Mitigation Targets, Burden Sharing and the Role of Economic Modeling in Climate Policy

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Introduction

One of the current headline issues in climate policy is the resubmission process for national targets under the Kyoto Protocol. By the end of April 2014, all parties to the Protocol are supposed to have made a submission 'relating to its intention to increase the ambition of its commitment' (UNFCCC Secretariat 2012: 3). At the time of writing, the recently created Department of Industry, Innovation, Climate Change, Science, Research and Tertiary Education (DIICCSRTE) was working through the Government's position on the target and considering whether it should move beyond the unilateral target of a 5% reduction in emissions on 2000 levels by 2020. Simultaneously, the Climate Change Authority —one of several new statutory authorities created as part of the Clean Energy Future package — was effectively doing the same thing in its 'Caps and Targets Review' (Climate Change Authority 2013).

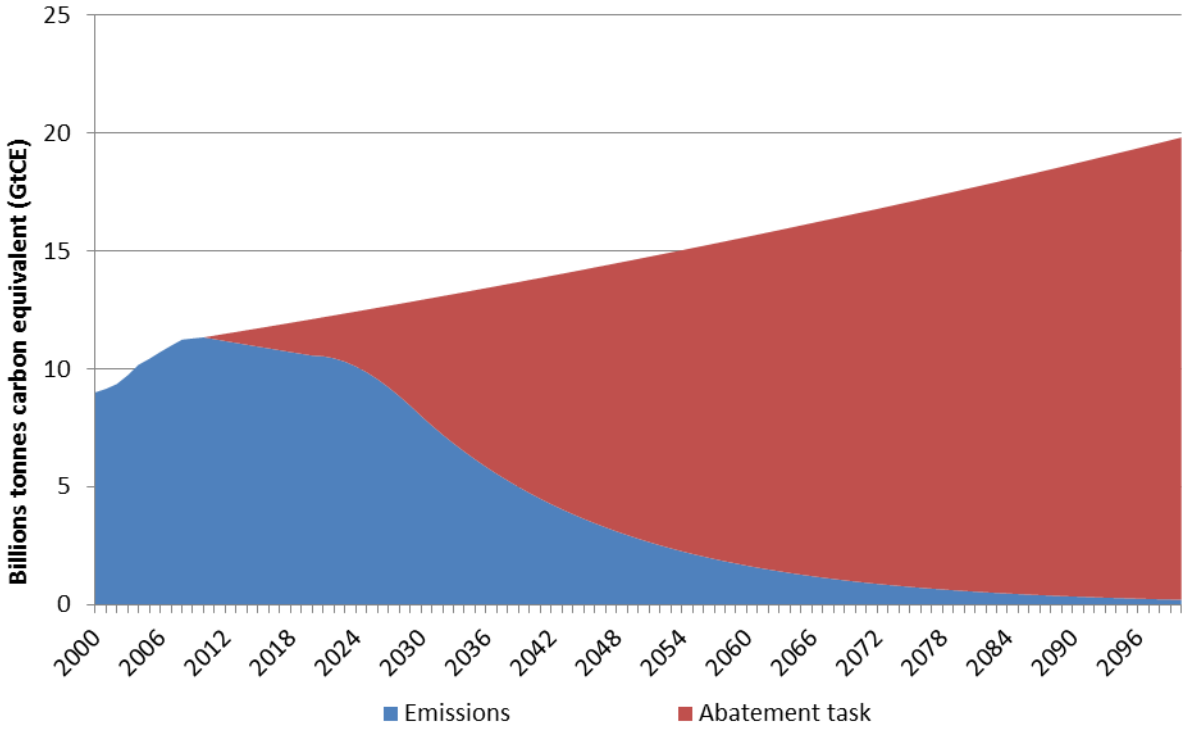
If these and other similar processes elsewhere are to be based on something other than raw self-interest, the starting point should be a decision on what ethical framework will determine the targets. There is an extensive literature on methods and approaches to target setting that goes back several decades (Beckerman and Pasek 1995; Rose et al. 1998; Baer et al 2000; Berk and den Elzen 2001; Germain and van Steenberghe 2003; Gupta et al. 2007; Chakravarty et al. 2009; Ekardt and von Hövel 2009; Müller et al. 2010; Oberheitmann 2010). Reduced to their most simple, the proposed approaches can be divided into two groups based on their starting points: 'resource division' and 'burden sharing'. Under the resource division approach, the remaining cumulative global emissions that are consistent with the desired climate outcome (what is often called the 'global emissions budget') is treated as a resource that needs to be divided up between countries. This is analogous to allocating a finite mineral resource — it has even been referred to as an emissions pie (Broecker 2009). Advocates of this approach often come down in favour of something approaching a per capita division; each person gets an equal share of the remaining budget, sometimes with adjustments to account for historic emissions and/or the need for a transition period (Gupta and Bhandari 1999; Baer et al 2000; Meyer 2004; Bode 2004; Höhne et al. 2006; Ekardt and von Hövel 2009; Oberheitmann 2010).

Burden sharing starts from the premise that targets should be based on a division of the global abatement task — or the difference between what emissions would be in the absence of mitigation measures and where they need to be to achieve the desired climate outcome. Under this approach, it is not an emissions pie that gets allocated amongst the parties but an abatement pie (and rather than wanting more of it, self-interested parties want less). Although there are a variety of burden sharing methods, many seek to determine allocations on the basis of economic cost (Gupta et al. 2007). Essentially, if it costs a country more in terms of lost social welfare to cut emissions, it should receive a higher target and *vice versa*. Generally, the presumption in burden sharing approaches is that the costs should be roughly equivalent, with some give and take to account for existing levels of development and the social and economic capacity to absorb costs (Jacoby et al. 1998; Rose et al. 1998; Ringius et al. 1998; Babiker and Eckhaus 2002; Lecocq and Crassous 2003).

Figure 1 is a hypothetical representation of the two approaches. In resource division approaches, the job is to divide up the remaining emissions (the blue area). For burden

sharing approaches, targets are determined on the basis of a division of the abatement task (the red area).

Figure 1 Resource division versus burden sharing (hypothetical)



Of the two, the burden sharing approach has been more dominant in domestic and international climate circles. The reason is partly due to the prominent role that economists have played in climate policy and the tendency for many economists to frame problems around issues they can model. The central role that modeling plays hinges on the fact that, to assess the cost of cutting emissions, the standard method involves forecasting the rate of economic growth under two counterfactual scenarios:

- a business-as-usual case where there is no direct attempt to mitigate emissions; and
- a mitigation case where policy measures are deployed to reduce emissions.

The difference between the two scenarios in terms of reduced gross national product (GNP) (or sometimes gross domestic product (GDP), gross national expenditure (GNE) or gross national income (GNI)) is taken to represent the reduction in welfare, which is then used to benchmark the 'equitable' contribution to the global effort to reduce emissions (Rose et al. 1998; Babiker and Eckhaus 2002).

There are many grounds for opposing this approach, the most obvious being that GNP, GDP, GNE, GNI and other similar macroeconomic indices are poor proxies of social welfare (Fluerbaey 2009). Various other ethical and legal arguments could be mounted against burden sharing, including that it is anti-liberal (e.g. it penalizes those who have chosen not to pursue a high growth-fossil fuel dependent development path) and runs counter to the customary law principle that no state has the right to damage the environment outside their jurisdiction (known as the 'no harm principle') (Tol and Verheyen 2004).

A more practical objection against burden sharing approaches is that the economic projections on which they so often depend are unreliable. As Deidre McCloskey once said of economic forecasting:

> By all means attend to the forecasts of experts, as one must in order to live; but expect little, and trust them not (McCloskey 1992: 42).

For burden sharing to have legitimacy, there must be an objective basis from which to make cost comparisons on an ex-ante basis. Because 'economists cannot predict much, and certainly not predict profitably' such a benchmark does not, and cannot, exist (McCloskey 1990: 10). Even with the best of intentions and skill, projections require modelers to make subjective judgments about uncertain variables, including population and productivity growth, technological developments and deployment, government policy and implementation, and greenhouse accounting rules. Not surprisingly therefore, there is more than a reasonable chance they will be inaccurate. For example, none of the economic analyses that were done for these purposes before 2008 foresaw the onset of the Great Recession. Now, emission reduction targets that previously appeared ambitious, according to the logic of burden sharing, will be achieved with little economic sacrifice — a point illustrated by the situation in Europe and the current carbon price.

Given the significance of targets to sovereign interests, there is the added difficulty that it is in the interests of all parties to skew the analyses in their favour. This would not be overly problematic if the analyses were transparent but the complexity of the modeling often shields it from scrutiny and leaves it vulnerable to manipulation. Governments can shape the scenarios to produce results that support their negotiating position safe in the knowledge that most people will be bamboozled by the numbers, graphs, maps and other material that typically accompanies the analysis.

The object of this article is to demonstrate the practical problems with burden sharing approaches that rely on economic forecasting by looking at how one of the six greenhouse reporting sectors, known as land use, land-use change and forestry (LULUCF), has been dealt with in the modelling exercises that have been done in Australia for climate policy purposes. The article looks first at the modelling that was undertaken in relation to the first commitment period of the Kyoto Protocol (2008 to 2012) (the 'Kyoto studies'). It then reviews the two major analyses that have been done by the Australian Treasury in relation to the post-2012 period before concluding.

First commitment period and the Kyoto studies

In 1997, in the lead up to the Kyoto Climate Conference (the 3rd Conference of the Parties to the United Nations Framework Convention on Climate Change), the Australian Bureau of Agricultural and Resource Economics (ABARE) published estimates of the cost associated with reducing developed country emissions to 1990 levels by 2010 (Brown et al. 1997). The major finding from the study was that Australia would have to cut its emissions by 28% in 2010, involving a reduction in real GNE of 2.6%, significantly above the projected losses in most other developed countries. These projections provided the basis for Australia's claims for concessional emissions targets, which it duly received. Australia's target in the Kyoto Protocol's first commitment period — to limit emission increases to 108% of 1990 levels over

the period 2008 to 2012 — was the second most generous of all developed countries behind Iceland.

In 1999, after the Kyoto Protocol had been signed, ABARE published a follow-up report that found that meeting the 108% target would require a greater than 20% reduction in emissions and cut 0.5-0.7% off GNP (Brown et al. 1999). Two years later, after the Kyoto Protocol's accounting rules were finalised, ABARE revised its estimate of the abatement task to a 6.5% reduction in emissions, and the GNP losses were downgraded to 0.15% in 2010, rising to 0.24% by 2015 (ABARE 2002). In a mirror report to the Australian Greenhouse Office in 2002, economist Warwick McKibbin projected the impact of the Protocol on the Australian economy would be roughly double the ABARE estimate: a 0.33% reduction in GNP in 2010 and a 0.47% reduction in 2015 (McKibbin 2002).

All of these studies are likely to have significantly overestimated the costs associated with meeting Australia's first commitment period target because they either ignored or underestimated the availability of low-cost, no-cost or even negative cost LULUCF offsets (Macintosh 2012a). During the first commitment period, Australia only accounted for three of the possible seven LULUCF activities: afforestation, reforestation and deforestation (known as the 'Article 3.3 activities') (for simplicity, hereafter, afforestation and reforestation are collectively referred to as reforestation). Australia elected not to account for the other four LULUCF activities (forest management, cropland management, grazing land management and revegetation — the 'Article 3.4 activities'), officially because of concerns about the impacts of bushfire and drought but probably also because the Government thought they would be unnecessary as Australia was likely to get a healthy supply of 'hot air' from deforestation ('hot air' is credits for which no direct policy effort is required) (Australian Government 2008a; 2008b).

The hot air stems from Article 3.7(2) of the Kyoto Protocol (known as 'the Australia clause'). This provision allows Australia (and a handful of other developed countries) to include deforestation emissions in its base year for the purpose of calculating its target. Australia insisted on the inclusion of Article 3.7(2) because its deforestation emissions had fallen by 50% over the period 1990 to 1997. By including deforestation emissions in its base year, the Australian Government knew it could receive credit for the reductions that had already occurred and use these to offset emission increases in other sectors (Macintosh 2012b).

This is what has happened. Between 1990 and 2011, emissions from the non-LULUCF sectors increased by 135 million tonnes of carbon dioxide equivalent ($MtCO_2$-e). These increases are being offset by roughly 80 $MtCO_2$-e yr^{-1} of offset credits from deforestation, and a further 24 $MtCO_2$-e yr^{-1} from reforestation (DIICCSRTE 2013a).

Despite the importance of reforestation and deforestation to the end outcome, in the analysis prepared in the lead up to Kyoto, LULUCF was completely excluded (Brown et al. 1997). ABARE's report on the impact of the Protocol that was released in 1999 also did not model LULUCF; even the impacts of Article 3.7(2) were omitted (Brown et al. 1999). The ABARE and McKibbin reports of 2002 both included reforestation and deforestation offset projections but they underestimated the actual outcomes by almost 50 $MtCO_2$-e yr^{-1}, or roughly 80% (ABARE 2002; McKibbin 2002).

The treatment of LULUCF in the Kyoto studies raises a question about whether cost comparisons in burden sharing should be based on the lowest possible ways of reducing emissions or whether there should be some scope to exclude abatement opportunities if they are considered inconvenient or otherwise unachievable. For example, does the fact that Australia elected not to account for the Article 3.4 activities mean that, for the purposes of a burden sharing analysis, these activities should be excluded, even if the inclusion of one or more of these activities could have lowered the welfare losses? The obvious problem with excluding abatement opportunities is that it sacrifices any claims that burdening sharing may have to objectivity. It is the equivalent of having a handicap race where the size of the handicap is set on the basis of prior performances and then allowing the runners to 'go slow' in the benchmark races. Note that the Kyoto studies published after the 3rd Conference of the Parties cannot be critiqued on these grounds as their aim was merely to evaluate the cost of meeting Australia's targets under the agreed rules. But I'll return to this issue later in the context of the analyses that have been done for the post-2012 era.

Returning to the Kyoto studies, the obvious response to the critique about the exclusion of LULUCF is to claim that the fall in deforestation and increase in reforestation were the product of government policies. Hence, while the cost may not have been as much as predicted, the LULUCF credits were not 'effort free'. The rejoinder to this argument has two parts. First, as a matter of fact, while policy changes have been a major driver of the increase in reforestation, they are not the main reason for the decline in deforestation.

It is widely believed that the downward trend in deforestation has been brought about by land clearing laws in New South Wales and Queensland — a view that has been aired by numerous politicians and found its way into several government reports (Australian Treasury 2008; Garnaut 2008; Department of Climate Change and Energy Efficiency 2012a; Macintosh 2012b). Reform of land clearing laws commenced in both New South Wales and Queensland in 1995 (Macintosh 2010; 2012b). In New South Wales, further rounds of reform occurred in 1997 and 2003, with the last of these coming into effect in 2005 with the promise it would end broad-scale clearing. Queensland went through a similar staggered reform process, with the initial 1995 changes being followed by major modifications in 1999, 2004 and 2009.[1]

Due to the timeline of reform, the laws could not have been the driver of the fall in deforestation that occurred in the early- to mid-1990s; they did not exist. The observed trends were a product of three factors.

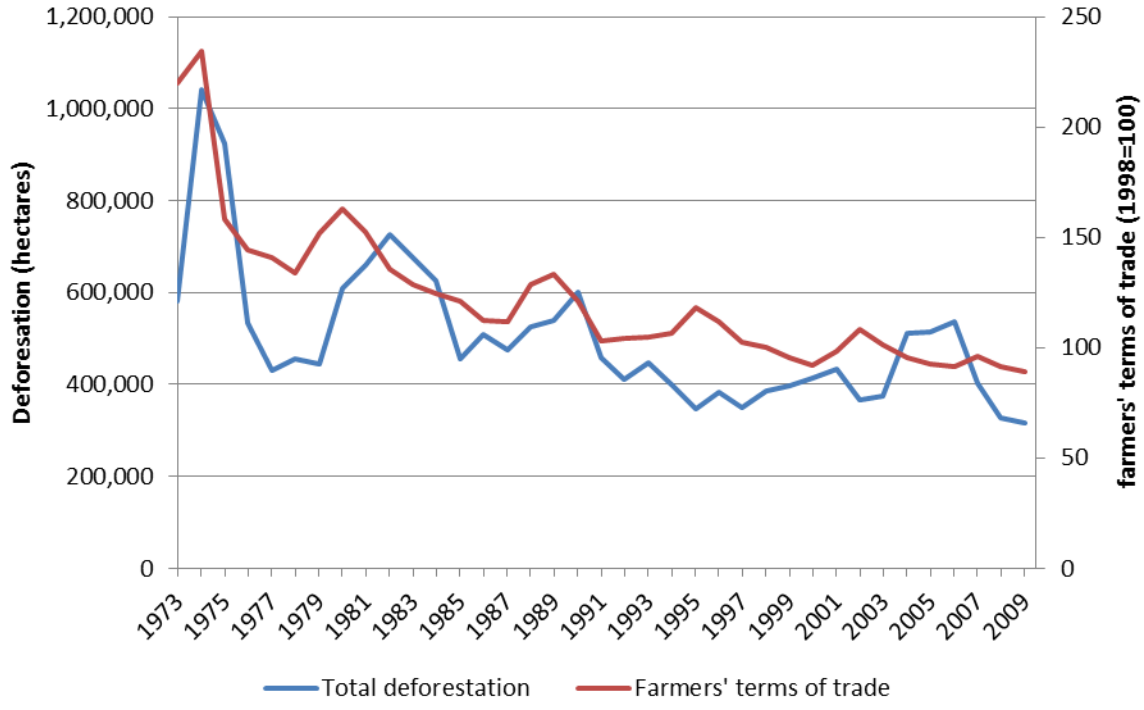
- *Declining availability of uncleared productive land*. Since European settlement, most areas that are suitable for agriculture in Australia have been deforested and converted to either cropland or grazing land (and more recently urban land uses). Generally, the remaining uncleared areas are less productive and often require accompanying large-scale irrigation infrastructure. The diminishing opportunities for profitable agricultural development on uncleared land has contributed to the gradual downward trend in deforestation.
- *Long-term deterioration in farmers' terms of trade*. Since the 1970s, the prices paid for farm inputs have risen faster than the price of farm outputs, reducing

[1] In May 2013, some of these changes were wound back by the Newman LNP Government.

the surplus generated by farm businesses. This has reduced the demand for forest conversion — farmers have been better off putting their money in other ventures than expanding agricultural output through deforestation. The influence of these market forces is evident from Figure 2, which shows farmers' terms of trade and total deforestation (forest conversion plus reclearing). The coefficient of determination (R^2) from a linear least squares regression using annual percentage change in total deforestation and farmers' terms of trade over the period 1973-1997, with a one year lag in clearing, is 0.60 ($p<0.01$), suggesting that falling terms of trade was an important contributor to the decline in deforestation over this period.

- *The late 1980s and early 1990s spike*. During the late 1980s and early 1990s, there was above average rainfall and high commodity prices, the combination of which helped trigger a spike in clearing — the rate of deforestation went from 450,000-500,000 ha yr^{-1} in the mid- to late-1980s to 600,000 ha yr^{-1} in 1990. With the onset of the global recession in the early 1990s and the 1991-1995 drought that struck parts of Australia, the main deforestation drivers subsided and deforestation rates fell. This chain of events ensured that Australia had a relatively high rate of deforestation in 1990, which is now used as the baseline in calculating the net impact of deforestation under the Kyoto Protocol (Macintosh 2010; 2012b).

Figure 2 Australia total deforestation (forest conversion plus reclearing) and farmers' terms of trade, 1973-2009

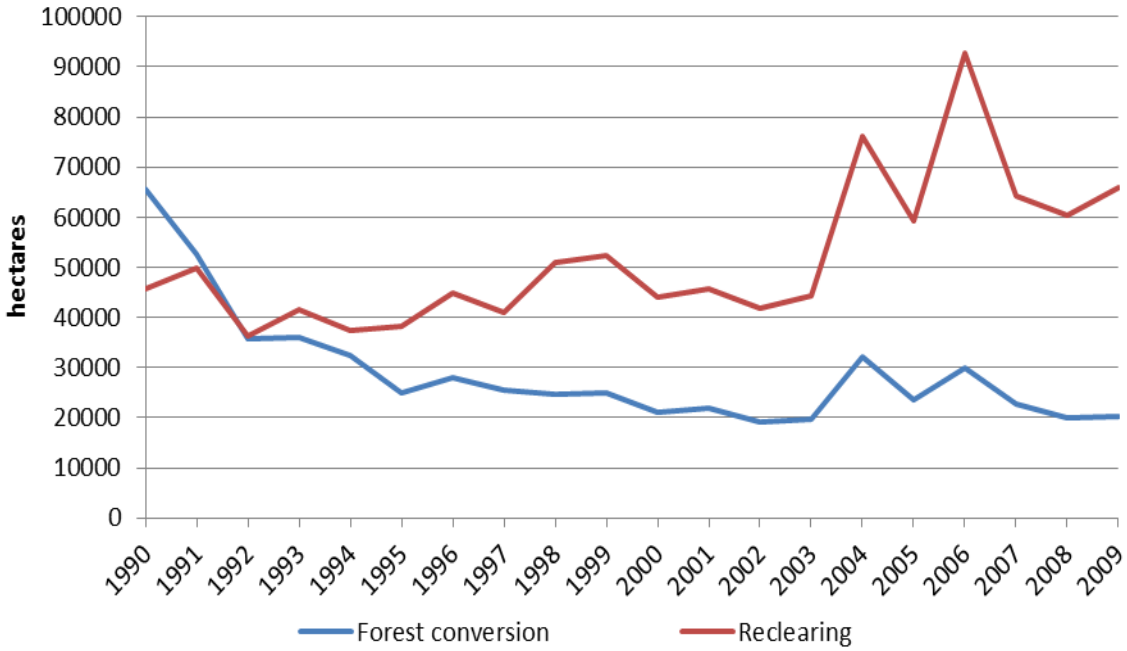


Source: ABARES (2012); DIICCSRTE (2013a). Data for 2010 and 2011 have been omitted because they are preliminary.

The land clearing reform process that started in 1995 has had mixed effects. In New South Wales, the clearing laws have not triggered a decline in the rate of either forest conversion or reclearing. As Figure 3 shows, the rate of forest conversion increased in

the mid-2000s, probably as a result of landholders trying to pre-empt the legal changes, and has since stabilised at levels similar to those seen prior to their introduction. The rate of reclearing has increased since the laws were introduced.

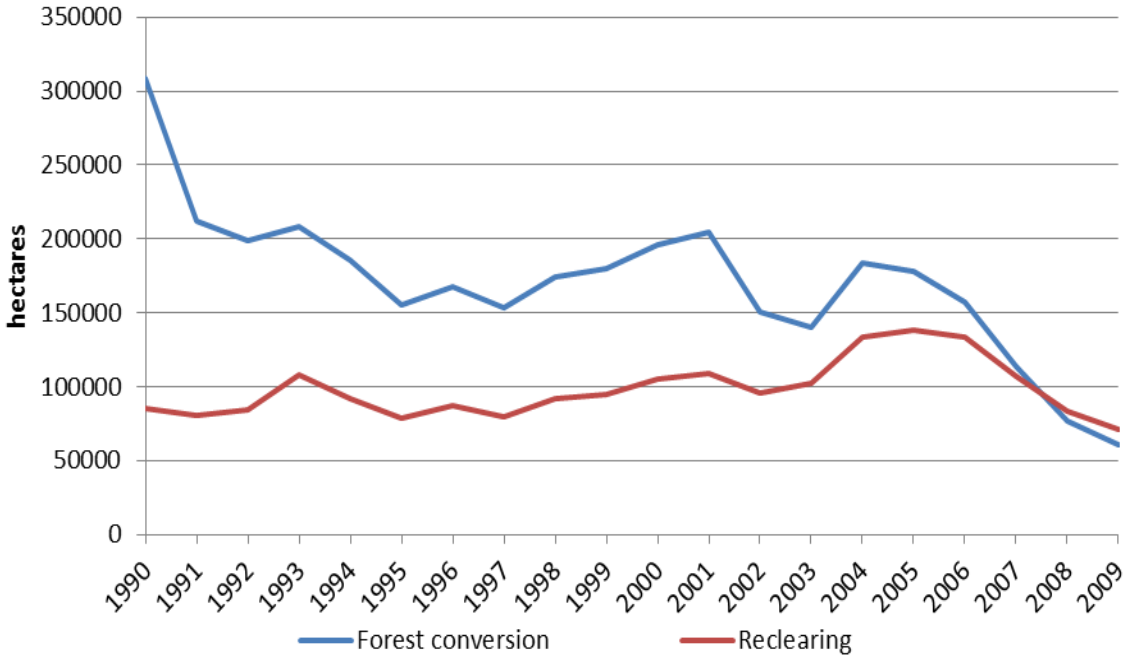
Figure 3 New South Wales forest conversion and reclearing, 1990-2009



Source: DIICCSRTE (2013a). Data for 2010 and 2011 have been omitted because they are preliminary.

Queensland's reform process followed a similar trajectory to New South Wales until a moratorium on broad-scale clearing applications was introduced by the Beattie Labor Government in May 2003, which was then formalised with the legal changes of 2004 (Macintosh 2010; 2012b). These changes aimed to phase out broad-scale clearing by the end of 2006. Owing to a combination of good design and effective monitoring and enforcement, the laws succeeded in driving down the rate of both forest conversion and reclearing (Figure 4). However, despite these recent successes, the market and climatic factors identified above will still be responsible for the majority of the deforestation offsets that Australia will receive in the first commitment period.

Figure 4 Queensland forest conversion and reclearing, 1990-2009



Source: DIICCSRTE (2013a). Data for 2010 and 2011 have been omitted because they are preliminary.

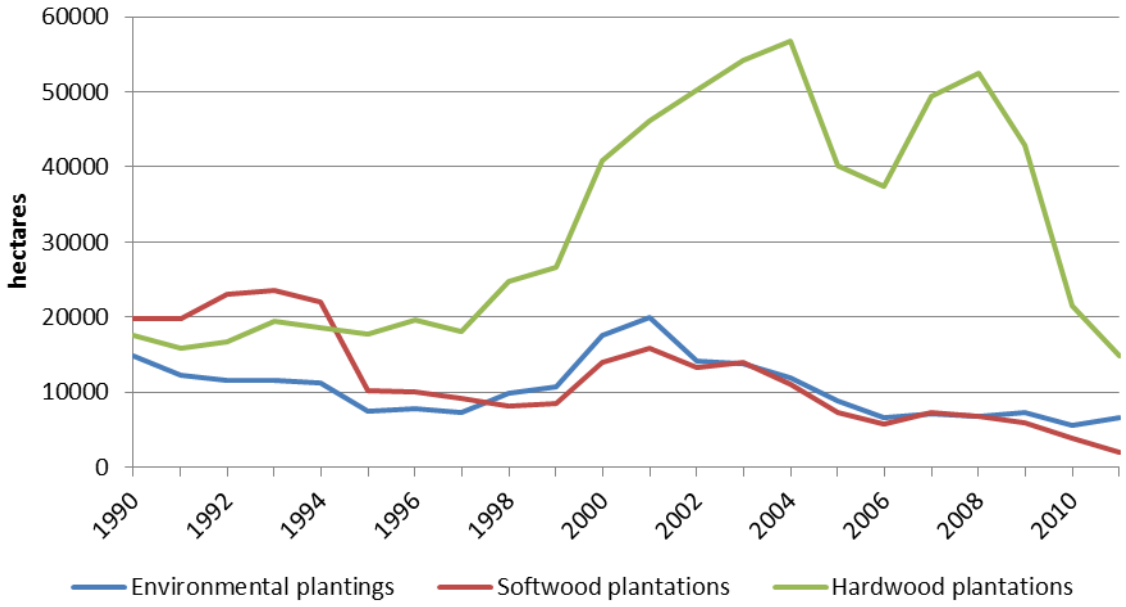
The second flaw in the argument that the deforestation and reforestation credits were the product of government policies is that it assumes all policy measures, whether or not they were directed at mitigating greenhouse emissions, are relevant. The price paid for reducing emissions in the burden sharing approach should not include costs associated with policies that are introduced for non-climate reasons — that is, policies that would have been introduced in the absence of concerns about climate change. These policies should form part of the business-as-usual scenario. The land clearing laws were intended to address concerns about land degradation and biodiversity loss. The New South Wales laws make no mention of climate change and it was not raised as a significant issue while the laws were being designed and formulated (Knowles 2003; Costa 2003; P Cosier pers comms 2009; P Gibbons pers comms 2009; Macintosh 2010).[2] In Queensland, the mitigation of greenhouse gas emissions was not raised as a material issue until the 2004 reforms and, even then, there is little doubt the laws would have been introduced irrespective of concerns about climate change (P Beattie pers comms 2009; Macintosh 2010).[3]

The same applies for reforestation. The *Plantations for Australia: The 2020 Vision* — a joint Australian Government/state government/industry initiative launched in 1997 — aimed to triple Australia's plantation estate over the period 1996-2020; from 1.1 million hectares (Mha) to 3.3 Mha (Plantation 2020 Vision Implementation Committee 1997; Senate Rural and Regional Affairs and Transport References Committee 2003). To realise this objective, generous tax concessions were offered to the plantation sector, including through managed investment schemes (Ajani 2007; 2011; Macintosh 2013). As a result of these incentives and favourable market

[2] *Native Vegetation Act 2003* (NSW).
[3] *Vegetation Management Act 1999* (Qld); *Vegetation Management Bill 1999: Explanatory Notes*; *Vegetation Management and Other Legislation Amendment Act 2004* (Qld); *Vegetation Management and Other Legislation Amendment Bill 2004: Explanatory Notes*.

conditions, the national plantation estate expanded rapidly in the late 1990s through to the late 2000s (Figure 5). This upswing in plantation establishment, most of which are short rotation hardwoods designed to produce pulplogs, is the primary reason Australia will record around 24 $MtCO_2$-e yr^{-1} of credits from reforestation over the first commitment period.

Figure 5 Australia area of new forest plantings, by planting type, 1990-2011



Source: DIICCSRTE (2013a).

As with the Queensland land clearing laws, greenhouse gas abatement was not the main driver behind the *2020 Vision*. The *2020 Vision* was primarily intended to help reduce the trade deficit in wood and wood products and promote growth in the forest sector. A related factor behind its introduction was that policy measures, and management and market factors, were leading to reduced log supply from native forests. By promoting the expansion of plantations, the *2020 Vision* hoped to ensure the forestry sector would have an ongoing supply of logs. The sequestration of carbon dioxide and generation of LULUCF offsets were acknowledged as benefits of the policy but there are few who would claim that, in the absence of climate change, the *2020 Vision* and associated plantation incentives would not have been created (Plantation 2020 Vision Implementation Committee 1997; Senate Rural and Regional Affairs and Transport References Committee 2003).

Second commitment period studies

Two major modelling exercises have been done by the Australian Treasury in relation to the post-2012 era; both have had similar problems with LULUCF. The first of these, *Australia's Low Pollution Future: The Economics of Climate Change Mitigation*, was released in 2008 and analysed the costs associated with meeting mitigation targets under four scenarios: two based on a multi-stage emission entitlement allocation approach (CPRS-5 and CPRS-15) and two based on a modified contraction-and-convergence model (Garnaut-10 and Garnaut-25) (Australian Treasury 2008).

The multi-stage emission entitlement allocation approach is a burden sharing method in which mitigation obligations are determined on the basis of an assumed rate of divergence from a projected business-as-usual or reference case. In the *Australia's Low Pollution Future* report, all countries had the same rate of divergence from their reference scenario but they were assumed to take on mitigation obligations at different dates. Contraction-and-convergence is a well-known resource division approach where countries' per capita emissions are assumed to converge to an agreed global level over a specified timeframe. For current purposes, it is sufficient to confine the discussion to the CPRS-5 scenario, under which it was assumed that the international community agrees to stabilise the atmospheric concentration of greenhouse gases at ~550 ppm in 2100 and Australia undertakes to reduce its emissions by 5% on 2000 levels by 2020, consistent with the current unilateral target.

According to the *Australia's Low Pollution Future* report, meeting the 5% target under the CPRS-5 scenario would reduce GDP by 1.1% and GNP by 1.1% in 2020 relative to a reference case that included pre-existing policy measures like the 9,500 gigawatt hour (GWh) Mandatory Renewable Energy Target and the NSW and ACT Greenhouse Gas Reduction Scheme (note that this is a reference case not a true business-as-usual scenario, which would exclude the impacts of policy measures explicitly designed to reduce emissions and address climate concerns). This cost was assessed as being larger than those incurred by most other developed countries in meeting equivalent mitigation obligations. Only Russia (and other CIS member states) and Canada were found to incur similar or higher costs.

As was the case with the analysis carried out in the lead up to the Kyoto negotiations, the findings from the *Australia's Low Pollution Future* report were used to support Australia's negotiating position on its target. For example, in a submission to the Ad Hoc Working Group on Further Commitments for Annex I Parties under the Kyoto Protocol and Ad Hoc Working Group on Long-Term Cooperative Action, the Australian Government stated:

> Differentiation of targets helps reduce cost differences, ensuring greater comparability of national efforts. The analysis shows that Australia faces high economic costs, relative to most other developed countries, due to its large share of emission- and energy-intensive industries and a dominance of low-cost coal in electricity generation. … Australia's costs are higher than both Japan's and the European Union's, despite being allocated smaller percentage reductions from 1990 levels in all of the scenarios. These broad results are typical of modelling by other groups. They highlight that while the reduction from 1990 is a convenient common way to express an emission target, it is not necessarily informative about the degree effort required to achieve that target (Australian Government 2009: 3-4).

Similar to the pre-Kyoto analysis, the *Australia's Low Pollution Future* report downplayed the roll that LULUCF could play in the second commitment period and ignored the potential for Australia to get cheap abatement from other sources. Specifically, the report assumed that Australia would only account for Article 3.3 activities (reforestation and deforestation) in the second commitment period (2013 to 2020). The optional Article 3.4 activities were excluded from the analysis. Although not known at the time the report was prepared, it has now been resolved that Australia will account for all four of the activities that were covered by Article 3.4 in the first

commitment period. It has chosen not to account for the new optional Article 3.4 activity; wetland drainage and rewetting.

As alluded to above, the exclusion of the Article 3.4 activities from the scope of the analysis does not sit easily with a principled approach to burden sharing. For burden sharing to have legitimacy, the cost comparison should be based on the economic sacrifice associated with the cheapest possible sources of abatement or, at the very least, the lowest cost abatement opportunities that are technically feasible to realise. Potentially accessible abatement opportunities should not be excluded from the scope of the analysis because, in doing so, it can artificially inflate the cost estimates. This is what the *Australia's Low Pollution Future* report did. By excluding the Article 3.4 activities, Treasury ensured that the modelling was blind to the potential for cheap offsets to be sourced from these land management categories. It even overlooked the potential for offsets to be recorded in these sectors as a result of market factors and land management changes that have already occurred.

Since the early 1990s, improved crop management practices, including controlled traffic farming and minimum tillage, have been widely adopted across Australia's almost 25 million hectares of croplands (Tullberg et al. 2007; Llewellyn and D'Emden 2009; Kingwell and Fuchsbichler 2011; DIICCSRTE 2013b). Although the relevant national accounting methods are still evolving, a rough estimate is that these practices, if maintained, could generate in the order of 20-25 $MtCO_2$-e of offset credits from cropland management over the second commitment period; all at no or negative cost (Llewellyn and D'Emden 2009; Environment Canada 2012).

Grazing land management and revegetation could provide a similar but smaller windfall. Australia has over 400 million hectares of grazing land, providing considerable scope for abatement through increases in soil organic carbon and biomass via the adoption of sustainable grazing land management practices (e.g. establishment of perennials and maintenance of groundcover) (DIICCSRTE 2013b). At present, there is limited data on land management changes and those that are available suggest the uptake of improved techniques has not been as dramatic as in croplands. Despite this, a rough estimate is that Australia could get around 10 $MtCO_2$-e from grazing land management and revegetation with little or no direct policy effort, and considerably more with targeted programs.

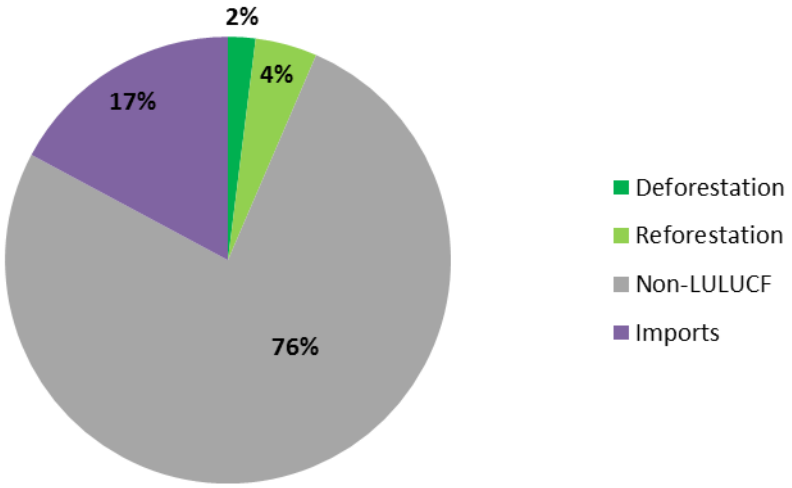
The last of the four Article 3.4 activities is forest management, where the potential for effort-free offsets hinges on the state of the native forestry sector. Harvesting in native forests has fallen steadily over the past 20 years, and dropped dramatically since 2008, mostly because of increased domestic and international competition and declining demand for native forest wood products. Despite considerable government assistance and the best efforts of the sector to attract more, a dramatic revival in its fortunes looks unlikely. If this assessment proves correct and harvesting remains around current levels, Australia will get approximately 80 $MtCO_2$-e of credits from forest management over the period 2013-2020 without the need for any economic sacrifice (Macintosh 2011a; 2011b).

All told, it is reasonable to assume that Australia could receive around 110-115 $MtCO_2$-e of credits over the period 2013-2020 from the Article 3.4 activities with little or no policy effort. This constitutes 7-9% of the *Australia's Low Pollution Future* report's estimated total abatement task associated with the 5% 2020 mitigation

target (1,335 $MtCO_2$-e). If all cost-effective sources of abatement were realised — say, where the associated abatement cost is <$30/$tCO_2$-e (real) — the credits from Article 3.4 activities could be several times greater. These estimates are subject to uncertainties, including in relation to methods and activity data. However, there is little doubt that, by ignoring the Article 3.4 activities, the *Australia's Low Pollution Future* report overlooked a sizeable amount of low-cost, no-cost and negative-cost abatement.

The same criticism can be levelled at the estimated abatement from reforestation and deforestation, both of which were exogenous inputs to the modelling. In the reference scenario, net emissions from reforestation and deforestation were projected to average -7.5 $MtCO_2$-e and 44 $MtCO_2$-e respectively over the period 2013-2020. In the CRPS-5 scenario, over the same period, they were forecast to average -15 $MtCO_2$-e and 41 $MtCO_2$-e, providing combined abatement of 87 $MtCO_2$-e (6% of the abatement task) (Figure 6). These projections are conservative and potentially significantly underestimate the available low-cost abatement opportunities associated with these activities.

Figure 6 *Australia's Low Pollution Future* — estimated abatement from reforestation, deforestation, non-LULUCF sectors and imported credits, 2013-2020



Source: Australian Treasury (2008).

The second modelling exercise undertaken by the Australian Treasury was the *Strong Growth, Low Pollution* report, which was released on 10 July 2011 to coincide with the launch of the details of the carbon pricing scheme and other elements of the Clean Energy Future package (Australian Treasury 2011). The modelling was similar in structure to that from the *Australia's Low Pollution Future* report. It analysed the welfare losses associated with cutting Australia's net emissions by either 5% (core policy scenario) or 25% (high price scenario) by 2020, and by 80% by 2050, relative to 2000 levels. These costs were estimated by comparing changes in GNI and GDP in the mitigation scenarios relative to a reference case that incorporated the impacts of policies in existence at the time, including the enhanced Renewable Energy Target.

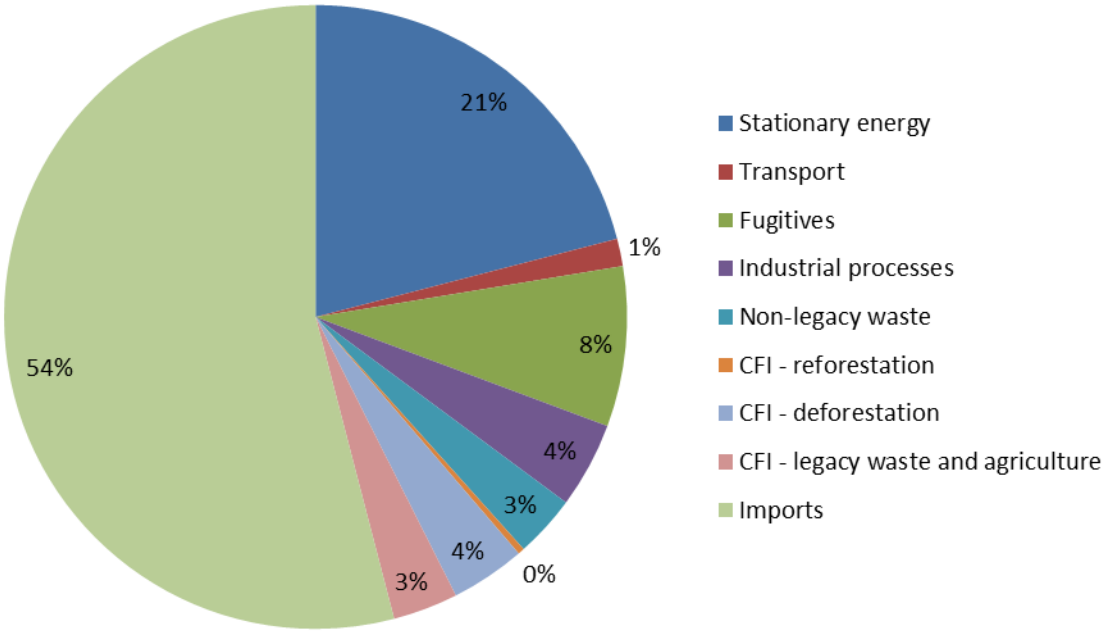
The headline results from the report were that meeting the 5% target under the core policy scenario would reduce GNI by 0.5% and GDP by 0.3% in 2020. The reduction in the size of the economic cost compared to the results from the *Australia's Low Pollution Future* report is attributable to a number of factors, including the change in the policies embodied in the reference case.

As before, LULUCF was seen as only a minor contributor to the abatement task. The Article 3.4 activities were excluded — even though it was becoming increasingly likely Australia would account for one or more of these activities — and the LULUCF analysis was confined to deforestation and reforestation. In the absence of the Carbon Farming Initiative, net deforestation emissions were projected to average 48 $MtCO_2$-e yr^{-1} over the second commitment period. The Carbon Farming Initiative was forecast to generate 4 $MtCO_2$-e yr^{-1} of abatement but, in the reference case, it was assumed these credits would be excluded from Australia's accounts because they would either be exported or used in voluntary markets (the Government had undertaken to cancel Assign Amounts Units where Carbon Farming Initiative credits were used in domestic voluntary markets). In the core policy scenario, net deforestation emissions were assumed to be the same as in the reference case (i.e. average 44 $MtCO_2$-e yr^{-1}), only the 4 $MtCO_2$-e yr^{-1} of abatement from the Carbon Farming Initiative could be counted towards Australia's targets because the associated credits would be used in the domestic carbon pricing scheme.

Net reforestation emissions were assumed to average -14 $MtCO_2$-e yr^{-1} in the reference case without the Carbon Pricing Scheme and -15 $MtCO_2$-e yr^{-1} with it. Again, in the reference case, the reforestation credits generated under the Carbon Farming Initiative (0.3 $MtCO_2$-e yr^{-1}) were assumed to be exported or used in voluntary markets. In the core policy scenario with the carbon pricing scheme, these credits were assumed to be used in the domestic compliance market.

As was the case with the *Australia's Low Pollution Future* report, the treatment of LULUCF in the *Strong Growth, Low Pollution* report was conservative. In total, LULUCF was forecast to contribute only 4% to the total abatement task over the second commitment period, the vast majority of which was expected to come from avoided deforestation (Figure 7). Reforestation was all but irrelevant.

Figure 7 *Strong Growth, Low Pollution* — estimated domestic and international abatement, by sector, 2013-2020



Source: Australian Treasury (2011).

The exclusion of the Article 3.4 activities is the most obvious problem with the LULUCF projections. The other stand out LULUCF-related deficiency of the *Strong Growth, Low Pollution* report is that it ignored the substantial surplus that Australia will carry into the second commitment period. By 2011 it had become apparent that Australia would meet its first commitment period target by a considerable margin (Macintosh 2011c; Department of Climate Change and Energy Efficiency 2012b). Emissions from non-LULUCF sources were not growing as fast as forecast because of a range of factors, including the global economic slowdown, softening of commodity prices, climatic influences (droughts and floods), changes in energy use patterns and policy measures. Net deforestation and reforestation emissions had also fallen sharply as a result of the impacts of the Queensland clearing reforms and the deterioration in woodchip demand and terms of trade. The available data suggest that, as a result of these factors, Australia will end up with a surplus of 90-100 $MtCO_2$-e from the first commitment period, which it is allowed to use to offset emissions in the second commitment period. This was ignored in the *Strong Growth, Low Pollution* report. In the most recent government emission projections, the fact that Australia was likely to come under its target was noted but the surplus was not subtracted from the abatement task (Department of Climate Change and Energy Efficiency 2012a).

If the results from the *Strong Growth, Low Pollution* report are to be used to evaluate the fairness or otherwise of Australia's targets, it could also be argued that the reforestation and deforestation forecasts are too cautious. The Government may even have underestimated net removals from reforestation in the reference case. In 2010

and 2011, they were forecast to be -21 $MtCO_2$-e yr^{-1}, whereas they have recently been reported to have averaged -26 $MtCO_2$-e yr^{-1} over this period (-17 $MtCO_2$-e yr^{-1} without the harvest sub-rule),[4] possibly because of conditions in the forestry sector, particularly the decline in export woodchip prices and increased foreign competition in the Japanese and Chinese chip markets (DIICCSRTE 2013a; Macintosh 2013). Whether net reforestation removals fall in line with the projections over the second commitment remains to be seen and will depend on market conditions and government policy.

Prior to the May 2013 reforms to Queensland's land clearing laws, which wound back the prohibition on broad-scale clearing and watered down the enforcement powers, it appeared the Australian Government had overestimated both the likely rate of deforestation under the existing policies and the impacts of the Carbon Farming Initiative. Although preliminary, the most recent data suggest net deforestation emissions in 2010 and 2011 were 45 $MtCO_2$-e and 38 $MtCO_2$-e respectively, significantly below the projected levels of 49 $MtCO_2$-e and 48 $MtCO_2$-e (DIICCSRTE 2013a). As for the Carbon Farming Initiative, deforestation has only recently been put on the positive list (i.e. made eligible under the scheme) and, with the current methodology and likely future carbon price, it is unlikely to generate anything like the forecast 29 $MtCO_2$-e of credits from avoided deforestation.

As has been noted elsewhere, projecting trends in deforestation is particularly difficult because of the extent of the uncertainties associated with underlying drivers and policy factors (Macintosh 2010; 2012b). The recent trends in deforestation emissions and the May 2013 reforms to the Queensland clearing laws illustrate this. Significantly, the Queensland regulatory changes could result in a rebound in deforestation emissions and increase the abatement task associated with the 5% target.

Conclusion

The treatment of LULUCF in the modelling that has been done for policy purposes in Australia highlights the problems with burden sharing approaches that use economic forecasts to determine national targets. Put simply, economic modelling is too unreliable, too subjective and too vulnerable to manipulation to provide a reliable and objective basis from which to set caps. Economic modelling has its uses, including in relation to the formulation of climate policy. The danger lies in exactly how it is used.

In this case, the modelling has tended to ignore or underplay the role of LULUCF and the low-cost, no-cost and negative-cost offsets it offers. This has inflated the abatement task and welfare losses associated with meeting various targets. This is not to say that there has been a conspiracy to manipulate the modelling to produce particular results. As Hanlon's razor suggests, given a choice between malice and error, the latter is likely to be true. More specifically, all useful forecasts are uncertain and nobody has perfect foresight. A distinction also needs to be made between the task often given to modellers (e.g. what is the likely abatement task and welfare losses associated with meeting a target under specified government policies?) and the uses to which the results are put. Further, when making predictions for these purposes, there

[4] The harvest sub-rule, which applied during the first commitment period, provides that debits accounted on a reforested land unit cannot exceed the recorded credits. This rule does not apply in the second commitment period.

are strong incentives for government modellers to err on the side of over-estimating rather than under-estimating the abatement task.

Any principled approach to target setting should strive for objectivity. Burden sharing based on projected welfare losses cannot provide this. Because of errors and unforeseen events, the welfare losses associated with meeting a given emission reduction target could be, and is in fact likely to be, different from the forecasts. As a last word, it is worth noting that the true test of those who support a burden sharing approach based on projected welfare losses is whether they also support a process for raising targets when it becomes apparent that the welfare losses of a state are less than projected. Without a forked tongue, it is difficult to argue for one while opposing the other.

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