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managing price AND targets

Why a hybrid policy is better for Australia

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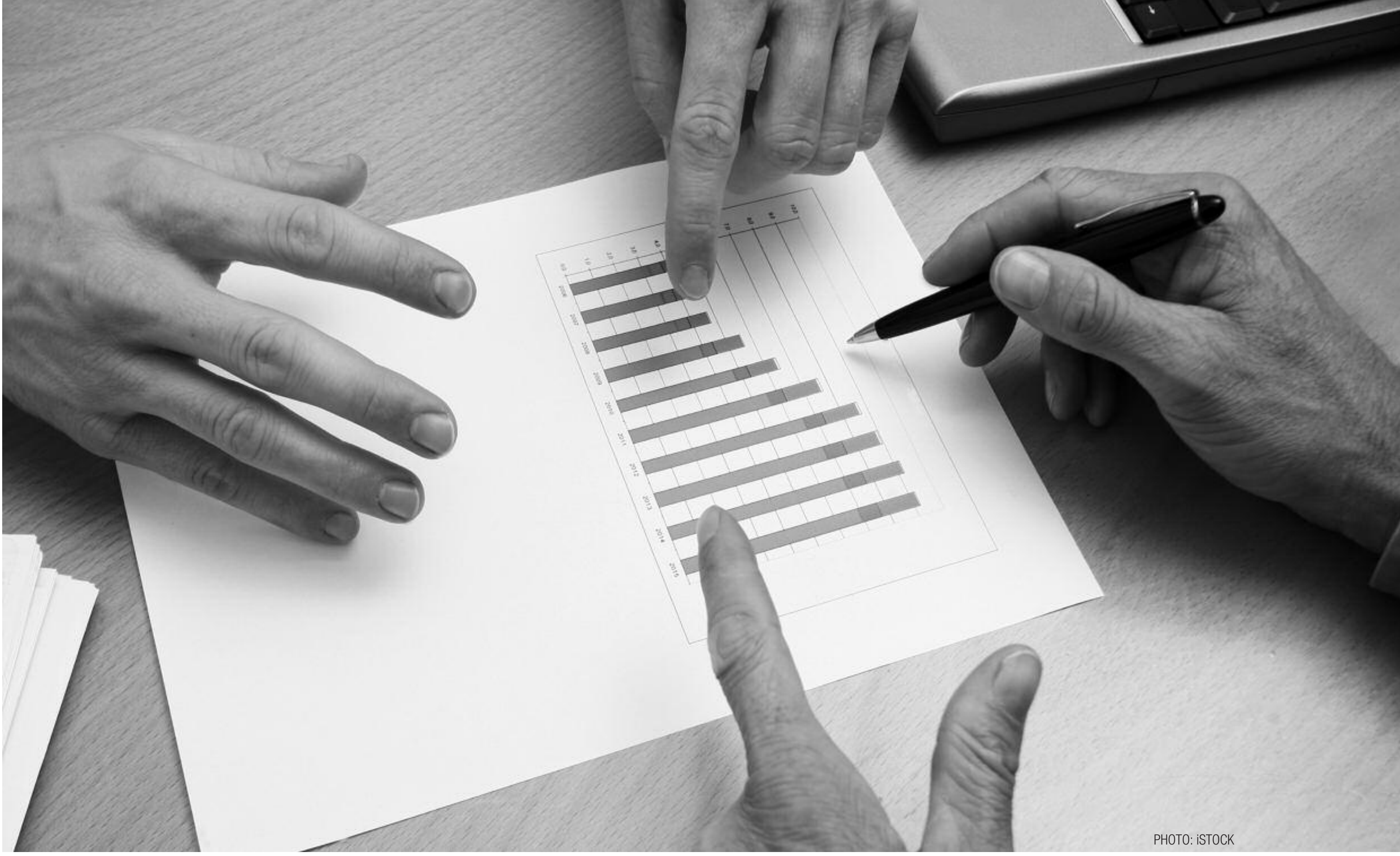

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and use of large-scale intertemporal general equilibrium models. He is a co-author of the Jorgenson-Wilcoxen model, a 35-sector econometric general equilibrium model of the US economy that has been used to study a wide range of environmental, energy and tax policies. He is also a coauthor of G-Cubed, an eight-region, twelve-sector general equilibrium model of the world economy that has been used to study international trade and environmental policies. He has published more than 50 papers and has co-authored two books: one with Warwick McKibbin on the design of an international policy to control climate change, and one with Peter Dixon, Brian Parmenter and Alan Powell on the design and construction of large-scale economic models. Dr. Wilcoxen's past positions include: Associate Professor of Economics, the University of Texas at Austin; Assistant Professor of Economics, the University of Texas at Austin; Visiting Fellow, the Brookings Institution; Visiting Scholar, Harvard University; and Senior Research Fellow, the University of Melbourne in Australia. His research has been funded by the Environmental Protection Agency, the Department of Energy, the US Geological Survey, and the National Science Foundation.

Summary

Promising to reach an emissions target on a precise timetable is a popular approach to climate policy – indeed it underlies the Kyoto Protocol. Despite its popularity, there are many problems with this strategy. A better approach is to specify a target but to allow costs to determine the speed at which the target is approached. This can be achieved using a hybrid of targets and emission fees. This paper summarises the targets and timetables approach to climate policy and how it is usually implemented in cap-and-trade permit markets. However, as a basis for domestic policy or for an international climate regime there are major flaws in this approach. We then present the McKibbin Wilcoxen hybrid approach and compare it to the approach proposed by the Prime Minister's Emissions Trading Task Group.

Introduction

Climate change is caused by anthropogenic emissions of greenhouse gases, principally carbon dioxide, and addressing it will require those emissions to be reduced over time. Many people believe that the best way to reduce greenhouse gas emissions is to specify a target for emissions and a timetable for reducing those emissions. This "targets and timetables" approach seems like common sense and, until recently, has been the basis of most of the climate policy debate in Australia and internationally. The Kyoto Protocol, for example, requires that participating countries achieve specified emissions targets over the period 2008–2012. Unfortunately, many aspects of the targets and timetables approach that look so attractive in theory do not work well in an uncertain world.

Setting targets and timetables seems like commonsense because it's a familiar approach that works well in many day-to-day situations. When driving from one part of the country to another, for example, it's natural to set goals for each day's drive. These goals are achievable because of the relative certainty of the driver's information. As a climate policy, however, a targets and timetables strategy is flawed because climate change involves vast uncertainties, especially in the cost of reducing emissions. Any significant climate policy is largely a venture into unknown territory. Establishing a set of emissions targets to be achieved by specific dates makes no more sense than deciding to drive through a sequence of cities on particular dates without a map, and without knowing the distance between the cities or the obstacles that may lie along the way.

The initial step in a targets and timetables program is to establish a sequence of emissions targets and set a timetable over which the former will be achieved. Once the targets have been adopted there are a number of policies that could be used to achieve them: subsidies for emissions-control devices; direct intervention such as mandating the use of particular devices or technologies for controlling emissions; an appropriate emissions tax; or creating markets in emissions rights based on the target. Economists generally agree that a market-based approach is the lowest cost way to implement an emissions target. In recent years much attention has been focused on so-called cap-and-trade mechanisms, under which total emissions are capped but firms are permitted to buy and sell emissions allowances among themselves. The cap-and-trade approach has many attractive features for conventional pollutants, but it has important liabilities for climate policy. In particular, it does not work well in a world of uncertainty.

In this paper we argue that there is a much better approach to climate policy, one that addresses the inherent uncertainties and provides credible, long-lasting incentives for reducing emissions. It is a hybrid approach that combines the best features of two market-based mechanisms used for controlling other kinds of pollution – emissions taxes and tradable permits.

The second section of this paper, "Policy risks", summarises the reasons climate policy is difficult to formulate and why uncertainty must be at the core of policy design. The following section, on carbon trading, outlines the standard way of implementing the approach of targets and timetables in the form of cap-and-trade emissions trading. The problems with the cap-and-trade approach are outlined in the next section titled "The hybrid blueprint", where it is argued that the appropriate short-term policy for Australia is to abate emissions up to a particular cost, rather than to hit a particular emissions target. This can be done via a hybrid of a permit trading system based on long-term permits and a price-based system with a short-term price cap. In the final section we summarise how a hybrid approach could work in Australia and compare the approach we proposed (McKibbin and Wilcoxen 2002) with the approach of the Prime Minister's Task Group on Emissions Trading (2007).

Policy risks

Designing a viable and effective climate policy is very difficult for a number of reasons. First, climate change cannot be entirely prevented, even if worldwide emissions were to cease immediately. The accumulated greenhouse gases from past emissions, largely from industrialised economies, would continue to raise global temperatures for decades to come. Thus, a comprehensive response to climate change will require both mitigation actions – to reduce emissions and decrease the severity of climate change – and adaptation policies to respond to climate change that can no longer be prevented. Second, climate policy is complicated by the extraordinary range of emissions sources, from individuals to major corporations. Third, it is a policy that must cross many jurisdictions – international organisations, national, state and local governments – which makes formulating and coordinating the policy extremely difficult. Fourth, the time scales for climate policy are much longer than most other policy problems. Policies enacted today may not have noticeable effects on the climate until 50 years or more into the future. Finally, the uncertainties surrounding climate change are large, numerous and mostly intractable. There is uncertainty about future emission levels, the impact of these emissions on future carbon dioxide concentrations, how those concentrations affect the timing and extent of temperature change and climate variability (and distribution across regions), what impacts these temperature changes and variability have on ecological systems and the extent of economic damages and economic benefits in different regions at different times. Most difficult of all, climate change could lead to large changes in sea level and other catastrophic events, but the likelihood of these catastrophes is both low and poorly understood. Formulating a policy to reduce the chance of rare but disastrous events is especially challenging.

What should be done given the uncertainty? Fortunately, the conceptual techniques for understanding uncertainty and managing risks are well developed, and they should be at the core of any climate policy. Climate policy should be designed to manage risks, especially taking into account the unusual nature of the risks associated with climate change. For example, the possibility of catastrophic outcomes from climate change needs to be taken into account. It is also necessary to make sure that the costs of mitigation actions are not excessive because there are many other problems competing for society's scarce resources, such as alleviating poverty or controlling preventable diseases. Important trade-offs are involved, hence it is essential to take into account the opportunity cost of the actions taken in policy.

FIGURE 1

PERMIT MARKET EQUILIBRIUM IN LOW- AND HIGH-COST CASES

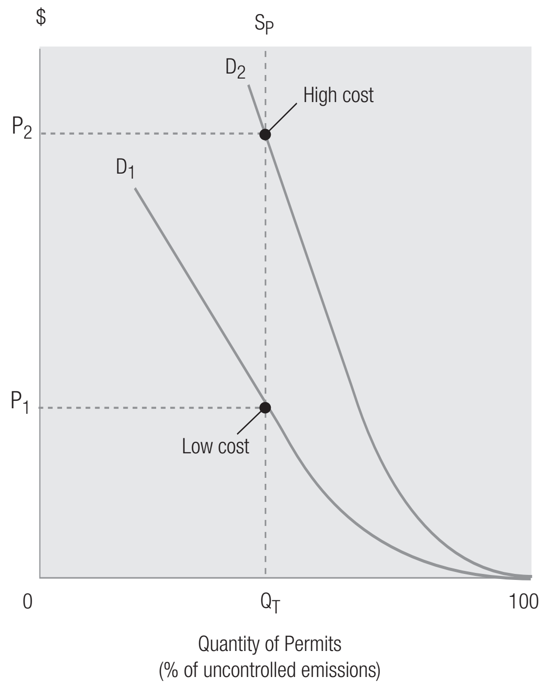
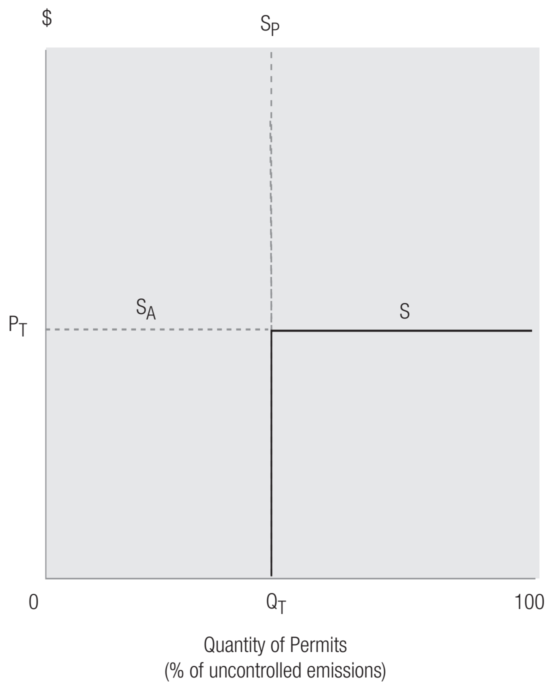


FIGURE 2

SUPPLY OF EACH TYPE OF PERMIT FOR USE IN A GIVEN YEAR



Carbon trading

The idea behind a cap-and-trade permit system is relatively straightforward. A target for emissions is chosen for a given year. Emission permits are then printed and distributed for that year. Legislation is also enacted that requires an emitter of carbon to have permits equal in number to its emissions, and to specify rules for monitoring polluters and punishing violators (for example, the penalty for non-compliance is often a very high fee). Figure 1 illustrates the resulting market for permits. With a cap on emissions fixed at quantity Q_T, market trading will result in a price that depends on the demand for permits. The demand for permits, in turn, will depend on the marginal abatement costs. The higher the marginal abatement costs, the higher the demand for permits at a given price. In Figure 1, if abatement costs are low the demand for permits will be low. The demand curve might look like D1, and the price that the market generates will be P1. However, if the marginal abatement costs are relatively high the demand for permits will be given by curve D2.

This is a conventional cap-and-trade permit trading system. The strength of the system is that the emissions outcome is known and specified explicitly in the policy: it is the target Q_T. However, the price of an emissions permit (often called the price of carbon) will not be known until after the market clears. Moreover, it will move around with shifts in the demand for permits, and can be highly variable. A conventional permit system works well if there is a clear target that needs to be achieved, such as with a "threshold pollutant" that causes damage only when it exceeds a particular level. In this case the way to reduce risk sharply is to set a clear emission target that is not to be exceeded under any circumstances. However, the system does not work well for pollutants that don't have thresholds, such as carbon dioxide. For such pollutants there is no clear distinction between safe and dangerous levels; all emissions contribute equally to the problem.

Moreover, what matters for the climate is the concentration of emissions in the atmosphere. It is not the flow of emissions each year but rather the accumulation of these emissions over time that is important. As a result, it is important to achieve any given amount of abatement as cheaply as possible over time. Reaching a precise target at high cost in one year and then achieving the same target at low cost in another year would be inefficient because it is the sum of emissions in the two years that matters. It would be better to do more abatement in the low-cost year and less in the high-cost year. A conventional carbon-trading market performs poorly in this context because it targets the annual flow of emissions rather than the stock. A better policy would be to have a flow of emissions each year that is determined in a manner allowing for cost-smoothing over time. As will be discussed below, the hybrid approach allows exactly that.

Climate scientists generally agree that if global temperatures are to be stabilised there needs to be a substantial reduction in the flow of emissions. Deep cuts in emissions are required to stabilise temperatures. This is why many of the proposed reductions in emissions are quite steep – perhaps as much as 60 to 80 per cent reductions in the flow of emissions by 2050.[1]

The hybrid blueprint

A hybrid approach to pollution control, which would combine the best features of emissions taxes and tradable permit systems, was first proposed by Roberts and Spence (1976). A hybrid policy for climate change was first introduced by the authors of this paper in 1997 and has been extended and refined (McKibbon and Wilcoxen 2002, 2007). The hybrid we described back in 1997 was relatively simple. A country wishing to control its carbon emissions would issue a limited number of tradable long-term emissions permits, each of which would entitle the owner to emit one ton of carbon per year. A polluter emitting more than its permit holdings in any given year would be required to pay an emissions fee per ton of carbon in excess. In essence, the policy would present polluters with two mechanisms for compliance: buying permits or paying an emissions tax (or any combination of the two). The emissions fee is often referred to as a "safety value" because it would ensure that the costs of complying with the policy were not excessive. The idea of a safety valve has been adopted in the domestic debate in the United States.[2] We subsequently refined the proposal into a unified permit system with two classes of permits: the long-term permits described above, and short-term permits good only for one year and sold by the government for a stipulated price. In addition, the approach was extended to allow for differentiation between developed economies by imposing a tight and tightening constraint on developed economies over time but a loose and tightening constraint on developing countries, and adapted to provide stronger incentives for technological innovation.

All versions of the approach would provide a foundation for a global system of emissions control, but the emphasis would be on coordination of national policies rather than on imposition of an overarching international regime. Coordination would focus on achieving a common world price for carbon rather than implementing a rigid system of targets and timetables. An advantage of this approach is that it would build the global system by starting at national level in a few countries and adding greater coordination and additional countries over time. Moreover, it would not require global consensus and would allow individual countries scope to tailor the policy to meet their own national interests. Most importantly, establishing clear, credible policies at the national level will be essential for encouraging the private sector investments in key energy infrastructure that will be needed to address climate change.

Our approach, which we will refer to as the McKibbin-Wilcoxen Blueprint (MWB), has been widely discussed and extensively refined over the last decade. Moreover, elements of it have been adopted in many alternative proposals.[3] In the remainder of this section, we present a synopsis of the current version of the MWB proposal.

Long-term permits

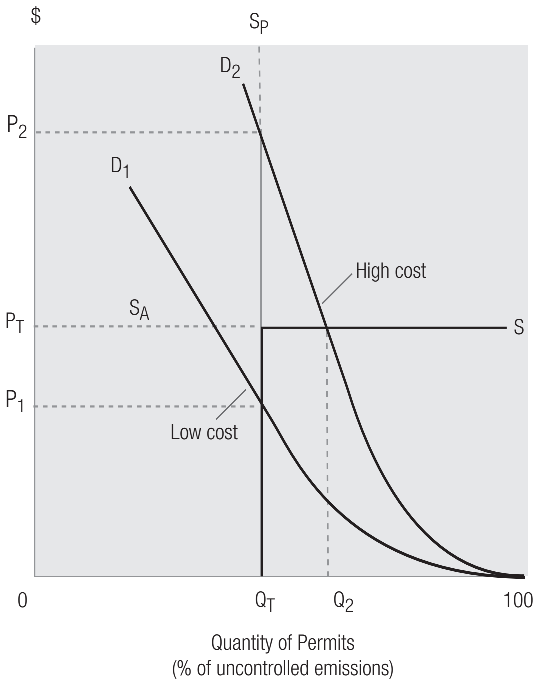
The core of the proposal is to combine a fixed (and declining) supply of long-term permits with a flexible supply of short-term permits that would be valid for only a single ton of emissions in a specified year. For convenience we'll refer to the different types of permits as long-term permits and annual permits. The long-term permits can be thought of as a bundle of short-term permits with differing dates, all packaged together. These long-term permits represent the long-term target for emissions. In practice, the number of long-term permits issued would be less than current emissions and would be declining over time, reflecting the desired target path for emissions. Once issued, the long-term permits could be bought, sold or leased without restriction and each one would allow the holder to emit a pre-specified amount of carbon per year. There would only be a one-off allocation of long-term permits. They could be given away, sold at a set price or auctioned. After the allocation the permits could be traded among firms and households, or bought and retired by environmental groups. Only those activities that emit carbon would require an acquittal of permits at the end of each calendar year. However, anyone could own the permits. The permits would have value because: (1) by law, emitters are required to have an annual permit and there would be fewer available than needed for current emissions; and (2) the number of permits would be diminishing over time, increasing their scarcity value. As a consequence, the owners of long-term permits would form an interest group with a large financial stake in the success of the policy. They would improve the policy's credibility because a large private-sector group with a clear financial interest in the policy would help prevent future governments from weakening or repealing it.

Short-term permits

The other component of the policy, annual emissions permits, would be issued by the government each year for a specified fee, such as $20 per ton of carbon dioxide. There would be no restriction on the number of annual permits sold, but each permit would be good only in the year of issue. The annual permits give the policy the advantages of an emissions tax: they provide clear financial incentives for emissions reductions but do not require governments to agree to achieve any particular emissions target regardless of cost.

Every year emitters within the country would be required to hold a portfolio of permits equal to the amount of carbon emissions they produce. The portfolio could include any mix of annual permits, long-term permits owned outright by the firm, or long-term permits leased from other permit owners. The implications of this can be seen in Figure 2, which shows the supply of permits available in any year. At a price below P the market price of permits is flexible and determined by demand, given the supply of long-term permits. Once the price rises above P_T

FIGURE 3
MARKET EQUILIBRIUM IN LOW- AND HIGH-COST CASES



the market price is determined by the government cap and the supply of annual permits. Figure 3 shows why this is important. If the marginal cost of abatement is low the market delivers a price of P_1. If the demand for permits is high, because it is costly to reduce emissions in the given year, then the price is bounded by P_T.

Investment incentive

Although the policy is more complex than an emissions tax or conventional permit system, it would provide an excellent foundation for large, private sector investments in capital and research that will be needed to address climate change. To see why, consider the incentives available to a firm after the policy has been established. Suppose the firm has the opportunity to invest in a new production process that would reduce its carbon emissions by one ton every year. If the firm is currently covering that ton by buying annual permits, the new process would save it $20 per year every year. If the firm can borrow at a 5 per cent real rate of interest it would be profitable to adopt the process if the cost of the innovation were $400 or lower. For example, if the cost of adoption were $300, the firm would be able to avoid buying a $20 annual permit every year for an interest cost of only $15. Adopting the process, in other words, would eliminate a ton of emissions and raise profits by $5 per year.

Firms owning long-term permits would face similar incentives to reduce emissions, because doing so would allow them to sell their permits. Suppose a firm having exactly the number of long permits needed to cover its emissions faced the investment decision in the example above. Although the firm does not need to buy annual permits, the fact that it could sell or lease un-needed, long-term permits provides it with a strong incentive to adopt the new process. At a cost of adoption of $300, the firm could earn an extra $5 per year by borrowing money to adopt the process, paying an interest cost of $15 per year, and leasing the permit it would no longer need for $20 per year.

The investment incentive created by a hybrid policy increases with the annual permit fee. For example, raising the fee from $20 to $30 raises the investment incentive from $400 to $600. That makes sense: if emitting a ton of carbon becomes 50 per cent more expensive every year, the amount a firm would pay to avoid that cost should rise by 50 per cent as well. Raising the annual fee even further would continue to increase the incentive in proportion, provided that the policy remains credible: a $40 fee generates an $800 investment incentive; a $50 fee generates a $1,000 incentive; and so on.

The critical importance of credibility becomes apparent when considering what would happen to these incentives if firms are not sure if the policy will remain in force. If the policy were to lapse at some point in the future, emissions permits would no longer be needed. At that point any investments made by a firm to reduce its emissions would no longer earn a return. The effect of uncertainty about the policy's prospects is to make the investments it seeks to encourage more risky. Firms will take that risk into account when evaluating climate-related investments and will be willing to pay far less to undertake them as a result. Consider the same investment that would save a firm $20 a year if the policy is in force, but now suppose the firm believes that there is a 10 per cent chance each year that the policy will be repealed. That may sound like a small erosion of credibility, but it can be shown that it reduces the maximum amount the firm would be willing to pay for the innovation from $400 to only $133. The drop in credibility – from 100 per cent confidence in continuation of the policy to 90 per cent – reduces the incentive for investment by two-thirds.

Policy stability

Since the incentives created by the policy increase with the price of an annual permit, a government might try to compensate for low credibility by imposing higher annual fees. For example, suppose a government would like a climate policy to generate a $400 incentive for investment but firms believe that there is a 10 per cent chance the policy will be abandoned each year. For the policy to generate the desired incentive, the annual permit price would have to be $60 rather than $20. That is, the stringency of the policy (as measured by the annual permit fee) must *triple* in order to offset the two-thirds decline in the incentives arising from the policy's lack of credibility. In practice the situation is probably even worse. Increasing the policy's stringency is likely to reduce its credibility further, requiring even larger increases in the annual fee.

FIGURE 4
EMISSIONS AND LONG TERM PERMITS IN AUSTRALIA

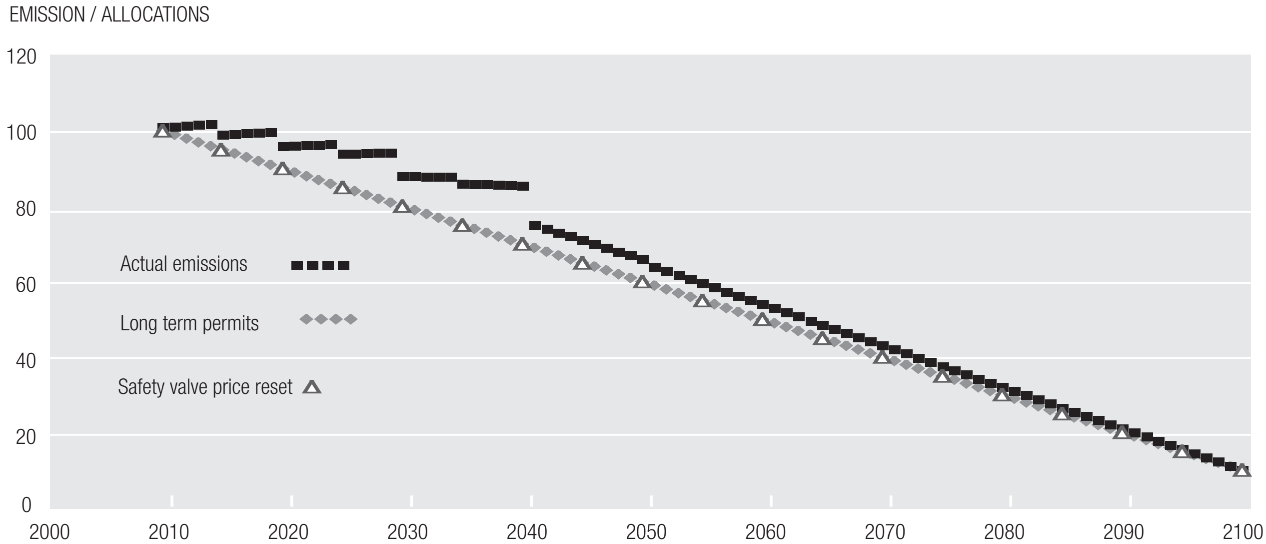
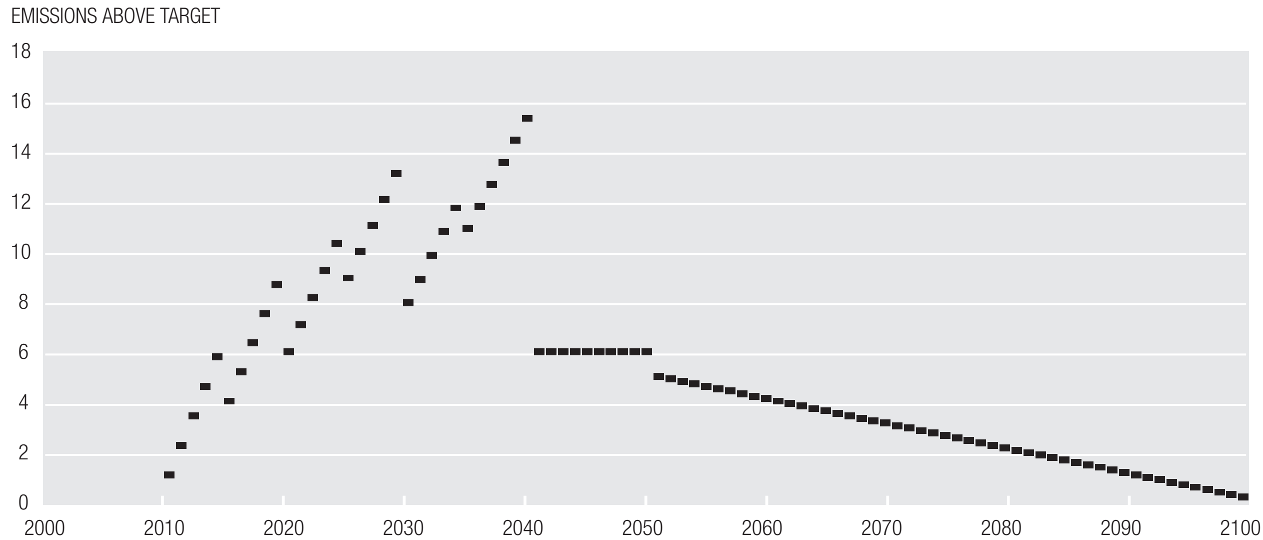


FIGURE 5
ANNUAL PERMIT SALES – AUSTRALIA



For example, suppose investors believe it is probable that the government will abandon the policy rises by 1 per cent for each $20 increase in the annual fee. In that case, maintaining a $400 investment incentive would require an annual fee of $70 rather than $60, which would be accompanied by an increase in the perceived likelihood of the policy being abandoned from 10 to 12.5 per cent. The general lesson is clear and vitally important to the development of an effective climate policy: a modest but highly certain policy generates the same incentives for action as a policy that is much more stringent but less certain. A hybrid policy with a modest annual permit price would generate larger investment incentives than a more stringent, but less credible, emissions target imposed by a system of targets and timetables.

In summary, a hybrid policy combining a fixed supply of tradable long-term emissions permits with an elastic supply of annual permits would be a viable and efficient long-term climate policy at the national level. It would be more credible than many alternatives, especially a carbon tax, because it builds a political constituency with a large financial stake in preventing backsliding by future governments. It thus addresses the inherent difficulty that a democratic government faces in binding future governments to continue carrying out the policy. At the same time, the provision for annual permits allows the hybrid to avoid the inefficiencies and political hurdles that would arise with a conventional system of permits that imposed a rigid cap on emissions. It would provide a strong foundation for investment decisions by the

FIGURE 6
ANNUAL PERMIT PRICE

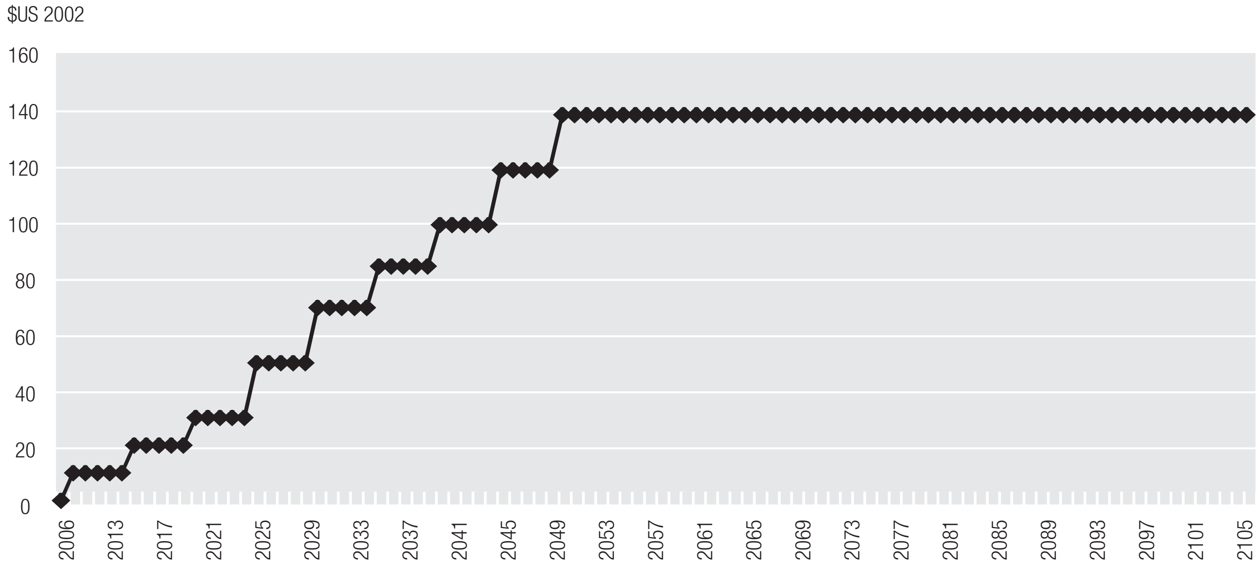
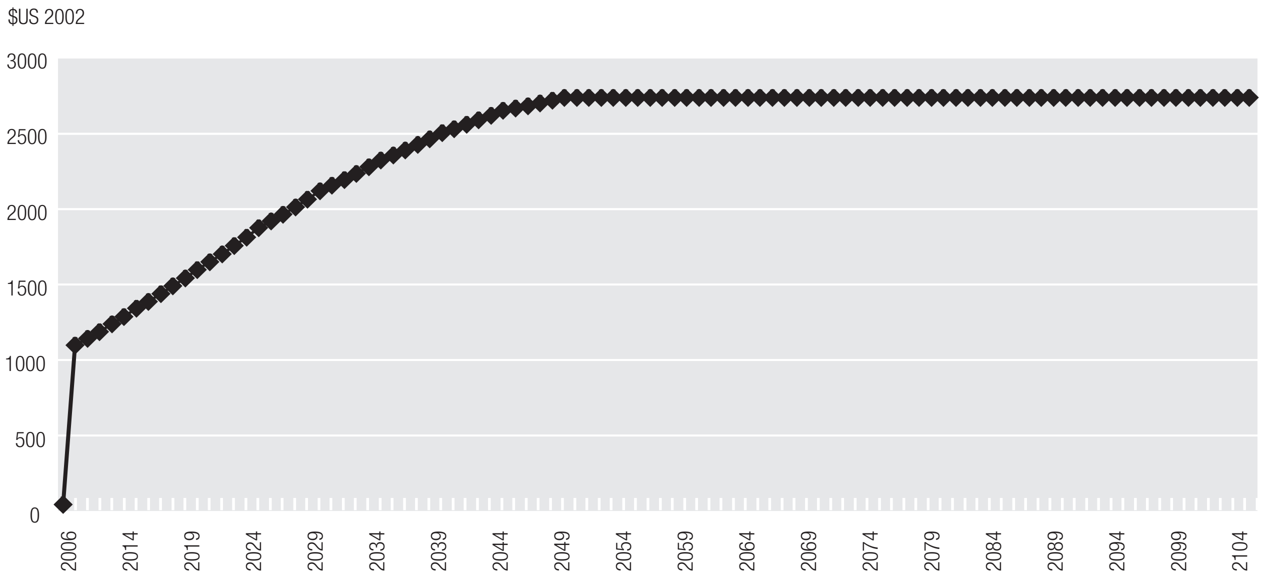


FIGURE 7
STYLISED VALUE OF LONG-TERM PERMITS



private sector because it would create credible, long-term returns for reducing greenhouse gas emissions.

To illustrate how this would work in practice, one possible scenario is illustrated in Figures 4 through 7. In Figure 4, the diamond line shows a long-run emissions target with emissions normalised to 100 in 2010, then declining to 60 units by 2050, and to 10 units by 2100. This target is also the quantity of long-term permits that are issued in 2010 with each long-term permit giving an equivalent annual permit allocation that diminishes over time. The actual emissions in this scenario might look like the broken line above the target path. The curve implies that the price cap was reached in most years and annual permits were issued (since the curve lies above the diamond line). The extent of annual permit sales is shown in Figure 5. Figure 6 shows the path of annual permit prices in this particular scenario. The safety valve price in this scenario has been set to follow a step pattern: increasing every five years but constant between the revisions. The price gradually ratchets up until the long-term target is achieved. Figure 7 shows the value of long-term permits each year. This is the expected future value of annual permit prices. It is clear that even a low initial price, when combined with a rising expected future price, can create a valuable long-term permit. This, in turn, creates significant wealth in the present from activities that will reduce carbon emissions in the future.

Carbon trading in Australia

One of the problems of a cap-and-trade permit trading system is that it requires a careful calculation of the cap. Setting a very tight target could, over time, lead to excessive costs being incurred. Setting too loose a target could, over time, result in excessive emissions and a missed opportunity for rapid, low-cost emission reductions. In determining the optimal target for Australia one option would be to use the percentage reduction in global emissions advocated by the Stern Review. However, this approach is likely to be sub-optimal when costs are taken into account. Numerous studies comparing marginal abatement costs show that Australia is relatively high on the list (that is, it has relatively high marginal abatement costs).[4] Under a global targets and timetables system, international permit trading is usually advocated as a way for high-cost countries to reduce their costs by buying emission reductions from low-cost countries. As a result, the marginal costs of the reduction would be equalised across participating countries. Although marginal costs will be equated, different countries might undertake very different emissions reductions. This key point seems to be ignored in the current policy debate on what unilateral actions countries such as Australia should take, which seems to presuppose equal percentage reductions.

One way around this dilemma is to choose a target without a specific timetable and focus on capping the short-term costs to the economy. This is the approach of the MWB. The long-run target is implemented in the long-term permit market. The cost of getting this calculation wrong in any particular year is limited by the operation of the safety valve, under which the government can print annual permits as needed to cap the short-run price. In a conventional cap-and-trade system the government does not have this capacity and cannot easily smooth out short-run difficulties in achieving the target over time. The only way around this problem is to set a short-time horizon for the emissions target and then renegotiate the target frequently through time. This is indeed the Kyoto strategy. The problem with this approach, however, is that is does not give clear or credible signals about future carbon prices, especially beyond the period of the commitment.

The PM's Task Group

Another approach has been proposed in the recent report by the Prime Minister's Task Group on Emissions Trading (2007). This report is a wide-ranging assessment of climate policy and is far more detailed than the MWB, although the basic idea is the same; that is, to tackle the climate problem by setting a long-run target with a flexible timetable and a short-run safety valve focused on minimising costs through time. However, there are some significant differences in implementation between the two approaches.

The first difference is in the way in which the safety valve is implemented. In the Task Group approach (TGA), the safety valve is a penalty that emitters must pay to the government if their emissions exceed the permits which they hold. The price effect of this is the same as buying annual permits from the government under the MWB approach. However, under the TGA it is a sanction for bad behaviour, whereas under MWB it is a market transaction in annual permits.

The second difference is that rather than setting a long-run goal for emissions and creating assets that reflect this goal and distributing these assets at the commencement of the trading, the TGA sets a goal and creates bundles of annual permits of different dates, which are distributed as a subset of the bundle. Every five years a decision will be made about whether to issue more permits of different duration to relax the constraints. This is similar to a government financing a fiscal deficit by issuing different duration bonds over time. This strategy of not pre-committing to the long-run target is designed to increase flexibility. However, it also undermines the credibility of the future carbon price which is critical for generating the incentives to develop alternative technologies. It is also not clear why this approach is needed since there would be sufficient flexibility in cost containment through the safety valve.

A third difference is the way in which permits are allocated. The TGA proposes an evaluation of the costs of the scheme to affected emitters, in particular those industries whose export competitiveness is harmed by the introduction of the scheme. These industries would receive an initial allocation based on expected costs. Further allocations may be made depending on future cost outcomes. Other permits of different duration would be auctioned. The new allocation through time would be auctioned. Under MWB all long-term permits are allocated to affected industries as well as consumers who would face higher energy bills. The compensation issue does not need to be as finely calculated because by creating such long-term assets that are claims over future emissions, enough wealth is transferred from future generations to current emitters to provide more compensation than required. This is important since it is difficult to precisely calculate winners and losers, defusing potential for the political coalitions that would form to support or oppose the policy.

The Task Group report is an important step forward, because, like the MWB it proposes an approach that can be developed in individual countries and then joined together with other systems to create a global approach.

Conclusion

The policy debate based on targets and timetables for climate policy is quickly being replaced with more flexible approaches in which the speed of reaching a given target is determined by an assessment of the costs and benefits of taking action. The approach of the Prime Ministerial Task Group on Emissions Trading is clearly in this new mould. This is an important step because it will reduce the likelihood that countries will commit to a system for carbon reduction only to withdraw when costs appear to exceed benefits. There is a debate currently under way in developed countries such as Japan, Canada and New Zealand that have ratified the Kyoto Protocol but are unlikely to reach their Kyoto targets. It's also taking place in developing countries where emissions are rising sharply despite the Kyoto Protocol. Cap-and-trade in these countries is unlikely to work in the climate area in the next few decades because of the uncertainty about what cap to impose. Thus the approach offered by hybrid policies that combine cap-and-trade approaches with a short-run safety valve mechanism to control costs are more likely to dominate the policy debate beyond the 2012 post-Kyoto period.

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ENDNOTES

1 See the Stern Review (2006).

2 See Kopp et al (1997, 1999).

3 See the papers in Aldy and Stavins (2007).

4 See the Energy Journal (1999).

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