THE AUSTRALIAN NATIONAL UNIVERSITY

CRAWFORD SCHOOL
OF ECONOMICS AND GOVERNMENT

POLICY BRIEFS

Climate change and public policy

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ANU COLLEGE OF ASIA & THE PACIFIC

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Policy Briefs 5

Crawford School of Economics and Government
ANU College of Asia and the Pacific
The Australian National University

ISSN 1835-3703 (print)
ISSN 1834-8599 (online)

Symbols used in tables

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About this Policy Brief

In the past decade climate change has become one of the world's biggest public policy issues. Ten years ago no one would have predicted that the Nobel Peace prize would be awarded to 10,000 or so climate scientists (Intergovernmental Panel on Climate Change) and a populariser (Al Gore) of its possible impacts. In this Policy Brief three contributors examine the policy issues of climate change from a global (Will Steffen), regional (Luca Tacconi) and a national perspective (Frank Jotzo). Collectively, they offer a range of insights that will be of use to policymakers and all those interested in the climate-public policy dimension.

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Associate Professor Luca Tacconi has extensive experience and has worked in many distinguished national and international agencies and for several governments around the world. His work is focused on improving knowledge about the theory and the management of natural resources in order to support policies and initiatives aimed at reducing rural poverty and conserving natural resources. He conducts rigorous, policy-oriented research that seeks to propose options for reducing negative changes in the environment and thier impacts. His research has been supported by the European Union, Japanese, Indonesian, United States, Vanuatu and Australian governments as well as the World Bank and conservation agencies.

Dr Frank Jotzo is a research fellow at the Research School of Pacific and Asian Studies at The Australian National University. Frank is an environmental economist and has worked on climate change economics, international economics and policy and development since 1998. His recent work includes analysis of economic instruments for greenhouse gas control, including emission trading, and analysis of options for future international climate policy, especially for developing countries. He leads a project on the economics of climate change and adaptation under the Environmental Economics Research Hub based at the Crawford School. Frank previously worked for the Australian Bureau of Agricultural and Resource Economics, and has collaborated with Stanford University and research institutes in Germany and Indonesia.

Climate change: science, impacts and policy challenges

Will Steffen

Basic science

The basic science of climate change is well understood. One of the most important features of the climate system is the role in the atmosphere of greenhouse gases: water vapour, carbon dioxide (CO_2), methane, nitrous oxide and others. These gases—which are constituents of the atmosphere naturally—change the energy balance at the Earth's surface by absorbing outgoing long-wave radiation (heat) and re-emitting it, some of which returns to the Earth's surface and warms it. This natural greenhouse effect is so important that without these gases, the surface of the Earth would be 33ºC colder than it was in pre-industrial times. That is, the Earth would be permanently frozen and life would not exist.

Since the onset of the Industrial Revolution, humans have been increasing significantly the concentrations of several greenhouse gases—the most notable of which is CO_2. Not surprisingly, this has changed the energy balance at the Earth's surface; the net effect, of course, should be a warming climate. That the Earth is now warming rapidly is unequivocal. There is very strong evidence that the observed warming trend since the middle of last century is due primarily to anthropogenic greenhouse gas emissions and is beyond natural variability (IPCC 2007).

The changing energy balance at the Earth's surface is leading to many other large-scale—continent or ocean basin—changes in climate, in addition to temperature changes. These include changes in wind patterns—particularly the movement of the mid-latitude westerlies in both hemispheres towards the poles; decreases in ocean salinity in some basins; decreases in the thickness and extent of Arctic sea ice; increasing dynamic instability of ice sheets—particularly in Greenland and possibly west Antarctica; and increases in extreme weather events, including heat waves and floods (IPCC 2007).

Potential impacts for Australia

The Intergovernmental Panel on Climate Change (IPCC 2007) has summarised clearly the basic changes in the climate system that have direct implications in terms of impacts and consequences.

- It is very likely that heat extremes, heat waves and heavy precipitation events will continue to become more frequent.
- The number of tropical cyclones each year is projected to decrease, but their intensity is expected to increase, with larger peak wind speeds and more intense precipitation.
- Storm tracks are projected to move towards the poles, with consequent changes in wind, precipitation and temperature patterns outside the tropics.
- Dynamical (ice-sheet) processes are not included in current models but recent observations suggest they could increase the vulnerability of the ice sheets to warming, increasing future sea-level rise. Understanding of these processes is limited and there is no consensus on their magnitude.

Many impacts are now discernible globally, as well as in Australia. For example, the European heat wave of August 2003—which led to about 35,000 premature deaths—was made about three times more probable by the underlying increase in mean temperature. A similar heat wave was experienced in eastern Australia in February 2004. Although the Australian heat wave did not lead to a significant increase in deaths, it did put considerable pressure on health services; for example, it led to the largest ambulance call-out ever recorded in southeast Queensland (Steffen, Love and Whetton 2006).

In terms of biodiversity, coral reefs are among the most threatened ecosystems in the world. Not only are they increasingly prone to coral-bleaching events as sea-surface temperatures rise, the increase in ocean acidity due to increasing dissolution of CO_2 from the atmosphere adds a further, interacting stress. Although reefs can recover from isolated bleaching events, shorter intervals between events and more severe events will lead eventually to a transition from a coral-dominated to an algae-dominated ecosystem. The latter is far less diverse and is unattractive from an aesthetic and tourism perspective. Good management—such as that for Australia's Great Barrier Reef—can forestall the loss of the coral ecosystem; it cannot avoid such a transition if CO_2 emissions are not reduced sharply by the middle of the century, at the latest.

Changes to the water cycle driven by climate change are among the most severe facing Australian society. Already a 15 per cent reduction in rainfall in southwestern Western Australia has led to a 50 per cent reduction in stream flows into the Perth water-supply dams, which has prompted the city to develop alternative—and more costly—approaches to water supply. The 50-year drying trend in eastern Australia appears to have intensified in the past decade, threatening the water supplies of all major east coast cities and greatly reducing the amount of water available for irrigated agriculture. Although the links between these drying trends and climate change have not been proven conclusively, there is a growing risk that there is a connection. Probably more than any other aspect of climate, the recent drought and more long-term drying trends have focused attention on the current and potential consequences of climate change for the well-being of the country.

What constitutes 'dangerous climate change' in terms of impacts and consequences is developing rapidly into a vigorous global debate (for example, Schellnhuber et al. 2006). Although scientific research into the nature of climate impacts can inform the debate, deciding what is really dangerous in terms of climate change is very much an individual and societal value judgement—and can vary markedly around the world. For example, the inhabitants of low-lying Pacific island states have already decided that the current level of climate change (a global mean temperature rise of about 0.7ºC) is dangerous and they are leaving their countries in large numbers for New Zealand. On the other hand, Russia could benefit in many ways from further warming: agriculture could move northwards, the country's vast boreal forests could expand into the present tundra regions and large deposits of oil and gas in the Arctic Ocean could become accessible as the sea ice retreats. A large number of interpretations of 'dangerous climate change' lie in between these two extremes, but the point is that societal judgements of what is dangerous will vary widely around the world—adding another layer of complexity to the task of building a global governance system to control climate change.

Policy challenges

The growing discussion of what constitutes dangerous climate change and economic analyses such as the Stern review (2007) have sharpened the policy debate surrounding climate change. Climate change is not just another environmental issue; it is, in fact, a challenge that goes to the heart of modern civilisation and our relationship with our own life-support system. One of the most complex aspects of devising effective policies to deal with climate change—on a national and a global scale—is that the biophysical characteristics of the climate system correlate poorly with the time scales, assumptions and values/ethics of contemporary policy processes. Below, three such aspects of the climate-policy system are described briefly.

Equity issues

Equity issues—focused sharply on the divide between industrialised and developing countries—cloud the international debate on climate change. Because CO_2 is a non-reactive gas and therefore has a long lifetime in the atmosphere (it will take many centuries for the atmospheric concentration of CO_2 to return to pre-industrial levels after human emissions are reduced to nearly zero), historic emissions play an important role in observed and future climate change. This basic fact has been obscured recently by the focus on China and India as future large emitters. By far, most of the additional CO_2 in the atmosphere now has come from the industrialised world—led by the United States, Europe and Japan. On the other hand, the most severe consequences of climate change will be borne disproportionately by the developing world—exacerbated by the lower adaptive capacity in developing countries. The equity issue is complicated by the ways in which various countries quantify their contribution to a global problem. For example, we in Australia—with only 20 million inhabitants—often argue that our emissions are a very small fraction of the global total, and are already dwarfed by China's emissions. Measured on a per capita basis, however, our emissions are about equal to those of the United States—the highest on the planet—and much higher than China's per capita emissions. The equity issue can be summarised as two fundamental questions: should the assignment of emission reduction targets in any global scheme be decided by aggregates based on national jurisdictions, or should every human being—regardless of the country in which they live—have the same right to the 'atmospheric sink'? How should the historical pattern of CO_2 emissions be factored into emission reduction schemes of the future?

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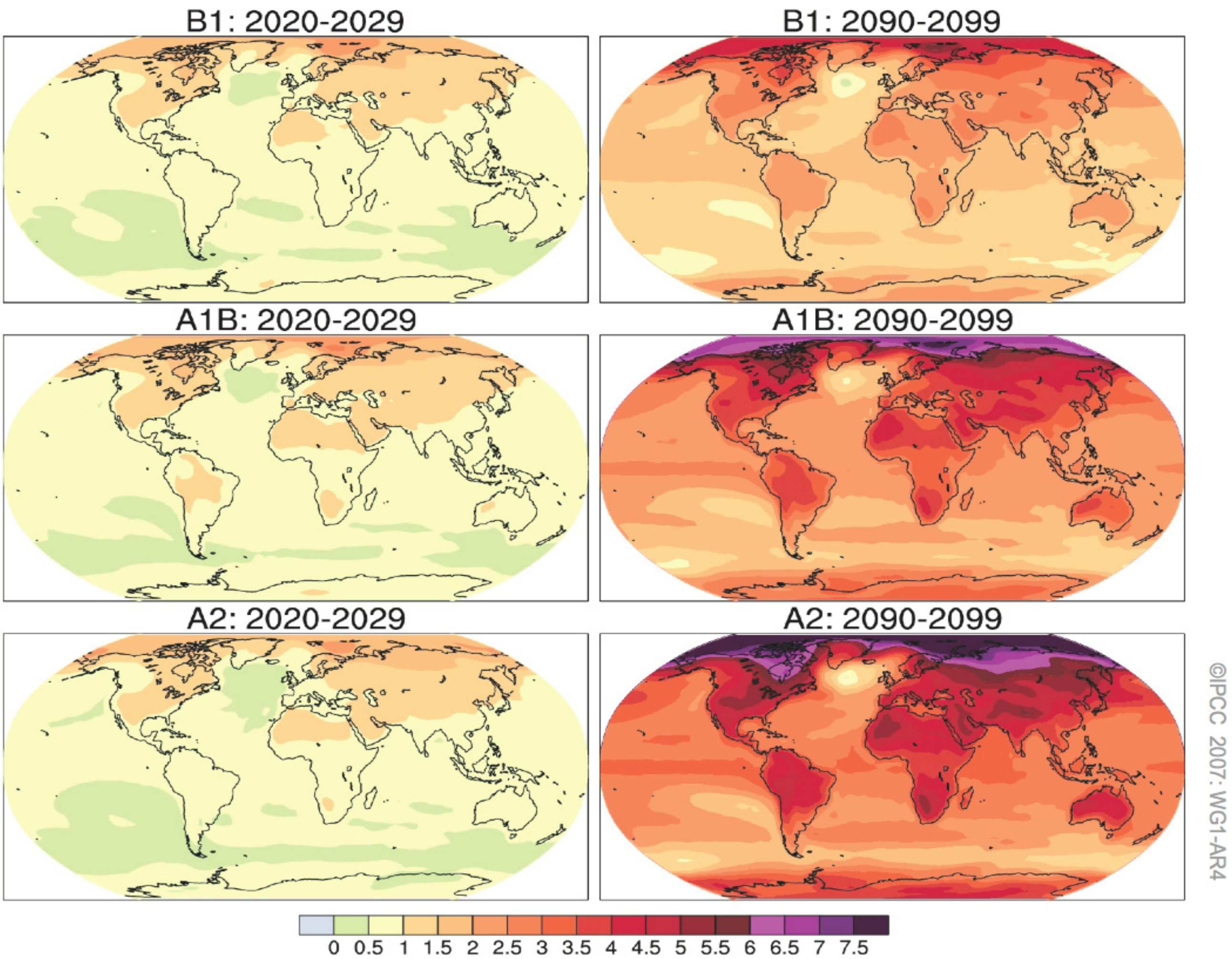
Mismatch in time scales

The very long—from a human perspective—time scales associated with the climate system present unusual challenges to the policy process. This is displayed best visually in Figure 1, which shows various projections of climate change—using global mean temperature as an indicator—for 2020–29 and 2090–99 (IPCC 2007). The challenge for the policy process is that no matter how vigorously we reduce greenhouse gas emissions in the next two decades, it will have virtually no effect on the extent of climate change that we experience during this period. Part of the reason for this is the momentum built into the climate system—due largely to the thermal inertia in the oceans and the cryosphere—which implies that we are committed to another 0.5ºC or 0.6ºC of global mean temperature rise regardless of human action. What government can convince its electorate to make possibly significant sacrifices now with no perceptible effect for 25 years?

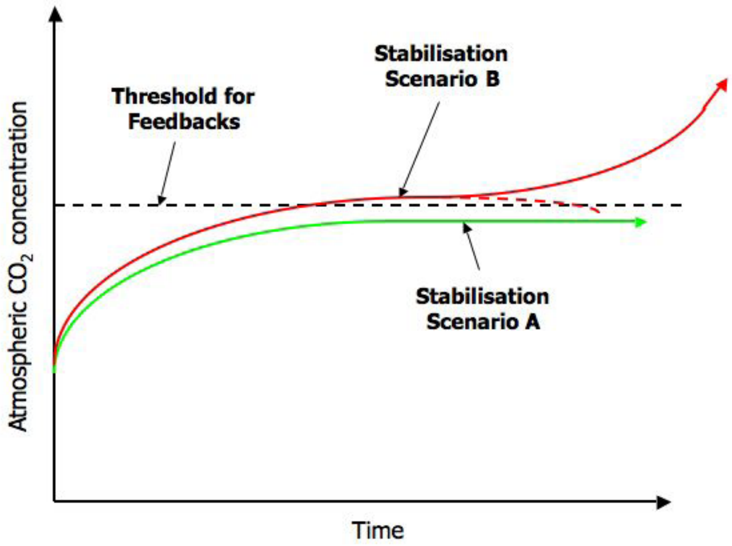
There are, however, even longer lags in the climate system to deal with. If temperatures rise to 2.5ºC or 3ºC above pre-industrial levels, it is highly likely that most of the Greenland ice sheet and parts of the west Antarctic ice sheet will melt—leading to an eventual sea-level rise of about six metres. How long it will take to reach this new sea level is uncertain—with estimates ranging from about only 100 years to a millennium or longer. What is certain, however, is that once this tipping point is reached, there is no going back, even if we could reduce greenhouse gas emissions to zero overnight.

Figure 1 **Multi-model mean of annual mean surface air temperature change, 2020–29 and 2090–99** (degrees Celsius)



Note: Figures are for the scenarios B1 (top), A1B (middle) and A2 (bottom). Anomalies are relative to the average of the period 1980–99.
Source: Intergovernmental Panel on Climate Change (IPCC), 2007. *Working Group 1 Report: the science of climate change*, Cambridge University Press, Massachusetts.

Figure 2 **Risks posed by the 'overshoot' phenomenon**



Notes: Stabilisation scenario A (green line) aims for a target atmospheric CO_2 concentration via an emission pathway that never allows the interim CO_2 concentration to rise above the final target value. Stabilisation scenario B (red line) follows an emission pathway that relaxes the interim targets to allow higher emissions in the near term, allowing the CO_2 concentration to rise above the final target value before dropping later towards the target (broken red line). The interim CO_2 concentration, however, rises above a biophysical threshold value, activating strong feedback processes that accelerate natural emissions of CO_2—and methane—from the land and the oceans. This trajectory (rising solid red line) is now out of policy or management control and will likely lead to dangerous climate change by almost any definition.

Thresholds, abrupt changes, non-linear effects and irreversible changes

From the perspective of the policy debate, one of the most misunderstood—or even ignored—characteristics of the climate system is that it is highly non-linear and is prone to abrupt changes, threshold effects and irreversible changes (in a human time frame) (for example, Hansen et al. 2007). As in any complex system, very small changes in a forcing factor can trigger surprisingly large and sometimes catastrophic changes in a system. In the case of climate, very small, incremental increases of just a few parts per million in atmospheric CO_2 concentration could tip the climate system into a cascade of feedbacks that would propel the Earth into a different climatic and environmental state. Examples include the rapid disintegration of the large ice sheets on Greenland and Antarctica or large-scale and uncontrollable feedbacks in the carbon cycle: activation of methane clathrates buried under the coastal seas, the rapid loss of methane from warmer and drier tundra ecosystems, increasing wildfires in the boreal and tropical zones, the conversion of the Amazon rainforest to a savannah and the release of CO_2 from warming soils. Once a critical threshold was crossed and such a series of processes was triggered, no policy or management approaches could slow or reverse the process. In an indirect way, therefore, CO_2 is very much a 'threshold gas' from the perspective of the climate system.

Threshold/feedback processes raise the issue of 'overshoot'. This refers to the possibility that, on the way to an overall emission reduction target by 2050, interim targets along the way might be relaxed for economic reasons, leading to an overshoot in atmospheric CO_2 concentration. This could lead to a threshold concentration of CO_2 to be crossed, activating the natural feedbacks described above and therefore rendering the original target impossible (Figure 2). The bottom line for policy is that not only is an ultimate target CO_2 concentration based on the biophysics of the climate system critical, the pathway to that target is just as important as the ultimate target itself. This raises the most difficult question that climate policymakers will face: what is the appropriate trade-off between the costs of mitigating climate change and the risk that crossing a critical CO_2 concentration threshold could have catastrophic consequences for modern civilisation?

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Deforestation and climate change

Luca Tacconi

Deforestation is a significant source of greenhouse gas emissions

Land-use change and forestry contribute 17 per cent of total greenhouse gas emissions—the third largest contribution after energy supply (26 per cent) and industry (19 per cent) (IPCC 2007). Most of the emissions from land-use change and forestry originate from deforestation, which means the permanent removal of forest. Forest degradation also contributes to emissions. There is very limited information on the extent of degradation for most countries; therefore, this paper focuses on deforestation.

Deforestation occurs mostly in tropical, low-income countries in Africa, Asia and Latin America. A notable exception was Australia, which was the only industrialised country among the top 20 deforesting countries in the period 2000–05 (Table 1). These countries account for almost 80 per cent of global deforestation.

The need to reduce deforestation has been stressed by the Intergovernmental Panel on Climate Change (IPCC 2007) and the Stern review (2006). Australia has also recognised the need to reduce deforestation—at least in developing countries. In March 2007, the Prime Minister, the Minister for Foreign Affairs and the Minister of Environment and Water Resources announced the A$200 million Global Initiative on Forests and Climate. The objective of the initiative is to facilitate significant and cost-effective reductions in greenhouse gas emissions in developing countries through reductions in deforestation and by encouraging reforestation and the promotion of sustainable forest management.

The causes of deforestation

The causes of deforestation have to be understood to estimate accurately how much it will cost to reduce it and whether financial incentives will be sufficient to achieve the objective.

Given the significance of deforestation, it might be surprising that in most countries there is considerable uncertainty about the current causes. Historically, deforestation was driven by the expansion of agriculture into forested land, the use of timber for energy production and, to a lesser extent, logging to supply timber products (Williams 2003). This trend appears to have continued in recent decades. Recent global reviews have derived conclusions about the causes of deforestation from surveys of other country-level studies that were carried out at different times and which did not cover large areas of the countries studied. These global reviews are useful as they provide an indication of the potential causes of deforestation that need to be researched further. It is not clear, however, to what extent they have been able to pinpoint accurately the causes of deforestation that are relevant to the most significant deforesting countries.

Recent studies of deforestation add corruption and illegal logging to the causes mentioned above. These are new findings and they need to be tested. They highlight, however, that deforestation involves complex relationships and a number of stakeholders, whose interests have to be considered. It is not simply a matter of providing economic incentives to countries—for instance, through a carbon market—to entice some of those stakeholders to reduce deforestation. We will return to governance issues later. Let us now consider the cost of avoiding deforestation.

The cost of avoiding deforestation

The Stern review (2006) reported that the cost of avoiding deforestation—in terms of forgone agricultural production—amounted to US$5 billion a year. This is an approximate estimate because there is limited quantitative information on the costs and benefits of alternative land uses and mitigation options (IPCC 2007). This paucity of information leads to

Table 1 **Deforestation and governance conditions in the top 20 countries**

	Deforestation 2000–05 (sq km[c])	Annual deforestation (%)	Contribution to global deforestation (%)	Public ownership of forest land 2000 (per cent)[c]	Freedom index 2007[d]	Corruption index (rank) 2007[e]	Failed state 2006[f]
Brazil[a]	155,150	0.6	24.1	..	Free	3.60 (72)	No
Indonesia[a]	93,570	1.9	14.5	100.0[b]	Free	2.25 (143)	No
Sudan	29,450	0.8	4.6	97.7	Not free	1.75 (172)	Yes
Myanmar	23,320	1.3	3.6	100.0	Not free	1.40 (179)	Yes
Zambia	22,240	1.0	3.4	..	Partly free	2.60 (123)	No
Tanzania	20,610	1.1	3.2	100.0	Partly free	3.15 (94)	No
Nigeria	20,480	3.1	3.2	100.0	Partly free	2.25 (147)	Yes
Democratic Republic of Congo[a]	15,970	0.2	2.5	100.0	Not free	1.95 (168)	Yes
Zimbabwe	15,650	1.6	2.4	..	Not free	2.10 (150)	Yes
Venezuela	14,380	0.6	2.2	..	Partly free	2.00 (162)	No
Bolivia[a]	13,510	0.4	2.1	..	Partly free	2.95 (105)	No
Mexico	13,020	0.4	2.0	28.0	Free	3.55 (72)	No
Cameroon[a]	11,000	1.0	1.7	100.0	Not free	2.40 (138)	No
Cambodia	10,940	1.9	1.7	100.0	Not free	1.95 (162)	No
Ecuador	9,880	1.7	1.5	..	Partly free	2.15 (150)	No
Australia	9,670	0.1	1.5	..	Free	8.55 (11)	No
Paraguay	8,930	0.9	1.4	..	Partly free	2.25 (138)	No
Philippines	7,870	2.0	1.2	..	Partly free	2.50 (131)	No
Honduras	7,820	2.9	1.2	75.0	Partly free	2.45 (131)	No
Argentina	7,490	0.4	1.2	..	Free	2.90 (105)	No

[a] country included in the Stern report's economic analysis
[b] author's indicative assessment
Note: The lower the score of the corruption index (with a range of 1–10), the higher the corruption level. The rank provides the position relative to the other countries.
Sources: [c] Food and Agriculture Organization of the United Nations (http://faostat.fao.org); [d] Freedom House (www.freedomhouse.org); [e] Transparency International (www.transparency.org); [f] The Fund for Peace (http://www.fundforpeace.org/programs/fsi/fsindex2006.php).

questions about the amount of financial resources required to avoid deforestation.

The background study prepared for the Stern review by Maryanne Grieg-Gran (IIED 2006) estimated the cost of avoiding deforestation by assessing the benefits from agricultural activities that a country would have to forgo. The rationale of this approach is that forests are cleared to enable the expansion of agricultural activities. If, in order to conserve the forest, agricultural activities were not allowed to take place, the country would forgo the benefits that would have been derived from those activities. Given that deforesting countries are normally developing countries, they cannot afford to forgo those benefits and should therefore receive financial compensation.

IIED (2006) reviewed studies that had assessed the returns of various agricultural activities in eight countries—including the five highlighted in Table 1—that accounted for about 48 per cent of global deforestation during the period 2000–05. The cost of avoiding deforestation in those countries was found to range between US$3 billion and US$6.5 billion a year. A scenario resulting in costs of up to US$11 billion a year was also identified. The cost estimate of US$5 billion a year—reported in the Stern review—was identified as a medium-level scenario.

The cost of avoiding deforestation could be significantly higher than the above estimates. For instance, according to this author's assessment, oil-palm cultivation in Indonesia—which in IIED (2006) is assumed to account for about 30 per cent of deforestation in that country—is currently generating financial benefits that are about twice as high as those assumed in the study. Ironically, the increase in the returns from oil-palm cultivation is the result of a surge in the price of palm oil, which is due partly to increased global demand for bio-fuels—palm oil being one of them.

The economic implications of avoiding deforestation are broader than the costs just discussed. First, the impacts on the economy of a reduction in the expansion of agricultural activities are broader than just forgone land-use change benefits. For example, if—in order to avoid deforestation—oil-palm plantations cannot be established, other economic activities will be impacted: palm-oil mills will not be built and construction companies will have less work. Second, there will be social impacts. Continuing with the example of reduced expansion of oil-palm plantations, plantation and mill workers and construction workers would not have employment—at least in those businesses. If the unemployment and underemployment rates are high—as is the case in many deforesting countries—these workers might not be able to find alternative employment. These issues need to be addressed to formulate a comprehensive assessment of the social and economic costs of avoiding deforestation and to formulate appropriate policies.

Development challenges

Deforestation is associated with productive activities such as agriculture and the extraction of timber; therefore, we need to ask: where will the products that would otherwise have been derived from deforested areas come from?

A first option is that productive activities could shift from the area targeted for forest conservation to other areas within the same country. The outcome would be a similar amount of deforestation. A second option is that productive activities shift from the country that reduces deforestation to other countries, which in turn deforest more. Again, there would be no net reduction in deforestation. A third option is that unused and deforested areas—in the country that reduces deforestation or in other countries—are brought under production. A fourth option is that existing producers become more efficient and produce more goods. The third and fourth options would allow avoidance of deforestation while providing the required goods. The real outcome of efforts aimed at avoiding deforestation would probably involve a mix of the above options. It would most likely also involve changes in the price of goods—which, for simplicity, has not been considered. These examples highlight, however, that activities aimed at avoiding deforestation will have significant development implications for the target countries as well as other countries—including industrialised countries.

Industrialised countries need to support deforesting countries to address these development challenges. Avoiding deforestation is not simply an issue of providing compensation for forgone land development.

Governance challenges

Many deforesting countries present very challenging governance conditions (Table 1). Only five of the top 20 deforesting countries are classified as 'free'—that is, they have functioning democracies. The other countries have outright dictatorships or democratic systems that are not functioning well. All the countries listed—with the exception of Australia—have high levels of corruption. Myanmar is perceived to be the most corrupt country in the world and it is ranked one hundred and seventy-ninth, a position shared with Somalia. Brazil and Mexico are ranked seventy-second—the best ranked among the top 20 deforesting countries apart from Australia—but they still have high corruption indices. Five of the top 20 countries are considered to be failed states as defined by the index that assesses social, economic, political-military and institutional conditions.

The contribution of governance conditions to deforestation is uncertain, as already noted. These same conditions, however, present significant challenges to initiatives aimed at reducing deforestation through the provision of financial incentives as well as to addressing the development changes highlighted above.

Many states claim ownership of significant shares of the forest estate (Table 1). This implies that the country could also claim the right to financial incentives received from other governments—or through carbon markets—to reduce deforestation. In many cases, however, local communities who claim traditional rights to forested land dispute the State's ownership of it. In those situations, deforestation for agricultural purposes would most likely continue, unless those communities were involved in the protection of forests and received financial benefits or alternative development opportunities.

High levels of corruption imply that the financial incentive schemes designed to reduce deforestation will face significant management challenges with a high risk of failure and high transaction costs. High levels of corruption are associated also with the capture of large forest areas by government officials and their associates. They would lose access to forest resources if those financial incentive mechanisms were put in place—unless of course they could capture the financial benefits arising from the same incentive schemes.

Failed states present difficult security environments in addition to the challenges of high corruption levels. Significant security problems make it either impossible to establish activities aimed at avoiding deforestation or lead to their failure.

Recommendations

Deforestation contributes a significant share of greenhouse gas emissions and it needs to be reduced. Governments have to address several issues to achieve this objective.

First, the information gap on the costs and benefits of alternative land uses has to be filled. Governments should support research on this issue to allow comparable analyses in Africa, Asia and Latin America. This research should consider also the broader social and economic costs of avoiding deforestation.

Second, governments should support the inclusion of deforestation and forest degradation prevention in the successor to the Kyoto Protocol in order to create a market for carbon credits from these activities. Direct support from industrialised to developing countries will not be sufficient to cover the cost of avoiding deforestation. Even a lower end of the spectrum cost of US$10 billion amounts to almost 10 per cent of global development assistance provided in 2006 (OECD 2007).

Third, donor countries should consider support for forest governance reforms when they support governance initiatives. This support would increase the likelihood of success of deforestation prevention activities.

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Climate change and public policy

Emissions trading for Australia

Frank Jotzo

Australia is set to introduce greenhouse gas emission trading, with both major political parties now committed to implementing a national scheme. The Prime Ministerial Task Group on Emissions Trading (2007) and the states' National Emissions Trading Taskforce (2006) developed the initial proposals (see ANU Institute for Environment 2007). While the framework is beginning to take shape, much debate remains about the design, what targets are to be set and the relationship of Australian emission trading to climate policy internationally.

Emission pricing is seen as the primary policy instrument to cut greenhouse gas emissions cost effectively, as it can deliver a pervasive signal to invest in cleaner technologies and to change production practices and consumption patterns. Specific measures to support the development of low-carbon technologies can play their role alongside emission pricing if they correct a specific additional market failure, such as spill-overs in innovation.

Emission trading requires the regulator putting a cap on total emissions, issuing permits and letting emitters trade those permits ('cap and trade'). Price-based emission control instruments such as emission taxes would be superior in dealing with cost uncertainty, but emission trading has strong political attraction, including being able to define the quantitative outcome from the policy and to channel resources easily to emitters by allocating them free permits.

Greenhouse gas emission trading is already in operation on a large scale in the European Union. Another scheme is to start in the northeastern states of the United States—the Regional Greenhouse Gas Initiative—and various other schemes around the world are in planning or preparation.

Allocating the permits

Imposing a greenhouse gas constraint with emission trading means creating a new commodity: emission permits. The total value of these permits can be very large. To illustrate, if permits were issued in Australia for 400 million tonnes of CO_2-equivalent per annum—roughly the current level of energy-related emissions—and permits were traded at, say, A$25 per tonne (EU permits were traded at about €22/tonne in October 2007), then the total value of Australian permits would be A$10 billion per annum, or about 1 per cent of gross domestic product (GDP).

The prime minister's task group proposed covering practically all of Australia's energy and transport emissions through a combination of direct ('downstream') liability for large emitters and an upstream system covering small emitters—for example, permits at the wholesale fuel distribution level rather than for fuel use in cars and by households. The states' initial proposal covers only large energy-sector emitters, but extending the coverage is now being considered.

Who should receive the newly created permit wealth? Users of energy and energy-intensive goods and services ultimately face the bill in the form of higher prices. Existing high-emission capital equipment such as coal-fired power plants will lose value, and producers of traded energy-intensive goods such as aluminium and steel will find themselves at a disadvantage *vis-à-vis* competitors in countries where there is no carbon pricing.

'Grandfathering'—in which governments hand out free permits to existing emitters in proportion to their past emissions—can give emitters large windfall profits, because most emitters pass on some of their extra costs (for permits or abatement measures) to their customers in the form of higher prices. For example, if power plants receive their permits for free, their net operating costs remain roughly the same, but the price fetched in the market goes up, and profits rise. In the European Union—where most permits are grandfathered—such windfall profits have been estimated in the order of several billion euros a year.

The preferred allocation method from an economic viewpoint is auctioning. If no permits are given away freely, there is no costly lobbying for free permits and no incentives for firms to distort their behaviour to reap more free permits. Auctioning generates revenue, which can be used to lower existing taxes or to finance public spending—including on climate change-related programs. From an equity viewpoint, arguments in favour of full auctioning are that policy changes are a normal business risk, that some form of carbon pricing has been expected for many years and that compensation would be due primarily to consumers. Developments in the United States show that permit allocation by auctioning is feasible politically: under the Regional Greenhouse Gas Initiative, several states are planning to auction 100 per cent of their permits.

The prime minister's task group acknowledged the theoretical superiority of auctioning, but recommended a mixed system of giving free permits to some emitters and auctioning the rest. The proposal is to compensate emitters that face a 'disproportionate burden' in the loss in value of their assets through a one-off allocation of permits of different vintages, including for future years. Similarly, the states' blueprint foresees upfront free allocations to electricity generators to compensate them for negative effects on their profitability.

The compensatory approach has an obvious political attraction in that it could buy out industry interests in a one-off manner. It would, however, base huge financial transfers on contestable modelling. The computation of free permits would require estimating economy-wide costs and firm-level changes decades into the future, and would rely on debatable assumptions about future energy prices, production technologies, emissions targets, permit prices and so forth.

Carbon leakage

The fear of 'carbon leakage'—namely that producers of energy-intensive traded goods such as aluminium and steel might shift production to countries where emissions are not priced—has been a strong impediment to emission pricing in Australia.

The approach in the states' and the federal government's proposals is compensation: firms that are emission intensive and trade exposed would receive free permits to cover the direct and indirect carbon costs they faced. Down the track, free permits would be allocated on the basis of best-practice benchmarks rather than real emissions, and free allocation would cease if and when international competitors were subject to similar carbon costs.

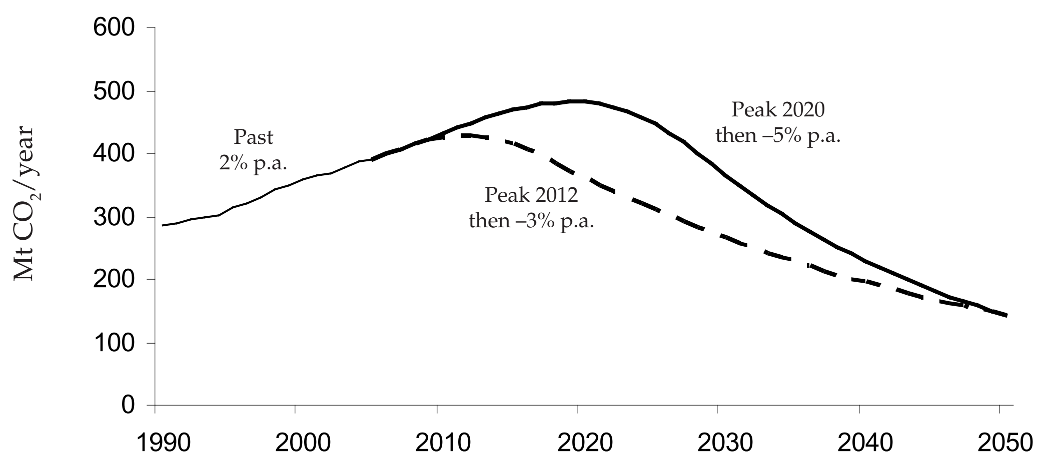
The compensation approach has the advantage that trade-exposed firms would face similar incentives as other emitters to use more efficient technology and practices. The prices of traded, emissions-intensive products in Australia would, however, not reflect the carbon price, so there would be no price incentives to substitute high-emission for low-emission materials—for example, opting for timber rather than steel in construction.

The main alternative in the discussion is border tax adjustments. Production for export would be exempted from the carbon price and any imports might be taxed for their carbon content. It has been argued that border taxes would be difficult to implement, particularly for imports. Then again, such adjustments would likely need to apply only to a small number of industries and firms engaged in exports.

Targets

To limit the risk of dangerous climate change, global greenhouse gas emissions will have to be reduced drastically in coming decades (see paper by Will Steffen in this policy brief). What levels of emissions and risk are acceptable is ultimately a question of societal choice. Proposals in the international discussion are for reductions of 50 per cent or more in global emissions relative to the year 2000 by 2050. Reduction commitments will likely need to be stricter in rich countries than in the developing world, because of differences in abilities to pay and historical responsibility for climate change.

Table 1 **Paths for halving Australia's energy-related emissions**



To illustrate the magnitude of the challenge, consider halving Australia's energy-related emissions by 2050 compared with 1990 levels (approximately –60 per cent compared with 2000). If prompt policy action was taken and emissions peaked in 2012, then annual reductions of –3 per cent would be needed thereafter, compared with growth in the past two decades of about 2 per cent a year on average. Delaying the peaking of emissions until 2020 would require reductions of close to –5 per cent per year later on. This is a relatively weak reduction scenario, compared to what may be needed to stabilise greenhouse gas concentrations in the atmosphere at acceptable levels.

Achieving and sustaining ambitious policies that will deliver such reductions could be difficult politically in a purely domestic scheme. Each review of the policy could bring temptation to lessen ambition and to postpone stringent action. This in turn would affect expectations of future carbon prices and weaken incentives to invest in low-emission technology.

International linking and trading

A straightforward way to commit to more sustained incentives is to link Australian emission trading comprehensively to other schemes internationally. The permit price in Australia is then equal with that internationally. As a relatively small country, Australia's choice of target would affect international permit trade flows, but leave the permit price and the incentive to reduce emissions almost unchanged. To lower the carbon price in Australia would require opting out of the international system—a much bigger hurdle than just revising the target.

International emission trading also provides a way of enticing new participants into the scheme. Industrialising or developing countries could be drawn into the linked scheme through relatively generous initial targets. They would face the same marginal cost and incentive to abate, but sell freed-up permits to other countries.

To be compatible with each other, national emission trading schemes need to be harmonised in many aspects. Perhaps the biggest obstacle to linking is the price cap—or 'emission fee'—in the Australian proposals, especially in the report of the prime minister's task group. This would create an upper limit on the permit price by way of the government issuing additional permits into the market at the predetermined threshold level. A price cap reduces the risk of a cost blow-out given uncertainty about abatement costs. In an internationally linked scheme, however, the level of a price cap would have to be the same between countries; otherwise emitters in 'linked' countries could comply with their obligations simply by purchasing permits originating in the country with the lowest threshold price, which would be unacceptable to governments.

Post-2012 international climate policy

With the first commitment period to the Kyoto Protocol ending in 2012, negotiations about the next phase of international climate policy are getting under way and could formally be launched at the Bali UN climate conference in December. There is now broad support internationally for working toward a future climate treaty under the UN Convention on Climate Change, but it remains to be seen what shape it might take.

Competing visions include a continuation of the Kyoto Protocol and a system based on pledges and reviews rather than emission targets. Despite the apparent dichotomy, there is room for convergence: a post-2012 treaty could take basic elements from the Kyoto Protocol, but offer much more flexibility and a broader range of commitments (Jotzo 2007). Targets could be indexed to economic growth, be made non-binding as an entry point for developing countries or apply only to specific sectors of economies that are not ready to commit to national targets. The Kyoto Protocol Clean Development Mechanism for developing countries could be expanded beyond individual projects to cover whole sectors or policies. Credit could be given to measures that are desirable but which do not result in readily quantifiable emission reductions, such as funding for research on future clean technologies or funding to avoid deforestation.

International developments need to be taken into account in deciding Australia's climate policy. As a relatively small economy, Australia's biggest contribution could be by encouraging other countries to act. Effective domestic policies—including a well-designed and ambitious emission trading scheme—will be crucial in that effort.

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