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A CREDIBLE FOUNDATION FOR LONG TERM INTERNATIONAL COOPERATION ON CLIMATE CHANGE

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A CREDIBLE FOUNDATION FOR LONG TERM INTERNATIONAL COOPERATION ON CLIMATE CHANGE[1]

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ABSTRACT

To succeed in reducing carbon dioxide emissions, a climate policy must establish credible long-term incentives for investments in new energy-sector capital and in research and development. We argue that credibility implies that international agreements should focus on enhancing coordination and collaboration between countries, rather than on coercion. At the national level, credibility requires political and economic incentives that can be provided by long-term tradable emissions permits, but it needs more flexibility than can be provided by a conventional permit system. We argue that the best mechanism for providing credible long-term incentives is a hybrid system of long and short term emissions permits. Key aspects of the system would be coordinated across countries but the permits would be issued and traded solely within national borders.

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The first step toward meaningful progress on climate change is to be realistic about institutions—both about how existing institutions, such as national governments, can be brought to bear on the problem, and also about the prospects for creating powerful new international institutions. It is, in essence, a decision about whether it is more productive to bring existing tools, however imperfect, to bear on the problem or to design new and better tools at the international level. The latter course has attractions, but the risk is that the design process may go on indefinitely—with greenhouse gas emissions rising unchecked—without producing a viable new institution.[2] Such has been the case over the last decade as attention has focused on designing the Kyoto Protocol, an elaborate new international institution without any real precedent that may do nothing to slow emissions.

In this chapter we argue that a better alternative would be to tackle climate change with simpler policies that can be carried out by national governments immediately. We discuss key characteristics needed in an effective approach to climate change and argue that prospects for creating a powerful international institution to control greenhouse gas emissions are dim at best. We then outline one policy, an internationally-coordinated system of national policies based on a hybrid tradable permit mechanism, that can be implemented with minimal development of new international institutions. It focuses on international cooperation and coordination, rather than on

[2] An old joke once told by physicists about computer scientists illustrates the point vividly. The joke went as follows: "physicists solve tomorrow's problems with today's computers, while computer scientists work the other way around." Over the last decade, international negotiations seem to have taken the approach attributed to computer scientists: designing an idealized future system while doing nothing about current emissions.

coercion. Moreover, the policy has a number of key strengths that make it a solid, long-term foundation for addressing climate change.

CREDIBILITY AND CLIMATE POLICY

For a climate policy to be effective, it must satisfy three broad requirements: it must be widely adopted; it must remain in force indefinitely; and it must provide credible incentives for individuals and firms to make the investments that will be needed to reduce emissions. The third point is particularly important. Although international negotiations focus on commitments by governments to achieving particular emissions targets, most governments have only indirect control over emissions within their borders. Emissions arise as a result of choices made by households and firms over energy technology and fuel consumption, not as a result of administrative decisions by government agencies. In contrast, other treaties often apply to actions that can be taken directly by governments themselves. International trade agreements are a good example: they restrict tariffs and other policies that are unambiguously under the control of participating governments. Even a government with the best of intentions on climate change will be unable to achieve much unless it can spur its citizens into action.

Moreover, the actions that individuals and firms will need to undertake in order to reduce emissions involve enormous investments in capital equipment and research and development, both with long payback periods. A climate policy will be unable to induce such investments unless it is clear that the policy is likely to be enforced, and is unlikely to be repealed. The single most important characteristic of a climate policy, in other words, is to provide a solid foundation for large, long-term investments by the private sector.

Although credibility is essential to an effective climate policy, it does not arise automatically. In a democracy, a policy does not become credible simply by being written into law. Every subsequent legislature will have the authority to repeal the law, and subsequent administrations will be able, if they choose, to relax enforcement until the law is irrelevant.[3] A current government thus has little direct ability to constrain the actions of its successors. As a result, a policy will only be credible if it is clear that future governments—whether controlled by other political parties, or facing very different economic circumstances—will *want* to continue carrying it out. Structuring a policy to provide powerful incentives for continuing enforcement by future governments is a critical step in designing an effective climate change agreement.

At first, the problem of credibility might seem insurmountable. If a current government can't adopt rules that future governments can't reverse, what else could it do? The answer is straightforward, but it has profound implications for the structure of a climate policy: it must create a constituency with a strong financial interest in perpetuation of the policy. Bluntly put, it must create a powerful lobby group that will vigorously resist any attempt at backsliding by future governments.

Before turning to a policy that would build such a constituency, it is instructive to consider a policy that would have exactly the opposite effect: a carbon tax. From an economic perspective, a carbon tax would be an ideal instrument for addressing climate change. It would be efficient given the uncertainties surrounding climate change,[4] and it would definitely work: high energy prices in the 1970's stabilized US emissions for nearly 20 years.[5] However, a carbon tax creates precisely the wrong constituency. No group in the private sector would have a

[3] A case in point is the Bush administration's decision to abandon the 1972 Antiballistic Missile Treaty.
[4] This is an application of Weitzman's seminal 1974 paper on prices vs. quantities; see McKibbin and Wilcoxen (2002) for a detailed discussion in the context of climate change.
[5] Jorgenson and Wilcoxen (1993).

large financial stake in seeing the policy continue, and all future users of fossil fuels would be motivated to lobby against it. Apart from satisfying the terms of an international agreement, the only incentive a government would have to keep the tax in place is the revenue it generates. However, that incentive may not be very strong: recent history has shown that governments may be willing to run large deficits for long periods of time in order to reduce taxes.

The broader lesson is that an international agreement cannot succeed in the long run if it relies on pitting national governments against broad, highly motivated groups of their own citizens. Ultimately, international agreements are voluntary and a climate change treaty will be no exception. Faced with a choice between angering constituents by adhering to an unpopular treaty, or repudiating the treaty and angering the international community, few democratic governments would be able to take the former course year after year. To be successful, an international agreement must be designed from the start to enhance and coordinate the efforts of national governments, not to use them as instruments of enforcement that are subsidiary in authority to an international regime. In terms of the analogy at the beginning of the chapter, national governments may not be the ideal tools for controlling climate change, but they are by far the best tools available today.

Returning to the issue of credibility, building a national constituency with a financial stake in maintaining a climate change policy is possible if the policy involves long-lived tradable emissions permits. We discuss long-lived permits in more detail below but the key feature of such a permit would be to allow one ton of emissions every year for the life of the permit. A perpetual permit, for example, would allow one ton of emissions every year forever. Once long-lived permits have been distributed, permit owners will have a valuable financial asset whose price depends directly on the health of the policy. With scrupulous monitoring and enforcement

of the policy, firms will pay high prices to emit carbon and the permits will be very valuable. However, if enforcement is lax, or if the policy is repealed, the value of the permits will drop to zero. Permit owners thus have a strong financial interest in supporting the policy. In essence, the permit system replaces the conflict that a carbon tax would cause between a government and energy users with conflict between two private sector groups: permit owners and energy users. It doesn't eliminate the difficulty of reducing emissions but it does even out the political landscape and reduces the pressure on future governments to repeal the policy.

Despite this advantage, an international climate policy based entirely on long-term permits is not a viable option. The reason is a straightforward: to ratify such a policy, a government would have to be willing to agree to achieve a specified emissions target by a given date, regardless of the cost of doing so. That approach would be appropriate if carbon dioxide were a threshold pollutant. Threshold pollutants cause little or no damage when emissions are low but cause substantial damages once a threshold is exceeded. As a result, keeping emissions below the threshold may indeed be imperative. Carbon dioxide, however, is a stock pollutant and *not* a threshold pollutant.[6] Excess emissions accumulate in the atmosphere and remain there for decades: current annual emissions are equal to only about 1% of the total anthropogenic carbon dioxide in the atmosphere. The risks associated with climate change result from the accumulated stocks of carbon dioxide and other greenhouse gases. Each additional ton of emissions increases the risks, although very slightly, and there is no threshold below which risks are zero.

This point is often misunderstood in the public debate because some of the consequences of climate change might occur suddenly, such as rapid melting of the Greenland ice sheet. However, a potentially sudden consequence does not necessarily indicate a distinct threshold in

emissions of the underlying pollutant. One way to understand the distinction is by analogy to the effects of cigarette smoking. Each cigarette raises the risk of lung cancer slightly. If cancer occurs, however, it doesn't make sense to argue that a particular cigarette caused it. Doing so would be to argue that all previous cigarettes were insignificant in causing the cancer. In the same way, all emissions of carbon contribute to future climate risks and the damage caused by one ton of emissions is essentially the same as the damage caused by the next.

In the absence of a clear threshold, basing a climate policy on a rigid emissions target makes little sense: achieving the target does not eliminate the risk and exceeding the target does not cause consequences markedly different from achieving it. Put bluntly, when every ton of emissions contributes equally to the problem, it is impossible to justify any particular emissions target, other than possibly no emissions at all. As a result, a rigid system of targets and timetables for emissions reductions is not economically efficient.[7] Nor is it politically realistic: a climate policy that doesn't take costs into consideration will never be ratified by the US Senate and is likely to be rejected—or ratified but later repudiated—by many other governments as well.

In summary, neither of the two main market-based mechanisms for pollution control are suitable for climate change. A carbon tax would be economically efficient but is a not a credible long term policy because of the conflict it would create between a government and its constituents. A permit system based on a fixed number of long-term permits is also unsuitable but has the opposite weaknesses: it would be credible, but it would be inefficient since carbon dioxide is not a threshold pollutant. Although both mechanisms have serious economic and political disadvantages when used alone, those problems can be overcome by a hybrid policy that

[6] See Newell and Pizer (1998) for a discussion of the economic theory behind regulation of stock externalities.
[7] For a detailed discussion, see McKibbin and Wilcoxen (2002).

combines the best elements of both.[8] For efficiency, the hybrid should act like an emissions tax at the margin: it should provide incentives for abatement of all emissions that can be cleaned up at low cost while not requiring that a particular emissions target be achieved. For long-term credibility, the hybrid should create a private sector constituency with a clear financial interest in the seeing the policy maintained and enforced. The structure and operation of a hybrid policy for addressing climate change at the national level are discussed in the following section; a subsequent section will discuss the international implications of the policy.

A HYBRID POLICY FOR CONTROLLING NATIONAL EMISSIONS

A hybrid policy for climate change is discussed in detail in McKibbin and Wilcoxen (2002) and summarized briefly in Box 1. It would combine a fixed supply of long-term permits with a much more 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 long-term permits as "perpetual," although in principle they could be valid for long but finite periods, and the short term permits as "annual". A country adopting the hybrid policy would distribute a number of perpetual permits less than its current emissions; for example, an amount equal to its 1990 emissions. The permits could be bought, sold or leased without restriction and each one would allow the holder to emit one ton of carbon per year. When initially distributed, they could be given away, auctioned, or distributed in any other way the government of the country saw fit. After that, the permits could be traded among firms, or bought and retired by environmental groups. The permits would be very valuable because: (1) there would be fewer available than

[8] The economic theory behind hybrid regulatory policies is due to Roberts and Spence (1976). A hybrid approach to climate change was first proposed by McKibbin and Wilcoxen (1997a) and has subsequently been endorsed or promoted by a range of authors and institutions. Examples include Kopp, Morgenstern and Pizer (1997); Kopp,

needed for current emissions, and (2) each permit allows one ton of emissions every year forever. As a consequence, the owners of perpetual permits would form the private-sector interest group needed for long-term credibility of the policy: they would have a clear financial interest in keeping the policy in place.

The other component of the policy, annual emissions permits, would be straightforward: the government would agree to sell annual permits for a specified fee, say for $20 per ton of carbon. There would be no restriction on the number of annual permits sold, but each permit would be good only in the year it is issued. To put the fee in perspective, $20 dollars per ton of carbon is equivalent to a tax of about $12 per ton of coal and $3 per barrel of crude oil; other things equal, the price of a $22 ton of coal would rise by about 50% and the price of a $60 barrel of oil would rise by about 3%. 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 achieving any particular emissions target regardless of cost.

Every year, firms 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, perpetual permits owned outright by the firm, or perpetual permits leased from other permit owners.

Although the policy is more complex than an emissions tax or conventional permit system, it would provide an excellent foundation for the large private sector investments in capital and research that will be needed to address climate change. To see why, consider the incentives faced by a firm after the policy has been established. Suppose it has the opportunity to invest in a new production process that would reduce its carbon emissions by one ton every

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Morgenstern, Pizer and Toman (1999); Americans for Equitable Climate Solutions (2000); Aldy, Orszag and Stiglitz (2001); and Victor (2001).

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% 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 perpetual 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 perpetual 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 unneeded perpetual 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 rises 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% more expensive every year, the amount a firm would pay to avoid that cost should rise by 50% 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 a $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 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 thus 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. The decline in incentives is surprisingly large. 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% 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% confidence in continuation of the policy to 90%—reduces the incentive for investment by two-thirds.

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% 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 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. For example, suppose that investors believe that the probability the government will abandon the policy rises by 1% 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%. 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 also less certain. A hybrid policy with a modest annual permit price would generate larger investment incentives than a more draconian, but less credible, emissions target imposed by a system of targets and timetables.

Our discussion of the hybrid policy so far has been somewhat abstract, which might give the impression that it is a complicated and unfamiliar mechanism. In fact, nothing could be further from the truth. Stripped to its bare essentials, the main effect of the hybrid is to create a new asset – a perpetual permit – that behaves very much like a conventional form of capital. Individuals face analogous decisions every day. The similarity can be seen by comparing the way a firm would use its permits with the way a household uses its automobiles. When a firm needed to emit carbon dioxide, it would compare the prospective emissions against its stock of perpetual permits. If it had too few permits, it would have four choices: it could reduce its emissions until they matched its stock of permits; it could buy more perpetual permits; it could lease additional perpetual permits from other permit owners; or it could buy annual permits from the government. Someone planning transportation for household begins by comparing the number of passengers to the capacity of the available vehicle. If the number of passengers exceeds the capacity, the alternatives are very similar to those faced by the firm: reduce the number of passengers; buy another vehicle; rent or lease an additional vehicle; or send some of the passengers in a taxi (the option equivalent to annual emissions permits). Although it may sound exotic, a hybrid policy is no more complex than other decisions involving capital goods routinely made by individuals and firms.

The analogy between permits and vehicles also helps clarify the role of annual permits. Someone with a predictable need to transport a large number of people would usually find it best to own several vehicles, while someone whose transportation needs were less predictable would find it better to own a smaller number of vehicles and use rental cars or taxies to cover peak periods. Similarly, firms with a predictable need for a large number of permits would generally find it best to own a large number of perpetual permits, while firms whose emissions fluctuate a lot from year to year would find it profitable to own a smaller number of perpetual permits and cover peak periods using leased or annual permits. Annual permits would thus play a valuable role in helping firms manage short-term fluctuations.

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, which would impose a rigid cap on emissions. Thus, it would provide a strong foundation for investment decisions by the private sector because it creates credible, long-term returns for reducing greenhouse gas emissions. It combines the best features of a permit system and an emissions tax, as shown in Table 1.

INTERNATIONAL COOPERATION AND HARMONIZATION

A key feature of the hybrid policy we propose is that emissions permits would be valid only in the country of issue. They would not be tradable internationally—permits issued in one country could not be used to cover emissions in another country.[9] Each country would manage its own domestic hybrid policy using its own existing legal system and financial and regulatory institutions. There would be no need for complex international trading rules, or for the creation of a powerful new international institution, or for participating governments to cede a significant degree of sovereignty to an outside authority. As a result, a treaty built around the hybrid policy would be very simple and would focus primarily or exclusively on harmonizing the price of annual permits across participating countries. To join the agreement, a country would simply agree to establish a hybrid permit system and to charge a specified price for annual permits. Unlike an agreement focused on achieving a national emissions target, governments would be making commitments that are within their direct control.

Easy accession is very important. To be effective in the long run, the agreement will eventually need to include all countries with significant greenhouse gas emissions. However, it is unlikely that all countries will choose to participate at the beginning. Developing countries, for example, have repeatedly pointed out that current greenhouse gas emissions are overwhelmingly caused by industrialized countries, and that those countries, therefore, should take the lead in reducing emissions. As a result, an international climate policy will need to cope with gradual accessions taking place over many years. Its design, in other words, must be suitable for use by a small group of initial participants, a large group of participants many years in the future, and all levels in between. Because it is fundamentally a harmonized system of

domestic policies, rather than a monolithic international policy, our hybrid proposal has exactly the flexibility needed. A country can participate by simply adopting the hybrid domestically, without any need for international negotiations.

Moreover, because permit markets are separate between countries, shocks to one permit market do not propagate to others. For example, accession by a new participant has no effect on the permit markets operating in other countries. Similarly, if a participating country withdraws from the agreement or fails to enforce its hybrid policy, permit markets in other countries are also unaffected. Collapse of one or more national permit systems would be unfortunate in terms of emissions control, but it would not cause permit markets in other countries collapse as well. Separate permit markets are, in essence, a form of compartmentalization that lends stability to the international agreement. In contrast, under an international trading agreement, such as the Kyoto Protocol, shocks in one country—ineffective enforcement, or withdrawal from the agreement, for example—would cause changes in permit prices around the world. Permit owners would receive windfall gains or losses and permit users would be faced with volatile and unpredictable permit prices. From the perspective of both permit owners and permit users, investments in emissions reductions would be more risky.

Compartmentalization is especially important for a climate change agreement, which must endure for many, many years. Not only must it be able to survive noncompliance by some of its members, it must be able to able to survive through economic booms and busts; through wars and pandemics; and through times of low concern about the environment as well as in times of high concern. Moreover, because of the uncertainties surrounding climate change, it must also survive through intervals where warming seems to be proceeding more slowly than expected

[9] Strictly speaking, the term "country" is too narrow. The permits would be valid only within the political jurisdiction of issue. If the relevant jurisdiction is multinational—the EU, for example—permits could be traded

and there could be political pressure to abandon the agreement on the grounds that it isn't necessary. Such intervals could arise because of random fluctuations in global temperatures from year to year, or because the policy is actually succeeding in reducing the problem. The latter point is worth emphasizing: if a climate regime is successful at reducing warming and preventing significant damages, it will be easy for complacency to arise: many people may interpret the absence of disasters to mean that the risks of climate change were overstated.

Another advantage of multiple national permit markets, rather than a single international one, is that individual governments would have little incentive to monitor and enforce an international market within their borders. It is easy to see why: monitoring polluters is expensive, and punishing violators would impose costs on domestic residents in exchange for benefits that will accrue largely to foreigners. There would be a strong temptation for governments to look the other way when firms exceed their emissions permits. For a treaty based on a single international market to be effective, therefore, it will need to include a strong international mechanism for monitoring compliance and penalizing violations. National permit markets reduce the problem substantially because monitoring and enforcement becomes a matter of enforcing the property rights of a group of domestic residents—the owners of perpetual permits—in domestic markets.

In theory, a possible disadvantage of separate permit markets is that the prices of perpetual permits might differ between countries. If so, the overall policy would not be minimizing the cost of abatement: it would be possible to lower overall abatement costs by doing more abatement in countries where permit prices are low and doing less abatement in countries where prices are high. However, it is unlikely that permit prices would differ significantly in practice. As long as each country's stock of perpetual permits is small enough that at least one

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between countries within the broader jurisdiction.

annual permit is sold, perpetual permit prices in all participating countries will be equal to the present value of buying a stream of annual permits. With annual permit prices harmonized across countries, permit prices will therefore be equal.

In sum, an internationally-coordinated system of national hybrid policies has a long list of advantages. It would be credible and efficient, thereby providing a solid foundation for investments by individuals and firms to reduce emissions. It would be implemented almost entirely via national governments and other existing institutions without the need for a powerful new international agency. It would require little sacrifice of sovereignty by participants. Accession would be straightforward and would not disturb existing permit markets. It would be robust, because adverse shocks in one permit market would not propagate to others. Finally, it would eliminate the disincentives national governments would face in monitoring and enforcing an international trading regime. It might not minimize costs completely, but that outcome only occurs in situations that are unlikely to arise in practice. Moreover, the potential loss of efficiency is likely to be insignificant when compared to the administrative gains achieved by using existing institutions.

EVOLUTION OVER TIME

Over time, more information will become available about climate change, its effects, and about the costs of reducing emissions. Revising the agreement in light of new information is straightforward: if it becomes clear that emissions should be reduced more aggressively, the price of annual permits can be raised. The political prospects for an increase would be helped by the fact that raising the price of annual permits would produce a windfall gain for owners of perpetual permits, since the market value of perpetual permit prices would rise as well.

If new information indicates that emissions should drop below the number allowed by perpetual permits, raising the price of annual permits would need to be augmented by a reduction in the stock of perpetual permits. One way to achieve such a reduction would be for governments to buy and retire some of the permits. Alternatively, the permits could be issued with expiration dates giving them long but finite lives. The main advantage of perpetual permits is simplicity and transparency, but it is not essential that the permits last indefinitely. A more sophisticated–but substantially more complicated–alternative would be to issue long-term permits with a variety of expiration dates, much the way governments now issues bonds. For example, a country with an allowance of 100 long-term permits might chose to issue 20 of them as perpetual permits, 40 as permits expiring in 50 years, and the remaining 40 as permits expiring in 20 years. In essence, this approach would create a family of assets with a term structure of expiration dates.[10] The government would have more ability to reduce the number of long-term permits than it would if the permits were perpetual; the cost, however, is a considerable increase in complexity and the opportunity for speculation and manipulation at the expiration date of each block of permits.

BUILDING ON THE FOUNDATION

The agreement outlined above—an internationally-coordinated system of national hybrid policies for controlling carbon emissions—provides a solid foundation for private-sector investments to reduce emissions of carbon dioxide. It provides clear and credible financial incentives for developing and deploying new innovations that reduce fossil fuel use or capture and sequester carbon emissions. However, it need not be the only policy adopted and could

[10] Nicholas Gruen and Geoff Francis have made similar suggestions to us along these lines.

easily be integrated with other actions taken at the national level. In this section, we discuss the advantages and disadvantages of: including gases other than carbon dioxide; including sinks; and including measures focused on technology, such as product standards or subsidies for research and development.

In principle, it would be straightforward to include other greenhouse gases in a hybrid policy on a carbon-equivalent basis. However, doing so would add considerably to the complexity and cost of monitoring and enforcement. Monitoring the use of fossil fuels is relatively easy because they are produced in a narrow segment of the economy. In contrast, monitoring emissions of methane from agriculture and landfills—for example—would be much more difficult. Because carbon dioxide accounts for most of the greenhouse gas burden, starting with a system focused on it would be an attractive approach. Other gases could be controlled later via separate hybrid policies for each gas. The policies would be coordinated by setting annual permit prices that were equal on carbon-equivalent basis. A hybrid policy for methane, for example, would use an annual permit price 23 times that used for carbon dioxide.[11]

Credit for sinks could also be included in a hybrid policy. In fact, an important advantage of the hybrid approach is that the decision on whether or not to allow credit for sinks could be left up to the discretion of individual governments and would not need to be a formal part of the international agreement. Including sinks would be straightforward. Individuals and firms carrying out sink-enhancement projects would apply to their own governments for certification of the number of tons of carbon sequestered by their projects each year. The owners of the sinks would then be allowed to sell an equivalent number of annual permits. In effect, a government granting credit for sinks would subsidize the activity by shifting revenue that it might otherwise have earned to the owners of the sinks.

Finally, the hybrid policy could also be combined with a wide range of measures focused on energy technology, including product standards, informational campaigns, demand-side management, subsidies for investment in non-fossil energy sources, or research and development subsidies. Although each of these could be combined with the hybrid, none of them could replace it. Without the clear, credible incentives for investment provided by the hybrid, individuals and firms will be slow to adopt new technologies to reduce emissions. In fact, without a price-based instrument like the hybrid, many of these policies would be counter-productive. Subsidized research and development, in particular, would have the effect of *reducing* energy prices, thus tending to increase energy consumption and greenhouse gas emissions. Using the hybrid policy in combination with a research subsidy would offset this effect.

CONCLUSION

If an international agreement is to succeed in reducing global carbon dioxide emissions, it should build on existing institutions to establish credible long-term incentives for major investments in physical capital and in research and development. In particular, it should focus on fostering collaboration and coordination among national governments, rather than on attempting to create a new international organization that would be likely to place national governments in the position of imposing unpopular international policies on their constituents. At the national level, a hybrid policy mixing long and short-term emissions permits has many features that would help provide credible incentives. It would create a powerful interest group—the owners of long-term

[11] See IPCC (2001a) for global warming potentials giving the carbon-equivalent warming burden of different gases.

permits—with a financial stake in the existence and enforcement of the policy. At the same time, the flexibility provided by annual permits allows the policy to be adopted without the need for a government to agree to achieve a rigid emissions target regardless of the cost. Tradability of the permits also provides the usual benefit of market-based environmental policies: it ensures that within each country, emissions reductions will be achieved at minimum cost.

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Box 1

A Hybrid Policy for Controlling National Emissions

In its basic form, the hybrid policy allows each participating country to issue two kinds of emissions permits: perpetual permits that entitle the owner of the permit to emit one metric ton of carbon every year forever, and annual permits that allow one ton of carbon to be emitted in a single, specified year. Key features of the policy are listed below:

Perpetual Permits:

- Limited quantity available, perhaps a specified fraction of 1990 emissions
- Distributed once, at the time when the policy is first enacted
- Could be bought, sold or leased within the country of issue without restriction
- Could only be used in the country of issue; no international trading
- Price will be determined by the market

Annual Permits:

- Would be sold for a stipulated price, say $20 per ton of carbon
- Valid only in the year and country of issue
- No limit on the quantity that could be sold

Table 1: Comparing Key Attributes of Market-Based Climate Policies

Attribute	Int'l Permits	Carbon Tax	Hybrid Policy
Attributes in Common			
Minimizes abatement costs within each country	✓	✓	✓
Encourages energy conservation and innovation	✓	✓	✓
Guarantees that benefits are greater than costs	no	no	no
Attributes of Tax-Based Approaches			
Relies on national legal systems and institutions	no	✓	✓
Economically efficient response to uncertainties	no	✓	✓
Explicit upper bound on compliance costs	no	✓	✓
Avoids large international transfers of wealth	no	✓	✓
Provides incentives for domestic enforcement	no	✓	✓
Does not need strong international enforcement	no	✓	✓
Robust to accession or withdrawal of participants	no	✓	✓
Low disincentives for developing countries	no	✓	✓
Limits propagation of shocks across countries	no	✓	✓
Attributes of Permit-Based Approaches			
Creates constituencies for enforcement	✓	no	✓
Flexibility in domestic distributional effects	✓	no	✓
Does not requires large transfers to the government	✓	no	✓
Easy to implement transition relief	✓	no	✓
Guarantees a given reduction in emissions	✓	no	no