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Incentives, risk and decision-making in mitigating climate change

William Blyth, Chatham House

Summary

- Responding to climate change will require clear and decisive action to be taken at many different levels, involving international and national institutions, corporations and individuals. The process of decision-making is made more complex by several sources of uncertainty and risk.
- Carbon pricing is one way in which governments create incentives for companies to adjust their behaviour and invest in lower-emitting technologies. But policy uncertainty introduces investment risk, weakening these incentives.
- Companies often call for greater regulatory certainty in order to reduce investment risk, but greater certainty may come at the expense of reduced policy flexibility. Policy-makers need an understanding of how risks are allocated in the decision-making process in order to design more effective policies and avoid simply transferring private-sector investment risk into more general economic risks.

Introduction

It is hard to get away from climate change in the news these days. Media mentions of the topic have increased fivefold since 2000 (Figure 1). Influential reports such as the IPCC Fourth Assessment Report[1] and the Stern Report[2] are adding momentum to this trend. Even the critics of these reports tend to focus on concerns about the pace of change, rather than denying the need for any action at all.

There has been an almost equal flurry of activity among groups wanting to do something about the problem. These range from grassroots civil action campaigns and umbrella groups of NGOs such as Climate Action Network and Stop Climate Chaos, through to groups of major financial investors such as the Carbon Disclosure Project and the Institutional Investors Group on Climate Change, representing tens of trillions of dollars in invested capital.

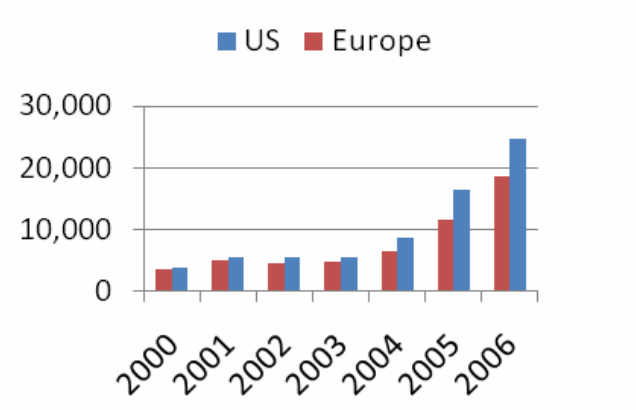
Beverley Darkin's paper in this series looks at what drives business and governments to take a leadership role in the issue of climate change. There is no doubt that some politicians and governments are starting to see a role for their leadership, with policies being proposed or introduced in most major countries, including China,[3] and in the US, actions at the state level[4] seem to be serving the intended dual purpose of drawing in other states and increasing the pressure for federal-level action. The number of bills introduced to Congress that are directly related to climate change increased from seven in 1997/98 to over 100 in 2005/06.[5] It is clear that this bubbling up of interest and pressure can lead to a position where national governments will take decisions to act on climate change. A striking recent example is the EU's decision to commit itself to a 20% reduction in emissions by 2020.[6] This is exactly the timeframe over which commitment is most needed – 2020 is far enough away to allow time for real structural changes to be made to the way we use energy (see Walt Patterson's paper in this series), but near enough that planning and decisions need to start now. This contrasts with targets set for the middle of the century which sound heroic, but in practice do not create the need for immediate action and are therefore more vague and avoidable.

What is more discouraging is that so far this apparent desire for action has failed to be reflected in a coherent global policy framework. The key United Nations Framework Convention on Climate Change (UNFCCC) process is being consistently frustrated by a lack of engagement by many countries but most importantly the US. The US-led Asia-Pacific initiative (AP6) is no substitute for the type of real leadership required in terms of shifting the economics of energy consumption to a more sustainable path. A solution to the post-2012 framework still looks remote, and will remain so as long as the US effectively remains out of the game.

This stalemate in the international game will surely be resolved eventually. Indeed, if the US takes its G8 announcement seriously, we may see the beginning of the end of the stalemate sooner rather than later: the key test of the United States' intentions will be its willingness to re-engage with international negotiations at the next Conference of the Parties to the UNFCCC later this year. But there are many other parallel negotiating games being played out at many different levels, all at the same time. For example, while the EU is negotiating externally with its international counterparts, the European Commission is at the same time negotiating internally on the review of policy options for delivering emission reductions.

Tackling climate change depends on a diffuse and complex system of decision-making involving many different players. Each player responds to a different set of incentives and risks, and these incentives and risks interact. This briefing paper explores how investment decisions are made in the power sector, and how they are affected by different layers of regulatory risk and uncertainty. The conflicts that this can throw up are illustrated by considering the implications for investment decision-making in power companies. The transmission of society's concerns about climate change into investment commitments by private energy companies in liberalized markets presents a delicate problem of incentive-setting and risk allocation, through several layers of institutional policy and corporate decision-making. While companies need policy certainty to encourage investment, national governments tend to prefer an evolutionary approach to carbon abatement as uncertainties on scientific evidence and international cooperation become resolved. In the face of uncertainty, decision-makers generally prefer to keep their options open. But this can become complicated, involving multiple layers of supranational, national and corporate decision-making, and the overall process can become dysfunctional.

FIGURE 1: MEDIA COVERAGE OF CLIMATE CHANGE



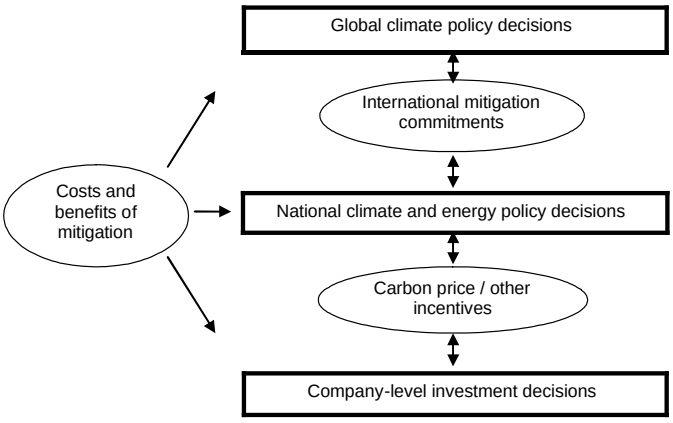
Source: Factiva.com, 2005

Structure of the decision-making process

The transition to a sustainable energy system will require decisions to be made at the global, national and company levels (rectangular boxes in Figure 2). In an ideal world, decisions would be beautifully consistent, informed by the factors in the oval boxes in Figure 2: the costs and benefits of mitigation would be known, and reflected in international commitments within a binding global policy framework which allocated the necessary emission reductions to the national level. Emission reductions would then be delivered by companies responding to carbon price signals or other incentives and requirements set at national or regional level to deliver the agreed reductions.

In practice, decision-making within each of the three levels is often tortuous, and to make matters worse, communication between the different levels of decision-makers is indirect and subject to uncertainty. Not only is there uncertainty about the costs and benefits of mitigation, for example, but these costs and benefits are significantly different for different countries. The gaming nature of international negotiations means that each country's commitment to action depends on other countries' commitments. Company-level investments will depend on expectations about the stringency of national regulation, while conversely the political will to set stringent targets will be more or less constrained by companies' willingness to act. Each party in the system therefore faces different risks and incentives, and these risks and incentives interact with one another.

FIGURE 2: DECISION-MAKING INVOLVES INTERACTION BETWEEN DIFFERENT LEVELS



We can illustrate this structure by showing how it applies to the current investment decision-making process for the power sector in Europe. One of the key policy mechanisms for delivering emission reductions in the European power sector is the EU Emissions Trading Scheme (EU-ETS). In collaboration with the European Commission, national governments set emission caps on the companies covered by the scheme. Together with a certain number of external credits for emission reductions originating outside the EU, this cap determines the total supply of allowances available for trading, while demand for allowances is determined by total emissions from companies in the scheme. A market for allowances requires scarcity (i.e. so that supply is less than demand), and the price of carbon in a well-functioning market will be driven by the cost of reducing emissions to meet this overall level of supply.

The EU is currently undertaking a review of the design details of the EU-ETS in time for implementation in the period after 2012, in consultation with all the key internal stakeholders in the scheme. However, the EU will also have one eye on the external game it is playing with respect to the global policy framework. We can see this process in action with the recent announcement of the EU-wide 20% reduction target for 2020. When announcing this commitment, the EU suggested it would make further reductions to 30% if other countries came on board with a similar commitment. This makes for interesting tactics in the global negotiation game. Conditional offers like this should in principle help accelerate action at the global level, but may be unworkable internally. How could the EU suddenly change track from a 20% trajectory to a 30% trajectory without going back on commitments it has made on emissions caps in the EU-ETS? In practice, there is no sign that the world's other major emitters are in a position to offer cuts of this magnitude, so the chances seem pretty low that the EU would have to change direction, but it illustrates the point that the desire for policy certainty and policy flexibility are not always compatible.

Just as carbon price in the EU-ETS can be used to analyse investment incentives at the company level, we can evaluate the incentives for policy-makers to take on national commitments based on the balance of costs and benefits of global mitigation. The process for this evaluation is described in detail in the Stern Report, leading to a quantification of what is often called the 'social cost of carbon': the cost that society ought to be willing to bear in order to reduce emissions of greenhouse gases, reflecting the benefits from avoided climate change damages. The actual value of the social cost of carbon is highly uncertain, and depends on all the contentious issues that were raised by the Stern Report including the scale and discounting of long-term future damages. But despite this uncertainty in the actual value, the social cost of carbon construct gives us a useful analytical tool, and provides three important messages:

(1) there is a limit to the amount we are willing to pay to reduce emissions;

(2) this limit rises over time, so we should plan for the stringency of action to rise in the future; and

(3) the limit depends on the collective action of other countries – the greater we think future

climate damages are likely to be, the greater the amount we should be willing to pay now to offset current emissions.

In practice, national governments will have a comfort zone for the level of costs they are willing to impose on companies in their territories. This range may be informed by the social cost of carbon, or by more immediate considerations of political economy that are affected by the decisions and actions of other governments. But either way, the Kyoto Protocol and the EU-ETS do not allow governments to control prices directly since the targets are couched only in terms of emission reductions. Cost expectations were clearly an important consideration when the original targets were set, but once the cap is fixed there is no direct control of cost.

Governments therefore face a twofold risk with respect to carbon prices. First, the price of carbon in these trading schemes may move outside the range they feel is appropriate. If prices rise too high, governments risk coming under political pressure for trying to move too fast and creating economic disruption, whereas if prices fall too low, climate policy will be deemed ineffective as it will not support the necessary investments in low-carbon technology. Secondly, governments' estimates for the appropriate price of carbon may change in response to a number of external and unpredictable events. For example, the political economy of taking on more stringent targets would change if there was a shift towards greater or lesser commitment to emission reductions by other countries. Or developments in the understanding of the impacts of climate change could change a government's calculation of the social cost of carbon.

Governments may therefore be averse to locking themselves in to long-term emission reduction targets that reduce their flexibility to respond to these risks. Within cap-and-trade schemes, if governments want to tailor the price of carbon they have to resort to indirect methods such as:

- setting new targets at regular intervals, which allows the overall cap to be adjusted in line with experience;
- loosening or tightening the supply of credits from outside the scheme;
- withholding allowances from the market, for example by setting a minimum reserve price on allowances sold under auction.

Other policy-design options that are under consideration for the EU-ETS include changes to the scope of the scheme (to include aviation and carbon capture and storage), extension of the duration of the scheme, linking the scheme to other trading schemes, and harmonization of the way in which member states allocate allowances to participating companies.

However, these different options will have an implication for companies' views of future carbon prices which is based on their view of the balance of supply vs demand, and of the cost of abatement opportunities among the companies covered by the scheme. Regularly reviewing targets, scope and other rules of the scheme therefore creates policy risk, which can have a detrimental impact on investment decision-making in the power sector.

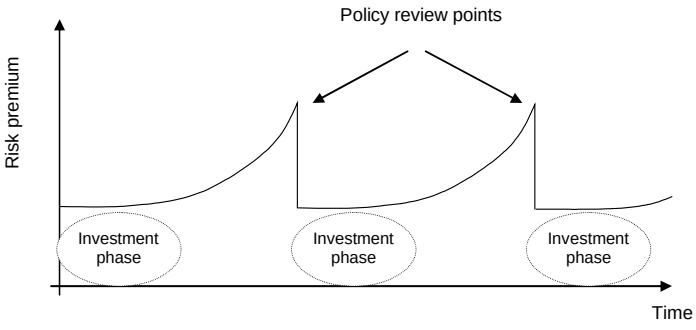
Quantifying the impact of regulatory risk in the power sector

Faced with uncertainty, decision-makers will generally prefer to keep their options open, and this holds true for investment decision-makers in the power sector facing uncertain changes in the regulatory conditions in which they operate. If this regulatory uncertainty is sufficiently great, this could lead power-sector decision-makers to delay investment until they can make a more informed choice. Intuitively, we could expect that the timing of regulatory interventions is also important. If a major regulatory decision is due in the near future, this will have a greater influence on investment decisions than if regulatory changes are not expected until a long time in the future. We can quantify this effect in terms of a risk premium which is a measure of the additional financial returns that would be required to justify investment.

If regulatory interventions are periodic – such as is currently the case for the EU-ETS, where new caps are set prior to the start of regular trading periods – then the risk premium will also be periodic. This is illustrated in Figure 3. As the date of the policy review points is approached, the risk premium rises because there is less time available to make a return on investment before a possible change in regulatory conditions. Once the new policy details have been established, the risk premium drops again until the next expected review point is approached. This means that companies will tend to prefer to make their investments as far as possible from the next expected policy review, leading to cyclical investment phases.

Such cyclical investment behaviour may not be too much of a concern, unless the 'gaps' in investment coincide with periods when the electricity system is already expected to be short of capacity. Modelling of

FIGURE 3: PERIODIC REGULATORY INTERVENTION LEADS TO PERIODIC INVESTMENT PHASES



the UK electricity system carried out as part of the DTI's Energy Review showed several scenarios where there is a significant dip in capacity as a result of the phase-out of coal-fired generation in 2015 as a result of the EU's Large Combustion Plant Directive. Some of the DTI's scenarios show capacity being insufficient to meet peak demand around 2015, and all scenarios would be exacerbated by a situation where investment was on hold pending resolution of regulatory uncertainty.

Analysis of energy supply investments carried out by the International Energy Agency and supported by Chatham House, indicates that electricity prices could rise as a result of these risks.[7] This is because in general increased risks lead to higher costs of capital and therefore higher required returns on investment. Prices will also rise directly as a result of delays to investment since this will increase scarcity of generation capacity in the power system. Electricity price rises in the order of 5–10% would be expected if regulatory intervention is expected to occur every 5–10 years, and could be more than this if there is an investment hiatus and capacity shortage close to the time of an expected regulatory intervention.

Some technologies are more vulnerable than others to these risks, and thus regulatory risk can affect technology choice. A notable and somewhat counter-intuitive result from the IEA work is that low-carbon, high-capital-intensive technologies, such as nuclear power and renewables, may be particularly vulnerable to climate change policy interventions. These technologies receive only an indirect benefit as a result of operating within an emissions trading scheme. Their cost-base is unaffected, and they do not receive any emissions credits. They merely benefit from a pass-through of costs from fossil-fuel generating plant to the price of electricity. Increased electricity prices raise additional revenue for all generators, but the effect on profits is not the same for all. For fossil generators, the profit rise is dampened by a corresponding increase in costs, since combustion of fossil fuel leads to additional emissions that need to be paid for. The counter-intuitive part is that this dampening of profits actually makes the profit margin of fossil generators less sensitive to large changes in CO_2 price, and therefore less exposed to climate change regulatory risks than nuclear or renewable generators. Regulatory risk was calculated to raise the threshold for nuclear investment by between 3% and 33% of capital costs, depending on the timing of uncertain regulatory events and the rate at which CO_2 costs are passed through to electricity costs.

Investment in carbon capture and storage (CCS) too is affected by various risks. This technology takes CO_2 from combustion plant, transports it in pipelines, and then pumps it down into different types of site for long-term storage. From the perspective of the CO_2 emitter, the key risks associated with this relatively new technology are uncertainty over the costs of the CO_2 separation equipment, over the performance and security of the storage sites, and over how much the avoidance of emissions will be worth in terms of reduced costs of emitting CO_2.

If coal plants are built in a suitable way and at a suitable location, CCS can be relatively easily retrofitted at a later date. It therefore provides coal plant with a good hedge against uncertain future CO_2 prices. If CO_2 prices remain low, the coal plant can continue to be operated without the capture plant, but if they rise sufficiently high, then CCS can be retrofitted, reducing emissions by 85% or more. The existence of CCS as a future retrofit option therefore makes current investment in coal look significantly more attractive. Thus investment in coal-fired power generation could accelerate while investment in CCS itself may not be implemented until carbon prices are significantly higher than they are today – a situation that would lead to an increase in emissions in the short term unless overall emissions are capped.

An important alternative to investing in additional supply capacity is to reduce demand through energy efficiency measures. If demand-side investments turn out to be more flexible and quicker to implement, and to involve lower capital expenditure, then they could be less exposed to policy risk than traditional supply-side options, and may therefore provide an attractive alternative. Currently, the structure of the electricity market does not incentivize such investments as strongly as supply-side investments, so there are other barriers to overcome (see the discussion in Walt Patterson's paper in this series), but potentially considerations of risk would encourage this type of switch.

Conclusions

This paper outlines a way of thinking about regulatory uncertainty in terms of its impact on investment risk. Work has been carried out by the International Energy Agency to begin to evaluate risks associated with regulatory uncertainty, and to see how this might affect investment behaviour and technology choices in electricity markets. The approach is illustrated by the example of power generation investments within an emissions trading scheme, but similar consideration of policy risks will apply to other types of climate change policy such as technology standards and obligations. In general, policy uncertainty introduces a risk premium which raises the required return on investment; this either drives up the cost or slows down investment rates in low-carbon technologies.

The work carried out so far has concentrated on investment decision-making in electricity supply by private companies treating policy uncertainty as an external risk factor. But potential conflicts arise when the degree of flexibility that should be built into the design of climate change regulation is being considered. Emissions caps under the EU Emissions Trading Scheme and the first commitment period of the Kyoto Protocol are currently set over five-year periods. This is patently too short a planning period

for companies making investment decisions in the power sector, as many of them will be building plants with a lifetime of 20–40 years. Extending the duration of these trading periods, or finding other ways of improving the predictability of likely future prices, would help reduce investment risks.

On the other hand, there is value for governments in maintaining policy flexibility so as to be able to respond to external changes such as shifts in the international negotiations. Governments are involved in negotiating with corporations in their territories which are demanding climate policies to be set over longer timeframes, while simultaneously negotiating internationally with other governments to create an overarching climate change agreement. These different negotiating games have different timescales and different incentive structures, and may send conflicting signals regarding the optimal design of policy. In addition, running through all these negotiating games is an evolving understanding of climate change science which could itself introduce an additional surprise to which government policy would have to respond.

Treating policy uncertainty as a risk factor that is 'external' to decision-making is therefore only a partial solution, and more work is required in order to better understand the interaction between different parties in the climate change decision-making system, as well as to understand the role of demand-side investments in reducing risk exposure.

Endnotes

[1] Working group 1 report on 'The Physical Basis of Climate Change' is now available at *http://ipcc-wg1.ucar.edu/wg1/wg1-report.html*.

[2] Stern Review, *The Economics of Climate Change*, HMSO/Cambridge University Press, 2006.

[3] Note commitments to renewable energy and reductions in energy intensity in China's 11th 5-year plan.

[4] Regional Greenhouse Gas Initiative, *http://www.rggi.org/;* California Global Warming Solutions Act 2006.

[5] Pew Center on Global Climate Change, *http://www.pewclimate.org/what_s_being_done/in_the_congress/109th.cfm.*

[6] Presidency Conclusions 7224/1/07 Brussels, 8/9 March 2007.

[7] *Climate Policy Uncertainty and Investment Risk*, International Energy Agency, Paris, 2007.

Dr William Blyth is an Associate Fellow of the Energy, Environment and Development Programme at Chatham House, and Director of Oxford Energy Associates, an independent research company specializing in energy and climate change policy. He works with a range of organizations in both the private and the public sector. He is currently working on a research project with London Business School to investigate how risks are allocated between different decision-makers, and how these risks are affected by different policy designs.

Future work on this topic

Chatham House is planning a research project with the London Business School to explore how investment decision-making in the electricity sector is affected by risks arising from the uncertainties of climate change. The context for this study is a recurring theme of energy policy, most recently outlined in the UK's Energy White Paper and the European Commission's Energy Policy proposals, concerning the ability of electricity markets to deliver sufficient timely investment in generation capacity with a choice of technology that reflects concerns over climate change, diversity of supply and energy security. DEFRA's draft Climate Change Bill also recognizes some of the challenges in providing a suitable investment environment:

> **The [climate change] mitigation framework needs to balance the objectives of minimising uncertainty for UK households and firms, and retaining sufficient flexibility to ensure that mitigation is not unnecessarily costly. This is especially true given that our emissions reduction targets could remain more stringent than those of other countries, risking a loss to UK competitiveness. – *DEFRA, Draft Climate Change Bill, March 2007***

While the investing community and the power generation companies in particular would prefer a commitment to policy certainty, governments would also like to preserve the flexibility to adjust polices to external events such as an improved understanding of the science of climate change or political changes in the international climate mitigation negotiations. This project will aim to develop a better understanding of the interactions between investment behaviour in the electricity sector and policy decision-making. The research should contribute to the ability to design energy policies that provide more appropriate incentives to companies to invest in the technologies needed to deliver policy goals on climate change and energy security. The study will focus on the effects of regulatory risk in investment decision-making, how policy-makers learn about uncertain costs and adapt accordingly, and how uncertainty over climate change economics and international policy create risks that have to be allocated between companies and governments.

Climate change research at Chatham House

Climate change is no longer an 'environmental protection' issue but one intimately connected with a wider world. Given the scale and urgency of the challenge, many of the decisions critical for global climate security and the effective transition to a low-carbon, high-efficiency economy will take place *outside* the field of climate change. It is the decisions made in the areas of foreign and trade policy, security and geopolitics, energy policy and investment that will have an influence on the global response to climate change.

Chatham House, as a leading international affairs think-tank, can play a unique role in analysing the wider forces that will shape the overall effectiveness of the international response to climate change. One aim of the Energy, Environment and Development Programme (EEDP) at Chatham House is to reframe the debate on climate and to make the connections between climate change and other international issues. The purpose of this briefing paper series is to highlight the analysis being undertaken by EEDP to better understand the linkages. Other papers in the series include:

- **How climate change is pushing the boundaries of security and foreign policy (Cleo Paskal)**
- **Climate change: the leadership challenge (Beverley Darkin)**
- **Transforming our energy within a generation (Walt Patterson)**
- **Linking trade, investment and climate change policies (Richard Tarasofsky)**

Energy, Environment and Development Programme
The Royal Institute of International Affairs
Chatham House
10 St James's Square
London SW1Y 4LE
T: + 44 (0) 20 7957 5711
eedp@chathamhouse.org.uk
www.chathamhouse.org.uk/eedp