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The ideas expressed in this paper are those of the author and do not necessarily represent the views of the OECD, the IEA, or their member countries, or the endorsement of any approach described herein.

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FOREWORD

This document was prepared by the OECD and IEA Secretariats in Autumn 2007 in response to the Annex I Expert Group on the United Nations Framework Convention on Climate Change (UNFCCC). The Annex I Expert Group oversees development of analytical papers for the purpose of providing useful and timely input to the climate change negotiations. These papers may also be useful to national policy-makers and other decision-makers. In a collaborative effort, authors work with the Annex I Expert Group to develop these papers. However, the papers do not necessarily represent the views of the OECD or the IEA, nor are they intended to prejudge the views of countries participating in the Annex I Expert Group. Rather, they are Secretariat information papers intended to inform Member countries, as well as the UNFCCC audience.

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The role of commitment periods in the climate challenge

Today's investment decisions in key sectors such as energy, forestry or transport have significant impacts on the levels of greenhouse gas (GHG) emissions over the coming decades. Given the economic and environmental long-term implications of capital investment and retirement, a climate mitigation regime should aim to encourage capital investment in climate-friendly technologies. Many factors affect technology choice and the timing of investment, including investor expectations about future prices and policies. Recent international discussions have focused on the importance of providing more certainty about future climate policy stringency. The design of commitment periods can play a role in creating this environment.

This paper assesses how the length of commitment periods influences policy uncertainty and investment decisions. In particular, the paper analyses the relationship between commitment period length and near term investment decisions in climate friendly technology.

Commitment periods define a time period within which emission reduction obligations are to be met. Even though they only partly determine the policies and measures that are needed to comply with the reduction targets, they play an important role in increasing the certainty/predictability for investors/decision-makers by establishing an internationally-coordinated timeframe. In other words, although investors' behaviour is driven by governments' domestic decisions on how to achieve environmental targets, domestic policy decisions tend to follow the timeframe set by the commitment period. As a consequence, the length of the commitment period is one important element of international climate policy coordination.

The extent to which the decision on the length of commitment periods can influence predictability for economic agents and thus the choice and timing of investments in climate friendly technologies hinges on a number of issues:

- The way the commitment period is chosen, particularly its length and the time gap between the decision and the start date of the commitment period;
- The stringency of targets/commitments;
- Domestic policy choices to implement commitments.

What length to choose for a commitment period?

There is no straightforward way to decide on the length of a commitment period. Both longer and shorter commitment periods have their advantages and disadvantages, and a decision on commitment period lengths will need to find a balance between them. The appropriate length of a commitment period may also vary depending on how a commitment is expressed (e.g. in terms of emission levels, or in terms of emissions intensity) and/or which country it is designed to apply to.

- Longer commitment periods increase predictability and certainty for business decisions and give investors a certain flexibility to offset short-term fluctuations in emission levels that might result from economic cycles, structural changes or weather conditions – provided domestic policy so allows. A longer commitment period also provides more certainty and so facilitates private sector investment decisions into low-carbon technologies – and potentially more ambitious commitments. In addition, longer commitment periods may lower administrative costs by requiring less frequent compliance assessments and lower 'negotiating costs' through less frequent negotiation cycles.

- A shorter commitment period is not able to provide sufficient certainty and predictability for investors making decisions on long-lived assets, e.g. in the stationary energy sector. This may lead to investors deferring decisions to replace ageing and GHG-intensive plants. Yet, shorter-term commitment periods could allow better adjustment to scientific, economic, political and technology developments. They provide a flexibility to incorporate new circumstances and necessary adjustments, if information were to emerge to require more (or less) vigorous mitigation and/or if political majorities change. In addition, through more frequent compliance checks, they increase the certainty regarding actual emission levels. However, the costs of reaching certain emission levels could be higher as shorter commitment periods reduce the possibility to absorb cyclical effects on emissions.

Accordingly, a decision on the length of commitment periods should aim at balancing:

- The needs of the governments in complying with climate targets, while avoiding sudden impacts on the economy;

- The needs of investors in facilitating long-term predictability, increasing therefore the attractiveness of investments in low-carbon technologies;

- The needs of the environment in encouraging certain emission reductions, while being able to respond to new scientific information.

An overview of design options for commitment periods

Given the importance of short-term investment decisions in long-term GHG emission levels, a climate regime should ideally provide long-term predictability even if the individual commitment periods within this regime are short. This idea is known as 'rolling' commitment periods, 'carbon budgeting', or 'gateways'. The effects of these options are as follows:

- 'Rolling' commitment periods can either include an automatic adjustment procedure for targets as in the Sao Paolo proposal (Basic, 2006) or a process that decides upon the targets of the upcoming periods in advance, as in the UK Climate Change Bill. This concept is attractive due to the combination of a long-term perspective while constantly reviewing the short-term development of emissions. Indeed, both options allow for periodic adjustments of emission limitation obligations.

- The 'gateway' mechanism represents an extension of the rolling commitment periods concept to give firm short-term targets and a medium-term range of expected future abatement efforts. This range gives the government flexibility to react to new information whilst maintaining the path towards the long-term target, hence providing more certainty to investors.

These design options combine a long-term emission trajectory with firm short-term and adjustable medium-term targets. The underlying idea is to enable a longer-term trajectory of an emissions path, being therefore able to impose significant emission reduction requirements over time, while short-term targets ensure a step-by-step enforcement of the mitigation efforts.

Some ideas to increase the impact of commitment periods

An early decision on the length of a commitment period could provide decision-makers and the private sector with better certainty on future conditions – provided that domestic policy follows. The longer the length of time between agreeing on a target and the end of the related commitment period and the sooner a wide-spread ratification of the agreement, the better are the conditions for investors. However, investment decisions are also affected by other aspects related to the commitment period than length, such as participation and its evolution over time.

The various design options for commitment periods show that there are ways of improving the balance between better economic certainty through longer predictability and environmental certainty of reaching certain emission levels. In addition, the experiences from the Kyoto framework suggest that domestic implementation is key to a climate regime's success as it is usually the national governments' domestic decisions on how to achieve reduction targets that drive investors' behaviour. Nonetheless, by facilitating the international coordination of policies and measures across Parties, the length of the commitment period is an important element and should not be neglected.

This report highlights the following four components as key in maximising a commitment period's contribution to both a low GHG- and investor-friendly environment:

- A longer-term emission reduction target or range; and
- Shorter-term targets to periodically monitor progress; and
- Periodic reviews of the long-term schedule and progress related to the short-term targets to enable later adjustment in the light of new scientific, technological or economic developments; and
- Strong monitoring and compliance rules promoting national compliance systems and integrating them with the multilateral compliance scheme.

1. Introduction

The signals to increase the level of mitigation are compelling. Given potentially strong implications of climate change, science urges us to significantly lower global greenhouse gas (GHG) emissions (cf. IPCC 4AR, 2007a,b; Stern, 2007). However, the economic decisions that need to be taken at the domestic level render the implementation of stringent mitigation objectives often difficult. In particular, there is a fundamental issue of uncertainty that surrounds climate policy, implying a trade-off between short-term economic costs of taking action and the expected longer-term environmental gains. Uncertainties related to climate policy can thus delay investments in certain technologies and capital with the danger of biasing investment to carbon-intensive technologies and capital stocks and a consequent lock-in for several decades. This study does not attempt to resolve this issue but aims to analyse how the length of commitment periods – in addition to the setting of (different types of) targets or identifying commitments – can contribute to put the world/society on a lower emissions path.

The scientific need to reduce GHG emissions combined with the world's growing demand for goods and services highlights the need for a portfolio of incentives to change investment decisions to encourage more climate-friendly technologies. Indeed, the availability of more efficient technologies does not automatically represent a driver of investment decisions in capital stocks if no policy or market incentives exist (cf. Lempert et al., 2002). The design of the commitment periods is one of the variables that affect these choices.

This potential is indicated by the current format of commitment periods as negotiated in the Kyoto Protocol. The current five-year format of commitment periods imposes an imperative on all the participating countries, providing a type of guideline that needs to be followed by all Parties. Yet, the specific impact of the commitment period length on certainty, investments and consequently GHG reduction strongly depends on how the Kyoto commitments are translated domestically, i.e. which policies and measures are included. This decision is primarily determined by governments' domestic choices and hinges only partly on the commitment period, even though the domestic timeframe may follow the commitment period length. In other words, even though it is the governments' domestic decisions on how to achieve the Kyoto targets that drive the investors' behaviour, the length of the commitment period facilitates international coordination and is therefore one element of international coordination that should not be neglected.

Indeed, also in the Kyoto framework governments are not prevented from setting longer-term targets or emission trajectories, but at least in the past have done so only rarely. As a consequence, it is difficult to create longer-term predictability, and the current five-year format of commitment periods has been claimed to not provide enough certainty for long-term investment decisions, especially in the energy sector. However, even if international agreements use longer-term commitment periods, businesses may still be subject to uncertainties in domestic policies for meeting international commitments, which may change more frequently as a factor of election cycles, economic fluctuations, or other domestic considerations.

The time period that is important for investment decisions does not necessarily need to correspond to the commitment period as such. The length of the period between agreeing on a target and the end of the related commitment period provides an even longer perspective for investors and plays therefore a significant role. In the context of the Kyoto Protocol, the emission reduction target as well as the commitment period was agreed upon in 1997. Even though a five-year commitment period was decided, lasting from 2008 to 2012, the time when it was decided implied a 15-year time horizon. If a second commitment period lasting five years was agreed in 2009 for 2013-2017, then this would imply a time horizon for investors of only eight years. In addition, any delay in the design, implementation and enforcement of domestic policies for meeting the international commitments could imply a further time lag.

This paper examines the issue of commitment periods that may influence policy uncertainty and investment decisions in a more general sense, including both elements that may be particularly important

for quantified emissions targets, but also for other types of possible post-2012 commitments, without providing detailed discussions for all of them. The focus is on issues around setting commitment periods in international agreements, even though the discussions and insights are also useful in the context of domestic policies.

The remainder of the paper is structured as follows. Section 2 defines the purpose and effects of commitment periods, also drawing upon earlier experiences in the context of environmental policy schemes. Then, Section 3 identifies the main arguments for and against longer-term commitment periods. This sets the floor for Section 4, which looks at the options and related implications of setting commitment periods. Section 5 moves the analysis a step further by discussing practical implementation issues before Section 6 concludes.

2. What is a Commitment Period?

2.1 A definition

The purpose of a commitment period is to establish a timeframe within which environmental goals must be met. In other words, once governments have agreed to set certain climate policy targets that are to be reached at a certain point in time, the specific period leading to this end point needs to be established, specifying when parties must comply with these targets.

There is a wide range of possible commitments that can be adopted, including fixed quantified targets, indexed targets, policies and measures or no-lose targets. These targets can be based on one or more of several indicators, such as total or per capita emissions, emissions intensity or financing levels. More importantly, the way these targets are imposed can differ significantly. These can include targets that are defined and automatically revised through previously-agreed rules (e.g. Sao Paolo proposal; Basic, 2006); or targets that are re-negotiated every few years, as implemented in the Kyoto Protocol or the EU Emissions Trading Scheme.

The main effect of commitment periods is to concentrate abatement efforts in an internationally coordinated period, providing decision-makers a guideline and thus improved (policy) certainty for a defined period as they are all subject to the same timeframe. The specification of a longer-term period at the end of which a certain target should be fulfilled has important implications on investment decisions and can change the valuation of climate-friendly technologies. However, (as indicated above), the extent of these effects hinges on a number of issues:

- The way commitment periods are chosen, particularly as regards their length and the period from when targets are agreed upon and the end of the commitment period;
- The stringency of targets/commitments;
- The way commitments are implemented domestically, i.e. which policies and measures are adopted.

2.2 Some insights from past experiences

Commitment periods are an essential element of international environmental systems/agreements. Therefore, a number of experiences are available. To learn from these experiences, let us briefly analyse the details of two earlier schemes that have been labelled as successful policy experiments, the Montreal Protocol on Substances that Deplete the Ozone Layer and the Acid Rain Program created by the 1990 Clean Air Act Amendments.

The Montreal Protocol has been designed to protect the ozone layer by phasing out a number of substances responsible for ozone depletion. It was signed in 1987 and entered into force on January 1, 1989. Since then, it has undergone five revisions, expanding the list of controlled substances and strengthening the timetables, and has been signed by almost 200 countries. The widespread adoption and implementation has led to a phasing out of already more than 95% of the global production and consumption of ozone-depleting substances[1] covered by this Protocol. A number of elements are responsible for this success, as amongst others quantitative emission limits for industrial and developing countries, trade sanctions for non-participants and violators and arrangements according to which industrial countries pay for added costs to developing countries. A critical element in the design of the treaty has been the temporary compliance profile for the reductions; the protocol includes timetables for phasing out requirements, which were initially modest but gradually tightened over a 10-year period. In addition, an adjustment provision enables Parties to respond to evolving science.

The US Acid Rain Program was designed to reduce the adverse effects of acid deposition through reductions in annual emissions of sulphur dioxide (SO_2) and nitrogen oxides (NO_x), to be reached in two gradually expanding phases. Phase I lasted from 1995 (1996 for NO_x) to 1999 while phase II started in 2000 and tightened the annual emissions limits. In 2005, emissions were less than half the level anticipated without the programme. The Acid Rain Program has become a success story for environmental schemes, emphasised through nearly 100 percent compliance due to rigorous emissions monitoring, allowance tracking, and an automatic, easily understood penalty system for non-compliance. Implementation costs have been contained due to flexibility in compliance strategies, particularly through the market-based trading system in the SO_2 scheme. In addition, the two-phase tightening of the restrictions has played a critical role. However, critics suggest that greater reductions could have been achieved if targets had been adjusted to actual abatement costs. The length of the "broad" commitment lead time, without any interim adjustment possibilities, appears to have prevented regulators to make targets more ambitious, as new, cheaper abatement possibilities arose.

The experiences of these schemes highlight some important characteristics that may improve the success of international environmental programmes

- Starting with a small coverage that is gradually expanded, in order to reduce economic inefficiencies;

- Designing the scheme in such a way as to acknowledge the importance of uncertainties, to maximise incentives for participation (as particularly abatement cost uncertainty is a major reason for reluctance). Stable and reliable rules and principles of the game are to be ensured, including a clear trajectory of emission reductions, attempting however to allow for adjustment possibilities over time without significantly changing the scheme itself.

Experiences from the earlier schemes have shown that an appropriate design of the commitment period can influence the performance and implications of environmental programmes. In particular, a compliance profile that takes account of the need for flexibility in the method to achieve emission reductions while providing for gradually strengthening reductions over a longer time period based on reliable rules has proven successful.

This detail is also emerging from the EU ETS, where the sequential cap-setting in three- and then five-yearly commitment periods has become one of the main criticisms as it led to considerable uncertainty about longer term reduction requirements with consequent effects on investment. Currently, a review of the EU ETS framework is under preparation, and an improved predictability of the scheme has become one of its objectives. In this context, a consensus is emerging that *"a stable framework of rules and principles on cap-setting (…) and the trajectory"* are critical elements for increased predictability (European Commission, 2007). The need for a longer-term perspective is emphasised, particularly in the sense of aligning predictability periods *"with the period on which a firm political decision (on reduction*

[1] For more information on the achievements of the Montreal Protocol to date see http://ozone.unep.org/Publications/MP_Key_Achievements-E.pdf

targets) has been taken." A similar lesson has been drawn in Australian proposals on emissions trading, where long-term predictability supported by flexibility to adjust the emission caps have become major features of proposed emissions trading schemes (see 4.2).

3. Arguments For and Against Longer Commitment Periods

What motivates different lengths of commitment periods? To come to grips with this question, let us start by looking at two extreme situations and ask why commitment periods should be longer than 1 year and shorter than 100 years:

- A commitment period of one year could require economic and structural adjustments in a very short timeframe, risking higher than usual costs of reaching an environmental goal, and thus a strong impact on the participants. Hence, compliance is made more difficult, potentially increasing the compliance costs. These difficulties could also question the actual compliance with the environmental goal. Further, such a short timeframe could make it difficult to provide the right signals for investments in technologies that enable long-term ambitious emission reductions, if no longer perspective is indicated. However, such a framework would make it easier to ensure short-term compliance, increasing the environmental certainty regarding actual emission levels. Nonetheless, the costs of achieving the environmental target are likely to be higher as shorter commitment periods provide for low flexibility in reaching the target.

- At the other extreme, a 100-year commitment period is difficult from a compliance perspective, as the timeframe is too long to set serious incentives for present actors/governments to start reducing GHG emissions. As a consequence, this long commitment period could also struggle with emissions going out of control. Even though the actors are given a high flexibility in complying with the goals, an objective to be achieved in the far future makes it also difficult to adjust to changing circumstances and new emerging knowledge. However, even though a longer commitment period in principle is able to provide predictability and certainty for business decisions, thereby favouring conditions for investments in effective low-carbon technologies, a 100-years period is too long as it sets incentives to postpone action to subsequent actors.

For these reasons, a commitment period should be somewhere in between a very short-term and very long-term perspective. Longer commitment periods may help create a long-term vision on where investment decisions should go by providing an indication of long-term trends, increasing thereby the economic certainty of affected actors. Shorter commitment periods may help ensure short-term compliance and thereby environmental certainty of reaching certain emission levels in the near future. The key issue in deciding upon the length of a commitment period regards therefore the achievement of a certain balance between these implications. Thus:

- The Kyoto Protocol decided upon a five-year period in order to allow Parties some flexibility in when they meet their GHG emissions reduction obligation. The length of the period was chosen to balance emissions fluctuations caused by inter-annual variability with the need to ensure short-term compliance. The emissions reduction objective for its first commitment period, 2008-12, has been determined in the Kyoto Protocol, but the potential cap beyond 2012 as well as the potential next commitment period is unknown and subject to new negotiations.

- In addition, the commitment periods of the European Union Emissions Trading Scheme (EU ETS), a cap-and-trade programme launched in 2005 to reduce emissions of greenhouse gases in Europe, was designed in conformity with the Kyoto Protocol. After its current 'pilot' phase that runs from 2005 to 2007, subsequent commitment periods are currently foreseen to last five years.

While decisions on the length of commitment periods are important, they should be seen in context. Thus, the lengths of any future commitment periods are unlikely to be the main stumbling block either to certain domestic policy decisions or to agreement of a post-2012 climate regime. In fact, a commitment period set under a multilateral agreement does not impose any implementation of any domestic policy –

and domestic policy choices could and sometimes even should span longer time periods than an internationally-established commitment period.

Yet, climate change policy uncertainty may affect investment behaviour, and in this context the length of commitment periods is likely to play a role. The next two subsections analyse the reasons for and against longer commitment periods from the perspective of aiming at higher certainty for decision-makers. Several evaluation criteria are taken into consideration (in a qualitative sense), including cost-effectiveness, environmental performance, and economic development.

It is difficult to exactly decide how long a 'long' or how 'short' a commitment period is. This decision may vary in the different sectors depending on the timeframes of investment decisions or on issues related to market evolution, technology development and investment trends. While further analysis on this issue would be helpful to shape the specific details related to a decision on commitment periods, it is beyond the scope of this paper. For this reason, we regard the 5-years commitment period agreed upon in the Kyoto Protocol as the reference and consider a 'longer' commitment period to be beyond 10 years, based on research related to investment decisions in the power sector that will be briefly discussed in 3.1.3.

3.1 Advantages of longer commitment periods

Longer commitment periods have several potential advantages. These are outlined below.

3.1.1 Accommodating short-term emissions variability

Seasonal and inter-annual variability in a number of factors can cause GHG emissions fluctuations. For example, structural changes within the economy as well as population changes influence emission trends. Variability in GDP, economic activity or fuel prices represents another source.

Economic activity usually fluctuates around its long-term growth trend. These business cycles – characterised by changing employment, industrial productivity, and interest rates – are important periods for decision makers, who attempt to plan decisions in accordance with these fluctuations. Not having sufficient predictability increases the costs to investors as they may make sub-optimal decisions triggered by higher uncertainty.

Seasonal to inter-annual weather variations also cause emissions fluctuations due to a number of reasons, mainly felt through the impact on the demand for, and supply of, electricity and heating fuel. Both increases and decreases in temperature can lead to increases in the demand for electricity. Cold weather will increase consumer demand for energy consumption resulting in utilities increasing their supply and thus their emissions. Hot weather can lead to a similar situation due to an increased use of air conditioning units. In addition, countries that rely on hydroelectric power also suffer from a precipitation effect as precipitation levels affect the share of power generated by non-CO_2 emitting sources and thus emission levels

The emission fluctuations induced by these variations are largely unpredictable and represent an uncertainty for the business decision-makers. Faced with a short-term perspective, this uncertainty and the related short-term costs can make investors unwilling to provide the capital necessary for longer-term climate-friendly investments. Longer commitment periods appear to be more appropriate to tackle this factor due to the following reasons:

- Over the longer run, the various weather effects tend to offset each other (Houbert and De Dominicis, 2006);

- Similarly, economic variations tend to offset each other over the longer term, as data on past business cycles suggest several regularities (sometimes called stylised facts);

- A longer-term emission reduction perspective sets incentives for investments regardless of variations.

3.1.2 Better short-term flexibility and 'smoother' economic costs

The opportunity to take into account long-term variability in weather, economic growth cycles and structural changes whilst facing a longer-term environmental goal helps 'smooth' the economic costs of complying with the environmental target. Decision-makers can take advantage of the flexibility offered by longer commitment periods to react to short-term phenomena while having a longer time period to plan abatement efforts. Also, as will be discussed in section 3.1.3, longer commitment periods provide appropriate incentives for investors to plan longer-term decisions and investments in climate-friendly technologies. These technologies are sometimes characterised by high upfront costs and thus are only sufficiently economically attractive if a longer time perspective is adopted (see the example provided by Figure 1).

The problem of higher-than-necessary economic costs of reducing GHG emissions is also related to other elements of the potential agreement on emission reduction obligations. Particularly, the policy instrument(s) allowed to reach any emission reduction goals within the commitment periods can make a difference. For example, emission trading can help to address problem of business cycles, especially if decision makers are allowed to bank emission allowances over time. The rationale behind emission trading is to ensure that the emission reductions take place where the cost of the reduction is lowest. Companies have the flexibility of determining how and where the emissions reductions will be achieved. Intertemporal rules like banking or borrowing can replace to some extent the function of longer commitment periods, increasing cost-effectiveness.

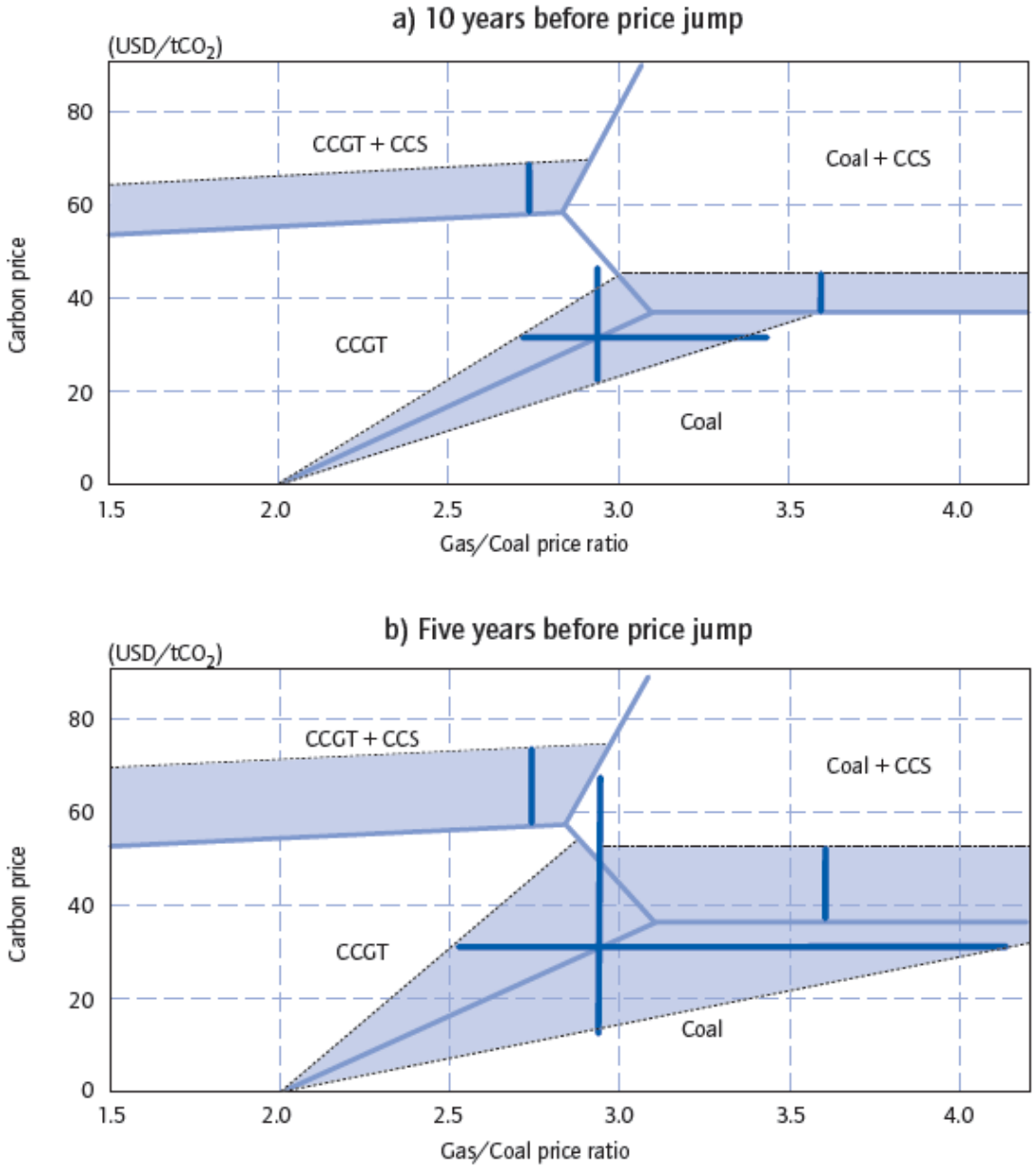
3.1.3 Incentives for long-term investment decisions

Capital equipment that supports the world's economic activity is expensive and once built can last for decades. Given these characteristics, decision-makers are generally faced with low economic incentives to retire plants, whatever the engineering and nominal service lifetimes of physical equipment or the available efficient technologies (cf. Lempert et al., 2002). Capital investments thus may have long-term implications for GHG emission levels, particularly in the energy sector, where investments are typically long-lived and require long lead times. Policy or market incentives are thus required to shape the long-term patterns of capital investment.

Shorter commitment periods and related short-term compliance could introduce a bias to pursue short-term/short payback abatement options rather than changes with longer payback time. Long-term certainty and vision are helpful to create the appropriate investment climate for business decisions and technology development. Longer commitment periods do not directly offer investment certainty for decision makers, but provide an indication of long-term trends that in turn influence investment decisions, particularly in areas where the lifetime of equipment is long. E.g., business cycles in the energy sector are in general not consistent with short commitment periods, such as the current 5-year periods in the context of the Kyoto Protocol, but call for longer commitments in order to facilitate investment in appropriate GHG saving technologies and reduce thereby economic costs.

This insight is emphasised by a recent study that analyses the implications of climate policy uncertainty on investment behaviour in the power sector (IEA, 2007). Climate policy uncertainty is found to weaken and delay investment incentives for low-carbon technologies. Given the choice to invest in gas or coal plants, or to retrofit these plants with carbon capture and storage (CCS), the best strategy for investors in a 5-years commitment period is to wait for the next policy change that is expected at the end of the period. In order to reduce the effects of uncertainty, and set incentives for investments in abatement technologies, the policy should be set over a longer timescale. In particular, if the commitment period is set to 10 years, then investments into climate-friendly technologies are expected much earlier.

Figure 1: The impact of climate policy uncertainty on investment decisions



Source: IEA (2007)

Figure 1 illustrates this finding by investigating the optimal length of the commitment period in the context of the power sector. In particular, the figure explores where the next investment in power generation should go to if investors are faced with the choice between gas and coal, with or without Carbon Capture and Storage. The vertical axe represents expected carbon prices over the duration of the project. The horizontal axe depicts the ratio of the gas to coal price. The higher the gas to coal price ratio, i.e. the further to the right, the more coal is economical. The bold black lines show the change in prices required to overcome the investment threshold. The shaded areas are price levels for which investors are likely to wait and postpone investment. Climate policy uncertainty is represented through uncertainty in the expected CO_2 price, a jump of which signals the change in policy, representing a new commitment period. Shifting the price jump from five years in the future to ten years in the future makes this 'waiting' region significantly smaller, helping to avoid creating cyclical investment incentives in the power sector. However, extending the commitment period length to more than 15 years brings only negligible additional benefits. The policy lesson is that a stable carbon regime for at least 10-15 years is necessary for inducing cleaner investment in the power sector. However, the analysis also shows that *"(s)etting*

aspirational targets for the very long term (e.g. to 2050) without providing milestones for this key mid-term period" does not significantly help overcome the investment thresholds.

3.1.4 Lower administrative costs

The administrative costs related to environmental targets include on one hand monitoring, reporting, and verification (MRV), and on the other hand the actual surrender/compliance with limits. A series of longer commitment periods require fewer full compliance assessments than a series of shorter commitment periods. Longer commitment periods may therefore lead to lower overall administrative costs in the context of monitoring, reporting, verification and compliance, given that GHG emissions in any case need to be collected and monitored annually. Indeed, under the United Nations Framework Convention on Climate Change (UNFCCC), all Parties are requested in accordance with the principle of "common but differentiated responsibilities" to report on steps they are taking to implement the Convention (articles 4.1 and 12). Since 1996, Annex I Parties also submit annual national GHG emissions inventories to the UNFCCC secretariat. These inventories are subject to an annual technical review process.

In addition, the time lag in emissions data collection and reporting (particularly in developing countries) is another factor that creates a relative advantage for longer commitment periods.

3.1.5 Long-term environmental signal

Longer commitment periods provide predictability, certainty and a vision about the longer-term reduction requirements with the consequent effects on investment. This circumstance allows for a longer-term environmental signal, which according to scientific studies (cf. IPCC, 2007a,b) is needed to change the current trend in greenhouse gas emissions.

3.1.6 Lower negotiation 'costs'

So far, commitment periods also set the pace of the negotiations, which is a time-consuming, expensive process, as international negotiations eventually take time away from officials often involved in domestic climate policy formulation and implementation. Longer commitment periods may require fewer negotiations and therefore lower the related 'negotiating costs'. However, given that the stakes are even higher the longer the period, negotiations may also become more complex on another front.

3.2 Advantages of shorter commitment periods

Shorter commitment periods also have several potential advantages. These are outlined below.

3.2.1 Greater long-term flexibility

The science of climate change is still evolving, and new insights on the impacts of higher GHG concentrations on the social and natural systems are a significant element to continuously improve the climate policy strategy. The risk of premature decisions on ultimate long term GHG concentration levels could translate in a consequent risk of reducing the flexibility to adjust long term reduction objectives to the reality of abatement costs, technology developments and new insights from climate science.

Longer commitment periods raise the difficulty of adjusting to changing circumstances in two ways. On one hand, the economic costs of adjusting the firms' decisions to changing circumstances such as energy prices could become very high. On the other hand, the environmental costs of adjusting both the firms' decisions and the environmental target to changing circumstances such as major changes in climate

patterns could become very high. Shorter commitment periods instead give policymakers the flexibility to adjust to the evolving information.

3.2.2 Stronger short-term signal

If commitment periods are very long, then there is a risk that governments and other decision makers may leave it to their successors to implement emission reducing measures. This risk has several problematic implications: it can lead to sub-optimal investments in climate-friendly technologies as well as to very low incentives for early action. In turn, these implications could trigger further potentially severe effects regarding the economy and the environment.

Recent research results suggest that a delay in the mitigation activities could be costly both in terms of direct abatement costs, irreversible damages and the potential foreclosure of reaching certain more ambitious stabilisation goals (see amongst others Meinshausen et al., 2005, Höhne et al., 2005). As emphasised in the Summary for Policymakers of the IPCC Fourth Assessment Report, Working Group III, *"(i)n order to stabilize the concentration of GHGs in the atmosphere, emissions would need to peak and decline thereafter. The lower the stabilization level, the more quickly this peak and decline would need to occur. Mitigation efforts over the next two to three decades will have a large impact on opportunities to achieve lower stabilization levels.*" (IPCC, 2007b). In the long run, regardless of the concentration level, stabilisation can only be achieved when net emissions are reduced to zero (Pershing and Tudela, 2003). Despite the various uncertainties in the climate and energy systems, near-term mitigation policies are therefore an indispensable step to keep stringent stabilisation targets within reach.

3.2.3 Political flexibility

The previous point highlights the role of political elements in the decision on the length of commitment periods. There appears to be a political need for commitment periods that are not too long. Long commitment periods bear risk associated with political changes, whereas shorter ones allow for new governments' approval. In this sense, there may be a disadvantage if commitment period are substantially longer than national election cycles, especially if no interim targets exist and/or compliance is not enforced in the interim. Short commitment periods provide the needed political flexibility to deal with these concerns.

3.2.4 Reduced likelihood of overly stringent or overly lax target

The perspective of short commitment periods reduces the likelihood of an overly stringent environmental goal, because abatement efforts need to occur in a short timeframe and the success of the policy will be seen soon. Likewise, but to a lesser extent (given that governments will not want to commit themselves to targets they know they cannot meet), also overly weak targets are likely to be avoided in order to maintain the credibility of the climate policy.

3.2.5 Potentially easier monitoring, verification and compliance

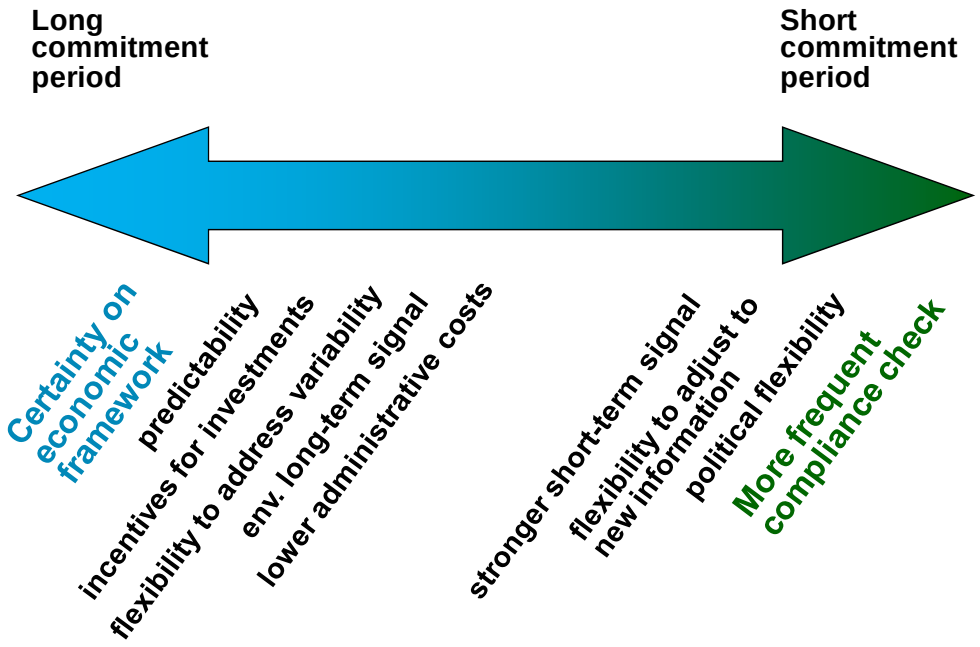
Shorter commitment periods may ease monitoring and verification given that complying with an emission reduction goal that lies far in the future may be more complex, especially if certain types of targets are involved and if compliance is not enforced in the interim. The reasons for this difficulty are mainly related to potentially complicated datasets that need to be collected to verify the compliance with

certain goals (e.g., indexed targets[2]), as well as to changing circumstances and low short-term abatement incentives, as will be explained in the sequel.

In addition, shorter commitment periods may set potentially greater incentives for short-term compliance, if the threat of non-compliance penalties is imminent. By checking compliance more frequently, they enable reaction to situations in which the environmental performance of Parties is not as good as it should be. Accordingly, environmental effectiveness can be better ensured.

Figure 2 provides an illustration of the advantages of both longer and short commitment periods, indicating a certain trade-off between each of the extreme design options.

Figure 2: The trade-off between long and short commitment periods



4. How to set commitment periods – what are the options?

In order to provide a balance between the advantages and disadvantages of extending commitment periods, the simple setting of longer or shorter commitment periods appears to be insufficient. For this reason, this section outlines current proposals on more sophisticated design options for commitment periods, which are meant to improve the investment climate whilst ensuring the environmental effectiveness.

4.1 'Rolling' commitment periods

An option that has been proposed in several settings is 'rolling' commitment periods. Rolling commitment periods involve an automatic adjustment process that commitments undergo. This adjustment process extends the commitments and makes them more stringent on a periodic basis while keeping the assessment of compliance at longer intervals. The process of automatic extensions implies that the commitments for participating governments and decision-makers are always known with

[2] For example, Herzog et al. (2006) show that due to data requirements intensity targets are less attractive in certain circumstances when different proxies for production, or production measurements that are difficult to define or understand are used.

reasonable certainty for a next set of years. This in turn reduces the uncertainty created by periodic renegotiation of commitments, as is currently happening in the context of the Kyoto Protocol.[3]

The innovative feature of an automatic adjustment procedure has been introduced by the BASIC Sao Paolo proposal, which outlines elements that should be included in a post-2012 climate regime[4]. Continuing the 5-yearly cycle, the proposal suggests an automatic extension of Annex I/B commitments for the next year that has not yet been decided. In this way, *"annual commitments are always known five years in advance and are predictable within a relatively narrow range (…) for the following 10 years"* (BASIC, 2006). An annual strengthening of the commitments equivalent to 1% for absolute commitments is foreseen, as well as an 'escape clause' meant to keep stringency unchanged in case compliance for the Annex I/B as a whole was too burdensome in the previous year. The latter is decided through two "trigger conditions" that indicate whether compliance for the Annex I/B has become easier or less costly over the last year.

The idea to provide a longer-term perspective through agreement on rolling commitment periods is promoted also elsewhere. Under a different term, so-called 'carbon budgets', it has become one of the key provisions of the currently proposed UK Climate Change Bill[5]. The Draft Bill suggests a system of "carbon budgeting" that establishes binding limits on CO_2 emissions over five-year periods (beginning with 2008); 'carbon budgets' refer thereby to the aggregated quantity of CO_2 emissions expressed in million tons. Within the 5-year period, emissions are allowed to fluctuate as long as the aggregate reduction objective is met at the end of the period. In order to provide medium-term clarity, the Bill proposes that carbon budget periods are set at least three periods (i.e., 15 years) ahead. Multi-commitment period decision-making is thus an alternative to stretching the length of the commitment period itself. In addition, medium and long-term targets are to be put in statute to offer an emission reduction pathway to 2050. This approach appears to be an attempt to overcome the problem of political instability related to electoral cycles. An independent statutory body advises the government on the level of carbon budgets, reporting annually progress towards achieving the budgets and providing every five years an explicit review of the UK's performance and consequent implications.

Prominently, also the Policy Background Paper to the 'Midnight Sun Dialogue on Climate Change' – the third of a series of informal meetings on climate change that took place in June 2007 in Riksgränsen, Sweden – suggests an extended commitment period length in combination with 'rolling' commitment periods, proposing an annual adjustment whilst retaining the assessment at multi-year intervals.[6]

4.2 The 'Gateway' proposal

The idea of establishing 'gateways' to provide decision-makers with longer-term predictability has first been proposed in the Australian States and Territories' Emissions Trading Scheme (National Emissions Trading Taskforce, 2006). The proposal suggests that firm annual emission reduction caps are set for the first 10 years (e.g., 2010-19). In addition, the upper and lower bounds of the ranges ('gateways') within which caps would be set for the second ten years would be announced (e.g., 2020-29), and extended on a 5-yearly basis. Once the scheme has started, an additional year of firm caps would be announced (e.g.,

[3] Indeed, the system of commitment periods introduced by the Kyoto Protocol can be seen as a precursor of what is now considered 'rolling commitment periods'. A system of rolling five-yearly commitment periods had been set, but without any automatic adjustment process to strengthen targets over time. Whilst specifying only the first period and the corresponding emission reduction targets, the Kyoto Protocol includes the possibility of review, strengthening and widening the targets afterwards.

[4] The proposal has been developed by researchers and policy analysts from 25 institutions in both developed and developing countries and is available at http://www.basic-project.net/data/SP_prop_rev_nairobi.pdf.

[5] For more information on the UK Climate Change Bill see http://www.defra.gov.uk/ENVIRONMENT/climatechange/uk/legislation/index.htm

[6] More information on the Riksgränsen meeting is available at http://www.sweden.gov.se/sb/d/2066. The Policy Background Paper is downloadable at http://www.sweden.gov.se/content/1/c6/08/40/82/add2137b.pdf

2020), chosen from within the previously established range of possible caps, and incorporating potential new information. On a rolling annual basis, every year the firm cap would be extended. The proposal articulates that a liquid permits market can be facilitated by issuing permits with 'date stamps' related to each year up to the lower bound of the gateway, which in turn is likely to gain higher credibility. The result of this approach is a form of price management.

Entirely separate from this initiative, the recent joint government–business Task Group on Emissions Trading launched by the Australian Prime Minister published its report. This report suggests a federal cap-and-trade scheme starting in 2011 with some key features to ensure predictability and flexibility (cf. Prime Ministerial Task Group on Emissions Trading, 2007 and Figure 3)[7]:

- A long-term aspirational emissions abatement goal (e.g., 2050/60), which will be backed up by a series of annual short-term targets (e.g., up to 2020) and indicative medium-term emission bands, called 'gateways'.

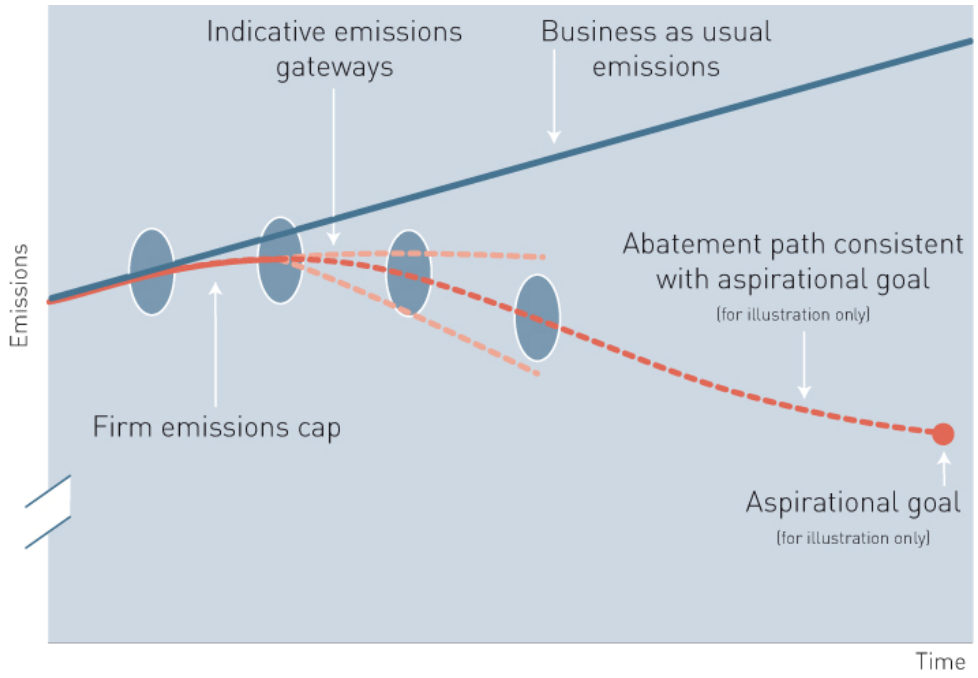
- Beyond the short-term firm emission caps, these gateways provide the context for efforts towards the long-term goal. The gateway mechanism, based upon the experiences of the states and territories proposal, involves indicative ten-year emissions ranges with upper and lower bounds.

- Five-year review points are foreseen to properly calibrate the sequence of short-term emission caps. Both short-term caps and gateways would be updated every five years.

All the design options discussed in this section combine a long-term emission trajectory with firm short-term and adjustable medium-term targets. In this way, they address the difficulties of balancing the advantages of longer and shorter commitment periods, aiming to obtain benefits from both to ease the commitment burden for governments, provide incentives for short-term mitigation efforts and investments in climate-friendly technologies and thus help approach ambitious long-term emission reductions. This idea of combining a level of ambition established in the long-term to guide shorter term decisions with the latter being fixed targets and the former being aspirational and subject to change with the science has also been raised in literature by Philibert et al. (2003).

[7] In addition, the proposal also includes a 'safety valve' emissions fee designed to limit unanticipated costs to business and the economy in general. However, from the perspective of an investor, price caps on their own – in the absence of a corresponding price floor – could create an asymmetrical price risk. As shown in IEA (2007), this would marginally improve the investment case for a high-emitting coal plant while making the investment case for low-emitting technologies marginally worse. However, the recently announced Clean Energy Target (CET) in Australia could encourage investment in low-emission technologies, and may therefore have the effect of balancing out any marginal disadvantage resulting from the proposed 'safety valve'.

Figure 3: Illustration of the Australian gateway mechanism: The Federal Proposal



Source: Prime Ministerial Task Group on Emissions Trading (2007)

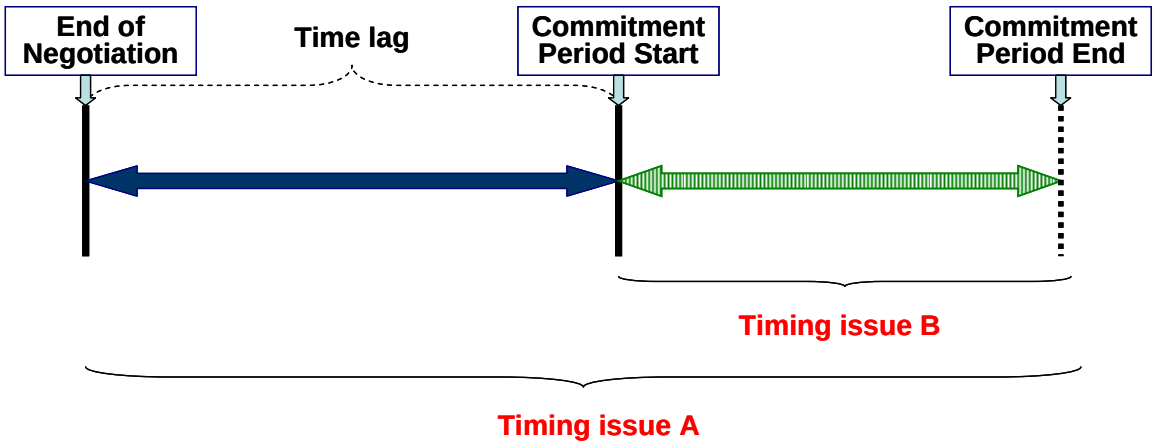
5. Implementation issues

What provisions and institutional requirements are needed to guarantee that commitment periods have the expected outcomes? The previous analysis shows that the way a post-2012 climate regime will design commitment periods has a critical impact on its outcomes. Different design options also imply different implementation requirements. Several items have already come up in the earlier discussion; however, others emerge from experiences in the Kyoto framework. In general, their weight and details may be influenced by the type of commitments as well as the type of commitment period chosen. This section provides an overview on the different items that need to be explored in the light of implementation feasibility.

5.1 Timing

Two distinct issues are important when negotiations focus on timing in the context of commitment periods. Both the decision on the length of the commitment period itself (issue B in Figure 4) and the period between this decision taken in the negotiations and the end of the commitment period (issue A in Figure 4) have important implications for investment decisions.

Figure 4: Timing issues related to the decision on commitment period length



The decision on the length of the commitment period is particularly influential because it determines the time lag between the adoption of the commitment period and the achievements of the commitments. This latter, extended time period provides an important signal for the investment decisions. The example of the Kyoto framework shows considerable visibility induced by an agreement signed in 1997 for a commitment period starting in 2008, yet with some uncertainty on the actual implementation as the agreement's entry into force took place only in 2005. In addition, the length of the commitment period itself has a major influence on investment decisions, amongst others by determining the flexibility businesses have to reach certain goals.

In order to provide decision-makers with certainty on future conditions, the decision on the length of commitment periods would be more helpful if made at an early point in the negotiations on a climate regime. This is because:

- The two most important sectors in terms of GHG emissions, the energy and forestry sectors, are both sectors where decisions taken now have impacts over several decades into the future.

- In particular, the patterns of capital investments and capital retirements may have long-term economic and environmental implications. Over the next decade, investment in the energy sector will lock in technology for up to 60 years, as large developing countries are significantly growing fueled by energy while a significant portion of power plants in industrialised countries are reaching a stage of retirement (IEA, 2006).

- The absence of more specific short-term commitments could impede the private sector to take forward several of the low carbon technologies with consequent effects on GHG emissions (cf Neuhoff, 2007). In addition, waiting for climate policy decisions may delay investments in one technology type and bias investment to alternative, less climate-friendly technology options (IEA, 2007).

- A short period between the target setting and the commitment period may lead governments to adopt only lax targets, given the difficulty of putting meaningful policies into place in a short time. Governments are unlikely to commit themselves to stringent short-term targets that they know they cannot meet.

- Given that – at least up to now – commitment periods also set the pace of the negotiation; the negotiation cycle appears to be related to the decision on the commitment period, which in turn may become a trigger to conclude the negotiations.

Furthermore, certain design options including e.g. automatic procedures may facilitate the future negotiation process, rendering therefore the negotiations over time much easier.

5.2 Adjusting length to types of commitments

The decision on the type of commitment has important interactions with the choice of commitment period length. Absolute caps may require different lengths of commitment periods than indexed targets.

Depending on the details of the commitment period, a variety of factors need to be known. Setting long-term fixed targets without the possibility of adjustments requires a high degree of reliability of the available data, as well as a good foresight of expected economic, technological, and scientific trends. The possibility of adjusting long-term targets according to newly emerging information lowers the data requirements as it provides more flexibility. Information to decide on firm short-term targets is easier available and includes lower risks. Information requirements also depend on the type of commitment that is set by the target. A series of absolute caps is likely to require more up-front information and data than a series of indexed targets, given that the latter allows certain adjustments. On the other hand, implementation of indexed targets requires more data collection than in the case of fixed, quantified targets.

The different data requirements can pose difficulties during the negotiations, as they need to be known for all the participating countries and bear incentives to cheat. Indeed, science alone is unlikely to be able to guide a reasonable decision for the length of the commitment period, as has emerged from the above discussion. Developments and costs of technologies, fuels, and abatement as well as weather patterns are important factors. The more important/long-term the choices are that are expected to be based on the data, the more countries may want to wait to obtain better information and the higher are the incentives of countries to overstate expected trends in order to avoid potentially excessive economic costs. The risk of attracting hot air is therefore imminent.

How often should Parties decide on new commitment periods? Given the efforts needed to establish them, the perspective to automate procedures as proposed in the Sao Paolo proposal is attractive. However, it is uncertain whether Parties would like to be bound by such rules.

5.3 Question of participation

Graduation provisions specifying transition periods may be included in order to enable economies in transition to enter the climate regime during an on-going commitment period. Provided countries fulfil certain pre-conditions, such as eligibility requirements or establishment of registries, they could be allowed to take commitments prior to the beginning of the next entire commitment period. Such provisions could help broadening the climate regime at an earlier stage without compromising its environmental and economic efficiency.

Related to the previous item, provisions could be included to allow for different lengths of commitment periods according to different categories of countries. Indeed, given that a post-2012 climate framework is likely to embrace different sets of countries with different forms of action, the length of the commitment period does not necessarily need to be the same for all participating countries. Different parallel commitment periods need not pose problems as long as the criteria for transition between them are clear and monitoring as well as compliance with the different targets is ensured.

For example, during their transition, developing countries could be given the possibility to face shorter commitment periods with lower stringency. These ‘pilot phases’ could automatically be extended into more stringent phases, once a certain threshold has been reached (as suggested for example by the Sao Paolo proposal). Broad participation in any climate change regime is important and should therefore also be incentivised through an appropriate and flexible design of commitment periods that may even set the time of entry of new participants in the global mitigation effort.

5.4 Question of monitoring and compliance

Progress under a multilateral climate regime requires emissions to be reduced. However, meeting the targets is a complex task, as the economic and social behaviour that drive GHG emissions occur across a wide array of sectors and are complicated by unpredictable changes in energy price and weather patterns. The complexity of accurate monitoring and compliance depends on the details of the commitment period as well as the type of commitments involved. Depending on the type of commitment involved, the compliance assessment may be more time-consuming (for instance if some kind of index is involved in the target).

In general, the verification and compliance process for reduction objectives that lie far in the future is more demanding, due to changing circumstances and low incentives for short-term efforts that make it difficult to verify whether abatement efforts are on their path to meet the goal. In addition, the type of commitment (e.g. indexed targets) as well as the nature of the compliance regime related to the climate agreement influence the complexity of monitoring and compliance. Different types of targets require the collection of different data sets. For example, more data collection is needed to verify indexed targets than fixed, quantified targets, and variations in the various parameters may complicate the process.

However, independent of the length of commitment periods, annual collection and monitoring of data is required. The Kyoto Protocol and Marrakesh Accords, adopted by COP/MOP 1 in Montreal, Canada, in December 2005, formally established a set of monitoring and compliance procedures to enforce the Protocol's rules, address any compliance problems, and avoid any error in calculating emissions data and accounting for transactions under the Kyoto mechanisms and activities related to land use, land use change and forestry (LULUCF). The Protocol's monitoring procedures are based on existing reporting and review procedures under the Convention, building on experience gained in the climate change regime over the past decade. Indeed, in accordance with Articles 4 and 12 of the Convention and the relevant decisions of the Conference of the Parties (COP) [8] , Annex I Parties already submit annual national GHG emissions inventories to the UNFCCC secretariat. These inventories are subject to an annual technical review process. As a consequence, by requiring full compliance evaluations only on a longer timescale, longer commitment periods can lower the administrative costs of verification. Non-Annex I Parties also report on inventories but in a more periodic manner.

Building upon these existing national compliance features, a multilateral compliance scheme composed by two branches, a facilitative branch and an enforcement branch, could contribute to rigorous monitoring, verification and compliance. There is no need for an additional monitoring mechanism, but one can build a network of national monitoring systems, controlled by a multilateral compliance scheme:

- As in the case of the Kyoto Protocol, the facilitative branch provides continuous advice and assistance to the parties and decision-makers. In addition, it periodically monitors the progress of the participants, informing Parties that may be in danger of not complying.

- The enforcement branch of the compliance committee is critical to show the consequences of non-compliance, in which case it has the power to apply certain penalties (the extent of which depends on the type of action imposed).

- Domestic compliance needs to be promoted, consistent with domestic priorities and legal tradition, as a core strategy to meet international commitments (cf. Dannenmaier and Cohen, 2000). A national compliance action plan to be developed by Parties could ease the compliance assessment process. This plan could include different indicators regarding the country's performance over the over the five to ten years prior to the start of the

[8] See in particular Articles 5, 7 and 8 of the Kyoto Protocol that address reporting and review of information by Annex I Parties under the Protocol, as well as national systems and methodologies for the preparation of greenhouse gas inventories. In addition, Decision 24/CP.7 of the Marrakesh Accords sets out procedures and mechanisms relating to compliance under the Kyoto Protocol, providing for facilitation, promotion and enforcement of the Protocol's commitments.

commitment period (e.g. variations in emissions) in order to provide some starting points for the compliance assessment process.

The greater weight given to national compliance can further ease the monitoring and compliance requirements. National compliance plays a key role in meeting international commitments because governments have a better oversight than multilateral institutions of adapting policy choices to their national needs and priorities, and are more capable of claiming jurisdiction over relevant entities where necessary to compel attention to those choices (cf. Dannenmaier and Cohen, 2000). They are also better informed about national circumstances and usually dispose about a good basis for gathering and verifying credible data. In addition, looking at the current Kyoto framework, it is the governments' domestic decisions on how to achieve the targets that drive the investors' behaviour.

The principles for monitoring, compliance and verification are already well established in the current FCCC system. A significant institutional capacity therefore exists to accomplish these functions and to provide continuous incentives for reliable compliance assessment and monitoring for Annex I countries. By putting even more focus on national compliance, available national compliance systems can improve their data sources for multilateral monitoring and verification, which in turn can be made more credible through the cooperative effort and integration with national systems. The work of existing national agencies could be stronger integrated with international compliance and verification institutions, lowering the burden for international monitoring institutions and strengthening the multilateral compliance process. The international reporting process could thus gain credibility, building upon existing national institutions.

Finally, a review mechanism can ensure that efforts towards the environmental target are underway while adjustments due to scientific, technological, or economic developments can be incorporated; longer-term commitment periods imposing fixed targets may require such a review.

6. Conclusions

Investment is driven by expectations of future returns, which will depend on future market conditions. However, in the absence of policies promoting emission reductions and efficient technologies, these conditions are mainly related to cost-effectiveness aspects, as the maintenance of capital equipment and key corporate goals. Given the economic and environmental long-term implications on capital investment and retirement, an environment should be created that shapes the long-term pattern of capital investment. Looking at the lessons from the dynamics of capital investment, refurbishing and retirement, ambitious long-term commitments are favourable for long-term investments in low-carbon technologies due to the predictability they provide as long as companies are allowed a *"high degree of flexibility in the timing with which they will respond to them"* (Lempert et al., 2002).

This flexibility is also needed because a number of factors, ranging from fluctuations in economic activity, weather patterns and energy prices, affect emissions, deviating them thus from what is expected. As a consequence, any given cap will be more or less constraining with consequent effects. While the instruments allowed for meeting the reduction obligation can help addressing these difficulties (e.g. through trading and specific intertemporal rules like banking), the length of the commitment period plays a significant role by specifying when emission reduction targets are to be met.

Both longer and shorter commitment periods have their advantages and there are thus a number of trade-offs involved. Basically, there exists a trade-off between higher predictability, certainty and flexibility for businesses to reach the environmental target and higher flexibility to respond to uncertainties in the international climate regime, as well as to scientific, economic, political and technological developments. The higher credibility of longer commitment periods comes at the costs of potential changes induced by electoral cycles or new emerging scientific information.

The appropriate length of a commitment period may also vary depending on how a commitment is expressed (e.g. in terms of emission levels, or in terms of emissions intensity) and/or which country it is

designed to apply to. Different parallel commitment periods may be appropriate to account for different sets of countries with different forms of action.

In the light of the lead time for investments, the important element when designing commitment periods is to provide a long predictability even if the commitment periods themselves are shorter. This idea has got attention in several policy proposals, under the terms of 'rolling' commitment periods or 'carbon budgeting', and 'gateways'. These design options combine a long-term emission trajectory with firm short-term and adjustable medium-term targets. The idea is to enable a longer-term trajectory of an emissions path, being therefore able to impose significant emission reduction requirements over time, while short-term targets ensure a step-by-step enforcement of the mitigation efforts.

The lessons from available design options are useful in indicating that there are ways to improve the balance between better certainty on the economic political framework for investors and the economy through longer predictability and the certainty of reaching certain emission levels through more frequent compliance checks. Combined with experiences of the Kyoto framework, where domestic implementation has emerged as the key to a climate regime's success, the following four components appear to maximise a commitment period's contribution to an environmentally- and investor-friendly setting:

- A longer-term emission reduction target or range;
- Short-term targets to periodically monitor progress;
- Periodic reviews of the long-term schedule and progress related to the short-term targets to enable later adjustment in the light of new scientific, technological or economic developments; and
- Strong monitoring and compliance rules promoting national compliance systems and integrating them with the multilateral compliance scheme to better steer legal and institutional requirements needed to encourage near-term investment decisions in climate friendly technologies.

By setting the pace of the evolution of climate policy, and providing a timeframe to which all Parties are subject, the decision on the length of commitment periods can improve certainty for economic agents and help favour the choice and timing of climate friendly technologies. More importantly, even though the policies and measures adopted to achieve the environmental target are only partly determined by the commitment period itself, the length of commitment periods facilitates international coordination. Domestic policy decisions usually follow the timeframe set by the commitment period, creating therefore a type of level playing field for which businesses frequently ask. The length of the commitment period therefore represents one important element of international coordination and should not be neglected. However, given the significant challenge to accelerate the investments in low-carbon capital stocks in order to avoid a locking-in in carbon-intensive structures and consequently the potential foreclosure of reaching certain GHG stabilisation goals, this element needs to be part of a far bigger policy vision.

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Glossary

CO_2	Carbon dioxide
EU ETS	European Union Emissions Trading Scheme
GDP	Gross domestic product
GHG	Greenhouse gas
IPCC	International Panel for Climate Change
NO_x	Nitrogen oxides
SO_2	Sulfur dioxide
UNFCCC	United Nations' Framework Convention on Climate Change