The Australia Institute Submission Number 4

Land-use change and Australia's Kyoto target

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Executive Summary

Although the Government's 'victory' in achieving a target of 108% under the Kyoto Protocol has received much publicity, in fact the last-minute insertion of the 'Australia clause' of the Protocol is arguably of greater significance.

The Australia clause allows countries to include emissions from land clearing to be added to their 1990 baseline to calculate the emissions target in the Kyoto commitment period of 2008-2012. In practice, it applies only to Australia. Higher baseline emissions imply a higher target, and if emissions from land clearing are declining for other reasons, this frees up allowable emissions for other sectors.

The bulk of land clearing occurs in Queensland – 70% of the Australian total in 1990 and 93% in 1997. Net emissions from land clearing (known as Forest and Grassland Conversion) were high in the 1990 base year but have since fallen sharply – from 102.7 million tonnes of carbon dioxide equivalent (Mt CO_2-e) in 1990 to 64.8 Mt in 1997, a decline of 37% over 6 years. Emissions from land clearing fell from 20.9% of Australia's total emissions in 1990 to 13.1% in 1997. The reasons for this decline are unclear but are probably related to the declining commercial profitability of clearing for grazing in the 1980s and 1990s and the fact that the best grazing land was converted in earlier decades.

The course of emissions from land clearing between now and the commitment period will have a major bearing on how much fossil emissions can increase. Three scenarios are considered:

1. The rates of land clearing that prevailed in 1997 remain unchanged through to 2010. In this case emissions from land clearing will be 54 Mt CO_2-e in 2010.

2. Land clearing falls by 20,000 ha per year from 2000, a policy announced by the Prime Minister in November 1997. In this scenario emissions from land clearing fall to 29 Mt CO_2-e in 2010.

3. No net loss of vegetation from 2001, the objective of the Federal Government's Bushcare program. In this scenario emissions from land clearing fall to 8 Mt CO_2-e in 2010.

Simple calculations show that even if rates of land clearing do not continue to decline (Scenario 1) then emissions from Australia's fossil fuel and other sectors can increase by 22% while Australia remains within the 8% overall target set at Kyoto. If the Government implements its announced plan to reduce land clearing by 20,000 ha/an then emissions from the fossil fuel and other sectors can increase by 28%.

If the Government succeeds in implementing its Bushcare objective of no net loss of vegetation then fossil and other emissions can increase by 33% above 1990 levels while Australia still meets its overall Kyoto target.

If Australia had agreed at Kyoto to reduce land clearing emissions to 29 Mt by 2010 and to limit fossil emissions growth to 18% above 1990 levels by 2010 – both of which were clearly announced Government policies – then Australia could have agreed to a target of 100% of 1990 emissions by 2008-2012 and avoided a great deal of international criticism.

Estimates of Australia's emissions from land clearing are extremely sensitive to estimates of the area cleared in each relevant year. According to the official inventory the area cleared fell by half between 1990 and 1991, from 675,000 ha to 331,000 ha. If the precipitate decline in rates of land clearing had occurred one year earlier (that is, before the Kyoto base year) then Australia's Kyoto target would be substantially lower – 528 Mt instead of 560 Mt.

Thus the fact that the large fall in the rate of land clearing occurred in 1991, and not in 1990 or earlier, was extremely fortuitous for it means that Australia's total allowable emissions under the Protocol are 6% higher than they might otherwise be, an extra tranche of emissions that may be worth $640 million in emission permits. The 6% is a very large number by any standard and Australia's land clearing data will undoubtedly attract intense scrutiny from other Parties to the Framework Convention.

1. The Australia clause

A proper understanding of Australia's Kyoto commitment is impossible without appreciating the unique role of land clearing in Australia's total greenhouse gas emissions. Although the Government's 'victory' in achieving a target of 108% has received much publicity, in fact the last-minute insertion of the 'Australia clause' in Article 3.7 of the Protocol is arguably of greater significance.

The clause allows the inclusion in the 1990 base year of net emissions from land clearing and thus increases the allowable target emissions in the commitment period 2008-2012. The clause, which effectively benefits only Australia, was included in the dying hours of the negotiations at Kyoto. The world's negotiators, preoccupied with the bigger issues involving the USA, Japan and the European Union were unaware of the implications of its inclusion.[1] As the implications have become clearer, other nations have reacted with dismay.[2] There are now officers in the European Union whose duties include monitoring the issue of land-use change in Australia, and who are better informed on the question than all but a handful of Australians.[3]

The Australia clause states:

> Those parties included in Annex 1 for whom land-use change and forestry constituted a net source of greenhouse gas emissions in 1990 shall include in their 1990 emissions base year or period the aggregate anthropogenic carbon dioxide equivalent emissions by sources minus removals by sinks in 1990 from land-use change for the purpose of calculating their assigned amount.

The implications of the Australia clause have been examined in detail by Hamilton and Vellen (1999) in a paper published in the international scientific journal *Environmental Science and Policy*. That analysis was based on the official 1996 inventory of greenhouse gas emissions published by the Australian Government in 1998. The 1997 inventory, released in September 1999, contains data for 1997 and revised estimates of emissions for the years 1990-1996. The estimates for emissions from land-use change, now known as forest and grassland conversion (F&GC), have been extensively revised on the basis of remotely sensed data.

This submission updates the analysis in Hamilton and Vellen using the new data from the 1997 inventory and analyses the policy implications.[4]

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[1] The Government has argued that the figures on land-use change were included in Australia's national communication and were not concealed. While this is so, the implications were not spelled out and there is little doubt that negotiators from other countries did not appreciate the significance of the clause for Australia's target.

[2] An issue covered in another of the Institute's submissions.

[3] There is a well-sourced report that a team of French scientists travelling unofficially on tourist visas spent some weeks in Australia in early 1999 quietly gathering information on land-use change in Australia in the context of the Kyoto Protocol. Their visit included several field trips to Queensland and western NSW.

[4] The methodology for estimating emissions from LUC (see Hamilton and Vellen 1999) did not change in the 1997 inventory. The changes were in the data for area cleared and carbon content of woody roots.

In the inventory the Land Use Change and Forestry (LUC&F) sector has four subsectors, of which the first two are the important ones:

- Forest and Other Woody Biomass
- Forest and Grassland Conversion (F&GC)
- Abandonment of managed lands (not estimated)
- Other (including non-CO2 from fire and pasture improvement).

This paper focuses on changes in emissions from the F&GC subsector (i.e. land clearing). Although Australia is a world-leader in research in this area, the estimates in the inventory of emissions from land clearing remain very uncertain. The Australian Government argues that it excludes land-use change emissions from the national totals of the inventories because of concern about the accuracy of land conversion data and the emissions that are generated from this activity. However, this uncertainty does not provide a reason for ignoring F&GC in the development of a policy response to climate change, especially as the final numbers agreed will have a substantial effect on allowable emissions from fossil sources. Moreover, uncertainties in the estimation of emissions from agriculture are also large, but this has not provided a reason to exclude them from the totals.

2. Comprehensive emissions

The Australia clause in Article 3.7 of the Kyoto Protocol allows Australia to increase its 1990 baseline emissions.[5] If emissions from F&GC form a large proportion of total emissions, and those emissions are falling irrespective of actions taken to reduce greenhouse gas emissions, then this will permit a greater expansion of emissions from fossil fuels than the 108% target suggests. This paper makes estimates of the extent to which the inclusion of the Australia clause will permit the expansion of fossil sectors by the commitment period 2008-2012.

But first there is an important issue concerning the interpretation of Article 3.7 that has a major bearing on the calculation of base year emissions. The clause provides a trigger which permits a Party to include land use change emissions in its base year amount; it applies to "[t]hose Parties … for whom land-use change and forestry constituted a net source of greenhouse gas emissions in 1990 …". This trigger applies almost exclusively to Australia.[6]

However, the clause goes on to say that those Parties to whom this applies "shall include in their 1990 emissions base year or period the aggregate anthropogenic carbon dioxide equivalent emissions by sources minus removals by sinks in 1990 *from land-use change*

[5] This is referred to in Europe as 'baseline inflation' (see eg. Oberthur and Ott 1999, p. 134).
[6] Britain and Estonia have net emissions from land use change and forestry, but the numbers are very small.

for the purposes of calculating their assigned amount" (emphasis added). In other words, while the trigger mechanism refers to emissions from both land-use change and forestry, the affected parties shall include in their base year calculations net emissions and removals from land-use change but not from forestry.

Since the forestry sector in Australia is a net sink in the terms of the Protocol, the effect of both including land-use change and excluding forestry is to increase Australia's base year emissions. In our view it is quite inconsistent to treat land use change and forestry in different ways and acceptance of the wording of Article 3.7 may have been a mistake on the part of the negotiators in the last hours of the Kyoto Conference.

Nevertheless, in calculating Australia's emissions task below we have interpreted the clause literally to exclude net emissions from forestry from the base year. This is the interpretation favoured by the Australian Government. It increases base year emissions and therefore the allowable emissions in the commitment period when the 108% factor is applied.

In Table 1 we set out Australia's comprehensive emissions for 1990-1997 measured in millions of tonnes of carbon dioxide equivalent (Mt CO_2-e) using the figures from the most recent inventory issued in September 1999. Following the IPCC, the term 'comprehensive' is used to refer to emissions of all gases from all sources and all sinks. Table 1 is necessary because the Australian inventory does not include emissions from land-use change in the summary tables of emissions, so it is not possible to get the full picture from the inventory. The Government claims that this is because emissions from land clearing are more uncertain than emissions from other sources, but this is not a valid reason to obscure Australia's total emissions picture.

Table 1 Emissions by sector and comprehensive emissions, Australia 1990-1997 (Mt CO_2-e)

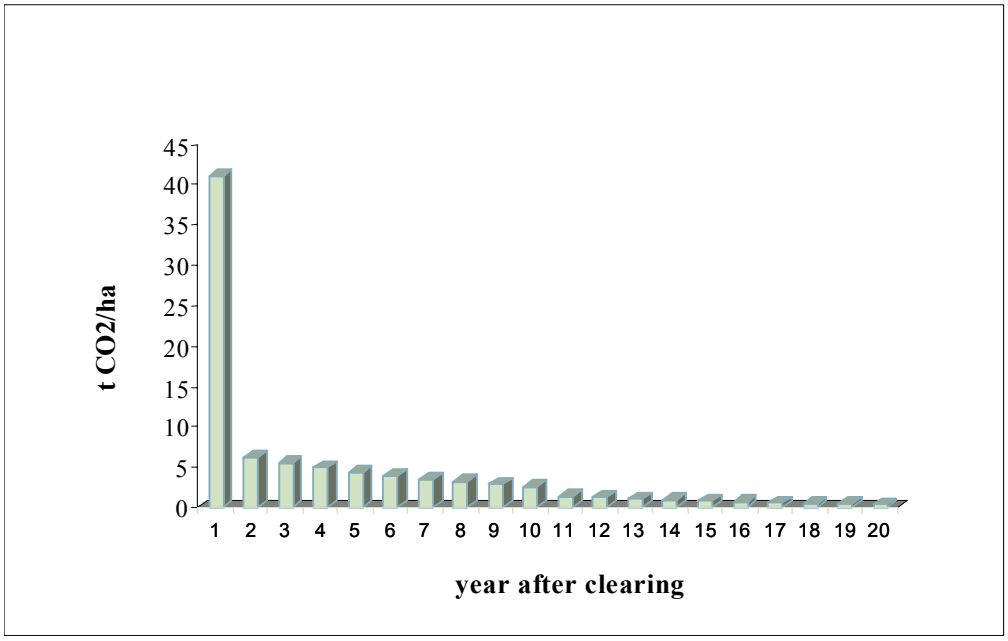
	1990	1991	1992	1993	1994	1995	1996	1997
Total comprehensive emissions	491.3	464.2	462.5	463.6	465.2	476.2	491.0	496.1
Total comprehensive emissions less Forestry and other	518.4	490.7	489.5	490.2	490.9	501.2	515.9	522.6
Energy	296.7	298.4	302.4	305.0	308.6	321.3	331.9	339.0
Industrial processes	12.1	11.7	10.4	10.2	9.9	9.0	9.2	9.0
Waste	14.8	15.1	15.3	15.6	15.6	15.2	15.3	15.6
Agriculture	92.1	92.5	91.3	92.0	92.0	93.0	92.9	94.2
LUC&F (total net)	75.6	46.5	43.1	40.8	39.1	37.7	41.7	38.3
F&GC (net)	102.7	73.0	70.1	67.4	64.8	62.7	66.6	64.8
Forestry and other (net)	-27.1	-26.5	-27.0	-26.6	-25.7	-25.0	-24.9	-26.5

Source: Derived from NGGIC 1999c, Appendix 1

3. Emission scenarios

What is the likely path of emissions from F&GC between 1990 and 2008-2012? We calculate three scenarios that vary with respect to the assumed rates of decline in emissions from land-use change. The analysis employs a model of emissions from land-use change incorporating decay functions for above-ground and below-ground biomass of various forms. Figure 1 shows the profile of emissions from one hectare of land for the first 20 years after clearing. Most of the emissions occur in the first year due to burning of above-ground biomass. After 10 years all above-ground and below-ground biomass is assumed to have decayed, leaving only continued emissions from soil carbon being released according to an exponential decay function.

Figure 1 Total net CO2 emissions from one hectare of cleared woodland (tCO2/ha)



Source: Institute estimates based on NGGIC 1997 methodology and data.
Note that in Figure 1 emissions are measured in C rather than CO_2.

It should be noted from Table 1 that net emissions from F&GC have been falling sharply – from 102.7 Mt in 1990 to 64.8 Mt in 1997, a decline of 37% over 6 years. Put another way, emissions from F&GC fell from 20.9% of Australia's total emissions in 1990 to 13.1% in 1997. The reasons for this decline are unclear but are probably related to the declining commercial profitability of clearing for grazing in Queensland in the 1980s and 1990s and the fact that the best grazing land was converted in earlier decades. The sharp decline in area cleared between 1990 and 1991 is discussed in Section 5 below. Three scenarios for emissions from F&GC are worthy of consideration.

Scenario 1 This scenario assumes that the rates of land clearing that prevailed in 1997 remain unchanged through to 2010. In this case we estimate that emissions from LUC will be 54 Mt CO_2-e in 2010. This figure has been calculated using the same

methodology and data as updated in the inventory (NGGIC 1997) and reflects the fact that a decline in land clearing in a given year will drag down emissions for more than 20 years due to the decay rates assumed in the methodology.

Scenario 2 This scenario is based on the statement by the Prime Minister in November 1997 that announced measures that are expected to see land clearing fall by 20,000 ha/a. We assume that this starts in the year 2000 and is sustained through to 2010. In this scenario emissions from F&GC fall to 29 Mt CO_2-e in 2010.

Scenario 3 The third scenario is based on the stated objective of the Federal Government's Bushcare program, i.e. no net loss of vegetation from the year 2000.[7] This has been interpreted to mean zero net clearing from 2002 onwards, with the rate halved in 2001. In this scenario emissions from F&GC are expected to fall to 8 Mt CO_2-e in 2010.

Figure 2 shows the path of net emissions from F&GC under the three scenarios.

Figure 2 Net emissions from F&GC 1990-2010, three scenarios (Mt CO_2-e)

[7] This is the interpretation put on the Bushcare program in media reports of correspondence between Senator Hill and State Governments (see, eg. ABC TV, 7.30 Report, 6 October 1999). The official objectives of the program are less clear. The national goal of Bushcare is to 'reverse the long term decline in the quality and extent of Australia's native vegetation'.

4. Australia's emissions task

Combining the estimated comprehensive emissions in 1990, the Kyoto 108% target, and the land-clearing scenarios we can estimate Australia's fossil emissions allowable under the Protocol. Table 2 sets out the emissions task facing Australia when all sources and sinks are included. In the table, Australia's total emissions are divided into just two categories:

1. net emissions from all sources other than land-use change (F&GC), including forestry, which we refer to as 'fossil fuels plus'; and

2. net emissions from land use change (excluding forestry), i.e. F&GC.

Australia's target (or QELRO) under the Kyoto Protocol is 108% of 1990 base year emissions by the 2008-2012 commitment period. This has been applied in Table 2 to total comprehensive emissions in the 1990 base year to calculate Australia's assigned amount or target.

It is apparent from Table 2 that even if rates of land clearing do not continue to decline (Scenario 1) then emissions from Australia's fossil fuels plus sectors can increase by 22% while Australia remains within the 8% overall target set at Kyoto. If the Government implements its announced plan to reduce land clearing by 20,000 ha/a, and emissions from F&GC fall to 29 Mt in 2010, then emissions from the fossil fuel plus sectors can increase by 28%.

If the Government succeeds in implementing its Bushcare objective of no net loss of vegetation then emissions from land-use change will fall to 8 Mt in 2010. This will allow fossil and other emissions to increase by 33% above 1990 levels while Australia still meets its overall Kyoto target.

The comprehensive inventory figures calculated for this paper reveal some interesting trends. Figure 3 shows the change in emissions from all sources. While total comprehensive emissions declined sharply between 1990 and 1992, they turned upward in 1993 and have risen rapidly since 1994. This is because, in the absence of adequate policy response in the energy sectors, the fall in emissions from land-use change (unrelated to greenhouse policy) has not been able to continue to offset the rapid growth in emissions from the fossil fuel sectors. This is apparent in Figure 4 which shows the changing sectoral shares of Australia's comprehensive emissions.

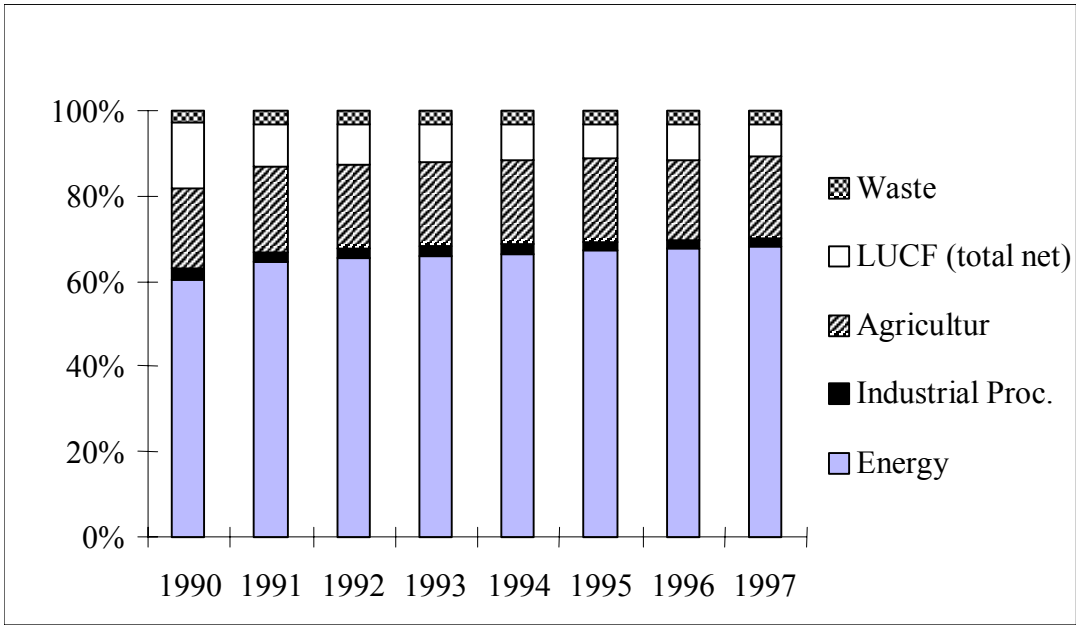
Table 2 Australian emissions from fossil fuels and F&GC under three land-clearing scenarios, 1990 and 2008-2012 (Mt)

	Mt CO_2-e	Change on 1990
1990 emissions		
Fossil fuels plus	416	
F&GC	103	
Total	518	
2008-2012 emissions: Scenario 1	No change	
Kyoto target[a]	560	+108%
Expected F&GC emissions[b]	54	-48%
Fossil fuels plus target	506	+122%
2008-2012 emissions: Scenario 2	PM's	
Kyoto target[a]	560	+108%
Expected F&GC emissions[b]	29	-72%
Fossil fuels plus target	531	+128%
2008-2012 emissions: Scenario 3	Bushcare	
Kyoto target[a]	560	+108%
Expected F&GC emissions[b]	8	-92%
Fossil fuels plus target	552	+133%

a. Calculated as a percentage increase on the relevant 1990 total emissions.
b. Calculated as a percentage fall on the relevant 1990 F&GC emissions.

Figure 3 Total comprehensive greenhouse gas emissions for Australia 1990-1997 (Mt CO_2-e)

Figure 4 Shares of total comprehensive emissions in Australia by sector 1990-1997 (%)



5. Estimates of rates of land clearing

Emissions from F&GC depend first and foremost on estimates of rates of land clearing. These data have been the focus of a considerable amount of work over recent years with information drawn initially from rough and ready estimates in the field and increasingly from much more accurate remotely sensed data, i.e. satellite imagery. The latest inventory relies more heavily than the previous one on satellite imagery but acknowledges that the work is on-going. The land-clearing data which form the basis of estimates of emissions from F&GC in the latest inventory are summarised in Table 3. The annual land clearing for Queensland and Australia as a whole are graphed in Figure 5.

Figure 5 Land-clearing rates in Australia and Queensland 1983-1997 (000 ha/year)

Source: NGGIC 1999c, Table 1

It is apparent that the bulk of land clearing occurs in Queensland – 70% of the Australian total in 1990 and 93% in 1997. The Queensland data are derived from the SLATS research project (Statewide Landcover And Trees Study) (NGGIC 1999c). The inventory notes that the 1990 clearing figure for Queensland (475,000 ha) is an 'interim sample'

figure only. It recommends a high degree of caution and suggests that the true figure could lie in the range of 350,000 to 600,000 ha/y (NGGIC 1999c).

Table 3 Land-clearing rates by State used in the 1997 inventory (000 ha/year)

Year	QLD	NSW	WA	Others	TOTAL
1983	298	52	93	55	498
1984	298	52	93	55	498
1985	298	52	93	55	498
1986	298	52	93	55	498
1987	298	52	93	55	498
1988	475	52	93	55	675
1989	475	52	93	55	675
1990	475	52	93	55	675
1991	285	16	21	8	331
1992	285	16	21	8	331
1993	285	16	21	8	331
1994	285	16	21	8	331
1995	285	16	21	8	331
1996	350	16	6	8	382
1997	350	16	2	8	378

Source: NGGIC 1999c, Table 1

Figure 5 and Table 3 show a sharp increase in land clearing between 1987 and 1988 followed by a halving of the rate between 1990 and 1991, from 675,000 ha to 331,000 ha. This estimate of a sharp decline in the rate of land clearing has major implications for Australia's Kyoto target. The previous section of this paper showed that Australia's Kyoto target in the commitment period, 108% of 1990 emissions, amounts to 560 Mt CO_2-e. If the precipitate decline in rates of land clearing had occurred one year earlier (that is, before the Kyoto base year) then Australia's Kyoto target would be substantially lower. The Institute estimates that the new target would be 528 Mt.[8] Thus the fact that the large fall in the rate of land clearing occurred in 1991, and not in 1990 or earlier, was extremely fortuitous for it means that Australia's total allowable emissions under the

[8] Obtained from Table 1 above by shifting the F&GC (net) row one year to the left so that net emissions in 1990 are 73.0 instead of 102.7 Mt.

Protocol are 6% higher than they might otherwise be. While enormous diplomatic effort was invested in gaining agreement to an 8% headline increase in emissions under the Protocol, a mere measurement decision makes a 6% difference in the target as a result of the Australia clause. This is a very large number by any standard and Australia's land clearing data will undoubtedly attract intense scrutiny from other Parties to the Framework Convention.

6. Conclusions and policy implications

The land-clearing loop-hole

The analysis of Australia's comprehensive greenhouse gas emissions using the latest official inventory shows that the expected decline in land clearing will mean that emissions from fossil and other sources will be able to increase by between 22% and 33% rather than the 8% figure anticipated at Kyoto.

The inclusion of the 'Australia clause' in the Kyoto Protocol opened up a large loop-hole which only one country is in a position to exploit. Parties other than Australia were unaware of the implications of this clause at Kyoto. Had they been aware of them, the land-clearing concession made to Australia would have perhaps provided the Kyoto negotiators from other Parties with the evidence to demand that Australia cut its emissions by considerably *more* than Europe, Japan and the USA.

Is it apparent from the analysis above that land-clearing emissions have become Australia's equivalent to Russian 'hot air', a phenomenon that is causing serious division amongst the Parties to the Protocol. Instead of fossil emissions declining due to industrial shutdown, as in the Russian case, land-use emissions are falling due to commercial factors unrelated to greenhouse policy. This why a recent European analysis of the Kyoto Protocol drew the following conclusion: 'The Kyoto targets surely have two main winners: Russia and Australia'.[9]

If Australia had agreed at Kyoto to reduce land clearing emissions to 29 Mt by 2010 and to limit fossil emissions growth to 18% above 1990 levels by 2010 – both of which were Government policies – then Australia could have agreed to a target of 100% of 1990 emissions by 2008-2012. As it stands, Australia's fossil emissions will be able to increase by up to 33% while other industrialised countries are cutting their fossil emissions. This is especially anomalous since, as we have shown elsewhere (Hamilton 1997), Australia will find it *easier* to cut fossil emissions than most other industrialised countries.

This paper has also demonstrated the extreme sensitivity of estimates of land-clearing emissions to technical measurement decisions. We noted that if the estimated fall in land clearing rates had occurred in 1990 rather than 1991, as the inventory shows, then this would result in a fall of fully 6% in Australia's allowable emissions in the commitment

[9] The authors go on to observe that the Australian deal 'has set a bad precedent for future negotiations, especially with regard to developing countries' (Oberthur and Ott 1999, pp. 137-38).

period. This sensitivity can be illustrated in another way. The revision to estimates of land clearing emissions in the 1997 inventory resulted in a 14% increase in estimated 1990 base year emissions (from 90 to 103 Mt). If tradable emission permits are valued at $20 per tonne of CO_2,[10] then this single revision to the inventory is worth $260 million to Australia. The fact that the sharp fall in rates of land clearing are reported to have occurred between 1990 and 1991, and not between 1989 and 1990, results in an additional 32 Mt of allowable emissions valued at $640 million.

Policy errors

The opportunity to end land clearing provides a means of making a large contribution to meeting Australia's Kyoto target very cheaply. It is, moreover, a Federal Government policy objective for reasons unrelated to climate change. Based on ABARE data, Ryan (1997) has estimated that the cost of ending land clearing in terms of forgone agricultural output would be less than $2 per tonne of CO_2 emissions saved. This compares with the AGO's best estimate of the abatement cost of $30 a tonne, and the Australia Institute's $20 a tonne of CO_2.[11] This suggests that ending land clearing in Queensland would make a very large a contribution to meeting Australia's Kyoto target at around one-tenth the cost of other measures.

However, current Federal Government policies appear to be working in the opposite direction, especially in pursuit of the Bushcare program objective of no net clearing of land by 2000. Environment Minister Senator Robert Hill was recently reported to have threatened to withhold $34 million in Bushcare grants to Queensland because it seems unlikely to meet the objective. As a result of this pressure from Canberra, and the expectation that the Queensland Government will respond by introducing legislative restrictions on land clearing on both freehold and lease-hold land, land holders in Queensland have reportedly increased clearing activity greatly. Bulldozers are reported to be working 24-hours a day including under floodlights at night.[12]

The error in this approach, and the solution to it, are obvious. Instead of withholding funds if landholders clear land, it would make sense to use the money to compensate landholders who agree not to clear. If 350,000 ha are being cleared each year in Queensland (the inventory figure for 1997) then $34 million amounts to around $100/ha. This compares to the estimated economic value of land clearing in Queensland of around $40/ha.[13] On average, each hectare of land cleared results in the net release of at least 87 tonnes of CO_2-e.[14] In other words, instead of withholding funds if land clearing is not stopped, the funds should be used to compensate land holders for not clearing. This would be a much more effective means to end land clearing.

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[10] See the discussion of prices of emission permits in Hamilton and Turton (1999).
[11] ABARE has estimated the marginal cost of abatement to be several times higher.
[12] *Sydney Morning Herald*, 30 October 1999; ABC TV 7.30 Report, 6 October 1999.
[13] This is the capitalised value of lost income streams as a result of proposed restrictions on tree clearing in Queensland, estimated in ABARE (1995), Table 5.1.
[14] Uses inventory methodology and a time frame of 20 years for soil carbon applied to Queensland woodland. Amore inclusive estimate would be substantially higher.

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