Executive Summary

Introduction

Business routinely deals with risk and uncertainty in decision making and will continue to do so in the face of climate change policy uncertainty. Risk is not inherently a bad thing. It is by taking calculated risks that companies aim to make profits in excess of their cost of capital. Nevertheless, sustained additional risk raises the cost of capital, and will alter investment decisions.

The response of business to policy risk is important for the effectiveness of both climate and energy policy. This analysis suggests that in some cases business decisions will be different under conditions of policy uncertainty, and that therefore policies may need to be designed differently or made more stringent than expected. This book can assist policy makers to understand the nature of the investment decision and how it is influenced by policy uncertainty. It can therefore contribute to more effective policy design.

This book provides insights into how investment behaviour in the power sector may be affected by climate change policy uncertainty. It looks at investment in coal, gas, oil, nuclear and carbon capture and storage technologies.

Key Message 1

The analysis suggests that it is unlikely in most markets that climate policy uncertainty would pose a serious threat to overall generation capacity levels in the long run.

This is because, if climate policy is set over sufficiently long timescales, the total risk will generally be dominated by fuel price risk, with climate policy risk contributing relatively little to the total risk profile of the investments.[1] Fuel price risks may however be less significant in some markets (*e.g.* Australia) where gas prices are perceived to be more stable than assumed in the model used here.

1. The exceptions to this are: (1) nuclear investments that require a significant carbon price to make them financially viable where coal plant is the marginal plant in the merit order; and (2) where CO_2 prices significantly increase the price of coal.

On the other hand, climate policy uncertainty does weaken investment incentives for low-carbon technologies. Uncertainty could also lead to investment choices that would appear sub-optimal in a world of greater policy certainty. Unfavourable effects of policy uncertainty could include, extending the life of existing plant rather than investing in more efficient new plant, modest increases in electricity prices, and the creation of investment cycles that may exacerbate short-term peaks and troughs in generation capacity.

It is certain that in the long run, we will have to find ways of satisfying our energy needs with near-zero net emissions of greenhouse gases in order to avoid the worst damage from climate change. This will require an almost complete turnover in the world's energy infrastructure.

What is uncertain, however, is when this transition will start in earnest, and how quickly it will proceed. The rate of transition to a near-zero-emitting energy infrastructure will determine the total stock of greenhouse gases emitted to the atmosphere and the degree of climate change to which the planet will be committed. The rate of transition will be constrained by the costs of transition, vested interests in the *status quo* and the level of political and popular will to drive change.

There have been over 15 years of international climate change negotiations, and many important climate change policy initiatives have been undertaken in many countries. Nevertheless, compared to the scale of the task, climate change policy and programmes are still in their infancy. During these early stages, policy uncertainty is high, perhaps at its peak. As action is taken to reduce emissions of greenhouse gases, this should strengthen the credibility and effectiveness of climate change policy, which in turn will improve the business case for further action to cut emissions. Until this self-reinforcing pattern is established, investment decisions will need to be taken under considerable uncertainty.

Investment is driven by expectations of future returns, which will depend on future market conditions. Changes in current market conditions will affect future expectations, but will not entirely determine them. For example, an estimate of the future price of a commodity will take into account the current spot price, but will also incorporate many other factors relating to expected future developments. This also applies for a newly introduced climate change policy. Since there is a possibility that the policy could change, future expectations are not simply determined by the current status of the policy.

Approach to quantifying uncertainty

The analysis in this book provides a quantification of the investment risk created by policy uncertainty. The approach puts climate policy uncertainty on the same footing as other investment risks faced by power companies and enables policy makers to determine its relative importance. It also provides a useful conceptual framework, moving away from a discussion of investment "barriers" towards an understanding of the likely risk management responses that companies may adopt in the face of climate policy uncertainty.

The principle by which policy uncertainty can be translated into investment risk is straightforward. Policy uncertainty creates an uncertain outcome in the cash flow of a project in which the company is proposing to invest. Faced with this uncertain cash flow, the company may have the option to wait until the policy uncertainty is resolved. On the one hand, by waiting, it may be able to avoid the worst financial outcomes by tailoring its investment decisions in response to policy developments. In the meantime, waiting rather than investing immediately could result in foregoing income. The value of waiting therefore has to be balanced against the opportunity cost of waiting.

The level of risks will depend on the type and design of the climate change policy being considered. We characterise all climate policies in terms of an effective carbon price, so that policy uncertainty is translated into a carbon price uncertainty. This approach is most directly applicable to taxes and trading schemes in which an explicit price is established, but could also be applied to any policy for which the price of carbon is a proxy for the costs of compliance with the policy.

We model two elements of carbon price uncertainty, a one-off jump in price to represent a possible change in policy at some time in the future, and an annual fluctuation to represent price volatility. In general, we find that policy uncertainty dominates the risk premium, whereas price volatility plays quite a small role. Whilst carbon taxes would eliminate price volatility, they are still prone to unexpected changes in levels, so do not necessarily perform much better in terms of reducing uncertainty than an emissions trading scheme. The techniques used in this analysis could be extended to look at the case where there is currently no effective price of carbon. In this case, a key uncertainty would be the timing of the introduction of climate change policy. This case is discussed qualitatively.

The analysis does not aim to include a full range of investment risks faced by companies. The main emphasis is on carbon dioxide (CO_2) price risks, but fuel price risks are also included to give a comparison and some context to the analysis.

Risk premiums

Risk, whether associated with fuel price uncertainty or carbon price uncertainty requires net returns to be higher than would be necessary where there was no uncertainty. This higher net return is called the "risk premium" for either fuel price uncertainty or carbon price uncertainty. The risk premiums depend on the technology being considered, the market context in which the company operates and the details of the climate change policy mechanism being considered.

The quantitative analysis in this book looks at the risk premium associated with uncertainty for an existing or a proposed new policy. These risk premiums are derived from a consideration of the flexibility that companies have to defer investment and wait for additional information that could improve the outcome of their investment decision.

For all generation technologies the climate change policy risk premium depends on how long there is left for the policy to run. The fewer the number of years remaining until an expected change in policy, the greater the risk premium associated with policy uncertainty. This assumes that there is no visibility at all about future climate policy before the end of the existing policy. Figure 1 shows the risk premiums in terms of additional capital investment costs (USD/kW) that are associated with uncertainties of energy price and carbon price.

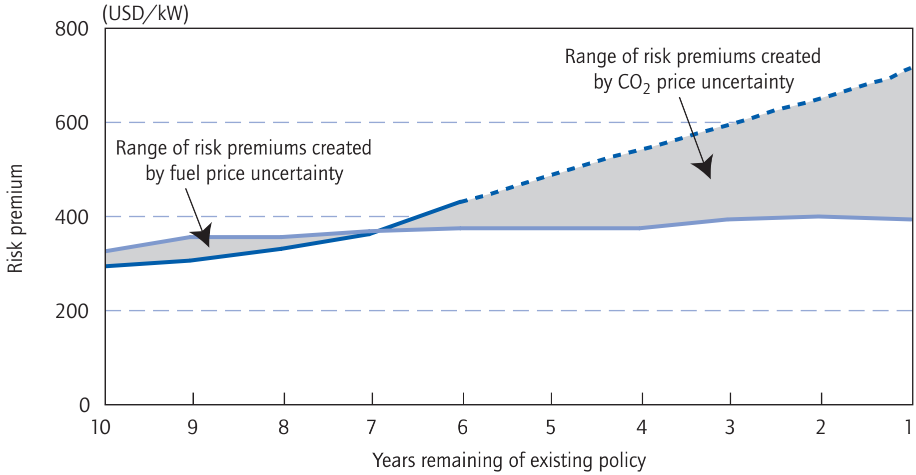
Key Message 2

The results indicate that climate policy risks may be brought down to modest levels compared to other risks if policy is set over a sufficiently long timescale into the future.

One method for reducing the effects of uncertainty is to try to shift the expected policy change further out into the future (*i.e.* to set policy over longer timescales). Investment risk premiums are significantly lower when the price jump representing the policy uncertainty is shifted from five years in the future out to 10 years in the future. The period of 5-15 years into the future is the key period

FIGURE 1

Range of risk premiums for new investments created by uncertainty*



*The dotted line is an extrapolation of modelling results.

over which a planned new power generation needs to recoup the majority of its investment. Creating visibility of prices and policy design decisions over this timeframe has been a consistent theme in all the discussions with companies during the analysis for this book. Ideally, this should be done as a continuous process, so that price visibility is always maintained at least 10 years ahead. This would also help to avoid creating cyclical investment incentives. Setting aspirational targets for the very long term (*e.g.* to 2050) without providing milestones for this key mid-term period does not significantly help reduce investment risk premiums.

However, simply defining a policy goal over a 10-year period is not sufficient to overcome policy risk. There also needs to be credibility that the policy will not be changed during this period. Policy credibility is not entirely within the control of individual national governments. If similar actions are not committed to by other countries, then there will always be a risk of backtracking on the grounds of maintaining competitiveness. Credibility relies on the accumulation of the experiences and actions taken by governments and companies internationally.

Key Message 3

Climate policy risks will be important for investments for which climate policy is a dominant economic driver.

The example taken in this book is carbon capture and storage (CCS). This technology separates CO_2 in the combustion process, transports it and pumps it into geological storage sites underground. The process requires energy itself, and therefore reduces the efficiency of power generation. The only rationale for the technology is as a way of achieving compliance with climate change policy. Uncertainty in climate policy therefore strongly affects the economic case for investment. The technology cost assumptions used in the model mean that the price of carbon would need to be USD 38/tCO_2 in order to stimulate investment in CCS under conditions of price certainty (*i.e.* using a normal discounted cash flow analysis). To stimulate investment in the technology under conditions of policy uncertainty, the effective price of carbon would need to rise to between USD 44/tCO_2 (when policy is set 10 years ahead) and USD 52/tCO_2 (when policy is set 5 years ahead). This shows that the greater the level of policy uncertainty, the less effective climate change policies will be at incentivising investment in low-emitting technologies.

Carbon capture and storage acts as a good hedge for coal generation against future increases in CO_2 price. The ability to retrofit CCS to an existing plant in response to policy changes reduces the risks for coal generation, and may accelerate investment in a new coal plant. In this study, we have not considered the technical risks of CCS. However, we conclude that as the technical risks are addressed, the option value of CCS will be further enhanced, further accelerating investment in coal.

Companies operating in a price-regulated market will have a different risk exposure from those indicated above. The key source of climate policy risk in these markets is whether the regulator will allow compliance costs to be passed through to the consumers. In coal-dominated markets in particular, operating costs are low and carbon emissions are high. Price increases associated with the introduction of stringent climate policies could therefore be strong, and it is not necessarily certain that regulators will allow everything to be passed through.

Key Message 4

The closer in time a company is to a change in policy, the greater the policy risk will be, and the greater the impact on investment decisions. If there are only a few years left before a change, policy uncertainty could become a dominant risk factor. This may occur as we approach the end of the current commitment period and investors face considerable uncertainty about the structure, stringency and timing of a post-2012 mitigation regime.

It is therefore possible that there could be a period with very little new investment in the lead-up to the start of a new policy (or a new phase of an existing policy) if key parameters such as tax rates or emissions caps are not announced well in advance. This could create problems, particularly if it exacerbates other factors in the market such as plant closures due to environmental regulation of nitrogen oxide (NO_x) and sulphur dioxide (SO_2) or nuclear phase-out for example.

Key Message 5

Risk premiums could be reduced if price constraints could be established that limited future price variability, either for a tax or a trading scheme. These constraints would have to be credible over a long period, with a very low probability that prices would move outside these constraints.

Price caps on their own, in the absence of a corresponding price floor, create an asymmetrical price risk. This would marginally improve the investment case for a high-emitting coal plant and making the investment case for low-emitting technologies marginally worse. It is possible however, that with prices capped, the political will to set more aggressive climate change targets would be increased, restoring the case for investment in low carbon technologies. Conversely, price floors on their own would improve the investment case for low carbon technologies and make the investment case for a high-emitting plant worse.

Key Message 6

Companies will generally be confident in committing capital to projects, even in an uncertain environment, as long as they can establish a competitive advantage over other players in the market. When it comes to regulatory risk, this requires that policy makers establish clear rules, and that companies can be confident that these rules will be applied consistently to all market players, irrespective of ownership structure.

Climate change policies affect companies in a number of different ways beyond just uncertainty about the carbon price. For example, in an emissions trading scheme, the allocation of free allowances to incumbents based on their historical emissions can have important financial implications for those companies. Transparency on these types of policy details, and the criteria and processes by which the rules may get reviewed and implemented can also be very important in helping to manage policy risk.

Climate policy risks are starting to be recognised by financial markets. Initiatives such as the Carbon Disclosure Project represent major groupings of institutional investors with assets of over USD 30 trillion. These groups have started to press for clear statements from big publicly owned companies of their exposure to risk from climate change and climate change policies. This type of activity raises the pressure on companies to consider policy risk in a more open and structured way. The risks are expected to increase as the pace of change increases.

Use and interpretation of results

This book demonstrates the importance of incorporating risk into policy analysis in order to understand investment behaviour. Given the broad geographical scope of the work (aiming to be relevant to all IEA countries), the purpose of the quantitative analysis is to demonstrate a conceptual framework for thinking about investment under uncertainty, and to give an illustration of the scale of the effects of policy uncertainty. It is not intended to provide a complete representation of investment risk – the quantitative results depend critically on the input assumptions, which are necessarily methodological choices. For detailed policy analysis at the national level, the assumptions would need to be more closely tailored to particular national circumstances. Other drivers of investment decisions, such as compliance with other (non-climate related) environmental regulations can be important, and should be incorporated into the analysis. Ideally, the results from this type of stochastic optimisation analysis should be combined with macroeconomic models in order to capture broader dynamic impacts.