. Insofar, we address some of the various options that appear possible.

Our first scenario, Race to the Top, is in line with Point Carbon’s reference scenario presented in September 2008 (see Carbon Market Analyst September 18, 2008: Copenhagen Commitments). This scenario assumes that the US will accept to negotiate over legally binding emissions obligations (e.g. an amended Kyoto Protocol). Over a period one or two years after the Copenhagen meeting, the US and the EU successfully push a number of non-Annex I countries to take on emission obligations. These obligations will either be for the whole economy, or for selected sectors.

The second scenario, Done Deal, is a variant of the first scenario, but assumes that the US and the EU do not succeed in broadening participation. E.g. except the current Annex I countries, almost no other countries accept new obligations before 2020.

The third scenario, Linking Framework, illustrates a development where a new international agreement under the UNFCCC, without legally binding obligations, replaces the Kyoto Protocol. The main driver of emission reductions will then be the planned regional cap-and-trade schemes, which are assumed to be linked in order to create an integrated market.

Finally, the fourth scenario, EU Alone, illustrates a development where the negotiations break down, but where the EU makes good of its ambitions of reducing emissions by 20 per cent by 2020, compared to 1990.

*Box 1: Expiry date for the Kyoto Protocol*

There is a common misunderstanding that the Kyoto Protocol expires in 2012, see for example the Economist Jan 4th 2009. The Protocol does not have an expiry date but requires an active decision to be determinate or changed. In fact the Protocol gives guidelines for how it will be modified for the post-2012 period. Article 9 establishes a process for reviews that might lead to changes in the operations of the Protocol. And Article 3.9 states that “Commitments for subsequent periods for Parties included in Annex I shall be established in amendments to Annex B to this Protocol”. It is hard to read this in any other way that the parties to the protocol have committed themselves to inscribe new commitments in amendments to Annex B (the table with quantified emission obligations). Now, some countries might choose not to submit new commitments but if the interpretation above is correct, that would be a breach on the obligations they have accepted when ratifying the Protocol. For a country like for example Canada this might not pose much of a problem, but for other countries, such as Japan, not complying with the protocol would imply considerable political costs for those in charge.

## Participation and coverage

Table 1 spells out which countries or sectors that are assumed to be covered by binding obligations, or by cap-and-trade, in our four scenarios. We assume two five years commitment periods towards 2022, in line with the Kyoto Protocol. As the table illustrates, the scenarios assume a gradual expansion in participation over time.

**Table 1: Participation and coverage in Point Carbons four scenarios**

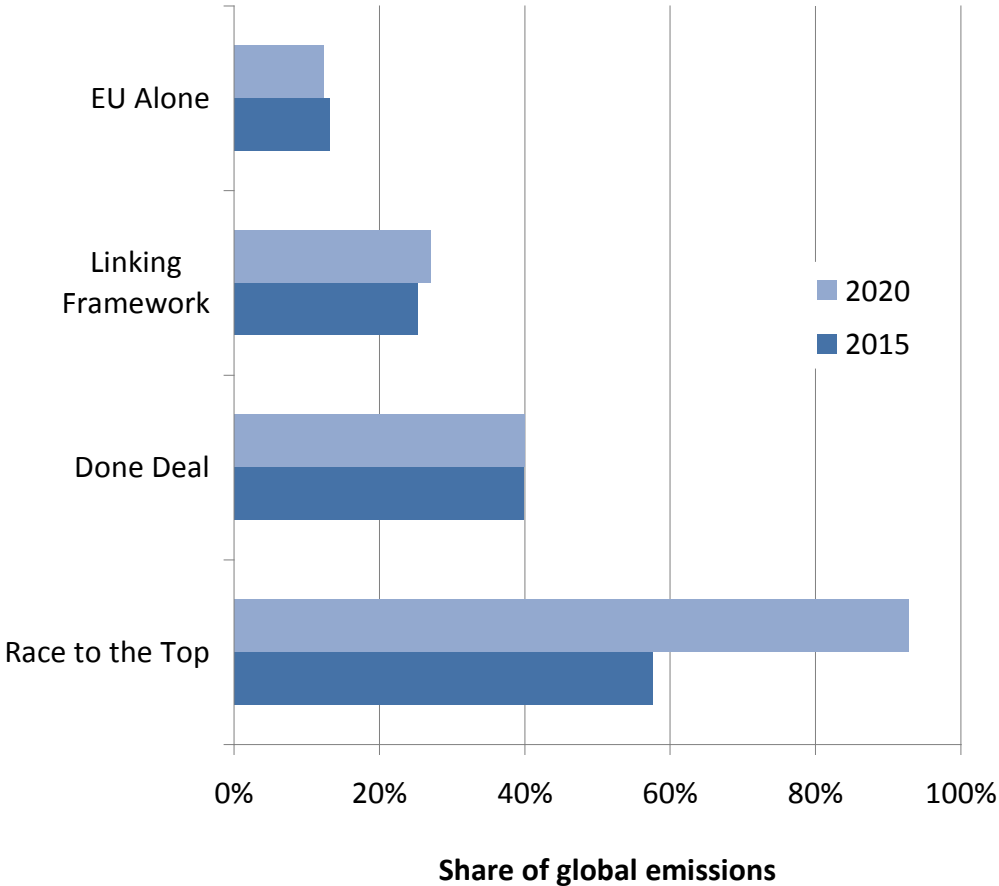
	2013-2017	2018-2022
<b>EU Only</b>	EU	+ New EU members
<b>Linking Framework</b>	EU ETS, US ETS, AUS ETS	+ JPN ETS, CAN ETS
<b>Done Deal</b>	Annex I	+ New EU members, OOECD
<b>Race to the Top</b>	Annex I; OOECD; Belarus; Kazakhstan; Turkey; F-Yugoslavia; Chile; Argentina. Sector targets for many countries with no national obligations	+ China and Brazil and a number of other countries (not LDCs and India)

The most ambitious scenario, Race to the Top, assumes that the number of countries that will take on national obligations are limited by 2013, but includes OECD countries (Mexico, South Korea, Israel); countries that have applied or have considered Annex I status (Kazakhstan, Belarus); new or potential EU members (Former Yugoslavia, Turkey); and some of the most developed Latin American countries which are in the US sphere of interest (Chile and Argentina).

Beside the national targets, a number of non-Annex I countries are assumed to take on sector targets covering 5 to 10 per cent of their emissions, allowing installations in these sectors to participate in international cap-and-trade. We have typically assumed that the steel and cement sectors will be covered in this early phase.

The sector obligations are important in order to expand the breadth of the system, but also in order to let the non-Annex 1 countries gain experience with emissions trading, which leads to more countries taking on national obligations from 2018.

Figure 1: Coverage of obligations, share of global emission



As figure 1 illustrates, the four scenarios are assumed to be very different when it comes to the share of global emissions that are covered by binding obligations, and which are thereby eligible for cap-and-trade. In the EU Alone scenario, the obligations cover 12 per cent of the global emissions by 2020, while in the Race to the Top, 93 per cent is covered.

### *Obligations*

Table 2 gives an overview over the emission obligations we have assumed in the four scenarios. The general approach has been to look at what has been stated recently by the various countries in regards to what emission goals they might have and adapted those to the various scenarios. In general we have assumed the EU will adopt obligations that are between 20% and 30% reduction compared to 1990, which is in line with their stated policy. For the most ambitious scenario we have assumed that the EU will be willing to push a bit further, i.e. to 35 per cent reduction.

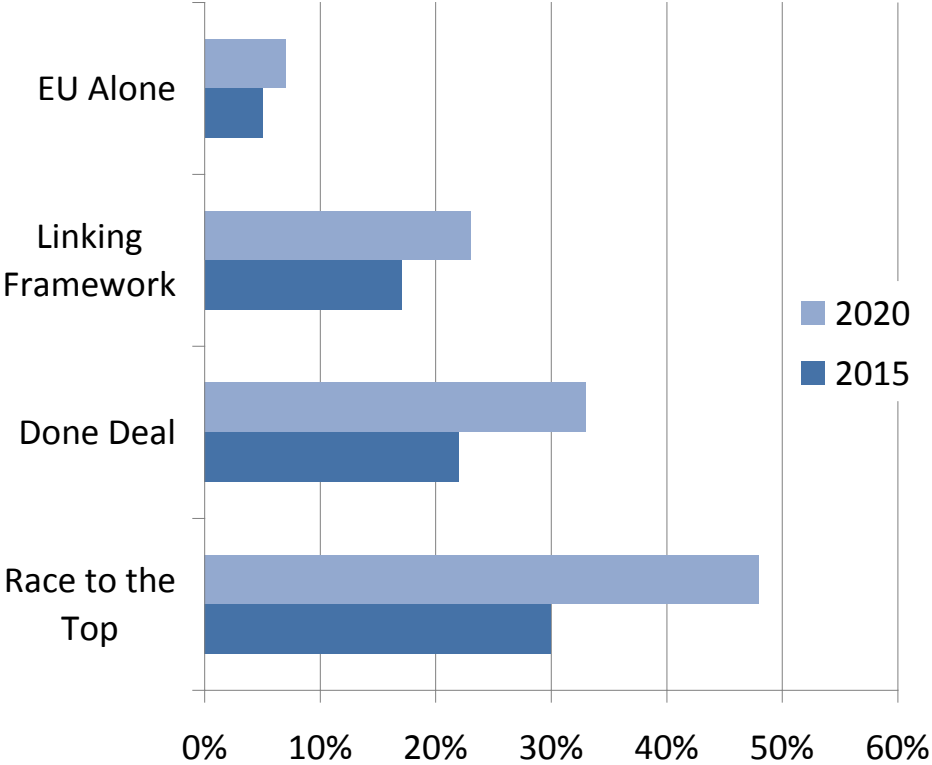
For the US, except for the EU Alone scenario, we have assumed that Obama will make good of his aim of returning emissions to 1990-level by 2020. However, in the most ambitious scenario we have assumed that the US will accept a somewhat more ambitious obligation, i.e. a five per cent reduction compared to 1990.

<b>Table 2: Assumed obligations, per cent reduction compared to 1990</b>			
<b>Scenario</b>	<b>Global</b>	<b>Annex I</b>	<b>EU</b>
<b>EU Alone</b>	76 %	10 %	- 20 %
<b>Linking Framework</b>	67 %	- 6 %	- 22 %
<b>Done Deal</b>	64 %	- 10 %	- 28 %
<b>Race to the Top</b>	55 %	- 16 %	- 35 %
<b>EU position</b>	-	- 25 % to - 40 %	- 20 % to - 30 %



For Japan, Australia, New Zealand and Canada, we have assumed that their obligations will be in the range defined by the US and the EU obligations, normally closer to the US end of the range. Norway and Switzerland are in line with the EU obligation. For the other countries and sectors we have assumed obligations that are more or less in line with business-as-usual, but in the most ambitious scenario, we have assumed obligations that are somewhat under business-as-usual, but not much.

Figure 2: Global emission paths under the four scenarios






Figure 2 illustrates what the global emissions would be if countries comply with the obligations stated in table 2. As the figure illustrates, only the Race to the Top scenario gives an emissions path that is close to what is recommended by the IPCC, e.g. emissions level out between 2015 and 2020. The three other scenarios significantly overshoot the emissions level recommended by the IPCC. Particularly for the EU Alone scenario we can see a relatively marginal deviation from business-as-usual, e.g. global emissions are estimated to be three per cent under business-as-usual.

### *Efficiency of policies*

When attempting to estimate the costs of the emissions reduction envisaged above, there are three empirical observations that influence our framework for analysis.

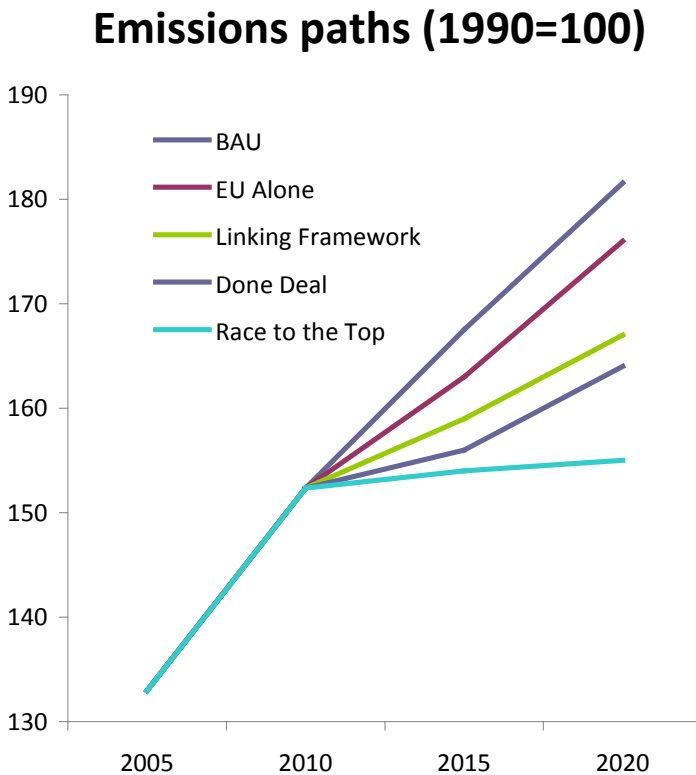
- A number of studies point to a large potential for emission reductions that are profitable by themselves, but are not currently being realized, ref. for example the recent McKinsey report on the global abatement potential.
- Most macro-economic models indicate that the reductions that should come out of non-Annex I countries under current carbon prices are much higher than what is being realized under the CDM.
- The reductions taking place under the EU ETS are not that far from what is being predicted by macro-economic and power market models.


This leads to the following three assumptions that we will try to reflect when estimating the costs of meeting the emissions obligations.

- The share of the cost effective potential that will be realized depends on the kind policy instruments that are being used, e.g. it seems reasonable to assume that a larger share of the cost effective potential is being exploited under cap-and-trade than under subsidy schemes such as the CDM.

- As countries take on more ambitious targets, there will be stronger focus on reducing cost of compliance, and hence they will tend to utilise more effective policy instruments.
- Due to institutional conditions, a policy instrument becomes more effective over time as the connected rules and guidelines being streamlined; the players adopt more effective implementation strategies; the cost of carbon becomes integrated in the companies' framework for assessment of profitability etc.

**Figure 3: Share of global cost effective potential realized in the four scenarios**





While there is strong empirical evidence backing these assumptions, representing it in a consistent way in a modelling framework is not straight forward. Figure 3 summarises the share of potential assumed realized under the four scenarios. As an indication of the size of the cost effective potential we have used marginal abatement cost curves from the EPPA model, see box 2 for more details.

When estimating the effectiveness we have approached this in the following manner:

For the CDM we have set the efficiency rate so that CER supplies will be in line with what our bottom-up model for CER supply indicates, e.g. normally in the range 5 to 30 per cent efficiency. For the scenarios where there are import limitations on CERs (EU Alone and Linking Framework) we have adjusted the efficiency so that CER supplies are at the level of the import limitations.

For sectors that are likely to be covered by cap-and-trade, we have assume an efficiency rate of 30 per cent in the start-up phase, moving to 90 per cent as the schemes become more mature.

For other instruments, like direct regulations etc, we have assumed efficiency rates that are between what we assume for cap-and-trade and CDM, e.g. typically in the range 10 to 50 per cent, depending on country, sector and timing.

When assigning the efficiency rates we have also partly looked at whether the resulting emission reductions seem realistic in light of what other models are indicating and what we observe on the ground.

### *Costs*

Table 3 shows the resulting costs, under the assumptions above when it comes to emission obligations, policy efficiency and the abatement costs indicated by the EPPA model. The total investment costs represent the investments in abatement measures

accumulated over the period 2013 to 2022. As the table shows, these costs increase from €331 billion in the least ambitious scenario to €1.2 trillion in the most ambitious scenario. I.e. in the most ambitious scenario the investment costs equal about 0.1 per cent of the annual global GDP.

	Total investments 2013-22 (€bn)	EU's costs 2013-22 (€bn)	Marginal Costs (€/t)	Average Costs (€/t)	Global reduction compared to BAU 2020
<b>EU Alone</b>	283	283	48	20	- 3 %
<b>Linking Framework</b>	789	342	42	20	- 8 %
<b>Done Deal</b>	854	480	37	19	- 10 %
<b>Race to the Top</b>	1 176	585	36	18	- 15 %

Being among the countries with the most ambitious obligations, EU carries a disproportionately large share of the costs. EU's costs in the table are calculated as the sum of the investment costs domestically and the costs of importing carbon credits and allowances. For EU Alone and Linking Framework we have assumed that import limitations lead to oversupply in the credit market and hence low prices on imported credits, e.g. €3/t. For the two other scenarios we have assumed an import price that is the same as the marginal costs in the fourth column in Table 3. The resulting annual costs for the EU are in the order of 2 to 3 per cent of its GDP.


The results represented in the fourth and the fifth column of table 3 might seem counter intuitive, e.g. the average and the marginal cost of reducing emissions decrease as larger reductions are achieved. This is a result of the assumptions made for policy effectiveness above; the improvement in efficiency more than offset the increase in abatement costs due to more ambitious obligations.

### *What does the model simulations tell us?*

In general, any results you get out of model simulation - such as those presented above - depend on the assumptions going into the model. As such the results from a model simulation that is based on fairly wide-ranging assumption about what the world will look like ten years from now - when we are still witnessing the very first evidences of how the carbon market works - should be treated with considerable caution. Hence, the estimated costs and the level of marginal costs are largely illustrations of some conceptually very different scenarios. Still, many of the results from the simulations above make a lot sense.

Firstly, the scenarios illustrate that the costs of reducing emissions, and ultimately the reductions that will be accepted by the larger public, is highly dependent on the efficiency of the policies that are implemented. In many ways, the effectiveness of policies seem as important as the underlying technical potential when it comes to estimating future costs of reducing emissions. Hence, it is important that costs estimations are explicit about the assumptions being made in this regard, and that price forecasts takes effectiveness into consideration.

Secondly, the simulations indicate that Linking Framework is likely to give smaller emission reductions than internationally binding obligations. Clearly, the Linking Framework could be constructed differently, giving larger reductions. However, we believe the picture painted in the analysis is a realistic one. The international coordination that takes place through the international negotiations, and the fact that the national commitments are on a comparable basis, tends to deepen the commitments by individual nations and makes free-riding more difficult. We believe that there is strong empirical evidence suggesting that the policies of for example the EU and Japan would be less ambitious than they are today if it was not for the obligations set by the Kyoto Protocol. Hence, as illustrated by the scenarios, we believe in general that international binding obligations are likely to bring forward deeper reduction than an international regime that does not have such obligations.



Thirdly, much as an effect of the two preceding statements, it seems likely that efficiency gains could offset the increasing costs of deeper reductions. We believe that there is strong empirical evidence that ambitious international obligations drive nations to adopt more effective policies. Again the EU ETS as well as the Japanese purchase programs are examples worth mentioning. It is very hard to see any of these policies being implemented in the absence of the fairly ambitious obligations set by the Kyoto Protocol. Whether the efficiency gains will more than offset the increasing abatement costs of deeper cuts - as our scenarios suggest - is debatable, but that the ambitious targets tend to lead more efficiency is an assumption that makes a lot of sense.


### *What does it take?*

In many ways the Race to the Top scenario comes out as the most attractive scenario; it gives reductions that are in line with IPCC scenarios, and will entail the lowest average and marginal costs. What will it take to bring such a scenario around?

As pointed out in the introduction, the choice is largely President Obama's to make. If the US is not going to negotiate over legally binding emission obligations, we are likely to end up in the Linking Framework scenario. If the US accept negotiating over binding commitments, we are likely to be in the Race to the Top scenario. And if we are going to get a deal in Copenhagen with binding commitments, it is likely to be an amended version of the Kyoto Protocol.

For the sake of the argument, let us assume that the US will aim for a deal in Copenhagen with binding emission obligations, what will it take to bring about the participation and obligations spelled out under the Race to the Top scenario?

The answer to this question has two aspects, a political one, and a legal one. The political one appears the more difficult one by far. One issue is that the US will have to get access to the substantive negotiations on the post-2012 regime. At the moment these negotiations take place between the parties to the Kyoto Protocol, e.g. future obligations and the review of the Kyoto Protocol. As the US




is not a party, it does not automatically have access to these negotiations. We do not know how this should be dealt with procedurally but guess that some clever US lawyers will come up with constructive suggestions.

Although the US might have the necessary national legislation in place and largely might be ready for adopting international commitments, many of the non-Annex I countries will need at least one to two years after Copenhagen to prepare and agree to taking on national or sector obligations. So in order to achieve the level of participation envisaged under the Race to the Top scenario an extended period, probably two years, will be needed in order to set the obligations for non-Annex I countries.

To the extent that non-Annex I will accept obligations probably depends on whether the US and the EU are able to push together. Both sticks and carrots can and probably will have to be applied. One carrot could be access to the market, e.g. if more countries take on obligations, the US and the EU will lift the limitations on import of carbon. Another one could be that the EU and the US state that they will accept more ambitious obligations if more countries join in, which of course will lead to deeper reductions but also increased revenues for the countries that are likely to export carbon credits and allowances.

Convincing non-Annex I countries to take on obligations will probably also entail a strong bilateral element. This could be through the application of “soft power” in bilateral meetings, but also more concrete discussions of how to implement cap-and-trade in the sectors that have obligations and how this should be linked in order to construct one common market. The US has traditionally been strong at applying such bilateral pressure, and we would expect that this would be the case in a Race to the Top scenario. However, in order to bring it about it will be important that also the EU engage actively in bilateral discussions on how to expand its trading scheme outside the EU, beyond linking to the US.





In order to be ratified, the Copenhagen deal will have to be sold as something else than the “Kyoto Protocol” to the US public, but suggesting exactly how best to spin this in the US is beyond our competence. That being said, whether or not the US ratify an agreement in the end is probably less important than whether the country will play a constructive role in the process running up to the deal. It is possible to foresee that the US will sign on to a deal, and implement it, but not ratifying it. In this case the impact on the global emissions and the global carbon market might be equal regardless of whether the US ratifies the agreement in the end.

With regard to legalities, a lot of the things that are needed in order to bring the US around are probably more of a procedural/operational character rather than the legal text itself. For example it seems likely that the US will emphasise measures to increase the efficiency of the CDM, expand the role of JI/domestic offset programs, as well as increase the role of emission reductions from avoided deforestation (REDD) . The changes to the legal texts that are needed to bring around the Race to the Top scenario might not be that extensive but would include 1) a way to inscribe sector obligations in amendments to Annex B; 2) some way to deal with the fact that the US will not comply with its obligations in the period 2008-12; and 3) an option for Annex I countries to adopt more ambitious obligations as more countries take on obligations.

### *Box 2: The EPPA model*

The EPPA model is a multi-region, multi-sector recursive-dynamic representation of the global economy. The model includes representation of abatement of non-CO<sub>2</sub> greenhouse gas emissions (CH<sub>4</sub>, N<sub>2</sub>O, HFCs, PFCs and SF<sub>6</sub>) and the calculations consider both the emissions mitigation that occurs as a by-product of actions directed at CO<sub>2</sub> and reductions resulting from gas-specific control measures.

Non-energy activities are aggregated to six sectors. The energy sector, which emits several of the non-CO<sub>2</sub> gases as well as CO<sub>2</sub>, is modelled in more detail. There are 16 geographical regions represented explicitly in the model including major countries (the US, Japan, Canada, China, India, and Indonesia) and 10 regions that are an aggregations of countries.

When emissions constraints on certain countries, gases, or sectors are imposed in a CGE model such as EPPA, the model calculates a shadow value of the constraint which is interpretable as a price that would be obtained under an allowance market that developed under a cap and trade system. Those prices are the marginal costs used in the construction of marginal abatement cost (MAC) curves that have been used in this study.

In the study we have for simplicity linearised the MAC curves from the EPPA model, which means that the costs estimated in this study is somewhat higher than they would have been if we had chosen the another representation that is closer to the actual shape of the results from the EPPA MAC curve.

For business-as-usual emissions, we have used our own forecast rather than those produced by the EPPA model. A comparison with other models, reveal that the EPPA model produces MACs that are close to the average of that of the other models, but probably give costs that are somewhat over the average.

**Sources:** Morris, Paltsev and Reilly, *Marginal Abatement Costs and Marginal Welfare Costs for Greenhouse Gas Emissions Reductions: Results from the EPPA Model MIT 2008*; Hoogwijk et al, *Sectoral Emission Mitigation Potentials*, available at [www.mnp.nl](http://www.mnp.nl)







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