Australian Agriculture as a Provider of Carbon Offsets

Possibilities and issues in developing an offsets market
A Discussion Paper

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Executive Summary

Key points

- This report proposes a coordinated package of measures to tap into the potential of agriculture to support climate policy objectives within an overall adaptive policy response. It focuses on ways to reduce large biases against accessing these opportunities early, to support more cost effective response to climate threats. In general, these measures would be complementary to discounting and other measures already emerging for addressing established concerns for permanence of sequestration etc.

- The report identifies limitations, of particular relevance to agriculture, in the focus on emissions reduction targets. It proposes instead that the primary objectives guiding policy development should relate directly to climate outcomes, such as the Copenhagen ‘ultimate goal’ of preventing dangerous anthropogenic climate change and its risk-based working objective of the proposed 2 degree peak warming target; this might possibly be extended to include peak ocean acidity.

- Agriculture has significant scope to reduce emissions and sequester carbon through offset arrangements. Broadly, agricultural offsets are certified changes in patterns of behaviour deemed to have delivered sequestration or abatement of greenhouse gases relative to baselines.

- Offsets which are Kyoto compliant (covering abatement of methane and nitrous oxide emissions from farms) could be traded into the CPRS (if it proceeds or with an analogous emission trading scheme) while offsets which are non-Kyoto compliant (soil carbon sequestration), or all offsets in the absence of an emissions trading scheme, can be traded in voluntary markets.

- The report flags two complementary instruments that could add greatly to the incentives for early investment in creating agricultural offsets:
  - In addition to certifying offsets based on a ‘safe’ assessment of minimum impacts, the certifying agency could issue ‘options’, redeemable as additional offsets in the future, should new science or changed rules indicate that greater abatement/sequestration can be safely inferred.
  - Pooling of diverse offsets into portfolios spanning farms, regions, farm systems and even countries, could be used to greatly increase the level of safe attribution of offsets to individual behaviour changes – simply reflecting sound risk management principles.

- It will be important to tap into the potential of agricultural offsets at an early stage, even in the absence of scientific certainty, since the costs of waiting in terms of the cumulative impacts of climate change, are likely to be high. Early development of agricultural offsets, especially in relation to soil carbon, can demonstrate to other countries the potential for such activity and could assist in rule changes to article 3.4.

- The report argues for a less restrictive approach to the concept of permanence in offset arrangements to reflect the importance and value of temporary and earlier sequestration or emission reduction as part of an overall adaptive approach to climate threats.

- It will be important to address the issue of leakage where the benefits of one farm’s emission reductions can be partly ‘clawed back’ by the normal market responses of other producers, or as a result of gaming behaviour.
  - Well developed models can identify leakage paths, and also enable various categories of offsets to be recognised based on the extent and magnitude of leakage.

- The report highlights the importance of complementarity in climate change policy with other arms of policy, such as drought policy, to avoid perverse incentives, reduce duplications and capitalise on policy synergies.
Purpose & context

This is an issues and discussion paper – exploring issues that arise in seeking to establish sound institutional arrangements for agricultural offsets, if these arrangements are to tap the potential of agriculture, while limiting any incentives for counterproductive responses. It is intended to feed into the public policy discussions leading up to the establishment, and progressive evolution, of effective offsets arrangements. In this role, it seeks to challenge some common assumptions – a number of which appear to have encouraged constraints on tapping the potential of agricultural offsets and that would, if allowed to persist, add significantly to the costs of effective climate response.

This Executive Summary has been written almost as a stand-alone document, at least for understanding the main narrative and for gaining a good overview of the main points raised in the paper, including key elements of the reasoning. The body of the report and its attachments involve finer detail, fuller development of the arguments and documentation of experience elsewhere.

We have not sought here to nominate ‘winning’ farm sector changes, though we have expressed strong views as to how these might be aggregated and packaged to maximise value. We have noted a wide range of credible suggestions for changes to farming practices that might be achieved at modest and competitive cost – and addressed the question of what arrangements could best tap into this potential, given the uncertainties, constraints in existing rules and need for international compliance in the broad approach over time.

We have assumed a continuing strong commitment to reducing greenhouse gas emissions as part of a collaborative international response and focused on how offsets may allow this to be done better. However, the Federal Government has just announced a delay in the reintroduction of its CPRS legislation and a range of recent developments have increased uncertainty regarding the form and timing of climate change policy in Australia and internationally. These uncertainties are now part of the policy context – and may well have strengthened the case for a strong and early focus on tapping the potential for abatement and sequestration offered by agriculture and land use.

Background & Rationale

The encouragement of voluntary measures to help limit Australia’s contribution to atmospheric greenhouse gas levels, or to reduce the costs to Australia of meeting any targets, is now a fairly uncontroversial concept. There is formal institutional support from the Federal Government via its National Carbon Offsets Standard. Importantly, two recent shifts in climate policy – the decision to defer indefinitely inclusion of agriculture in the proposed ‘cap and trade’ Carbon Pollution Reduction Scheme and the parallel strengthened...
commitment to pursue agricultural opportunities via offsets – have elevated the importance of offsets within Australian climate policy. The concept of voluntary offsets has been promoted by a number of farm organisations. And agricultural offsets measures, especially build-up of soil carbon, play a central role in the policy approach recently announced by the Federal Opposition.

One of the great attractions of agricultural offsets lies in the substantial evidence that there may be a wide range of opportunities for offsets where the effective cost of creating these offsets would be low and, in some cases, negative. This is in sharp contrast to the likely economics of some other Australian core climate policy initiatives, such as the commitment to the development of geosequestration. These favourable economic pointers arise largely from the complementarity between a range of ‘climate friendly’ behaviour changes and improved farm productivity. While not all of these measures are low cost, there is scope for sharing the costs across the value of improved farm output as well as the value of abatement services created. In this way, offsets production might be viewed as fitting into an expanded farm product mix that offers joint economies across traditional production and the delivery of environmental services – as can be true now of complementarity between livestock and crop production and, even more tightly, between wool and sheep meat production.

Areas where this complementarity appears particularly high – where there may be opportunities for low cost abatement and sequestration as a result – include:

• productivity benefits of direct application of carbon (such as biochar) to the soil as a soil improver, with implications for soil structure and water retention and use;

• productivity benefits of genetic and herd management processes that limit methane emissions from ruminants, noting that high methane emissions could be viewed as wasted energy;

• productivity benefits from better targeted application of nitrogenous fertiliser, with nitrous oxide emissions being indicators of unutilised nitrogen in fertilisers;

• potential for productivity benefits from increased steady state levels of carbon stored in vegetation, whether through farm trees or increased density and biomass of other productive species – and extending to vegetation mass in soil as a result of low tillage farming systems etc.; and

• potential for more cost effective and less GHG-intensive production as a result of modifications to some current policy settings that post perverse incentives for high emission production practices – including aspects of drought and water policy.
Given current policy positions and trends, and the reality of agriculture’s current and potential role in influencing national emissions, we see an extremely valuable role for agricultural offsets as part of the Australian, and global, response to climate change threats. It appears feasible to move fairly quickly to begin tapping this potential, though the short-term gains in terms of effective mitigation are likely to be modest because of a series of constraints and issues that can probably only be addressed safely and efficiently over time. These issues are real and must be addressed.

However, some of the approaches that have emerged to address these issues, including decisions not to credit carbon abatement from a range of measures (a ‘too hard’ basket) and to heavily discount the effects of others, seems almost certain to entail a bias towards unnecessarily high conservatism and unnecessarily high costs of pursuing emission reduction and other climate change objectives. We see scope for bringing a range of mechanisms to bear. These measures could attack the unnecessary biases while protecting the integrity of the overall response. Prominent here are two classes of instrument for greatly reducing the constraints posed by uncertainty and the desire to limit risks of encouraging counterproductive changes: pooling of risks across diverse behaviour changes, across multiple instruments, farms, regions, production systems and possibly even countries; and assigning to those willing to change behaviour retrospective access to value in the event that later determinations conclude that their actions resulted in more abatement or sequestration than was at first allowed.

Importantly, it seems feasible to look to an evolution of these arrangements from this initial base, to permit progressively more comprehensive tapping of the real potential of agriculture while ensuring the integrity and credibility of its contribution to global atmospheric carbon levels.

This evolution might sensibly involve:

- increasing coverage of patterns of behaviour change that are accepted as the basis for offsets, bringing in instruments initially considered too uncertain for accreditation;
- increasing ‘packaging’ of individual offsets into more robust parcels of behaviour changes and contracts extending across and between farms and regions;
  - this approach extends well beyond aggregation of similar projects, to include creation of extensive diverse portfolios of measures, and actively exploiting that diversity to increase confidence in aggregate impacts;

… these strategies will need to be accompanied by sound governance measures, and we have not recommended backing off an approach.
that only certifies ‘safe lower bound’ estimates of value as a way of limiting risks and intensifying incentives;

- increasing use of increasingly sophisticated regional farm modelling tools to allow estimation of loss of abatement benefits as a result of market responses to individual behaviour change (abatement ‘leakage’);
  - supporting less harsh discounting of value and posting explicit incentives to limit leakage and to invest in improving the models;

- increasing financial incentives to agricultural offset providers while managing the risks of posting counterproductive behaviour change incentives;
  - reflecting both the likely rise in the marginal cost of abatement to the economy, and the strengthening science allowing a higher proportion of actual abatement benefits to be recognised safely;

- a shift away from the trading of ‘lumpy’ offsets on a one-off capital payment basis, towards greater reliance on ‘rental’ mechanisms linked to active monitoring and assessment of value;
  - reducing the level of uncertainty attached to valuation, allowing payment as a revenue stream linked to the flow of climate services provided over time, even from ‘lumpy’ investments in sequestration (there may well be commercial incentives to develop these instruments within the market, as a way of managing risks); and
  - providing an additional facility for ‘banking’ credits in expectations of rising value over time;

- increasing capacity to tap into additional value of past investment in offset creation, as improvement in the science and/or applicable rules establishes past abatement/sequestration that was not fully recognised originally;
  - creation of explicit options instruments with prospects for later conversion to credits could be used to allow the prospects for these improvements to be tapped early to encourage abatement and sequestration; and
  - the growth in this pool of options would result in accumulating pressure to improve the science and to effect changes in rules that are limiting the realisation of this value for Australia;

- expanding scope for voluntary trading of offsets into compulsory ‘cap and trade’ markets, including the Australian CPRS, if it proceeds – but extending to overseas markets if and as they emerge, providing scope for even greater financial incentives for change and allowing these traded offsets to reduce the costs of complying with the cap while other offsets directly reduce atmospheric carbon; and

- evolution of regulatory measures in ways that support the efficient functioning of these offsets arrangements, in particular limiting ‘leakage’ of the abatement benefits through market responses that counteract some of the nominal abatement benefits of specific behaviour changes:
The early operation of the voluntary offsets market could yield valuable information on which to base judgments regarding the most cost-effective form and intensity of complementary measures – to strike a sensible balance between accuracy of incentives posted and relevant transaction and compliance costs.

This process, and the wider adaptive evolution of the market arrangements would be strongly supported by on-going monitoring of sectoral emissions and analysis of underlying trends.

Assuming the CPRS proceeds, agricultural offsets could be viewed as a range of measures intended to help plug the ‘gap’ between the emissions covered by the CPRS and aggregate Australian emissions. The recent firm decision to exclude agriculture indefinitely from the CPRS, locks a substantial ‘gap’ – the share of emissions not covered by the CPRS – into the longer term. At about 25 per cent of current emissions, this gap (of which about two-thirds are directly attributable to agriculture, mainly methane and nitrous oxide) is likely to require effective complementary (non-cap and trade) measures, especially if proposed 2050 targets are to be safely and affordably attainable.

Here, offsets could have a role to play alongside regulatory and educational measures and international trading of credits.

However, focusing on contributions to emissions and ways of limiting them, tends to undervalue the potential of agriculture as a carbon sink – capturing and sequestering the atmospheric emissions of others through biological processes and sequestering for long periods the carbon produced in other industrial processes (including biochar). The potential of agriculture in climate policy is not constrained by its level of emissions. Here agriculture commands both a large sequestration resource and the scope for exploiting complementarities between sequestration and farm production. Also, the potential for technologies and institutional arrangements developed and/or implemented in Australia being extended to other countries appears substantial – with the possibility of this making a substantial difference to atmospheric GHG levels.

We see an important role for agricultural offsets whether the CPRS is implemented or not. The decision here will, however, shape the most appropriate wider policy settings. In principle, the potential value of agricultural offsets, as contributors to emissions reduction, is likely to be greatest in the absence of an ETS. This is because the need to source the lower cost emission reduction opportunities will be enhanced without the coverage of the CPRS or other ETS, especially if the alternative is strong regulation or direct investment in emission reductions without some form of market testing. Conversely, without the CPRS, there are likely to be greater difficulties in posting significant incentives to generate agricultural offsets – if no offsets can be traded into an ETS market with a high carbon price.
Effectively, without the CPRS, greater care may be needed in the design – but in return there would be scope for greater ‘returns’ from the investment. There is likely to be a need for greater emphasis on complementary regulatory measures and probably a need for greater precision in these complementary measures, even if this entails somewhat elevated transaction and compliance costs. These will be needed to limit incentives for perverse behaviour changes. However, we would strongly favour an evolutionary approach to the development of the right mix of measures – tied into on-going monitoring of the sector and of wider national and international developments. The proposed 2015 Productivity Commission inquiry, to assess relative merits of policies and programs, could have a central role to play in the development of this mix.

Should the CPRS proceed, then it can be expected to deliver strong demand signals, as the cap on emissions is reduced. This will be particularly true of any offsets directly tradable within the CPRS, but should apply also to other offsets that may be amenable to later conversion to CPRS-tradable entitlements. This could occur as a result of improvements in science or negotiated changes in current trading rules – such as the Kyoto treatment of land use change.

Broadly speaking, offsets that are tradable and traded into the CPRS, or other cap and trade arrangements (including international trades), should have the effect of lowering the costs to Australia of working within the cap. For this to be efficient, and internationally credible, it will be crucial that sound approaches are applied to dealing with the risks of leakage and impermanence, amongst other issues. Trading of offsets in this way may also, under current offsets policy, create scope for additional affordable tightening of the cap over time.

Other offsets, that are not tradable but that offer demonstrable reductions in atmospheric carbon, can be viewed as contributing directly to global and Australian climate change goals.

Voluntary offsets, with scope for accreditation and trading, offer scope to find cost competitive behaviour change and to limit and sensibly target transaction costs, by encouraging behaviour change only where the gains, in terms of emission reductions, are ‘considered’ large enough to justify the costs. This can be much harder to achieve through regulation, which is generally ‘blunter’ in its reach and capacity to differentiate between efficient and inefficient constraints. In reality, a mix of offsets and regulation is likely to offer the most cost effective means of achieving effective constraint – with a greater, safe role for offsets being likely to support finding lower cost ways of meeting targets.

It is also important to note that a voluntary market, by definition allowing ‘opting out’ by some enterprises, is prone – without other corrective measures – to substantially constraining the scope for rewarding the offsets created by other enterprises, effectively diminishing the real value of offsets. These rights to opt
out flow from both the exclusion of agriculture from the CPRS (which has a built-in ‘leakage containment’ mechanism) and the right not to participate in the offsets market with the associated accounting for enterprise emissions – and with an associated ‘right’ to actually increase emissions in response to commodity market signals.

Reduced emissions by some will in turn be partially ‘offset’ by the encouragement their farm changes offer for increased emissions by others. This is particularly (but not only) true where enterprises seek to create offsets by switching output mixes, such as from sheep and cattle into crops. This problem is real and places extra emphasis on regulatory measures, warts and all, to limit these problems – or will otherwise require a higher cost (payment for offsets) to achieve a similar level of effective abatement.

In the paper we address (and summarise below) the central issues that need to be handled carefully if the objectives in establishing offsets arrangements are to be achieved. Some of those pose substantial challenges. Attempting to slur over them is likely to be counterproductive and in some cases these challenges are unlikely to be amenable to complete resolution – they will remain as constraints on the value that can be obtained via offsets arrangements.

**Proposed shift in paradigm – better risk management**

*Current methods* being used to address these issues in established offsets markets appear systematically, and substantially, biased towards underutilisation of the potential offered by these offsets. These biases stem from the use of highly conservative methods to prevent crediting individual project-level behaviour change for greater abatement, sequestration or climate change value than it actually delivers. While addressing these concerns for downside risks head on, we believe the focus is on the wrong indicators of downside risks (project rather than whole of strategy risks of delivering less than has been credited) and that these methods generally involve no accounting for the value of the crucial upside to these same uncertainties. Many behaviour changes will deliver much more value than is indicated by estimation of a safe lower bound on project value. This asymmetry involves bias away from lower cost overall climate response strategies within acceptable whole of strategy safety limits.
Our concerns begin with the strong focus on emissions targets at points in time as though they were ends in themselves, when they are imperfect means that can and should be subject to adjustment as new information emerges. They embed a bias against early sequestration. More fundamentally, the presumption that the least cost way of meeting these emissions targets is the optimal strategy is misguided, given the uncertainty about these targets over time. A low-cost ‘solution’ that lacks the flexibility to be adjusted to meet newly reassessed demands over time could be very costly relative to an alternative strategy with a nominally higher cost but greater flexibility. We firmly believe that climate outcomes, not instruments to manipulate these outcomes, should form the overarching goals that guide strategy development. This aligns well with the Copenhagen commitment to stabilising GHG levels to prevent “dangerous anthropogenic interference with the climate system” and its current interpretation as a risk-based working goal of limiting temperature rise to 2 degrees.

The conservatism is understandable, but we believe the level is greatly in excess of what is needed to protect the integrity of the system and the confidence that can be attached to the impact of the abatement arrangements on climate change objectives. This project-level emphasis on certainty does not incorporate efficient modern approaches to risk management, where these risks relate not to uncertainty at the project level but to the net aggregate impact of all measures. Here, the value of a project lies in the extra value delivered to the overall strategy, adjusted for the change in risks of the overall strategy: a key point developed below is that strategy risk is very different from the sum of individual risks; project risks are poor, sometimes incredibly poor, pointers to the change in strategy risk delivered by a project.

It is also important to formally recognise the costs of delaying tapping into high prospect opportunities for behaviour change that appear likely to entail only modest costs relative to alternatives. Many of these delays are largely irreversible in terms of the impact of the economic costs of climate response and the impact on actual climate outcomes. A strategy that avoids the risks of moving too soon needs to account for any associated risks introduced from not moving soon enough. Of course caution is needed – but caution is needed in respect of missing upside as well as adding to downside.

A different paradigm is proposed, with the potential to alter very substantially: the nature of the arrangements; the strength of early incentives for behaviour change; the assignment of risks and of the value of upside opportunities and their associated incentive effects; the incentives, private as well as public, for investment in strategic R&D and model development to support greater precision as to the impact of behaviour changes on net emissions; and the incentives, private as well as public, for achieving improvement in the
international rules, especially as they relate to soil carbon but extending to elements of permanence, additionality and verifiability.

Central to this change in paradigm are the following concepts suggested for serious consideration within an offsets strategy:

- Recognition that the primary value in the initial offsets arrangements will lie in the foundation they provide for evolving policy and the arrangements to address the main issues and information constraints over time:
  - they will encourage and focus the development of capability within the sector, within the research community and within international negotiation processes – capability consistent with efficient process evolution, rather than seeking (futilely) to be efficient at an early point in time;
  - they will also deliver some early abatement but their value will probably be much broader and greater than the direct value of the immediate abatement; and
  - the initial arrangements should be viewed as securing access to much broader options for sound and cost-effective climate response over time;

- Moving progressively away from single instrument, single farm (or aggregation of similar farms) offset products to admit and encourage more diverse portfolio products that span instruments, soil types, rainfall, production systems etc.
  - Creating room to exploit economies of scope as well as economies of scale in managing the risks associated with high levels of uncertainty when dealing with individual instruments and projects – because these portfolios, appropriately designed, will effectively be self-hedging in dealing with risks of under-delivery of anticipated benefits.
  - These methods should allow substantially higher safe levels of initial accreditation and will shift the emphasis from project abatement safely created to incremental portfolio abatement safely delivered. The two concepts are fundamentally different, implied numbers are likely to be radically different and the latter concept is far more directly linked to climate change goals than the former;

- Use of increasingly sophisticated and targeted regional farm sector models, with explicit balancing of supply and demand, modified to provide the capability to assess likely levels of leakage and to adjust accreditation accordingly – effectively discounting for leakage risk;
  - and using the same models to create incentives to adapt behaviour in ways that limit leakage and resultant discounting;

- Recognising the basic principle that waiting to act until the benefits of the action can be proved definitively can be, and commonly is, highly inefficient and can entail locking into costs many times greater than the costs avoided;
– and following through on the consequences, that encouragement of early action can represent sound and cost effective insurance that justifies the risks;

• Explicitly recognising upside opportunities associated with behaviour change – including greater abatement than can yet be safely assumed and future changes in rules – and providing policy support for the value of these ‘options’ to become part of the incentives for earlier and stronger offset creation.

– Allowing past abatement to be converted to credit as and when this is supported by the research and the rules.

– Explicitly recognising the value to climate goals of earlier change, as a result of the cumulative warming nature of climate change, and allowing past abatement options to be ‘inflated forward’ for the value of any climate benefits associated with the early action (while also discounting for any breakdown of stored carbon) before conversion to formal credits.

– Building incentives, private as well as public, to improve the science, change limitations in the rules and update the verification processes to reflect the new knowledge and to allow options to be exercised.

– Combining these to encourage earlier and more extensive creation of credits; commitment to the monitoring and research that will allow accumulated options to be converted to credits, and encouraging the commercial markets that are creating offset portfolios to take into account the value of these options to encourage more efficient targeting of farm sector resources.

It is important to recognise that a shift in paradigm along these lines may challenge a range of current assumptions – and indeed challenge what is considered best practice in farm response to climate threats and in processes for valuing and rewarding farm responses. The altered approach to risk management embodied in the proposed approach is quite fundamental and could result in fundamental re-ranking of the relative attraction of different forms of farm behaviour change.


Box 1  Example of increasing incentives from pooling risk across a portfolio

Consider the case of a farm behaviour change being assessed for a carbon credit. The assessors recognise substantial uncertainty as to the level of carbon that might be captured and conclude that the distribution of plausible outcomes is approximately a Normal distribution, with a mean of 7.9 tonnes and a standard deviation of 3 tonnes. They adopt a project focus, in which a safe lower bound is interpreted as the 1 percentile outcome – a level of accredited abatement that will be delivered 99 per cent of the time. This results in credit being issued for 1 tonne of carbon abatement, even though the expected abatement is 7.9 tonnes. Incentives are very weak.

What now if we could pool 100 such measures, spread across different forms of behaviour change, different farms, regions, rainfall patterns, production systems – even countries. Purely for simplicity, assume all offer the same distribution of possible outcomes.

If assessed case by case, the assessors would conclude that each offers safe abatement of 1 tonne and would issue credits for 100 tonnes of carbon.

However, if instead they looked at the distribution of the portfolio of 100 initiatives, again using the 1 percentile safety rule, they would reach a very different conclusion – because the ‘Central Limit Theorem’ applies to the distribution. The 1 percentile of the portfolio is 718 tonnes, not 100 tonnes. Each farm contributes 7.18 tonnes, not 1 tonne, to the safe lower bound performance of the portfolio, and could receive credit for over seven times the abatement that would be recognised in a project-by-project assessment process. The whole climate change initiative gains from the greatly enhanced, and now much less biased, incentives to deliver abatement and sequestration.

The remaining upside – the gap between the 718 tonnes credit and the expected contribution of 790 tonnes, and the 540 per cent chance that the actual outcome could be greater again, could then be tapped by issuing options over this upside – to be exercisable if and when the assessment rules are changed to reflect new information.

Any or all of more stringent verification requirements, larger portfolios, greater uncertainty on individual initiatives and scope for including in the portfolio some measures whose outcomes are negatively correlated (self-hedging), would serve to strengthen the point made by this example. There is no requirement for all initiatives to be identically distributed.

Observations on key issues

Objectives

There is a big difference between an objective of contributing equitably to a global strategy to limit warming to two degrees (especially if also linked to limiting acidification of oceans), and one directed at specified emission targets in future years, accounted within agreed principles. The former affords much more scope for recognising the true value of agricultural offset options, especially ‘lumpy’ sequestration options. In particular, it affords a stronger basis for recognising that early action with good prospects for delivering early abatement has value relative to equivalent abatement at a later date.
Consideration should be given to ensuring that the offsets market does not incorporate unintentional bias against these strengths of agricultural offsets – bias that seems highly likely within current approaches to offsets. In general, any focus on targets for point in time emission rates appears prone to potentially serious bias against the potential offered by agriculture. Similarly, the stronger the emphasis on value because of Kyoto compliance, the greater the bias against potentially lower-cost ways of meeting objectives stated in terms of actual climate outcomes and risk.

It may well be best for offsets policy to be formally focused on climate change objectives – in terms of indicators such as temperature trends and peaks and ocean acidification – even, while recognising the need for international reporting and compliance. The international rules do not prescribe the national objectives, nor do they require policy optimisation solely in terms of the rules.

**Treatment of soil carbon under international rules**

Effectively, changes in soil carbon as a result of changes in land use are excluded from Australia’s accounting for GHGs – and cannot be traded into an internationally compliant cap and trade scheme. This stems from the decision to require bundling together all land use impacts, whether a result of deliberate decisions or external factors (such as climate change trends). We consider this to be seriously flawed policy that has severely limited the incentives for soil-based carbon storage being pursued by Australia and a number of other countries that have, in response to this ‘all or nothing’ requirement, decided in favour of ‘nothing’ – for sound reasons.

In Australia, non-anthropogenic changes in soil carbon are likely to stem largely from droughts, emergence from droughts and bushfires – with quite limited implications for trend levels of atmospheric carbon, but with volatility that is challenging for sound policy in an environment heavily driven by annual reporting against targets. In other countries, non-anthropogenic carbon changes may trend strongly in response to climate trends (e.g. tundra melt) but the drivers are beyond the control of the individual country.

Australia is lobbying for change to the rules and this should continue. Pending change, the prospects for the rules being changed could be harnessed, via options instruments, to increase incentives for otherwise sensible investments in building soil carbon – via options that can be exercised in the event that the rules change to recognise such soil carbon contributions.

We have also noted, here and elsewhere, the scope for an Australian target on aggregate anthropogenic emissions, inclusive of anthropogenic soil carbon changes, alongside formal reporting within Kyoto principles against lower Kyoto-compliant targets, to enhance incentives for tapping the potential of soil carbon and to increase
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pressure on the international arrangements. The combination of these elements could address head-on the understandable concerns of the Australian Government with the costs of failing to comply with international commitments – while providing scope both to tap into measures that are cost effective for Australia and to increase pressure on the international rules where they are proving costly internationally.

Uncertainty

It is hard to be precise about the abatement impact of individual farm level changes – relative, for example, to a generator remaining shut down for an hour. These concerns have led to agricultural offset possibilities being rejected as too uncertain – or harshly discounted. However, this reasoning needs to be applied carefully:

- Uncertainty entails upside opportunities as well as downside risks. Rejecting action because it may under-deliver should only be done after an assessment of the chances that it might instead over-deliver.
- This is fundamentally an efficiency issue – the likely cumulative effect of rejecting a series of initiatives on the grounds that each, individually, involves large downside risk, is the rejection of a portfolio of actions likely to have much less downside risk and to offer access to greater upside opportunity.
  - This flows simply from the way that portfolio risk arises. With diversity across a wide range of risks, achieved across instruments, soil types etc., the volatility of the portfolio will be much less than the sum of volatilities of each element. Sound risk management must exploit this feature of diverse portfolios to prevent valuable contributors to the solution being dissuaded.
  - The potential in this approach may be to allow offset portfolios to be safely valued at many times the safe value attached to its individual components.
- The logic presupposes that offset providers need to be compensated fully at the time they create the offsets – and when the uncertainty is greatest.
  - Systems can be established to assess annual (or some other time period) values on services provided, based on monitoring of actual storage levels – an approach that can greatly reduce the effective uncertainty. Expectations of future success in demonstrating impact can then drive incentives for early change.
  - Use of options instruments, issued at the time the offsets are created, with the options exercisable if and when improved science or measurement recognises greater impact from the offsets than was originally allowed, can also be used to introduce early incentives for behaviour change with good prospects for being able, later, to demonstrate higher value.
Similarly, rates of discount (for lack of permanence, benefit leakage etc. as below) that have initially been set high to ensure that abatement is not over-estimated and over-compensated, could be subject to future (downwards) revision, with associated rights to exercise options over this potential future value. Again, these will translate into stronger early incentives for creation of offsets, despite their high uncertainty and the level of discounting initially imposed – highlighting the potential for complementarity between the two instruments for managing risks.

**Permanence**

Within the proposed paradigm, technical permanence of carbon capture can be ‘over-rated’ – which is not to underrate the significance of future loss of stored carbon. Most sequestration possibilities trigger resistance on the grounds that they cannot be guaranteed to keep the GHGs out of the atmosphere indefinitely. This is commonly addressed through some form of discounting of the value of the sequestration. Temporary capture can still have value – in slowing cumulative warming and its damage, in slowing ocean acidification, and in buying time to replace the sequestered carbon in the future. In relation to some possibilities, like biochar application, the gap between a likely average life of the carbon in storage, and a safe lower bound on the storage of carbon at a specific site, could be centuries. The potential for costly bias is substantial if the emphasis is on project-level safe lower bounds, with discounting based on them.

The proposed options instruments and/or the use of ‘service rental’ approaches, in which payment is made for demonstrated storage over defined time periods, could go a long way towards correcting for these substantial biases. These instruments would be used, in most instances, in addition to differential discounting for different sequestration activities. Furthermore, contractual mechanisms could be used to guarantee replacement of lost carbon – using the most cost effective technologies then available to ‘recapture’ any losses in excess of any already applied discounting. Precisely analogous issues have had to be addressed in relation to forestry investments – and, in turn, these might be better addressed by tapping into the potential of options instruments.

**Leakage**

Leakage could be viewed as a special case of lack of permanence. A farmer reduces livestock production, limiting farm emissions. This reduces supply, encouraging a price rise that, in turn, encourages increased supply from other farms – so the net reduction in emissions is less than the farm-level gross reduction. Some of the benefits are lost as a result of market response.
If, instead, the farmer were to alter animal breeding or feed mix to lower the emissions intensity of meat production, the level of leakage is likely to be much less. If this were done without cost, there should be no leakage. Broadly speaking, output mix changes will tend to be more vulnerable to leakage than input mix changes.

Various forms of sector modelling can be harnessed to provide a basis for estimating the net effect on production of single farm decisions that alter levels of production. While it will make sense, in time, to consider whether the substitute production will tend to be more or less emissions intensive than the initial production forgone, it would seem feasible to move fairly fast to produce a credible set of product and region-specific leakage factors, that could be further improved over time.

It may also be possible to limit leakage risks by compiling offset portfolios that are self-hedging – that limit or eliminate the market incentives to expand emissions outside of the portfolio. There would be strong incentives for this to be done if it could be achieved at a modest transaction cost.

Additionality

Farm systems are already changing in ways that are tending to lower emissions intensity – precisely because of the complementarity between lower emissions and higher farm productivity recognised earlier. Some abatement can be achieved at zero or even negative cost – with the trends into lower tillage systems and more targeted application of nitrogen being clear examples.

This said, earlier change is again better than later change and there may well be a case for encouraging more rapid take-up of already cost-competitive innovations where there is natural inertia.

Interactions with other environmental values

Many of the prospective areas of behaviour change in the farm sector, to deliver abatement or sequestration, are likely to involve significant interactions with other areas of environmental policy and associated policy objectives. Given that these other values may be less than perfectly priced, there are risks of intervention failure to be addressed – possibly alongside opportunities for complementary pursuit of GHG and other environmental objectives.

Accumulation of increased soil carbon and movements out of livestock into cropping would have implications for levels and patterns of water interception, for patterns of fertiliser use, etc. Care is needed to ensure that an apparent small saving in the cost of abatement is not being bought at high cost to other elements of the land and water system. Conversely, of course, these very interactions are part of the processes that support the view that some of these
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processes may deliver low-cost abatement and sequestration – precisely because they can also enhance enterprise productivity through better structured soil, better management of water, etc.

**Perverse interactions with other policies**

More generally, a number of existing policy settings – notably drought policy settings – have the effect of encouraging relatively high GHG-intensity patterns of agriculture. Earlier work by ACIL Tasman emphasised the incentives that flow from elements of drought policy – and recommended attacking these policy distortions ahead of creating counteracting incentives in offsets markets. If there are constraints on how rapidly these policy changes can be made, there would still seem to be scope to move on the offsets opportunities in a policy setting committed to progressive correction of the perverse interactions.

**Demand for offsets**

If the CPRS proceeds, and posts a clear price signal, this will open opportunities for a range of offsets to be offered to this market at a market-determined price.

Demand for offsets can come from several sources:

- **Commercial value**
  - as now, there is likely to be some commercial value in being able to demonstrate ‘green credentials’ through either coverage of own company emissions by offsets or through active, demonstrable, and accredited proof of direct contribution to reduced atmospheric GHGs;

- **‘Altruism’**
  - individuals and companies may seek access to instruments for directly making a positive contribution for, essentially, altruistic reasons – though extending to concerns for children and grandchildren, and encompassing values linked to social responsibility;

- **Trades with CPRS**
  - where trade into the CPRS or other cap and trade arrangements is possible, the direct value of such trades could underpin rising value; in the absence of such demand, regulatory measures might be used to support analogous demands;

- **Value in ‘banking’ rights**
  - where there are good prospects for such trading opportunities to arise, then these measures could have value in hedging exposure to cap and trade risks – there could also be demand to hold the rights to any future trading opportunities; and

- **Government**
  - governments could choose to express demand directly – analogous to the expressed demand to ‘buy-back’ environmental water flows in the Murray-Darling Basin.
The first two of these are real, but probably quite limited in the incentives they can post – as reflected in values that have emerged from the CCX, for example. Indeed, these incentives could actually diminish with introduction of a CPRS – especially for firms and households whose main emissions are linked to energy and fuel use.

Commercial linkage to the CPRS could clearly drive substantial value that works in the opposite direction. This policy agenda would tend to favour progressive extension of the range of effective offsets for which such trading is possible – or prospective. Complementary regulatory devices could go some way towards simulating these incentives, though probably with less precision.

Direct government demand, whether funded through other mechanisms (CPRS revenues, special levies, etc.) or not, could certainly increase incentives and could, under some circumstances, make economic sense where there are market or intervention failures remaining. In the context of large commitments by governments to supporting analogous measures, such as geosequestration, there is a legitimate question of whether the acquisition and extinction of relatively low-cost and immediately effective offsets may not be competitive with some of this spending. In the absence of the CPRS this strategy, possibly linked to a funding mechanism, could make greater sense.

**Market mechanics**

Choices will be needed between governments establishing the institutional and regulatory environment within which commercial offsets markets flourish, or intervening more strongly to establish a central market, probably with some resultant monopoly power. There seems little case for preventing other markets and a good case for encouraging commercial exploration of opportunities to better ‘plug gaps’.

However, a case for a more central solution may emerge from the value in tapping size and scope economies effectively. This is likely to still be feasible through sound institutional arrangements that encourage and reward the assembly of high value diverse portfolios, including aggregation of portfolios across different commercial markets. A more ‘hands-on’ role might be supported by a strong desire to move early to make major progress – though again this might also be achieved by governments agreeing to enter these markets as buyers with a clearly understood demand profile, rather than seeking to run the market.

Governments are likely to have a more natural role in formal accreditation processes. High credibility, internationally recognised standards for accreditation could deliver a lot of value to the markets, while advancing government objectives for demonstrating real abatement and for...
demonstrating to other countries ways of delivering real abatement in agriculture.

If the proposed paradigm shift were adopted, then this has implications for the National Carbon Offset Standard, for the accreditation processes, and for how these would need to evolve over time.

Liquidity in markets is likely to favour the development of something like standard contract specifications – in terms of product, duration, etc. A focus on this is appropriate, but care seems necessary to prevent it from discouraging effective tapping of scope economies. It would be easy for standardisation to favour single instrument measures, and dealing with permanence via a requirement to roll over a similar instrument. It seems likely that any such bias could prove quite costly in the longer term.

**Box 2 Upside options need not create new information needs, nor add much complexity**

It would be quite feasible to routinely issue options over upside revisions of accreditation rules without introducing substantially greater complexity to the market. While the existence of the options is likely to intensify the pressures to improve the science or address defects in the rules, this is an opportunity and an options market can operate without any major changes.

All that is required is a system that allows previously accredited farm behaviour changes, for which safe credits have already been issued, to be resubmitted based on the original documentation plus the information contained in the option document itself. If the then available science, and standard accreditation process, would recognise a higher level of abatement or sequestration than originally credited, then all that is needed is a process to:

- reassess the total credits, using the new accreditation rules, and to issue fresh credits for the difference between the new and the earlier assessments; and
- incorporate the derivation of these additional credits into the options document, providing a basis for further reassessment in the future.

What is involved here is a sensibly evolving accreditation process. This evolution will make sense whether options have been issued or not – the rules are reviewed periodically to factor in new information. The fact that the rules may change over time provides the basis for one or more tranches of option value to be realised, by having past actions reassessed within current rules.

**Contract duration not prescribed**

For related reasons, we see little value in prescribing the duration of contracts. Better discovery of smarter solutions would seem likely to flow from a more flexible approach that handles uncertainty and impermanence soundly. This would not, of course, mean there could not be a standard contract – this could allow much lower transaction costs across multiple activities. It would seem sensible, however, to allow opting out where greater value could be demonstrated. In time, the emphasis on large and diverse portfolios might actually prove more effective at containing transaction costs via size and scope.
economies, and the increased application of regional modelling methods to underscore value demonstration.

For single instrument measures, we would favour the use of realistic (and probably therefore fairly harsh) discounting for risks, coupled with options over future upside potential. These options would themselves be amenable to packaging into more diverse portfolios in the future, as a way of demonstrating greater value than was at first considered justified. Use of this approach would favour early effective communication regarding the nature of the investments that will be made in improving the science, establishing revised thresholds, changing limiting rules, and developing portfolio accreditation methods that will recognise the value of scope economies in managing risks.

A range of mechanisms could be used to encourage and assemble portfolios of measures – ranging from relatively light-handed, market-driven mechanisms through to a centralised process. We consider the role of government likely to be more in early facilitation and capability building than in long term operation of these pooling arrangements.
1 Introductory comments

With today’s focus on the challenges of developing and implementing effective and efficient climate change policy, facilities to encourage voluntary offsets for greenhouse gas emissions have strong intuitive appeal. This intuitive appeal is enhanced where climate change policy has been developed to protect society against the severe risks that have been mapped out over years of detailed scientific inquiry.

The establishment of voluntary offsets will necessarily be only a component of a much wider range of policy measures developed within Australia and overseas, but it is easy to appreciate the logical ways in which such measures could add value:

- Posting signals to ‘discover’ and implement more cost-effective ways of contributing to meeting climate policy objectives – posting explicit ‘incentives for abatement and sequestration’ in the language of the Federal Government, and for ‘direct action’ in the language of the Federal Opposition.
- Building-in natural market checks on incurring transaction costs in creating offsets that exceed the benefits of the offsets – something that can be a lot harder to do within regulatory or compulsory emission market settings.
- Helping to fill potentially costly ‘gaps’ that would arise in a strategy based solely on compulsory regulation and emission markets, especially where substantial activities and emissions are excluded from the formal and compulsory emission markets (or from other measures to post a ‘price on carbon’).
- Creating incentives for pursuing and reporting on measures that will reduce atmospheric concentrations of greenhouse gases, even where there are current difficulties for Australia in fully accounting for the benefits of such actions within current limiting international accounting rules.
- Using such institutions to assist in bringing pressure to bear on the international accounting rules.

These conceptual arguments have acquired much greater strength in the last few years, with a growing empirical understanding of the opportunities that may exist for creating cost-competitive, and in some cases potentially highly cost-effective, abatement and sequestration strategies within Australian agriculture. Several recent studies, including by ACIL Tasman (Campbell & Barber, 2009), have summarised the emerging support for the view that agriculture offers substantial opportunities for sequestration and abatement, and that in many cases the activities needed to achieve this sequestration and abatement have the potential to also contribute significantly to farm productivity.
For some time now, the Federal Government has had in place formal mechanisms to encourage changes in behaviour that would assist in reducing rates of greenhouse gas (GHG) emissions, or promoting recapture of existing atmospheric GHGs. These mechanisms include a mix of regulatory measures, education and, importantly for the purposes of this discussion paper, a formal standard to apply to so-called ‘offsets’ – the National Carbon Offsets Standard.

The notion of ‘offsets’ is that real net emission reductions are possible from voluntary emission reduction activities.

While these offsets markets are being proposed as measures complementary to the CPRS, such offsets, including agricultural offsets, could have significant value whether the CPRS is established or not. In general, in the absence of the CPRS (or prospects for moving to the CPRS or some other explicit price on greenhouse gas emissions) offsets markets are likely to have greater potential value, but probably be harder to make work well, with strong incentives for participation and constraints over incentives for counterproductive behavioural change.

Establishing a carbon offset market is, in one sense, relatively easy; there are a number of carbon and other markets operating in agriculture that could serve as a template. The hard part is to establish arrangements that allow a high proportion of agriculture’s potential to contribute to climate policy to be tapped, while managing substantial risks of intervention failure – stemming from a complex set of issues that affect the relationship between specific patterns of behaviour change at the enterprise level, and effective changes in atmospheric GHG levels.

To do this will be complex. We envisage some sharp trade-offs needing to be addressed:

- simplicity of arrangements vs. their breadth and effectiveness;
- sophistication of market measures vs. extent and depth of complementary regulatory measures applying to agriculture to manage the level and costs of aggregate emissions;
- stability and certainty of market design features vs. effectiveness and cost-effectiveness, over time, of offsets as an integral part of climate policy:
  - with efficient policy likely to require substantial market evolution and involve medium-term uncertainty as to how the markets will evolve;
- trade-offs between arrangements designed to tap size economies in the costs of transacting offsets trading, by aggregating up lots of very similar initiatives, and arrangements designed to tap scope economies by building diverse portfolios of measures that afford ‘self-hedging’ of some risks as a way of managing risks downwards – and allowing the capture of more of the upside opportunities; and
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• the sophistication and hands-on nature of government-driven offset registration and trading arrangements, versus the quality of the standards, and the scope of the value-creation opportunities they encompass:
  − Increasing the scope for value-creation could deliver strong incentives for private services to emerge efficiently. Private services could take over from central processes over time.

We could have focused in this study on mapping out the design of a market in credits. We do, in fact, attempt to do this later – but we see real risks in jumping in at the nuts and bolts end, before looking carefully at the character of the opportunities and threats that need to be managed – including why and how. These, in turn, help shape the discussion of how a market might be structured and the way in which its evolution might occur.

Importantly though, we come out of this consideration of ways of addressing concerns within the design of the market with substantial optimism that agriculturally based credits can, and most likely will, have clear value. This market could form part of Australia’s and the international response to climate threats, and can be established in a way that allows progressive growth in value while protecting the integrity of the market and confidence in the level of contribution being made to climate change objectives.

However, a cavalier approach to the issues, with simplistic design, could well prove counterproductive. Dealing with the trade-off between limiting the scope for rewarding changes that are not in fact valuable and limiting the discouragement of valuable changes, is hard – and requires sophistication and some complexity of arrangements. Failing this, the outcome could be either counterproductive or unnecessarily costly. We are firmly of the view that dealing efficiently with this trade-off will require a high degree of flexibility to adapt the mechanisms and the rewards over time – and also requires tapping into not yet proven, but prospective value, to encourage stronger and earlier behaviour change.

Currently practiced approaches to dealing with these issues seem, at best, heavily biased against tapping into the potential value and may, in some cases, be counterproductive. We argue the need for a shift in paradigm – a different approach to the definition, as well as the treatment, of risk and a different approach to assessing the value to overall climate strategy of specific forms of farm sector behaviour change. We believe this is feasible, and set out both a framework and a range of instruments that could allow for practical implementation of more valuable arrangements with well-managed risks and costs. In most cases these would operate as enhancements to the types of instruments that have already emerged to address these concerns – including various forms of discounting for possible losses.
Consequently, this discussion paper broadly works through:

- An examination of the role of an offset market in a national emissions strategy, inclusive of the role such a market can have in assisting Australia contribute to the design of the international abatement strategy.

- A discussion of how stronger incentives for participation, spanning most of the significant opportunities, can be established – or can be allowed to evolve over time – while limiting intervention failure risks.

- An analysis of the various elements of the design and operations of a carbon offsets market, given the policy objectives and the level of participation likely.

The paper draws heavily on a recent ACIL Tasman (2009) paper, which explored options for tapping into the climate policy potential of agriculture. That paper saw a valuable role for an offsets market – not just in delivering specific offsets, but also in building capability and systems that could evolve to play an increasingly valuable role in Australia’s climate policy and that could serve as a model for other countries with a substantial agricultural sector.

However, that paper was written before the recent shift in Australian Government policy that deferred indefinitely any consideration of including agriculture in the CPRS. As is argued below, this has both increased the importance to overall climate policy of developing effective agricultural offsets markets and heightened concerns about how to sustain the effectiveness of these markets – especially how to manage risks of the nominal benefits of changes by individual enterprises being substantially lost, as a result of both market responses to these changes and opportunities for gaming limitations built into the voluntary character of these markets. These matters have now shifted centre stage.
2 The role of an offsets market

The proposed CPRS amendments recognise two distinct classes of credits – those that comply with international accounting rules and that might be suited to direct use as offsets within the CPRS, and those that relate to activities that would not be accorded recognition under current international rules, but that satisfy stringent tests (based on internationally recognised accounting principles) to demonstrate real impact on atmospheric greenhouse gas levels. Both classes of credits are relevant to agriculture:

- The former involves the potential to offset commercial liabilities under the CPRS, possibly reducing national costs of complying with a shrinking cap;
  - while not directly reducing net emissions, these cost reductions could possibly make future, more aggressive, reductions in the cap politically acceptable.
- The latter offers direct opportunities to reduce aggregate Australian emissions – to actually reduce net emissions and impact on atmospheric GHG levels;
  - and may assist in meeting targets for these aggregates, or make the pursuit of more aggressive targets more affordable and politically acceptable;
  - crucially, it creates a ‘door’ for pursuing a range of high-potential agricultural initiatives that would not currently comply with the international rules.

With the recent decisions by the Government to defer indefinitely any compulsory inclusion of agriculture in the CPRS, and its linked assertion of a strong commitment to offsets markets for agriculture, the focus on offsets instruments has intensified.

Agriculture accounts for almost two-thirds of the 25 per cent of all Australian emissions now proposed for indefinite exclusion from the CPRS – so effective instruments directed at abating agricultural emissions could help fill a substantial gap in the coverage of the CPRS.

Indeed, failure to effectively constrain emissions from these ‘uncovered’ activities could make Australia’s commitments to 2050 targets via the CPRS extremely difficult and costly. Were these ‘uncovered’ activities to actually increase their net emissions\(^1\), even modestly, then this could render a 60 per

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\(^1\) As the CPRS cap is lowered, this can be expected to increase the competitiveness of activities not covered by the CPRS (or otherwise constrained) relative to those covered by the CPRS. The CPRS itself may post incentives for growth (at least relative to a ‘business as usual’ case) in agriculture and agricultural emissions – as may wider trends in international supply and demand for food.
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A cent target for 2050 almost impossible to achieve (through real reduction within Australia) without access to large-scale cost-competitive sequestration. E.g., an annual growth rate of 1 per cent in uncovered emissions translates to the need for a 96 per cent reduction in the CPRS cap in order to deliver on a 60 per cent reduction target for aggregate emissions by 2050.

ACIL Tasman (2009) reviewed where Australia fits in the spectrum of countries assessed on the significance of agriculture in their emissions and their economies. In terms of countries we naturally compare to, Australia falls between New Zealand – where agriculture accounts for half total emissions (and where there is also limited scope for attacking aggregate emissions via reductions in coal-fired energy generation) and Europe and North America, where agriculture accounts for substantially less than Australia’s 16 per cent of emissions. New Zealand has chosen to include agriculture in its cap and trade arrangements – Australia, US and Europe have chosen not to.

Offsets are one of a range of instruments to be harnessed to address the need to constrain emissions. One of their attractions lies in the way a voluntary offsets market uses ‘carrots’, rather than ‘sticks’, to encourage restraint. Conversely, the lack of ‘sticks’ in a voluntary market heightens concerns that the restraint exercised by one enterprise may be at least partially cancelled out by the responses of other enterprises to this changed behaviour.

That said, the greater the success in tapping these opportunities for offsets to deliver real restraint over aggregate emissions, the less is likely to be the needed extent of reliance on heavy-handed regulatory, taxation or other measures to limit emissions in areas not covered by the CPRS. Voluntary offsets have particular attractions, relative to most other measures, in the way they could favour encouragement of the more effective/competitive behaviour changes and can limit enterprises incurring high transaction and compliance costs where these are high relative to the implied value of the emission reductions.

Perhaps as importantly as agricultural abatement opportunities, agriculture has prospects for delivering substantial sequestration of atmospheric carbon, irrespective of source, through farm system changes that increase the level of carbon held in soils and vegetation. There are indications (Campbell & Barber, 2009) that some of these sequestration opportunities might prove highly cost-competitive with the price of abatement likely to emerge over time from the proposed CPRS. The nominal costs suggested in some studies for substantial opportunities for agricultural sequestration and abatement are very low relative to the likely marginal cost of abatement that would emerge from the proposed CPRS over time.

At the same time, caution is needed here. Many of these studies do not address the substantial issues that arise in assessing the net cost and value of such
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Cost-competitiveness through cost sharing

measures, taking into account the issues discussed in Section 3 below. Equally though, they typically fail to take into account a number of the features of these opportunities, and the way their risks might be managed, that could add to their attraction within a sound policy setting. We consider it highly likely that there are substantial opportunities for agricultural behaviour change to deliver cost-competitive support for Australian and international climate policy objectives.

A key source of this cost-competitiveness – not just of sequestration, but also in abatement of methane and nitrous oxide emissions – lies in the potential synergies between reduced emissions and improved farm productivity. Broadly, methane emissions are pointers to wasted energy in feed; nitrous oxide emissions point to wasted nitrogen; and across much of Australia’s cropping land there are strong indications that heightened soil carbon can improve soil structure and crop productivity. These opportunities point to scope for cost sharing lowering the effective cost of achieving a given level of abatement or sequestration through farm enterprise behaviour change.

Effectively, there are opportunities for farms to expand their product mixes, to include climate services alongside meat, crops and fibres. The evidence points to the scope for tapping the economics of joint production inclusive of climate services. The principles involved here are closely analogous to the way that wool production can gain competitiveness through the joint production of sheep meat, and that both can support cropping productivity within a rotational farm system through impacts on soil nitrogen, etc. The result is scope for cost-sharing across product lines.

It seems sensible, if voluntary offsets markets are to realise their potential, that the agricultural sector start to look to the delivery of offsets as a feasible, and possibly cost-competitive, product line. Just as enterprises need to weigh the best balance between wool and wheat and sheep meat, after exploiting the production synergies as well as competition for resources, the same reasoning can extend to farming in a context where there is demand for climate services of the type reflected in carbon offsets, alongside the demand for wool, wheat and sheep meat.

In Figure 1 the results of some recent overseas work (Moran, 2008) on the possible net costs of a range of changes in farm practices that might deliver abatement or sequestration services are set out. Care is needed in interpreting the chart – though the overall picture portrayed is considered important, and broadly consistent with a range of studies undertaken across several countries. Included in the important riders are the facts that: several of these instruments are dependent on technologies yet to be delivered, with no certainty of this happening; the cost estimates are dependent on uncertain science and in many cases will be very sensitive to site-specific (and country-specific) factors; and in

The role of an offsets market
general the calculations appear not to adjust for leakage of benefits as a result
of market responses to these changes and to assume that soil carbon changes
are sustained indefinitely (which may be plausible but requires particular
assumptions). These matters are of great importance and are addressed in
some detail below. They do not, however, detract from an overall assessment
that the upside potential of farm behaviour change, to deliver cost-competitive
abatement and sequestration services, appears high – as long as the downside
risks can be managed.

The headline feature of the chart, and analogous charts from other studies, is
the wide band of possibly very low cost, or even negative cost, farm changes
when viewed in terms of the cost of abatement, net of any productivity
benefits associated with the changes.

The production of climate services could be further enhanced by the fact that
some farmers are likely to be willing to make some financial sacrifice to deliver
climate services – in the same way that most buyers of hybrid motor vehicles
or purchasers of carbon offsets for flights do not do it because of its
commercial attraction. If such motivations are real, then it is quite appropriate
that they be factored into enterprise planning.

It is worth noting the comparison between the evidence for building soil
carbon and the emerging picture in respect of the economics of
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Geosequestration – with a very large commitment having been made by the Federal Government as a central plank of its climate policy:

- Geosequestration remains a theoretical prospect – technically feasible, but with current technologies a long way from being commercially viable.
  - In contrast, a range of mechanisms for building soil carbon – including low tillage cropping methods – are currently available and are commercially attractive across a reasonably broad application base – without any payment for the carbon sequestration.

- Recent trends in the estimated costs of geosequestration have not been promising – raising serious questions about its future viability or the need for high levels of subsidy in roll-out as well as technology development.
  - Prospects for expanding the range of soil carbon activities with good prospects for being more than competitive with the marginal cost of abatement from the CPRS – including prospects for direct application of biochar products – appear good.

- Geosequestration entails political and social concerns that are likely to remain entrenched and divisive, stemming as they do as much from philosophy and values as from understanding of facts.
  - Soil carbon build-up would appear far more acceptable, and even attractive, if the concerns for effectiveness are well addressed.
  - It has received strong endorsement from such highly respected community-based expert groups as the Wentworth Group of Concerned Scientists (2009).

An often quoted indicator of the theoretical potential of soil and vegetation carbon – ‘terrestrial carbon’ – is to note that all the growth in atmospheric carbon since the industrial revolution would be offset by a 15 per cent increase in the earth’s terrestrial carbon. This can be misleading as an indicator of scope for farm offsets, to the extent that the rundown in terrestrial carbon has been dominated by the clearing of forestry – though clearly farm forestry can be part of the overall build-up of terrestrial carbon.

Table 1  **Annual biophysical potential of rural land to sequester carbon or reduce emissions, 2010-50, Mt CO$_2$-e per year, Australia**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Potential (Mt CO$_2$-e)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grazing land management (incl. soil carbon)</td>
<td>100</td>
</tr>
<tr>
<td>Livestock emissions (mainly methane)</td>
<td>26</td>
</tr>
<tr>
<td>Crop land management (incl. CO2 and N2O emissions)</td>
<td>25</td>
</tr>
<tr>
<td>Savannah Fire Management</td>
<td>13</td>
</tr>
<tr>
<td><strong>Total Agriculture (excluding biochar and biofuels)</strong></td>
<td><strong>164</strong></td>
</tr>
</tbody>
</table>

Data source: (CSIRO, 2009)

Table 1 sets out recent CSIRO estimates of the physical capability of rural lands to build soil and vegetation carbon – with soil carbon being the
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dominant component. Note, however, that these figures do not include the potential of biochar, which was not assessed.

The CSIRO estimates represented a substantial scaling back of the analogous figures compiled in the Garnaut Report (Garnaut, 2008) – reflecting the substantial uncertainties, but perhaps also converging towards a reasonable set of estimates.

The very existence of these possibilities, suggested by Figure 1 and Table 1, and associated incentives, challenges traditional views of optimal patterns of farming output mix and, just as significantly, input mix. Farm productivity can then be defined across the input/output mix and inclusive of the value of all outputs, including climate services.

This said, it is important also to retain a sober assessment based on the uncertainties alluded to above, and practical constraints on mobilising the volumes of carbon capture suggested in these calculations. The key point we would want to emphasise is the evidence of potential for a substantial impact at a plausible competitive price. A key purpose of any offsets market should be to deliver the actual information on which to base a sensible estimate of how much of this potential is commercially accessible.

Against this background, the concept of pursuing voluntary offsets is largely uncontroversial – with support from the Federal Government and Opposition and from within the farm sector – and, potentially, the value is high. Voluntary offsets markets already operate, under increasingly mature protocols, in a number of places around the world and, in an important sense, already in Australia. However, we believe there is a need, and also the scope, to improve substantially on the design of these models. Many of the potential improvements in these models relate to addressing the key issues identified and discussed in the following section of this report. This should allow far more of the potential to be realised, while still managing risks of under-delivery of anticipated abatement benefits.
3   Key issues to be addressed

There are significant issues to be addressed if the potential identified in the previous chapter is to be adequately, let alone comprehensively, and safely tapped. The problems entail a mix of risks – of the commercial incentives to create offsets being too low to result in much of the potential being tapped, coupled with risks that the offsets mechanisms, to the extent they are effective, could actually result in counterproductive incentives or in the creation of nominal offsets that grossly over-represent the real impact of the behaviour changes.

If offsets generated by agriculture and land management in Australia are to be a central part of a credible climate change strategy over many years, it is crucial that a sound balance be struck here and that attention be paid to building well-focused incentives, strong enough to make a real difference.

These issues are complex. To date, the dominant international approach to these issues has been to constrain, in most cases quite severely, the effective opportunities to create agricultural offsets, especially sequestration offsets – or to create an environment in which those offering such offsets can only realise a small fraction of the potential social value of the offsets created, thus severely limiting the incentives. In effect, simplicity has been strongly favoured relative to effectiveness.

There is an important trade-off here. Complexity brings costs that can challenge the cost effectiveness, and even the effectiveness, of policy. On the other hand, simplistic arrangements can be counterproductive or largely ineffective – and could still (if they encourage significant ineffective behavioural change) entail high costs with little benefit.

The right level of complexity is likely to vary across countries. The greater the need for emissions restraint in agriculture, and the more suited a country’s agriculture is to delivering cost-effective abatement and sequestration, the greater is the likely level of justified complexity.

We have concluded that close emulation of these existing offset market models would be relatively straightforward – but would also yield severely constrained access to benefits. Such an approach, unless seen purely as a starting position for a rapidly evolving set of market arrangements, in which the key constraints are targeted and relaxed over time, would fail to do justice to the opportunities offered by agriculture to Australia (and to the world) in addressing the climate change challenges.
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Assuming the CPRS is implemented, such an outcome could be expected to entail growing threats for agriculture and other ‘uncovered’ activities, as a contributor to alternative measures, for the reasons outlined above. These risks could exhibit through increasingly stringent regulatory intervention (probably with some serious efficiency costs) or as renewed probing of the appropriateness of continuing to exclude agriculture from the CPRS indefinitely. If the CPRS is not implemented, it is likely to prove even harder to build strong incentives into the offsets mechanism (via tradability with the CPRS) – but the need to tap the offsets opportunity is likely to be seen as increasingly important as a means of containing the distortions of other intervention mechanisms directed at achieving targets.

Indeed, given the significance of the agricultural land base in Australia, and Australia’s disproportionate exposure in its coal and energy sectors to the consequences of current climate policy trends, an approach that severely sells short the potential offered by agriculture could be seen as severely biased against Australia and against the achievement of a cost-effective outcome.

We have therefore looked closely at the major issues that have so far constrained tapping into the potential for agricultural offsets – and have sought constructive responses to these issues, that can both address the underlying concerns and limit the extent of any resultant bias against tapping these opportunities. In some cases, this involves the development of procedures to adjust the offsets to ensure that what is to be certified and traded provides a fair statement of the net impacts implied. In other cases, we have been forced to challenge assumptions being made, within the Australian and international climate policy debates, where we see these as entailing biases and risks of excessive costs.

That said, the same probing of the role of offsets has highlighted, to a greater extent than has so far pervaded the public discussion of offsets mechanisms, some serious issues that also mean that an ill-considered offsets market could deliver nominal abatement and sequestration well in excess of the real net impact of the behaviour changes being encouraged. There are risks of over- as well as under-estimation of the benefits of pursuing offsets, and care will be needed in the design of the markets, and probably in complementary measures outside of the markets, if these risks are not to translate into serious undermining of the merits of the offsets concept.

The following provides a summary of the major issues and key points made in relation to them. They are presented in the context of a discussion paper, inviting serious consideration of whether apparently reasonable requirements might not, in some cases, have the effect of undermining primary objectives and how a better alignment with objectives might be achieved. Indeed, it is even worth standing back and addressing what the primary purpose and
objectives/goals of climate change policy are. It is all too easy to slip into thinking in terms of emission targets as being the purpose of policy when they are just one instrument with some serious limitations.

### 3.1 Policy purpose and objectives

Australia is participating in a complex, international policy development process. A strong element coming out of these processes has been a policy focus on managing rates of emission of GHGs, accounted within a set of rules, at specific points in time – with these ‘parameters’ being linked to plausible ‘tipping points’ in managing the climate change threat.

This approach has been understandable, but it is important to recognise that it is more about means than ends. Emission targets are not primary goals of climate policy and the two do not correlate perfectly, with the divergence being most apparent when dealing with opportunities for sequestration as well as abatement and with opportunities to shift the timing of ‘lumpy’ sequestration opportunities. These are key features of some of the offset opportunities offered by agriculture – more so than the dominant opportunities in most sectors.

There is also room for major divergence flowing from current limitations in the climate science – creating substantial uncertainty about the relationship between specific rates of emission (even if sequestration has been well handled) and actual climate outcomes, including levels of atmospheric GHGs, rates of temperature rise over time and peak temperature changes.

Of particular interest in relation to the ultimate goals of climate policy is the recent Copenhagen outcome, in which a maximum 2 degree (Celsius) global temperature rise received broad acceptance as a working goal, underneath an ultimate goal as discussed below. This working goal relates to the maximum shift in mean global temperatures before the warming trend is halted.

A peak temperature target is still more a means to an end than an end in itself, though one that appears more directly linked to climate change fears than are emissions targets. Focusing on such a ‘target’ immediately challenges the confidence that can, and should, be attached to longer-term global emissions targets, and any associated country-level commitments – presumably much more so for 2050 targets than for 2020 targets.

Given current scientific uncertainty, there has to be a be very high likelihood that, in time, the inferred level of emissions restraint needed to comply with a peak temperature change target will require revision – up or down – to reflect changes in knowledge of the underlying science and, of course, longer time series on which to base improved modelling. Rigidly locking in to an emissions
target risks either jeopardising the peak temperature target or locking into potentially unnecessarily high costs.

Two degrees emerges out of climate modelling, and in particular modelling of the consequences of global warming, with 2 degrees being broadly viewed as an indicator of an upper limit before the risks of catastrophic consequences start to rise rapidly. It does not imply that a lesser temperature rise would be costless, nor that anything greater than 2 degrees would necessarily be catastrophic. It is, in effect, a working risk management target linked fairly directly to current credible modelling of potential damage as a result of climate change. In particular, it relates to levels of atmospheric GHGs over time and not directly to emission rates at points in time.

Importantly, a logical consequence is the, at least implicit commitment to reassess emission targets, and the timing of emission reductions between ‘milestones’ (such as 2020 and 2050) if the science evolves in ways that suggest a different relationship between global emissions and maximum temperature rise.

Similarly, reassessment of the risks of damage on each side of 2 degrees would support reassessment of strategy – including emission targets – over time. The logic embedded in this process is one of adaptation to new science, not one of setting long-term behaviour targets and pursuing them regardless of new insights into how these behaviour changes are influencing real risks.

Indeed, the Copenhagen Accord comes a lot closer to stating an ultimate goal, in which the two degree target is also seen as a means, not an end – and in which the two degree target should be seen as amenable to change should the “scientific view” change:

“To achieve the ultimate objective of the Convention to stabilize greenhouse gas concentration in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system, we shall, recognizing the scientific view that the increase in global temperature should be below 2 degrees Celsius, on the basis of equity and in the context of sustainable development, enhance our long-term cooperative action to combat climate change.”

“...We agree that deep cuts in global emissions are required according to science, and as documented by the IPCC Fourth Assessment Report with a view to reduce global emissions so as to hold the increase in global temperature below 2 degrees Celsius, and take action to meet this objective consistent with science and on the basis of equity. We should cooperate in achieving the peaking of global and national emissions as soon as possible...” [emphasis added]

We assume the primary goals are far more about damage minimisation and risk management – about preventing dangerous anthropogenic interference – with this being linked by the currently available science to levels of atmospheric
carbon influencing temperatures and climate (and, indeed, though not explicitly in the quote above) to associated levels of acidity in oceans.

Box 3  Value of policy flexibility

The currently unavoidable uncertainty of the relationships between rates of emission, peak temperature rise and climate damage has important policy implications. It implies caution about investing to minimise the cost of meeting current emission targets, and in particular encourages consideration of the flexibility a strategy has to accommodate the need to alter parameters such as emission targets and even peak temperature rise.

Suppose that Australia concluded it could (just) comply with a 60 per cent emissions target by 2050 as a result of a package of measures that radically restructured electricity generation, tapped commercial, industrial and domestic demand for energy, and moved to adopt new transport energy systems. This package has understandably ‘picked the low-hanging fruit’ – resulting in substantially reduced flexibility for further demand management (demand hardening) and pushing coal and gas-fired energy technologies close to their technical limits, hardening supply-side emission rates. The restructuring involves a massive investment in energy-efficient coal (inclusive of geosequestration), increased relative use of gas and renewables, etc. This energy mix is found to be expensive, but the least-cost way of delivering a 60 per cent reduction in emissions.

Suppose this investment has been largely sunk by 2040, but the science available in 2041 leads to the conclusion that the 2050 target needs to be ramped up to 70 per cent reduction (for Australia, as its ‘fair share’ of the needed restraint) to avoid cataclysmic climate change. Where does this leave Australia? Will Australia have sunk high costs into a technology mix that lacks the flexibility to adjust to the changing reality? Will the original attraction of CCS and gas as lower emission technologies turn out to be the problem rather than the solution – because their emissions are not low enough and there is massive sunk investment in the technology? Conversely, what happens if sequestration technologies, or revised climate modelling, suggest that a 40 per cent target would be adequate – to what extent will Australia have locked into very high sunk costs?

Given the divergence between working targets, such as emission targets, and policy goals, such as damage minimisation, it is appropriate to ask whether such a ‘least-cost’ strategy for pursuing working targets would constitute sound risk management. Would it be better to pursue a nominally more costly strategy with greater flexibility to adapt to changing information? Such investment in strategy robustness and insurance is common commercial practice – precisely because businesses try not to lock into the pursuit of rigid targets based on questionable assumptions, but rather to pursue a strategy that fairly robustly protects shareholder interests despite high levels of uncertainty.

The prospect for a climate strategy that sensibly taps into the capability of agriculture to afford a more robust, safer and flexible strategy for Australia – and in a real sense a more cost-effective strategy inclusive of the higher level of insurance – is one of the serious prospects to be considered in planning an offsets strategy. In this context nominal weaknesses might be reassessed as strengths. E.g., lack of guaranteed permanence in nominally low-cost sequestration might be reassessed as creating valuable temporary deferral options, allowing some high costs, that might later prove unnecessary, to be deferred, and possibly avoided, while retaining the flexibility to re-sequester if and as needed (i.e., implying access to a permanent sequestration process, to be used if and as justified, even if a specific sequestration is not necessarily permanent). This could offer a much lower expected cost than would the least-cost alternative with guaranteed permanence.

This simply reflects modern investment theory that requires explicit consideration of the value of flexibility when planning strategy in the presence of high levels of uncertainty.

Source: Drawn heavily from (Campbell & Barber, 2009)

We further assume we are dealing with a global challenge in which aggregate global response is what matters and in which an equity principle is being evoked to say...
something about how the burden of the global response should be shared, across countries and through time.

We also assume that damage minimisation and risk management will be assessed inclusive of the damage and risks implied by the intervention options, reflecting conventional policy principles, even though the Accord is less explicit here.

Arguably, the acceptance of a 2 degree ceiling, and that peaking will take time, is based on implicit recognition of this cost-effectiveness principle, or the associated principle of political feasibility. There is some trade-off involved even at these levels – given the suggestions of ecosystem damage and possibly increased intensity of extreme weather events already occurring. If there is already some damage, then it seems likely that substantially more would accompany a gradual rise towards a 2 degree peak. The Copenhagen language of preventing dangerous anthropogenic warming may also have a role to play in justifying the ‘target’ – though this begs the question of what constitute dangerous – and danger to whom. The reality is that there must be substantial inertia in climate change trends, and a level of pragmatism is needed – but certainly with an eye to potential tipping points that could fundamentally change the ‘game’.

We would expect also that Australia has a specific interest in making sure the burden is shared ‘fairly’ – in line with the equity principle above. We would see a key element in its policy as being to support international engagement to encourage behaviour change in other countries – as part of the burden sharing and as part of the cost minimisation.

### 3.2 Treatment of land use change & soil carbon

ACIL Tasman (Campbell & Barber, 2009) adopted a position of strong opposition to current treatment of GHG abatement via land use change, including deliberate build-up of carbon in soil and vegetation, under international rules – reflecting and extending the formal Australian position. We argued that it conflicts with sound policy principles and that it entails high cost policy that reduces international prospects for limiting climate change damage. Effectively, we argued that the world could pay a high price for constraining access to otherwise cost-competitive and potentially large-scale ways of contributing to the overall response to the climate challenge – and that to do so would be inequitable in relation to countries with substantial agricultural sectors.

Under the Kyoto Protocols for countries accounting for carbon emissions, there is a choice – to account for all land-based carbon changes or for none. The protocols do not allow for the option for a country to account for changes only in anthropogenic (induced by man) emissions, even where changes in
non-anthropogenic emissions are being driven by chance cycles or by global emissions over which the country has no direct control.

This means that, to account for the impacts of changes in soil and vegetation carbon levels stemming from behaviour change within Australia, it would be necessary to bring to account all carbon emissions flowing from natural processes and/or triggered by behaviour outside the country – including effects of drought, bushfires, etc. and any long-term trends in these attributable to overall global warming trends.

In international negotiations, Australia and a number of other countries have challenged this ‘all or nothing’ principle as poor policy design and rejected the second of these approaches as highly discriminatory for Australia – which keeps specific measures, even if they demonstrably boost soil and vegetation carbon, outside of the reporting within these protocols, and has been interpreted to preclude the use of such measures in meeting emission targets unless the rules are changed. This is true even if the measures have an unambiguous beneficial effect on atmospheric greenhouse gas levels – changes that would seem entirely consistent with the objectives that gained broad support at Copenhagen, as set out above.

There is nothing to prevent also reporting in a manner inclusive of the demonstrable effects of any such measures. The National Carbon Offset Standard (NCOS) certainly provides a basis for such separate recognition and reporting – and we assume that such reporting is envisaged by the Australian Government.

There is a logical question, raised in the earlier ACIL Tasman work, as to whether Australia should announce and pursue a target on emission reductions inclusive of induced soil and vegetation carbon changes, in addition to its targets exclusive of soil carbon – and indeed whether it should adopt a position of proposing a lower exclusive target (but higher inclusive target) pending sensible improvement in the rules.

Working with the objectives as set out earlier, such a strategy would seem quite defensible as being more supportive of the objectives, and more reflective of the cost effectiveness principle, than would a narrower focus solely on internationally compliant accounting where the accounting rules are in clear conflict with the policy objectives of minimising damage, inclusive of the costs of limiting atmospheric GHGs. Agricultural offsets would appear to offer a high value platform for pursuing such an approach – and even for demonstrating the opportunities for similar measures being adopted by other countries.
If the aggregate commitment to emission reduction targets, inclusive of changes in anthropogenic soil and vegetation carbon levels, were at a greater level than the current commitments to emission reductions, then in fact such a strategy would seem inherently more consistent with the objectives flagged in the Copenhagen Accord. Indeed, this would remain true even if the targets in respect of emission reductions compliant with current standards were lowered (or not raised as rapidly over time) alongside of the setting of these more comprehensive and higher targets that are better linked into objectives. This would require that the ‘upside’ from the expanded scope offset the ‘downside’ from any contraction in targets within the current protocols. Clearly such a move would be heavily dependent on credible establishment of the assumed upside benefits – but if this could be done it should support a more cost-effective climate response by Australia contributing to a more effective global response while bringing pressure to bear on international protocols to be adapted to reflect this logic.

Well structured agricultural offsets that include sequestration in soil and vegetation appear to offer a powerful means of highlighting internationally the discrimination in the current rules and the potential cost for the world, and of bringing additional pressure for change to bear – without this being seen as a means of ‘watering down’ Australia’s commitment to reducing its contribution to atmospheric greenhouse gases. The potential value of this role for offsets is to create stronger incentives for the associated behaviour changes, underpinning higher value attached directly to such offsets. For this process to work, it is crucial that the offsets have very high credibility, which involves also addressing a number of the other issues below.

More broadly, the offsets mechanism appears to offer a powerful means of dealing with this inherent conflict between:

- the objectives that have emerged from Copenhagen; and
- the current accounting standards that cut strongly across the implicit cost-effectiveness principle and that imply no confident relationship between reductions in compliant emissions and the 2 degree target;
  - plausible changes in levels of carbon trapped in soil could fundamentally alter the likelihood of remaining within the 2 degree target.

These arguments link strongly to the opportunities offered by Australian agricultural offsets and strongly suggest that the potential of agricultural offsets may need to be tapped in order to deliver on the international objectives of damage and risk minimisation. They also suggest a key ‘transitional’ role for agricultural offsets during the period in which the current rules for accounting for soil carbon remain in place – a role in keeping open Australia’s options to make a strong and cost-effective contribution to global damage and risk minimisation, in a way that can be viewed as equitable. This includes equity in tapping the comparative...
advantages offered by different countries in delivering competitive contributions to the solution of the global problem.

Having said this, it is important to recognise, and deal effectively with, some well-founded concerns about the long-term impact of changes in soil carbon – as reflected in the following ‘generic’ issues discussed in the subsections below, but also dealing with some technology-specific concerns.

The scope for building soil and vegetation carbon through a range of land use practices is not particularly controversial – and specific mechanisms have already been developed in relation to forestry, while overseas offsets markets have paid particular attention to reduced tillage farming methods. However, the current enthusiasm for biochar, while founded in plausible and prospective technological possibilities, should probably be approached with some caution as to how big the practical opportunity is.

Large-scale production of biocarbon suited to biochar production may well find itself competing strongly with second generation biofuels for land. These offer two different technologies for extracting abatement value (net of the emissions involved in production and use) from land that would generally have low value in traditional farming uses – and both appear prospective. Biofuels deliver their abatement benefits by substituting a renewable energy source for oil or coal burning – effectively leaving carbon in the ground where it is stable and located already. Biochar works mainly by inserting carbon into the soil in the expectation of stable retention with only slow degradation. The competitive mix of these two approaches will depend on a range of factors – including how the issues below are handled for biochar (notably permanence), but also developments in oil prices and alternatives to liquid fuels for transport. Trends here may well favour growing competitiveness of biochar, though this could be altered by technical breakthroughs in biofuel technologies.

These comments are made because of the high level of public interest in biochar. It looks attractive as a prospect and may well be able to play an important and growing role, with cumulative impact on climate change objectives over time. However, it is likely to remain as one element within a broad sweep of climate instruments and may well command only a modest share of the value of all farm land use changes.

2 Though it is notable that the process for manufacturing biochar can itself yield, as a by-product, significant amounts of biofuels (syngas) and bio-oils. Also notable is the fact that the mix of attractions in biochar – better soil and farm productivity, production of biofuels and management of biowaste – can be varied by choice of inputs and process, implying that soil application may need to compete for product. One further value in biochar lies in its possible function as a natural hedge for the risks still present in the geosequestration programs.
What is striking is the potential upside of biochar relative to some assessments of permanence concerns. Some of the permanence concerns might be matched by the indications that biochar can also reduce emissions of NO\textsubscript{2} and CH\textsubscript{4} from soils to which it has been applied. On the permanence issue, a recent CSIRO report (CSIRO, 2009), on Australian rural options for sequestration, commented:

“There is sufficient evidence to be confident that over 90 per cent of carbon in biochar produced from wood at temperatures in excess of 500°C will be stable for at least 100 years (this estimate is likely to be exceeded by 5 to 10 times once more data are available to consolidate these numbers.)”

Another CSIRO-commissioned report (Sohi, Lopez-Capel, Krull, & Bol, 2008) provides further insight into the nature of the remaining research challenges – though we would recommend that that be considered in the context of the approach proposed for dealing with remaining scientific uncertainty. Through this lens, these research challenges might be seen as rather more tractable in the short term.

Not all biochars satisfy these assumptions, but this does suggest a lot of caution will be appropriate before discounting biochar to the point where it is effectively excluded from a competitive role. There would certainly be scope for distinguishing treatment of biochars based on both method of production and application. The possibility of upside options instruments having high value against this sort of backdrop – and encouraging greater care in the choice of biochar – appears substantial.

Further comments on the reliability and permanence of biocarbon are included in Sections 3.4 and 0 below.

### 3.2.1 Non-anthropogenic soil carbon changes

Offsets mechanisms do allow some scope for recognising and crediting behaviour changes that affect soil and vegetation carbon levels, even where these would not be seen as complying with the accounting rules (unless Australia were to accept responsibility for accounting for non-anthropogenic as well as anthropogenic carbon). However, constraints on treating them as valid offsets for compliant, internationally tradable carbon credits within the proposed CPRS represent a significant constraint on fully valuing such measures in a manner commensurate with their potential value to overall climate policy objectives.

While there is superficial appeal in an argument that says countries should not be able to pick and choose which soil carbon they account for, we do not believe this argument stands up to close scrutiny as long as the line drawn between carbon types is not capable of being seriously gamed. Of interest here is the
line between anthropogenic and non-anthropogenic changes in carbon, with the terms being interpreted locally. Burying biochar is clearly an anthropogenic change, as would be deliberate switching from pasture to trees (or vice versa). Melting of the tundra as a result of global warming is non-anthropogenic, because any such trend is essentially caused by global temperature developments outside the control of the individual country. The same could be true of loss of vegetation as a result of increased insect pests that thrive under climate trends, as a result of increased propensity for drought or bushfire flowing from global climate trends.

There is a legitimate question as to where responsibility for non-anthropogenic soil and vegetation carbon changes should lie – a question that could sensibly be addressed through international negotiation. It seems unlikely that these processes will require that the Inuit wear responsibility for tundra melt and certainly to date the arrangements have allowed countries to not assume responsibility for globally-induced patterns of change in soil carbon.

However, once a decision has been taken that countries are entitled to not accept responsibility for these changes, it is hard to see a sound policy case for requiring that countries ignoring these emissions must also ignore the possibilities for change in anthropogenic carbon levels where they can control the instruments to make these changes happen. The international decision to ‘bundle’ the two has major ramifications for agricultural offsets markets. The general effect has been for countries that would feel exposed to needing to account for non-anthropogenic carbon changes, opting out of accounting for all soil carbon – and effectively walking away from a set of policy instruments that could offer highly cost-effective contributions to global climate policy goals.

For Australia, the major non-anthropogenic carbon issues would seem to be loss of soil and vegetation carbon as a result of drought and bushfires.

There are distinct concerns that arise in relation to non-anthropogenic carbon levels and changes:

• Individual droughts and bushfires generally have very short-term impacts on stored carbon. Carbon lost during these events is generally recovered after the events – presumably with minimal long-term implications for climate goals.
  − Of course, protocols are needed to ensure that a particularly harsh drought or bushfire season in a key emissions target year – such as 2020 or 2050 – does not result in a harsh assessment against targets that do not reflect the real implications for climate policy objectives.
  … In reality, a bad bushfire year or a bad drought entails very short-term carbon loss and creates a natural capacity for rapid sequestration in the near-term. It would be crucial that both these
features be recognised if severe bias were not to follow. Overall the net impact on climate objectives is likely to be very small (though not zero, for reasons addressed further in relation to the timing of sequestration in Section 3.4 below).

- This may be something more easily done through the offsets mechanism than via emissions accounting.

- Global climate change might make large parts of Australia more prone to drought and bushfires – with more frequent and more intense events. Of course, it might also have the opposite effect in some regions.

- Such trends, if they do result in a progressive trend to running down average stocks of carbon in soils and vegetation, look more akin to the melting of the tundra than to an Australia-specific issue. They would be non-anthropogenic and, like threats to the melting of the tundra and Antarctic ice sheets, be a central challenge for global climate change policy.

- The same modelling that factors in ice sheet and tundra melting as part of its assessment that a two degree temperature rise is a sensible threshold, should be accounting for such trends on soil and vegetation carbon that flow from climate change.

This is not the place to resolve these issues – but it is a suitable place for recognising that the capacity to tap agricultural offsets cost-effectively is likely to be shaped heavily by how these questions are addressed. In turn, this reinforces the case for continued pressure on the international arrangements in respect of soil carbon, in line with current Australian Government policy and possibly extending in some of the directions suggested by ACIL Tasman (2009).

The very fact of such pressure, and prospects for success, could be used to build incentives for early agricultural investment in anthropogenic carbon changes – if such investments provide access to options in respect of the higher value that would be created if the rules are later changed. We return to this as a key theme when we map out a possible way forward with offsets markets in Sections 6 and 7.

### 3.3 Stocks versus flows of greenhouse gases

Climate change mitigation (as opposed to adaptation) policy is largely seeking to influence future patterns of global temperature and, more recently, ocean acidity by altering the levels of atmospheric greenhouse gases.

Currently, there are limited viable and acceptable instruments for directly manipulating these levels – though there have been suggestions that this could be done through a range of sequestration mechanisms, including ocean seeding for carbon capture, artificial reefs, etc. In a serious sense, some of the
opportunities offered by agriculture and broader land use – especially sequestration of carbon in soil and vegetation in the sense of building a higher trend level of such stored carbon than is implied by the business as usual case – come closer to fitting this ‘direct instrument’ role than do the main measures currently being pursued internationally.

These main measures rely instead in reducing the rate at which GHGs are being emitted, and relying on natural background sequestration processes to move to a lower equilibrium level of atmospheric GHGs than would have occurred under business as usual behaviour. The logic of this is sound – it can deliver lower GHG levels over time and these can be expected to translate into lower temperature and ocean acidity effects. However, it is important to recognise that this relies mainly on this indirect strategy, of reducing atmospheric GHG levels by reducing emissions, rather than by directly dragging GHGs out of the atmosphere. It is important that we do not confuse the instrument of lower emissions with the objective of lower atmospheric GHGs – when there are other instruments that do not necessarily rely on lower emission rates.

The purpose of the policies is to change the level of atmospheric GHGs that in turn shape the warming and acidification patterns. The instruments include lower rates of emission (coupled with natural sequestration processes), and artificial sequestration processes. The objective is about altering the stock of atmospheric GHGs over time. The instruments include ones that alter the flow of GHGs into the atmosphere, ones that alter the flow of GHGs out of the atmosphere and, crucially, ones that could make lumpy corrections to the stock of atmospheric GHGs. Care is needed to ensure that the current emphasis on emission reduction, as an instrument, does not result in artificial impediments to tapping the potential of some sequestration as an instrument – and we have reasons to believe that such bias has already arisen in ways that constrain realising the full potential of agriculture.

Changing to more energy efficient appliances, replacing brown coal generation with gas, and even implementation of a steady-state geo- or bio-sequestration process to capture/avoid a specified percentage of generator emissions, all have a direct and sustained impact on the flow of emissions into the atmosphere. They are likely to translate into predictable reductions (relative to some ‘business as usual’ case) in annual emissions running forward over time. As such, summary measures of performance in the form of annual emission rates may do a reasonably good job of measuring impact (subject to some of the important comments regarding timing below), and it seems not unreasonable to seek to capture the aggregate impact of a range of such measures in the form of target levels of net emissions at future points in time (such as 2020 and 2050).
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Agricultural carbon sequestration opportunities are not necessarily like this. An opportunity to improve farm soils by incorporating into the soil a large weight of carbon, in a form such as biochar, is a ‘lumpy’ opportunity. It could be expected to result in a large block of sequestration when added, but there need be no follow-on effect in later years. Indeed, the discussion of permanence below appropriately includes the possibility of net emissions from the buried carbon in later years – and these effects need to be taken into account in weighing the value of investments in building soil carbon levels.

Such lumpy impacts on the stock of atmospheric carbon are not well handled via annual accounting for net emissions. An analogy exists with farm accounts – there is a clear difference between the balance sheet and the profit and loss statement. Burying carbon is a capital investment that should offer a flow of future benefits in the form of lower rates and levels of atmospheric GHGs and lower rates of acidification of oceans – both tied strongly and directly to climate policy goals. But the flow of services stems from a change in the stock of atmospheric carbon.

If the incentives for pursuing such ‘lumpy’ investments are to be right, then it will be important that the approach taken to recognising the value of such lumpy capital investments is sound, and allows the future service flow value to be accounted in the future (e.g. in 2020) without any need for there to be actual abatement/sequestration in that year.

As was noted earlier, international processes have been heavily geared around needed rates of annual emissions. This offers a simple language for agreeing on targets, etc. – but does potentially risk bias against the opportunities offered by the Australian (and other countries’) agricultural sectors unless there is significant sophistication in the way ‘stocks’ are handled.

We assumed above the primary purpose of setting targets lies with damage and risk minimisation, tied to the impact over time on temperatures, levels of ocean acidity, etc. – with annual emission rates being purely an imperfect indicator of these primary effects. It is important that the imperfections do not drive behaviour away from some of the more cost-effective opportunities to pursue the primary purpose.

These concerns seem real – there is a tendency to reject one-off measures relative to sustained measures, when the science indicates there is a valid role

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3 The same is actually true of other forms of emission abatement, but is commonly not viewed in this way – there is a tendency to think in terms of the value of reduced emissions in their own right, rather than the cumulative stock effect delivered to atmospheric GHG levels by each annual reduction in emissions. It is the time profile of stocks of atmospheric GHGs that matters to climate policy goals – not emission levels as such.
for both and the economics suggests that the most cost-effective policy will almost certainly involve a portfolio that includes both. This argument depends significantly on the way that GHG stock levels over time translate into rates of temperature (and ocean acidity) rise and into damage and risk – as is discussed below.

These points of course link back strongly to the treatment of soil carbon and carbon stored in vegetation, such as trees, but also other perennial crops and pastures. Reduction in the stock of carbon stored in vegetation, via land clearing, has been one of the major contributors to recent levels of assessed net global emissions. Until relatively recently, it was also a major component of the assessed level of emissions from Australian agriculture, and controls over land clearing have had a dramatic impact on the emissions attributed to Australian agriculture.

Still, however, these statements are focussing on the flow effects. Just as validly, and probably more importantly, we could note that the reduction in the stock of forestry, and more general reductions in the levels of land-based carbon (soils and vegetation) have translated into an increase in the stock of atmospheric GHGs. That damage has been done, but the direct challenge then is to redress this shift in stock levels, not to focus solely on redressing the rate of emission of GHGs. The potential for changes in behaviour within agriculture to do just that – directly target stocks of atmospheric GHGs – would seem to be one of its strengths.

The Australian Government has undertaken substantial investment in the capability to deal with the stock as well as the flow implications of land use patterns in Australia. The National Carbon Accounting System is underscored by the FullCAM Model, “to integrate data on land cover change, land use and management, climate, plant productivity and soil carbon at a 25m resolution over a thirty-year period.” This is supported by ongoing mapping of land use patterns and monitoring of carbon levels.

More generally, there is a lot of work being done on the impact of land use patterns on carbon stocks – but more heavily in relation to accounting and reporting than in relation to policies that will affect these stocks. The two need not be independent activities – and an offsets scheme that effectively taps into the potential will almost certainly need also to tap into this capability for modelling the relationships between land use patterns and carbon emissions, and carbon in storage in soil and vegetation. The public debate remains heavily about flows of emissions, and is heavily based around points in time rather
than recognition that the path by which reduced emission rates are achieved is of vital importance – because it affects atmospheric stocks over time.

We note that FullCAM includes two modules of particular importance – CAMAg, that deals with cropping and grazing systems and RothC that deals with agricultural soil carbon. There are tantalising possibilities and serious challenges in looking at how to harness these carbon models in support of behaviour change incentives, where an offsets market might be the central institutional structure.

3.4 Timing of impact

Closely linked to the stock and flow discussion is the significance of timing of any effects from agricultural sequestration on the stock of atmospheric carbon.

Assuming that agricultural sequestration delivers real reductions in atmospheric carbon, then it follows that early sequestration is better than later sequestration – in the sense of a given level of sequestration delivering greater benefits. This argument is particularly strong when thought about in terms of objectives tied to peak temperature rise (and the 2 degree target) rather than in terms of specified targets for emission reductions over time. The translation of reduced atmospheric carbon into higher temperatures and increased ocean acidity is not instantaneous – there is a cumulative effect. Any delay in the accumulation has both a direct beneficial impact and avoids an opportunity cost.

Carbon buried tomorrow should have a cumulative effect on temperature and acidity ranging out to 2020, to 2050 and even beyond that. Compared to burying the same quantity of carbon in 2020 or 2050, the world should be better off for having it buried tomorrow – even if it will not necessarily be buried permanently. The effect of earlier burying should be a fundamental shift in the forward distribution of expected temperature patterns and acidity levels – and this distributional shift should bring with it greater flexibility to limit maximum temperature rise and to push out the time till any specified level of temperature rise occurs (with similar comments in relation to ocean acidity). Early action delivers options not available with later action and these options should have value.

All ways of meeting 2020 and 2050 targets are not equally valuable. It is better to start abatement earlier, because of both cumulative impacts on atmospheric levels of GHGs – something that is widely recognised but not well-factored into international target-setting – but also because the process of translating lower GHG concentrations into less damage starts early and is also cumulative.

Of course, like most things, it is not quite this simple and counterarguments have been raised. While early sequestration delays warming, precisely because it lowers atmospheric GHG levels, the same process can be expected to reduce
the rate of ocean sequestration – lower concentrations in the air translate into lower rates of absorption into the oceans. It has been argued that this could mitigate, and even fully offset, long-term temperature impacts under some circumstances if the GHGs are later fully released\(^5\). However, there are some important comments relevant here:

- Temporary storage of carbon may delay irreversible damage to ecosystems (such as species destruction, etc.) – buying time to find better solutions.
  - Effectively it keeps alive options for society that would otherwise be lost. Of course it will be appropriate to weigh the benefits of this against the costs, but the benefits are real.
  - These options relate to the lower rates of acidification of the ocean as well as to the implications of lower rates of temperature rise. The very oceanic sequestration mechanism invoked to offset the benefits of temporary storage is a key contributor to the growing concerns with ocean acidity.
- An analysis of a single temporary sink, in isolation from a consideration of how the presence of that sink is used to modify broader strategy, is artificial.
  - This is particularly true of sinks such as soil carbon, sequestered by incorporating biochar, retaining crop residues and or perennial pastures included in the crop rotation, where there is likely to be significant commercial incentive to retain/replace the carbon in view of wider productivity benefits.
  - However, it is also true as long as there is ongoing research with good prospects for delivering better ways of managing long-term atmospheric carbon.
- In any case, even if it were accepted that temporary sinks do not lower long-term peak temperatures, they do delay that peak. Reflecting the above points, this buys options to reduce the peak by other means, but the delay has value in any case under traditional deterministic discounting of future benefits – with sequestration with good prospects for lasting a long time being likely to support substantial value from this source alone.

These arguments apply with special potency to agricultural sequestration options. As far as we know, none of the existing markets have sought to

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\(^5\) This argument has been made by a CSIRO researcher (Kirschbaum, 2006), who argued that on average the climate change positives would be closely matched by the climate change negatives, linked to lower oceanic sequestration. This argument was later rebutted by (Dornburg & Marland, 2007), who argued that “Even temporary sinks put us on a lower path for climate change, a path that will not otherwise be accessible. For carbon sinks in the terrestrial biosphere, we argue that sooner is better and longer is better, but even known temporary sinks have value.” This later view is strongly supportive of the optionality approach to value and timing that we are proposing – even temporary carbon sequestration buys options that might not otherwise be accessible.
recognise this important source of value, and indeed many of the market designs are likely to have counterproductive incentives that favour delaying ‘one-off’ sequestration initiatives, effectively to speculate on the likely rising value of carbon emerging from other mechanisms, including cap and trade markets. These could be interpreted as market failures – because these emerging markets are not adequately accounting for the option value delivered by early sequestration relative to late sequestration. In theory, the sequestration could occur early, and the flow of benefits – in the form of reduced atmospheric carbon each year and lower expected temperatures each year – could be traded at their opportunity value later.

The markets currently lack this sophistication, but this raises questions as to whether offsets markets could be designed to provide greater recognition of this option value – and whether this might not in turn be used to intensify the incentives for both earlier action and for ongoing husbandry of sequestered carbon in ways that better sustains this value.

Especially in relation to soil carbon, it is worth recognising the plausibility for the case that sequestration will, in many cases, be very long-lived. Difficulties arise under an approach that handles uncertainty poorly because of the possibility that some will have only a short life – and problems in identifying in advance which these are.

That said, there is growing evidence that biochar can be very long-lived in soils. This includes samples of charcoal in soil that date back many hundreds of years, and more recent sampling of rates of decay. For example, a recent study (Kuznakov et al, 2009) inferred, based on monitoring of decomposition rates of black carbon in samples of soils exposed to well above average levels of factors encouraging breakdown, that:

“Considering about 10 times slower decomposition of BC under natural conditions, the mean residence time (MRT) of BC is about 2000 years, and the half-life is about 1400 years. Considering the short duration of the incubation and the typical decreasing decomposition rates with time, we conclude that the MRT of BC in soils is in the range of millennia.”

Zimmerman (2010) reports estimated half-lives for biochar C “on orders ranging from $10^2$ to $10^7$ years. Perhaps more importantly, he noted that “measurements of volatile weight content may be a convenient predictor of biochar C longevity” – with scope for this and other predictors to underscore more site-specific assessments of the duration of biochar.

These assessments compare to the earlier (Section 3.2) reference to (Sohi, Lopez-Capel, Krull, & Bol, 2008), where a ‘safe’ lower bound on decomposition of some soil applied biochars of 100 years was suggested, with expectations that this could rise to 500 to 1000 years with more research.
Australian Agriculture as a Provider of Carbon Offsets

We are not proposing adoption of such figures – and we strongly endorse explicit monitoring and testing in Australia. Available estimates range widely, but it does seem likely that across a broad range of cropping country, and within a broad range of farming systems, there could be substantial scope for confidence that the mean duration of carbon in soils would be long enough to really matter. The indications here are that, even if a very low estimate of duration were used initially, any options over upside duration could have substantial value – possibly well in excess of the nominal value associated with a safe lower bound estimate.

Just as importantly, the scope for a broadly-based portfolio of soil carbon build-up measures, under suitable governance arrangements, to offer a defensible half-life or mean-life many times greater than that which could safely be attached to a single application, would seem high (see Box 4).

Box 4  A portfolio of soil carbon offset activities

A broadly based portfolio of soil carbon build-up may include a suite of measures that, if assessed individually, represent significant technology and permanence risks. The suite may comprise of the use of biochar, retention of crop residues using conservation tillage techniques, and inclusion of perennial pastures in crop rotations. The actual offset produced could be based on the buildup and maintenance of a stock of carbon in the soil where the method of sequestration and maintenance is based on series of approved activities.

It is also likely that there could be synergies between the various soil sequestration activities. An initial inclusion of biochar may promote a range of soil conditions conducive to increased crop production. Increased crop production could mean greater biomass is produced as well as grain. If managed appropriately, the increased biomass can be returned to the soil and stored as carbon. Using perennial pastures in the crop rotation would lead to greater carbon sequestration at depth (assuming deep rooted perennial pastures are used).

If the pastures have high legume content, such as lucerne, the nitrogen fixed in the soil may lead to less applied nitrogen during the crop phase. Nitrogen fixed during legume rotations in the cropping program can be prone to large uncontrolled releases if it is not managed appropriately through tillage, etc.

Clearly this discussion could have been included as readily under the discussion of permanence (Section 0) as here. The key point is that the risks in being ultra-conservative in assessments of the duration of some forms of sequestration could be very high.

The more the threats to long life relate to small area or chance risks – rather than systematic factors that suggest ‘all or nothing’ outcomes – the stronger will be this point, for reasons discussed further in Section 3.5. Indeed, the
timing concerns seem only amenable to sound treatment if considered from the perspective of risk management.

### 3.5 Uncertainty regarding science/verifiability

Limitations on the available science – on our ability to predict with accuracy how behaviour change will translate into altered net emissions and (linked to the permanence discussion below) how long impacts will last – has been widely used as a reason to delay the encouragement of a range of behaviour changes with high levels of uncertainty as to impact.

International processes have evolved a strong focus on verifiability as a core criterion. The reason why this has happened is understandable, but there are strong reasons for being cautious here (or cautious about how verifiability is interpreted), as the requirement can result in deterrence of behaviour change with a high likelihood of delivering substantial and cost-effective benefit. However, offsets can be designed to reduce the costs and uncertainty of verification (see Box 5).

Companies generally attach value to holding insurance well ahead of specific claims being made on that insurance. Climate change policy is essentially risk management. Most proposals are for nations to incur substantial costs as a means of defraying a likely higher cost set of risks of climate change and damage. The negotiating processes are proceeding on the basis of the assessment of risk, not on the basis of the demonstration of the certainty of damage. This seems to us sound, but if the logic is accepted, then it casts a wide range of investments in insurance in a different, and more attractive light.

Australia has committed large sums to R&D into geosequestration – seen as a sound investment in insurance to protect a significant part of Australia’s historical competitive advantage (its coal-based energy sector and exports). Subject to sober assessment of projects, the logic supporting this position seems sound – even though the chances that the research will not deliver a large-scale commercially competitive technology are far from zero. Cars get insured even when the chance of no claim being needed are well above zero.

The same logic, linked to the above discussion of the benefits of early reductions in atmospheric GHG levels, raises important questions of the insurance value of early investments in agricultural sequestration and, of course, in early behaviour change that may reduce emissions. These can be assessed relative to the value of holding on to the option to later sequester the carbon.

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6 This is fairly explicit in the Section 3.1 discussion of the rationale for the 2 degree ceiling.

7 Standard options theory recognises there is a trade-off here. Early sequestration maximises the value of the sequestration to reducing damage, but increases the risks that the costs will be incurred only to later emerge as having been unnecessary or not cost-effective. The
Box 5 Using genetics to lock in emission reductions and reduce verification costs

Using genetic selection techniques to reduce emissions could be a way of locking in emissions or sequestration activities so long as the genetics continue to be used. Using genetics to reduce emissions or increase sequestration is not dissimilar to coating nitrogenous fertiliser to reduce N$_2$O emissions.

For example if heritability of reduced methane emissions is proven, flocks or herds of lower-emitting animals could be produced using the genes from proven low-emissions sires and dams. If the genetics are regularly used to maintain the lower emissions profile of the commercial flock or herd, individual animal measurements would not be required to periodically verify the emissions reductions.

The offset package that could be produced using genetic selection may be a payment made to a stud breeder to include methane production as a selection index for a period of time. The stud breeder could accrue the credits based on the incorporation of the estimated breeding values of stock sold, and the number of times a sire is used. The number of times a sire is used could be calculated based on a standard estimate of the average number of females a sire is mated to per year (mating percentages begin at about 1 per cent in higher stocking rate areas) multiplied by the average working life of a bull or ram.

Simple genetics statistics could be used to calculate the flow-on benefits of the genes, once they are in the gene pool, and an adjustment made for this in the offset.

Alternatively a commercial animal producer could claim a credit for each year a low-emission bull or ram is used. The transaction costs of this would be higher but there are likely to be fewer assumptions used in the calculation of the benefits, particularly if the benefit stream is restricted to only the progeny of the sire.

Similarly plant genetics can be used to lock in emission reductions and reduce the costs and risks of verification. Pasture species and varieties could be bred to reduce the methane emissions of the livestock that consume them or increase the amount of biomass stored in the soil.

Clearly genetic engineering is likely to play a role in the modification of plants to reduce methane emissions or sequester more carbon. Similarly genetic modification or other techniques such as cloning could be used to modify the emission of livestock. Consumers will need to consider the tradeoffs from the use of low emissions genetic technology and their preferences for genetically modified food.

Substantial barriers to early action in these areas have arisen as a result of an inability to demonstrate certainty of impact – without the same test (i.e. certainty) being applied to the broader climate change policy.
The fact that agriculture offers a range of sequestration and abatement options that may also offer complementary benefits in the form of improved farm productivity suggests that these could entail cost effective insurance options – well in advance of some of science being proven, just as the R&D investments are justified well in advance of the technologies they are focusing on being proven.

Unless the value of such insurance is recognised in the design of the institutional arrangements, it is likely that the mechanisms will fall well short of realising the full potential offered by agricultural offsets.

Box 6  **Certainty is not essential for value**

Suppose the possibility emerges of undertaking a one-off investment in a unique sequestration prospect. The prospect is unusual, in that it is costless and non-repeatable. What we know is that it will either work – and sequester a billion tonnes of carbon indefinitely – or not work at all, but with no other adverse implications. Subjectively, the chances of it working are assessed to be about 10 per cent. It will not be known for 5 years whether it worked or not.

Would it be worth doing? What would it be worth paying to get it done?

One approach would be to say that a safe lower bound on the benefits is zero – but does that mean the value is zero? Current international thinking would probably say just that about the level of credit to be awarded the investment. But that same reasoning would imply that Australia should immediately cease any investment in carbon capture and storage, in new renewable technologies or in any of a raft of “R&D” investments, most far from costless, even though they are seen as having upside value. The decision to invest hard cash in such initiatives places a lower bound on the value of these initiatives.

This one-off opportunity offers real option value to the efforts to manage atmospheric carbon levels. A 10 per cent chance of permanently sequestering a billion tonnes of carbon looks pretty valuable as an option – as a way of offering society a 10 per cent chance of not needing to source such a reduction in atmospheric carbon by other means later. Of course, if the chances were more like 90 per cent then the value would be very much higher again. But in any case, a portfolio consisting of many such one-off elements could offer very high prospects for delivering abatement/sequestration much greater than would be indicated by the sum of lower bounds for each element.

Any process that only values at the safe lower bound value is prone to bias against assembling the most cost effective parcel of measures to pursue the primary goal – of reducing atmospheric GHGs and their consequences.

A common approach to uncertainty is one that seeks to recognise only a safe lower bound estimate of the level of abatement/sequestration that has been delivered – even where the upside, the potential for the beneficial effects being much greater, is large. This is perhaps understandable in a process directed at ensuring that a minimum level of abatement is achieved by certain points in time. However, it is also a process that is heavily biased against getting full value out of agricultural offset opportunities and is biased towards higher than necessary costs in delivering a given level of damage containment.
One relatively simple device for addressing these concerns would be to attach an option to offsets measures (and, indeed, under wider abatement measures, even those planned for trading within the CPRS but where uncertainties remain). Thus an issued credit could include immediate recognition for a verifiable lower bound on impact, plus an ongoing option over the value of any upside that emerges later from R&D investments or other sources. The two parts would be linked (that is the option would only be able to be exercised against the credit it was issued with), but could be traded separately.

These options could be expected to have value, for the insurance they offer, and this value would rise with any increase in the likelihood of upside being demonstrated and with any rise in the expected level of such upside. This approach would allow market expectations – as to the likelihood of later revision of conservative benefit assessments – to be factored into the current and/or future value of investments undertaken now. The logic of this applies to abatement as well as sequestration measures where there is uncertainty. As is generally the case where options exist or are created, the higher the uncertainty, the greater the likely value of the options.

This suggests that this form of reasoning is likely to be broadly of greater relevance to agricultural offsets than to most other ‘industrial emissions’ where uncertainly levels, at least in relation to net emissions, are likely to be lower. It also suggests that lumpy investments in changing soil carbon levels may benefit particularly from such measures. We also note the potential value of options that could be realised in the event that international rules are changed in such a way as to later recognise the value of carbon sequestration measures that have already been undertaken.

We argue that such options could add dramatically, and efficiently, to the incentives for creating agricultural offsets, especially those with significant upside potential.

There is also (complementary) scope for addressing these concerns through the pooling of diverse uncertainties across portfolios of offsets. In our earlier study (ACIL Tasman 2009), we demonstrated how such portfolios could support much higher safe ‘lower bounds’ on impact in a manner that respects sound policy principles for risk management (see Box 7). The ability of such pooling to

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8 We argue later for an emphasis on compiling diverse, as opposed to homogeneous, portfolios precisely to tap this potential. To date, the development of offsets markets has tended to take the opposite approach – to seek aggregation across broadly homogeneous measures to tap transactional size economies. It is highly likely that this allows tapping of moderate transaction cost savings while sacrificing the potential for tapping very large scope economies, across diverse measures.
dramatically raise safe conservative lower bounds on the impact of abatement and sequestration measures can be profound.

In that earlier study, we provided some examples of how the basic mathematics of portfolios can mean these effects are very large. Farmers are very familiar with the concept of developing enterprise diversity to limit risk. The same principles can apply across multiple farms and multiple instruments for limiting emissions and/or sequestering carbon, in limiting portfolio risk despite raising substantially assumed ‘emission factors’, etc. One of the examples developed in the earlier work suggested situations in the highest ‘safe’ setting of an emission factor for an individual initiative might be less than a thousandth of the safe level that could be applied to a diverse portfolio. The implications of this for incentives to tap agricultural opportunities are potentially profound.

This same reasoning cautions strongly against locking into any approach to agricultural credits that focuses only on attaching credits to individual farm initiatives involving narrow instruments. Focusing on individual projects in this way could seriously underestimate the value being offered and, as a result, could dramatically lower the incentives for farmers to offer highly cost-effective behaviour change.

At present, offsets schemes tend to operate at a narrow project level – with some measures to encourage or force aggregation within reasonably homogeneous project blocs. The above reasoning suggests – and this is highly likely to be true – severe under-crediting of behaviour change relative to what would be possible under an approach that include rewarding diverse portfolios of measures undertaken across multiple enterprises and even regions.

Similarly, these portfolio diversity approaches could allow recognition to be accorded to measures where, assessed at the individual project level, the uncertainties are deemed just too great to support accreditation and satisfaction of verification requirements. The potential therefore to substantially broaden the base of agricultural offsets that could be tapped to add to a cost effective climate policy – without the need to wait for major advances in the science – is one of the strengths of this approach to the management of uncertainty.

Indeed, this notion of encouraging and accrediting diverse portfolios of behaviour changes, with associated safe estimation of impacts on atmospheric GHGs, and recognition of upside options, emerges below as a central theme, as we develop possible models for the offsets markets.
### Box 7 Reducing methane emissions from livestock

There are a number of activities presently available that could lead to a reduction in methane emissions from livestock. These activities could be introduced as offset activities in the short-term as standalone offset activities but should over time be incorporated into wider whole of farm, region or industry portfolios of measures to mitigate risks of technology failure, seasonal variability and other risks associated with single instrument use.

The options for reducing methane emissions in livestock provide a useful case study of how single emission reduction activities can be introduced and aggregated up over time to the types of portfolios discussed in this report.

According to Roger Hegarty, Principle Research Scientist and nutritionist at NSW Industry and Investment’s Beef Industry Centre in Armidale, there are three broad approaches to reducing livestock emissions:

- reducing livestock numbers;
- reducing the methane produced per kg of feed intake; and
- reducing feed intake per head (Hegarty, 2009).

From this, a number of potential offsets can be identified. Reducing livestock numbers is perhaps the most simple activity but, as discussed extensively in this report, is likely to be the most prone to leakage if used as a single instrument. However, there are nuances to this strategy that could be introduced to reduce the extent of leakage, permanence and uncertainty over the science.

The way in which livestock numbers are reduced can make a significant difference to the net contribution this mitigation strategy can make. The ways that livestock numbers could be reduced that may increase net mitigation efficiency include:

- identifying and culling underperforming animals, such as dry or lack calving/lambing females;
- selecting sires with earlier maturing/higher weight gain genetics; and
- turning off stock earlier by meeting weight and condition specifications earlier.

Increasing animal performance is a combination of improving the quality and quantity of feed available to the animal, and improving the capacity of the animals to utilise the higher quality feed through genetic selection and aligning animal production with pasture production. Improving feed utilisation can be achieved by:

- improving pastures (converting annual native pastures to improved perennial pastures) and ensuring adequate pasture nutrition;
- aligning animal production cycles to pasture production by ensuring lambing and calving timing allows peak demand to coincide with peak pasture production (assessed by quality of feed on offer and quantity); and
- selecting animals with superior growth rates (or other target production characteristics, such as wool production).

The Cooperative Research Centre for Sheep Production has assessed the short-term methane production of over 1200 sheep from the Genomics flock based in NSW and WA. Preliminary heritability estimates vary between the two flocks screened so far (30 per cent and 11 per cent respectively) but the phenotypic standard deviation is large indicating opportunities to breed for lower methane production from sheep (Vercoe, 2010)

This research raises the prospect that a sheep CH₄ selection index could be introduced into breeding programs through quantitative genetics tools, such as estimated breeding values (EBVs) and even selection indexes. The trade-off with the inclusion of methane emissions in selection indexes is that it may slow down advances in other production traits, such as wool micron.

Individually each of these opportunities may produce a reduction in methane emissions from livestock that could be packaged into offsets able to be traded. However, if traded individually each would be discounted due to the scientific, measurement, permanence or leakage uncertainty. Much of this discounting could be offset by combining all of these individual opportunities into a farming system based offset, where each activity is practiced and the probability of achieving a net reduction rises exponentially with each activity added.

This farming system approach could be extended to include other farms and other regions where the net offsets produced are pooled.
We are proposing a fundamental rethink of how uncertainty should be managed within climate change – and are arguing that failure to do so would add greatly to the cost of climate policy, threatening to undermine the prospects for achieving the goals of damage minimisation and risk reduction.

It is important to recognise that a shift in paradigm along these lines is likely to challenge a range of current assumptions – and indeed challenge what is considered best practice in farm response to climate threats and in processes for valuing and rewarding farm responses. The altered approach to risk management embodied in the proposed approach is quite fundamental and could result in fundamental re-ranking of the relative attractions in different forms of early farm behaviour change.

3.6 Permanence requirements

A classic objection to many of the proposed agricultural offsets lies with the argument that the permanence of such sequestration cannot be guaranteed and, indeed, in most cases the sequestration will, in a real sense, not be permanent. Soil carbon (and additional carbon stored in vegetation) will break down over time unless there are processes of guaranteed replenishment. Aspects of this were flagged in the discussion of timing in Section 3.4 above.

The National Carbon Offsets Standard, and the Australian Government’s current policy position, both entail clear commitment to permanence – but given the commitment of the policy position to also accommodating soil carbon, this would appear to open the opportunity for sensible interpretation of what is to be meant by permanence and how it is to be maintained.

The principle of permanence is well established in the public policy debate – almost to the point of being prone to assessing as worthless any measures that cannot guarantee permanence. However, the above discussion of timing, and the benefits of early action, provides one basis for seriously questioning whether the principle is not seriously overstated.

We can accept the need to move to a global strategy that allows lower levels of atmospheric carbon to be achieved and maintained. That does not require that every abatement/sequestration activity last indefinitely. Indeed, at the risk of seeming flippant, we would argue that the concept of project-level permanence is seriously overrated and potentially at very high cost. A rolling portfolio of investments in different forms of abatement and sequestration might deliver a sustainable limit on atmospheric GHGs even where many of the component

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9 Lack of permanence could be interpreted as a form of leakage of GHG benefits, and as such as a special case of the consideration of leakage in Section 3.8 below. However, in the public debate, the two are generally treated separately and we have retained this perspective.
investments in the portfolio cannot, assessed on a stand-alone basis, do so. A process can be sustainable where its elements are not.

Consider the implications if it were possible, at low cost, to return current levels of atmospheric carbon to pre-Industrial Revolution levels, and to hold that carbon in storage for 50 years. What if it were known that the carbon would then leak over the next 50 years until all had been returned to the atmosphere? Would such a strategy be deemed worthless?

An immediate effect would be to push out a long way the timing of any predicted ‘tipping points’ being reached. It would provide greatly increased breathing space in which to manage a smooth transition to a sustainably lower carbon emitting system. It may allow a lot of high-cost early transition to be replaced by lower-cost future technologies – spanning the range of demand and supply-side measures. Just as importantly given the politics, it may allow replacement of a politically unacceptable short term cost burden by a politically acceptable longer term burden – that allows climate policy objectives to be achieved where this might otherwise be politically impossible. It would appear to create, at a time in the future, a need to ‘replace’ the sequestered carbon, whether through rolling over the same technology or accessing more intensively one of a range of likely alternatives to emerge over the next 50 to 100 years.

We are not suggesting that agriculture can deliver that level of sequestration, but the principles are the same – just as they have been in dealing with the non-permanence of tree planting. Furthermore, as was flagged in Section 3.4, the duration of some agricultural sequestration, notably through soil carbon, could in fact, in many cases, be much longer than 50-100 years.

Some offsets markets (notably the CCX) have made substantial investments in developing ways of adjusting for lack of permanence – generally through discounting of credits and the creation of contingency funds for later replacement investment. The methods used appear heavily biased against reflecting the true value of early measures with good prospects for long term, if not indefinite, capture of carbon.

Reflecting the above discussion of uncertainty and the role of upside options, we argue that markets may be able to offer more efficient incentives for such offsets if the options being offered are appropriately recognised and valued – options in deferral of atmospheric carbon and associated damage, and options to bring in new competitive alternatives ahead of high cost ‘permanent’ measures now available, etc.
3.7 Additionality

The National Carbon Offsets Standard requires additionality, defined as:

- Greenhouse gas emissions reductions generated by the project must be beyond what would be required to meet regulatory obligations under any Australian laws or regulation or undertaken as part of a “business-as-usual” investment. The level of additional emissions reductions generated by an offset project is the difference between the emissions associated with the project (“project emissions”) and emission under a business-as-usual scenario (Department of Climate Change, 2009).

There is no explicit additionality test within the proposed CPRS – firms can benefit, through the CPRS mechanism, from ‘business-as-usual’ changes that lower emissions intensity alongside special initiatives designed to allow compliance. There is no need for the additionality test within the CPRS, given the way it operates to deliver a reportable outcome.

This is not true of voluntary offsets, but an additionality test is still somewhat problematic. It can be hard to prove – especially where there is a trend in place (such as into minimum tillage methods) – and there are still questions, linked to the above discussion of timing, as to whether we wish to use offsets to accelerate the rate of take-up of already economic measures.

An approach with some currency is that of rewarding farms that adopt practices at the leading edge – a willingness to reward ‘best practice’ on the assumption that this is more likely to be additional – and not rewarding other farms making changes at what may be a more rational point in time from a general risk management perspective. The desire to encourage innovation is understandable, but refusal to recognise that later farm changes, delivering the same levels of abatement, are not creating offsets of comparable value is harder to clearly justify. The approach again is relatively safe, in the sense of not rewarding changes that were in any case happening, but does risk slowing uptake, and even deterring it permanently, even though later wider adoption could offer high value abatement.

The two main areas of concern would be:

- innovations with high capital costs, or requiring radical and high skill changes in farm systems, where take-up rates are likely to be slow even if the innovations make sense economically; and
- changes that, while no longer at the leading edge, still only make sense if some of the value of the offsets is recognised.

Handling additionality, without deterring cost-effective changes on-farm, is likely to entail close attention to baselines and trends in determining how offsets will be measured. Too liberal an approach to additionality could encourage gaming behaviour, in which enterprises actually slow their rate of
change to increase their access to offset rights. In the initial stages of developing an offsets market, where capacity building is a priority along with achieving a net reduction in emissions, it may be worthwhile erring toward a liberal additionality test rather than risk constraining offset development through a heavy handed additionality policy.

However, in agriculture there is extensive adoption of new management practices and several large-scale farm surveys are conducted most years. There is also considerable productivity research, and associated grower surveys that could be employed to establish elasticities of supply that could be used to assess additionality of carbon services.

### 3.8 Leakage of benefits – market response & gaming

A particularly difficult issue with voluntary offsets lies in the potential for nominal benefits being themselves offset as a result of the incentives posted by the very creation of the offsets for increased emissions elsewhere in the system. Some of this ‘leakage’ could be as a result of deliberate activity to game flaws in the markets, but a lot would flow naturally from the normal operation of commodities markets.

Leakage could be viewed as a special case of impermanence, with at least a proportion of the nominal benefits being lost over time as a result of market responses to altered farm supply patterns. The issue is commonly treated separately and we retain the distinction here.

A cattle producer who switches to cropping may well be able to reduce enterprise emissions substantially – and could seek to be rewarded for the associated offsets. However, the fact that the enterprise has withdrawn from cattle production may, through normal market operations, lower market supply of beef, increase market prices and encourage other farms to expand production to satisfy demand.

For many of the internationally traded commodities Australian farmers produce, farm level production changes will have a modest effect on prices until the number of farms modifying production increases. The amount of substitution between one herd and another will be dependent on the elasticities of demand, which for most commodities is highly elastic, and supply. Supply elasticities will be subject to the marginal costs of production of alternative suppliers. Assuming the market is largely efficient, the lowest marginal cost suppliers are currently producing the beef. Thus an alternative supplier is likely to have higher marginal costs and is unlikely to substitute fully the cattle no longer supplied by the producer responding to the carbon offset price.
Enterprise-level reduction in livestock numbers will almost certainly overstate national reduction in livestock numbers – possibly quite substantially.

The gaming concerns/risks can be demonstrated through the potential opportunities for two enterprises, one running cattle and the other cropping, to effectively ‘swap’ production – with a negligible impact on livestock numbers, but delivering the possibility of one of the two enterprises then accessing credit for the apparent offsets created at the enterprise level.

The key point is that, in both cases, enterprise level reporting of emissions, with a voluntary mechanism allowing only those enterprises that have reduced

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### Table 2: Potential sources of leakage from an agricultural GHG credit market

<table>
<thead>
<tr>
<th>Broad definition</th>
<th>Description</th>
<th>Examples</th>
<th>Assessment technique</th>
</tr>
</thead>
<tbody>
<tr>
<td>Within the farm</td>
<td>Changes to an enterprise at the paddock scale</td>
<td>• Introducing minimum tillage on a paddock that was previously conventionally tilled, and conventionally tilling a paddock that was minimum tilled</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Changes between different enterprises on the farm</td>
<td>• Reducing cattle numbers but increasing sheep or crop enterprise to occupy the vacant land</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Reducing crop area but increasing fodder production such as lucerne or hay</td>
<td>• Farm enterprise models</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Removing pasture to allow the incorporation of biochar</td>
<td></td>
</tr>
<tr>
<td>Within industries</td>
<td>Substitution between enterprises within an industry</td>
<td>• Reducing the turn-off age of cattle but substituting this with more breeding stock</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Reducing wheat production but increasing legume or oilseed production</td>
<td></td>
</tr>
<tr>
<td>Across industries and land uses</td>
<td>A reduction of output from one industry may induce substitution by land managers with another enterprise outside of the industry</td>
<td>• Cattle may be replaced by sheep, cropping or other enterprises if the profitability of beef production changes</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Combination of farm enterprise models and economy wide equilibrium models</td>
<td></td>
</tr>
<tr>
<td>Across sectors of the economy</td>
<td>Reduced production from agriculture may release labour and capital for use in other industries that may not be covered by the CPRS or other emission reduction policies</td>
<td>• May increase the flow of labour from agriculture to the mining sector in states such as NSW and Qld that may have increased emissions relative to agriculture</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• General equilibrium models</td>
<td></td>
</tr>
<tr>
<td>Across national boundaries</td>
<td>Reduced output of any or all of Australian agricultural industries may be substituted with increased production from countries that do not face the same opportunity costs from their GHG emissions</td>
<td>• There are numerous examples that could be cited here but the most widely recognised would be Australian beef being substituted with South American beef</td>
<td></td>
</tr>
</tbody>
</table>

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numbers (or emissions) to ‘opt in’ with their enterprise level emissions, could result in serious overstatement of the net reduction in GHG emissions.

Without entering into the rights and wrongs of the recent policy debate and policy shift on treatment of agriculture, we stress that these leakage concerns are, in a quite fundamental way, made much more severe when farm practices are handled in a voluntary offsets setting, as opposed to a compulsory cap and trade setting. In a cap and trade setting, any (domestic) responses that seek to fill the market gap caused by one enterprise’s behaviour change would need also to account for the resultant emission effects. This is not so in a voluntary offsets market. In early work, we stressed the scope for using the potential for future convergence with a CPRS to limit leakage and other problems with agricultural behaviour change. That possibility has now been indefinitely excluded and brings with it the need for greater discipline either within the design of the offsets arrangements or in the design of complementary measures.

There is some scope for estimating the level of leakage from such behaviours – for example through equilibrium farm production models. Note that there is a dramatic difference in propensity for leakage between a farm shifting from livestock to crops, and one shifting to a different livestock production system entailing fewer emissions per kilogram of meat produced. This implies that a simplistic treatment through a ‘one size fits all’ discount factor could be counterproductive. Similarly, it tends to suggest some difficulty in targeting the problem through complementary measures operating outside the market. Some sophistication is likely to be needed in addressing a substantial problem.

A variant on the ‘leakage’ argument arises in circumstances where direct reduction in emissions intensity is commercially attractive even before factoring in the value of the climate services. Consider as an example the possibility that the use of a rumen inoculant is cost justifiable for a particular cattle herd. This could stem from its impact on feed efficiency improvements or increased growth rate.

If this is the case, it may well result in commercial incentives for the farm using the inoculant to increase its output – thus reducing emissions intensity but possibly not reducing the farm’s aggregate emissions (and possibly even raising the emissions from the farm). Here, of course, leakage effects through to other farms could work in the reverse direction – reducing, but not fully offsetting, any expansion in sector production.

These patterns of behaviour may be quite rational – just as a rise in world commodity prices will tend to induce increased production. However, some care would be needed in assuming that the sequestration benefits of biochar
could, for example, be factored into biochar prices without this resulting in some ‘perverse’ responses.

### 3.9 Interactions with other environmental values

Many of the prospective areas of behaviour change in the farm sector, to deliver abatement or sequestration, are likely to involve significant interactions with other areas of environmental policy and associated environmental policy objectives. Given that these other values may be less than perfectly priced, there are risks of intervention failure to be addressed – possibly alongside opportunities for complementary pursuit of greenhouse and other environmental objectives.

Accumulation of increased soil carbon and movements out of livestock into cropping would have implications for levels and patterns of water interception, for patterns of fertiliser use, etc. Care is needed to ensure that an apparent small saving in the cost of abatement is not being bought at high cost to other elements of the land and water system. Conversely, of course, these very interactions are part of the processes that support the view that some of these processes may deliver low-cost abatement and sequestration – precisely because they can also enhance enterprise productivity through better structured soil, better management of water, etc.

### 3.10 Perverse interactions with other policies

More generally, a number of existing policy settings – notably drought policy settings – have the effect of encouraging relatively high GHG-intensity patterns of agriculture. The earlier work by ACIL Tasman emphasised the incentives that flow from elements of drought policy – and recommended attacking these policy distortions ahead of creating counteracting incentives in offsets markets. If there are constraints on how rapidly these policy changes can be made, there would still seem to be scope to move on the offsets opportunities in a policy setting committed to progressively addressing the perverse interactions.

Some farm changes directed at the production of offsets may also have perverse side-effects in relation to other environmental values.

Until recently, the substantial expansion in farm forestry – potentially a valuable means of sequestration and/or delivery of feedstock for processes such as biochar production and second generation biofuels – has generated substantial controversy because of the perceived impacts on system hydrology, reducing effective water access for downstream users and uses, including environmental water. This conflict has emerged as a serious problem in significant regions in South-Eastern Australia.
This conflict will stand even if the trees are being replanted on land that was historically forested – total systems have changed to the point where restoration of forestry might not be the best use of resources unless and until much more extensive change to long-established arrangements can occur. This also highlights the potential for conflict between the creation of farm offsets and production of food and fibre – not just on the land where trees or other deep-rooted vegetation are planted, but in farming regions producing food and fibre below where the planting occurs.

These issues were addressed in some detail in ACIL Tasman (2009). Most of the points made there remain relevant, despite recent policy developments.

These arguments are not against the creation of offsets, but they do point to the complexity of delivering ‘safe’ incentives for behaviour change. Water interception concerns would have arisen without any prospects for a payment for sequestration services. The problem is one of institutional failure – of imperfect markets for water rights. While such imperfections persist, the possibility exists, that payment for climate services could induce changes in land use where full costs are not justified by the benefits. In these areas, there will be a need for carefully coordinated policy development – and this is one example where the uncertainties may sometimes justify not allowing offsets, pending resolution of key uncertainties. At the same time, it adds to the value in addressing such uncertainties early.

3.11 Wider recognition and treatment of option value

A persistent theme through much of the above is the fact that agricultural offsets options entail both promise and uncertainty. Early action offers potentially substantial benefits – though it could also entail high risks if the action involves high costs (for example substantial reduction in livestock numbers and a conversion to cropping on some properties). The ability to tap low-cost options early – to strike a sensible balance between these competing incentives – has attraction. However, early action will, in general, involve limited scope for guaranteeing the level of benefit – muting the incentives if the markets will only reward at current conservative assessments of value.

While one approach could be to reward at something more like expected value, this would raise complex issues of valuation and risk assignment. The alternative approach, flagged in the earlier ACIL Tasman work, of recognising additional upside value through an option, appears more flexible and potentially creates incentives for much wider verification of upside offsets by market participants. This would entail formal accreditation of actions with
possible future value – and would leave to market forces any prior trading of these options.

However, the value and the strength of early incentives would be tied strongly to the commitment made to investigating the actual level of abatement/sequestration delivered and the commitment to moving to later accreditation where the evidence justifies this.

Effectively, we are talking about measures to allow the true value of current activity to be ‘banked’ until clearer evidence emerges as to actual value. It might be possible for this option value to be traded – including into the CPRS or other markets – via successive tranches, as the scope for lifting the initial conservative estimate of value emerges.

Such processes are likely to introduce pressure for some form of conversion between past effective abatement/sequestration and current emission limits under the CPRS or other cap and trade arrangements in Australia or internationally.
4 Accounting for permanence, leakage & additionality

Attachment G draws together some of the mainstream thinking on ways to account for permanence, leakage and additionality – and flags ways where options instruments might be tapped to yield a more satisfactory solution.

If the rate of loss of stored carbon is known, and if we ignore the potentially elevated value of early versus late sequestration, the problem lends itself to a relatively straightforward assessment of discounting. Relaxing either or both of these assumptions adds complexity, but then favours consideration of portfolio and options-based instruments to manage the uncertainty, in line with the discussion in Section 3 and below in Section 6.

This is particularly true if the policy process favours a bias towards excessive, rather than inadequate, discounting. Such an approach is supported by a desire to ‘safely’ commit to delivering against targets, and may be further motivated by concerns for the risk of high penalties being enacted in the event that later developments show that Australia failed to deliver on its international commitments. These concerns are understandable but, as was flagged earlier, biasing strategy towards safety can and commonly does entail a bias away from lower cost ways of meeting targets. It will be highly desirable to find a way of relaxing this difficult ‘trade-off’.

Again we stress the need for care to ensure that discounting based on what is now known, does not unnecessarily depress the incentives for changes with high prospects for being later shown to have been of high value. Accounting tends to work with what are assumed to be certainties – but here, the need to recognise contingencies (including upside possibilities) and to adapt the process to ensure that these become part of the incentive structure, seems to be the central problem. Without this, the likelihood seems very high that offsets will prove to be only a small player for many years – or will have been supported by high subsidies that later prove to have been misplaced.

There in fact appears to be substantial scope for relaxing this trade-off. This fact lies at the heart of the strong theme through these paper favouring a shift in paradigm – and substantial use of three classes of complementary risk management instruments: continuing the practice of setting accreditation based on ‘safe lower bound’ estimates of the sequestration and abatement value; aggregation of diverse portfolios of offset measures to allow less restrictive but still safe low bounds to be accredited; and issuing options over possible later upwards revisions of the safe lower bounds, based on fresh information.
5 Drivers of demand for offsets

If the CPRS proceeds, and posts a clear price signal, this will open opportunities for a range of offsets to be offered into this market at a market-determined price.

Demand for offsets can come from several sources:

• As now, there is likely to be some commercial value in being able to demonstrate ‘green credentials’ through either coverage of own company emissions by offsets or through active, demonstrable and accredited proof of direct contributions to reduced atmospheric GHGs.

• Individuals and companies may seek access to instruments for directly making a positive contribution for, essentially, altruistic reasons – though extending to concerns for children and grandchildren, and encompassing values linked to social responsibility.

• Where trade into the CPRS or other cap and trade arrangements is possible, the direct value of such trades could underpin rising value.

• Where there are good prospects for such trading opportunities to arise, then these measures could have value in hedging exposure to cap and trade risks – there could be demand to hold the rights to any future trading opportunities.

• If carbon emissions were taxed (as against a cap and trade system) and offsets recognised in determining the tax liability, there would be demand for offsets priced less than the marginal cost of the tax.

• Governments could choose to express demand directly – analogous to the expressed demand to ‘buy-back’ environmental water flows in the Murray-Darling Basin.

The first two of these are real, but probably quite limited in the incentives they can post. Indeed, these incentives could actually diminish with introduction of a CPRS – especially for firms and households whose main emissions are linked to energy and fuel use.

Commercial linkage to the CPRS could clearly drive substantial value that works in the opposite direction. The policy agenda would tend to favour progressive extension of the range of effective offsets for which such trading is possible – or prospective.

Direct government demand, whether funded through other mechanisms (CPRS revenues, special levies etc) or not, could certainly increase incentives and could, under some circumstances, make economic sense where there are market or intervention failures remaining. In the context of large commitments by governments to supporting analogous measures, such as geosequestration,
there is a legitimate question of whether the acquisition and extinction of relatively low-cost and immediately effective offsets may not be competitive with some of this spend. In the absence of the CPRS this strategy, possibly linked to a funding mechanism, could make greater sense.

5.1 Demand for CPRS compliant offsets

One source of demand for agricultural GHG emissions credits could be from those seeking to offset emissions covered by the Australian Government’s emissions management policy, where the use of offsets is permitted. At this stage the Government’s policy is to introduce an ETS, but offsets could conceivably be used to offset an emissions tax if this instrument is used and offsets allowed, or might be traded internationally.

Thus one source of demand for offsets would be created by the capability of enterprises covered by a trading or tax system to meet their emissions cap by purchasing reductions from other sectors of the economy that are not covered. This is likely to create three key GHG credit demand side price drivers:

- the cap on emissions of those sectors covered by the policy;
- the marginal costs of mitigation with the covered enterprises; and
- the transaction costs associated with acquiring offsets outside the sector.

The amendments proposed by the Australian Government in November 2009 establish what appear to be two levels of emissions offsets:

- those that are compliant with international trading rules and therefore the proposed CPRS; and
- those that are non-compliant with international trading rules but recognised as robust verifiable offsets, which could become compliant if international trading rules are modified in line with Australia’s international climate change position. (This appears to be consistent with a two-part accounting system, where both compliant and non-compliant emissions reductions are reported).

A third type of credit could be attached to both of these offsets by including the option to recognise additional abatement generated by the activity if it is verified at a later date. We see a central role for such a mechanism in balancing the risks of investing in unproductive climate abatement and the risks of not investing in enough productive abatement. The issues here are discussed further in Sections 3.5, 4 and in Attachments H and I.

To ensure that offsets have the potential to be compliant in future if international trading rules are changed, the Australian Government has specified in the proposed amendments that offsets produced by agriculture will need to be compliant with international trading principles.
The Australian Government will introduce amendments to provide for crediting of abatement from agricultural emissions and other sectors not covered by the CPRS (for example, legacy waste) that are counted towards Australia’s international climate change obligations, with the following features:

- A policy and legislative framework that ensure any domestic offsets meet internationally accepted principles of permanence, additionality, measurability, avoidance of leakage, independent audit and registration (Australian Government, 2009, p. 6).

By ensuring that the credits traded in this market are based on international trading principles, the credits produced could be used to provide evidence in support of the Australian Government’s case for modifications to international trading rules.

The objective of lobbying to modify international trading conventions, particularly differentiating between anthropogenic and non-anthropogenic emissions from land use is contained in the amendments:

The Government will continue advocating in the international community climate change negotiations to ensure that post-2012 accounting rules only require countries to account for emissions and removals of greenhouse gases resulting from human activity (Australian Government, 2009, p. 7).

The international principles cited in the amendments are listed in more detail in the NCOS. The NCOS will be the standard used to ‘promote voluntary market offsets’ until if or when international rules are changed to allow the use of land-use and land-use change where only anthropogenic changes are included in national accounts.

The potential for change does raise the possibility of this prospect being used to encourage reductions in abatement or increased sequestration. In respect of land use changes, options instruments could again be used to increase incentives for behaviour change. This could be done without the Government needing to accept any risk in relation to changes to the rules not actually occurring. With access to options over the upside value of altered rule changes, earlier and stronger incentives for reductions in anthropogenic emissions through land use change could be posted. Secondary markets could play an active role in building incentives, in allowing these options to be cashed out (at a discount reflective of perceptions of risk that the rules would not change).

It appears that the Australian Government intends, at least in part, to deal with the leakage of emissions (discussed in detailed in Section 3.8) by requiring that leakage potential be taken into account in the registration process of the offset market. This would mean that each offset methodology proposed for registration would have to demonstrate that it did not substantially alter the
supply of a product if the definition used by Richards (Richards, Undated) is correct. Failing this, some credible adjustment for leakage effects would be needed – as discussed in Attachment G.

Practically, demonstration of no substantial supply effect is likely to be virtually impossible for any single instrument initiatives – and may be hard or costly if applied to broader portfolios. There is likely to be a need to adjust for leakage, possibly through the application of high quality farm modelling tools, and/or to introduce complementary regulatory instruments to offset the leakage. In the latter case, the compliance requirement might be met, but the effect is likely still to be to encourage overuse of instruments prone to substantial leakage which are not subject to additional controls, relative to those less prone. This is probably more an efficiency than an equity question.

Types of project that would produce offsets with only limited propensity for leakage could include:

- modified feeds (at modest incremental cost) for intensive livestock production to reduce methane emissions;
- improved pasture species; and
- genetic selection for low emission animals (provided production of the animal is not significantly compromised).

A more detailed discussion of leakage, and the application of farm modelling tools to its assessment, can be found in Section 3.8.

5.2 Extinction of credits

Another potential source of demand for credits supplied by an agricultural offset market is from those that would simply like to reduce total carbon emissions. This would be similar to the purchase of virgin rainforest by those seeking to preserve the forest.

The Australian Government has indicated that the extent of such behaviour change within the CPRS (for example, purchase and non-use of CPRS permits) will be taken into account in assessments of the cap level over time.

It is notable that there has been public resistance to aspects of the CPRS on the grounds that an individual’s ‘sacrifice’ by lowering the carbon footprint need not convert into any direct reduction in emissions. Facilities to extinguish CPRS credits can be seen in part as a response to these concerns, and as providing a clear forum in which individuals can express a willingness to pay at or above the CPRS’s marginal cost of abatement to further limit total emissions. An agricultural offsets market would provide a further opportunity for this behaviour.
Box 8  **Walmart Sustainability Index**

**Overview**

Walmart - one of America’s largest companies ($406 billion revenue in 2008) - is attempting to create a sustainability index. The index will be visible on the packaging of most products; this will give customers greater insight into the products that they are buying. Walmart intends to determine the emissions involved in each product that its 100,000 global suppliers produce. This will be achieved through a range of means from surveying suppliers to auditing certain products. To assist the company in creating this index, numerous NGO’s and Universities have been commissioned to provide knowledge and research capabilities. This will effectively mean that Walmart had the original idea but does not have ownership over the index.

**How the index will be created**

As one can imagine, determining the exact emissions involved with each product from 100,000 suppliers is a large project. Thus, Walmart is beginning the project by surveying suppliers with 15 simple questions about their own company’s sustainability. These questions are divided into four areas:

1. Energy and climate
2. Natural resources
3. Material efficiency
4. People and community.

At the conclusion of such a survey, Walmart will call on the consortium of universities, suppliers and NGO’s to develop a global database of information on the lifecycle of products (from raw materials to disposal). This will be achieved through completing further industry specific surveys and audits. Although Walmart will provide the initial funding for the consortium, it does not intend to create or own the index. Obviously Walmart stocks a vast array of products, finding out every piece of information about these products will be quite time consuming. Walmart has been in negotiations with Microsoft to make this information public, meaning that the environmental sustainability of certain companies will become far more transparent.

This will provide customers with sustainability information for each product. It is yet to be decided how this information will be conveyed to the customer, however, possibilities include colour coding or numeric scores.

This advancement is bold; the costs associated with such a project would be very large. Walmart is of the opinion, however, that the sustainability program will actually result in greater production efficiency and lower costs to consumers. Although this plan may seem overly ambitious, Walmart has a huge amount of market power. In the past Walmart stopped selling cotton products from Uzbekistan, this was intended to put an end to forced child labour in cotton harvesting. The company also led a shift to concentrated detergents, as it stopped stocking old-style detergents which required more chemicals, packaging and water.

It is likely to take many years for the index to be fully developed. However, it does have the potential to revolutionise retailing and consumer education. Walmart hopes that such an index will become an industry norm; it has encouraged its competitors to contribute to the scheme.

5.3 Demand for non-compliant offsets

Analogous considerations apply to non-CPRS offsets, acquired as a means of directly constraining atmospheric GHGs.

The size of this market is hard to determine, but there are already active markets of this form in Australia and internationally. They parallel ‘green energy’ markets and credit markets widely, but not solely, applied to offsets for aircraft emissions, etc.

There is, and presumably should be, nothing preventing some farmers and land managers donating credits (or selling them at a discount) to groups who would retire them rather than have them available for others to offset emissions elsewhere.

However, it seems likely that this component of demand could shrink substantially if the CPRS is introduced. The presence of a CPRS could encourage people to accept that the ‘problem is being handled’ by the carbon price – reducing the incentives for voluntary restraint. This is all the more likely as the CPRS translates into higher costs and a sense that households are paying for their emissions.
6 Offset instruments and portfolios

Before looking at the detailed form that an offsets scheme might take in Australia, there is a central design issue that warrants serious consideration. It relates to the nature of the products that might be offered as offsets – and the choices made here will have substantial implications for both the complexity of the scheme and for its ability to deal effectively with the issues outlined above.

The issue is whether offsets are to be granted only for what might be described as ‘single instrument’ behaviour changes – such as reducing stock numbers or switching to reduced tillage methods of cultivation – or whether credit is to be assessed also for more diverse packages, or portfolios, of measures.

Much of this material has already been flagged in the discussion in Section 3, but the implications are worth taking further.

6.1 Single instrument approaches

The single instrument approach is relatively easy conceptually and is the predominant form of offset covered by current schemes internationally – though some of the measures adopted to deal with concerns for leakage and lack of permanence do have the effect of extending some offsets into more broadly defined portfolios, via requirements to replace sequestration lost over time.

Measures designed to encourage, or compel, aggregation of single instrument initiatives across farms, to deliver size economies in the costs of operating offsets markets, encourage the formation of portfolios of measures. Importantly though, these portfolios are generally designed to be as homogeneous as possible – whereas one of the main reasons for considering a move from single instrument measures to portfolios is the potential to extract value from diversity across the portfolio – to tap scope rather than size economies as a cost-effective way of lowering risks and allowing greater gains to be pursued safely.

Assume, for example, that a farmer offers to switch out of livestock production into crop production – and has a basis for documenting likely reductions in emissions from the farm over time. An additionality test would be concerned with whether such a switch makes sense, even without accounting for the GHG credits. If such a test were passed, then this time series of reduced emissions might well be considered as a basis for offset accreditation and reward.
Such a change in behaviour would generally be fairly easy to document and could be amenable to periodic or random audit. The gains seem quite tangible – rather akin to someone choosing to switch to high-efficiency light bulbs. There are, however, some significant issues to be addressed such as leakage, 

Box 9 Reducing methane emissions from dairy cows using recombinant bovine somatotropin (rbST)

Researchers from the Department of Animal Science, Cornell University and Monsanto Company Animal Agricultural Group St Louis, analysed the environmental impact of using rbST in American dairy cattle (Capper, Castaneda-Gutierrez, Cady, & Bauman, 2008).

RbST is a biotechnology product approved by the USFDA in 1993. Somatropin is a key homeorhetic control in the regulation of nutrient partitioning; its administration to dairy cows increases milk production and improves the efficiency of milk synthesis (Capper, Castaneda-Gutierrez, Cady, & Bauman, 2008).

By increasing the level of feed efficiency, it is claimed that the use of rbST reduces the use of feed for maintenance of the animal, increasing the use of feed intake for milk production. This process, commonly referred to as ‘maintenance dilution’, is a concept that has underpinned much of the productivity growth in dairy cattle over the last century.

Capper et al (2008) claim that the use of rbST reduces manure production by 6.8 per cent and CH$_4$ by 7.3 per cent per litre of milk produced. Furthermore, nitrogen and phosphorous excretion were reduced by 9.1 and 11.8 per cent respectively.

When the whole of the production cycle is analysed (reductions in fossil fuel use, reduced emissions from manure, waste, etc.) the total reduction in GWP (global warming potential - CO$_2$ plus CO$_2$ equivalents from CH$_4$ and N$_2$O) conferred by rbST supplementation of one million dairy cows, was calculated by Capper et al as equivalent to removing approximately 400,000 family cars from the road or planting approximately 300 million trees.

The use of rbST is not without controversy; rbST is a growth hormone made using recombinant DNA technology and is currently banned in Australia, Japan and the EU.

The debate surrounding the use of rbST highlights that there are technologies that can reduce methane emissions but may meet resistance to their introduction due to other factors.

GM technology in crops is another example where productivity improvements appear possible but the technology has met with significant consumer resistance.

Where the technology is approved for use by regulatory agencies, but may meet consumer resistance, farmers and others in the supply chain may need to segregate the produce. Segregation usually incurs additional costs. Where such technology is introduced, producers may require additional incentives such as the ability to sell offsets to introduce the technology.

It appears as if the use of vaccines or rumen modifiers that reduce methane emissions may be up to 5 years away (Hegarty, 2009). However, recent break throughs may have the potential to reduce the time before vaccines and inoculants and even genetic modification of rumen bacteria might be available. In a paper released recently, research from the NZ Pastoral Greenhouse Gas Consortium announced that they had sequenced the methanogen genome. Methanogens are a variety of bacteria in the rumen that produce methane. The sequencing of the methanogen genome has allowed researchers to indentify vaccine and chemogenic targets for broad inhibition of rumen methanogen activity (Leahy, et al., 2009)
additionality and permanence (discussed at length in sections 0, 3.7 and 3.8) – and reasons why the gains are not as certain as where a household chooses to use more energy-efficient bulbs.

In fact, such single instrument approaches are at the extreme end of vulnerability to the range of issues outlined earlier, notably additionality, permanence and leakage, and uncertainty.

6.2 Diverse portfolios

What if biochar application in a particular type of soil, in a particular region, under a particular cropping system, proves to break down rapidly? A portfolio of nearly identical applications of biochar would be prone to very high volatility and the rate of lost permanence on a single hectare is likely to be about the same as across the whole portfolio. The aggregated portfolio may well allow lower transaction costs, but it delivers little in the way of economies of scope.

On the other hand, a portfolio spread across multiple soils, regions and farming systems, may be able to deliver dramatically reduced downside risk, expressed as the gap between a safe lower bound and the expected sequestration value. All participants in creating such a portfolio could stand to gain from the heightened lower bound value. Similarly, composing a broader soil and vegetation portfolio could be used to deliver an even narrower spread of lower bound, expected value outcomes.

The reality is that behaviour change with substantial expected sequestration value has value to overall climate change strategy, even if the safe lower bound is close to zero. For reasons developed in Section 3.5, the difference between the lower bound value and the value to overall strategy can be huge even if there is a requirement for a safe lower bound on overall portfolio impact. Failure to factor this difference into strategy potentially has a huge cost penalty.

In fact, the argument extends even further. A requirement on any portfolio to satisfy a safe lower bound requirement based on that portfolio alone is potentially quite costly – when Australian and global climate response will entail a very large number of distinct instruments and portfolios. Progression in time to deal sensibly with this cost seems to make sense. One approach, from the offsets end, is to recognise the way that single portfolio risk can be reduced through aggregation and diversity – and to reward this reduction in risk.
7 Indicative architecture and policy evolution

To provide a basis for constructive discussion, we have developed one interpretation of a broad approach to the architecture and evolution of offsets arrangements that might be considered for Australia. In assembling this model, we have sought to draw from the lessons and insights recognised above – including the fact that some form of evolution of arrangements is likely to be necessary if the arrangements are to be efficient and effective.

7.1 Early commitment to capacity building, R&D & rule change

Recognising this fact suggests a process in which the early arrangements are directed as much at building capability and understanding as they are at ‘picking the low-hanging fruit’, where the main issues can be sensibly addressed early. This includes bringing in initiatives where a confident lower bound estimate of impact is available, even when the available science suggests that this is likely to fall well below the actual impact of the initiative. It may allow bringing in portfolios of initiatives with safe lower bounds that are much greater than the sum of the lower bounds of their constituent parts – though such portfolio methods are likely also to be key parts of the evolution of the arrangements.

We would expect that the initial form of the arrangements would be accompanied by a strong commitment to processes of further investigation and negotiation – directed at both building our understanding of the science to underscore greater precision in inferring impacts, and at altering costly and unnecessary constraints flowing from international rules and international and domestic policy settings.

These initiatives could be viewed as separate from the offsets arrangements. However, we would stress that their presence, the level of commitment and the level of confidence of the markets in their outcomes, will have fundamental implications for the incentives to generate offsets and the demand for them. Under our approach these incentives would be much stronger from the very start of operations. In this sense, these commitments are part of the offsets arrangements in a quite fundamental sense.

7.2 Processes to underwrite credits

The first step in establishing a market will be the establishment of a system of approving, verifying and monitoring methodologies that will produce the credits. Central to this assessment system will be the formation of an authority
that will establish and publish an assessment protocol based on the NCOS. This authority will also oversee, probably through a series of accredited assessors, the verification, auditing and ongoing monitoring of credits.

The assessment process should also include an appeals mechanism, where projects that do not conform to existing protocols can be given a hearing. As part of this appeals process the authority would make available to applicants tools such as carbon models and other technical assessment techniques, to allow the development of a case for different treatment. This process allows containment of transaction costs for straightforward applications, but encourages higher transaction costs to be incurred, voluntarily, where expectations of being able to demonstrate greater value can justify those costs.

7.3 Compliant and non-compliant offsets

Initially the market should be based on trading two classes of offsets, reflecting both the structure of the Australian Government’s proposals and the reality of current issues in respect of the international rules:

• Those offsets which are immediately compliant with international trading standards will be tradable both domestically and internationally and count towards formal national emissions reduction commitments, assuming that Australia’s abatement strategy (CPRS or similar) is compliant with international standards. We refer to these as Class 1 credits.
  − Certification of compliance therefore will provide direct access to a market that is posting an explicit (and probably growing) price on greenhouse gas impacts, with this price likely to entail significant commercial incentive for the generation of these offsets where possible and likely to be cost competitive.
  − Note that some credits may conceptually be capable of compliance, but a judgment is made that the available knowledge is inadequate for bringing the credits immediately into the international trading context. Genetic selection of livestock is one example of a high potential emission reduction activity that appears to have broad scientific support but may not satisfy international trading rules, due a lack of supporting formal technical data:
    … We would favour limiting the extent of such cases, through processes that can credit lower bound estimates of impact and leave upside to be treated, as discussed below, through options instruments. However, at the start of the arrangements there are likely to be some opportunities falling into this group that may be better treated within the second class, with opportunities for later conversion to make them tradable.

• The second class of offsets will not (at least as yet) be compliant with international standards but will be consistent with the (possibly modified)
NCOS (and tradable)—and will have direct logical links into climate policy objectives, via impact on atmospheric greenhouse gas levels over time. Except insofar as there is speculation on future international acceptance, these offsets will be generated and traded for purposes other than meeting formal national emissions reduction commitments. We refer to these as Class 2 credits.

- It is likely that at least some of these credits will become compliant if Australia successfully lobbies for changes to international trading standards. It is important that this possibility be seen as part of the incentive for early investment in the creation of such credits.

- Reflecting the discussion developed earlier, there is likely to be a case for some change to the NCOS, or the interpretation of its terms, to allow it to better address some of the issues—such as permanence and timing. This could be done from the start, or as part of the early evolution of the arrangements.

### 7.4 Formal recognition of upside values

Attached to both these (and any subsequent) classes of credits should be formal recognition of the value of the implicit options associated with the fact that most initiatives will in fact be delivering benefits greater than the assumed conservative levels that are initially credited, and the prospects for later formal recognition of the right to claim credits for additional abatements found to have been produced in addition to those initially credited. This ‘option’ should be permanently linked to the credit but be able to be traded separately. Conversion of the option should be overseen by the Authority.

There are several forms of reassessment that could sensibly be considered in this setting:

- Assume, for example, that an initiative has been recognised and granted a level of credit, at a safe lower bound. Later research, and reassessment of appropriate protocols based on that research indicate, for example, that twice as much effective abatement was achieved:
  - The option would exist to apply for accreditation for the extra abatement—possibly adjusted (upwards) for the fact that it occurred in the past and has already contributed to cumulative climate change impacts.
  - These additional credits that are in the same class as the original credits are then available for trading at current values. Effectively, they have been banked and have just matured at current value.
  - This could apply to either Class 1 or Class 2 credits.

- Such ‘within-class’ reassessments could occur in multiple tranches, as the science becomes clearer or as site-specific monitoring yields data on which to base higher estimates of impact.
Indeed, the options market could generate incentives for holders of options to make investments in such monitoring to build a case for extra value. This might entail demonstrating that the site features allow inference of a safe level of abatement or sequestration well above the more generic assumptions previously made.

… Such ‘upgrades’ could be supported by the development of suites of modelling tools that allow the use of site-specific information – akin to the models developed in some jurisdictions to allow assessment of the implications of changes in land use patterns for regional water interceptions, etc.

• Now assume that an initiative accumulates Class 2 (outside CPRS) status, but with the option to convert to Class 1 (tradable with CPRS status) should the rules change.
  - The rules do change and application is made for rights to conversion.
  - If the original credits were sold, then the right of conversion is granted, subject to the original volume of traded class 2 credits being separately sourced, at current market prices. This makes sure the credits are not sold twice, and protects the interests, and market confidence, of those who had previously purchased the Class 2 credits as offsets. Clearly this exchange only makes sense if the price differential between the classes is enough to cover transaction costs.

7.5 Governments as market participants?

Class 1 credits will have a well-defined market – and likely opportunities for international trades.

The demand for Class 2 credits is likely to be weaker, as was flagged in Section 5. In principle, governments could enter such markets, on behalf of the community, to express community willingness to pay for these forms of abatement and in furtherance of any commitments to targets that would be expensive to pursue through other means, including through rapid wind-back in the CPRS cap (under CPRS arrangements). Such an expression of demand would clearly increase incentives and would have budgetary implications for government unless some parallel revenue instrument was introduced. There could be a case for such intervention if inertia in building offset offerings is high – especially if this is a result of inadequate handling of the difference between project, portfolio and whole of strategy risk, and the assessed capacity to meet targets and objectives.

Such an intervention would be less needed in relation to credits where there are high expectations of near-term movement to Class 1 status – that expectation, and the associated market in options, would essentially create a direct link to the value of carbon. Initiatives where such movement seems
unlikely, may face problems in delivering sufficient demand to justify widespread take-up without some input reflecting the social value of the behaviour changes.

Clearly if the Federal Government has committed to targets in respect of the aggregate value of internationally compliant and non-compliant but real abatement, then the basis will have been laid for seeking cost-effective ways of generating Class 2 offsets.

7.6 Registry process

A central registry may assist in building credibility and could support lower transaction costs – including in the compilation of diverse portfolios and possibly the registration of third party interests. However, sound standards and transparent, high integrity verification processes could create enough incentives for private provision of enough infrastructure to allow these objectives to be met.

An intermediate path would be for governments to support an initial registry and to allow other processes to develop – and for the possibility of later selling the registry process.

7.7 Evolution of coverage and valuation tools

To contain operating and trading costs the market should, where possible, begin with generic assessments of additionality, permanence and leakage, similar to the way the CCX methodologies are currently assessed. However, it will be critical that this market move toward case-by-case assessment of credit generating methodologies as volumes and technical assessment capacity increase. Case by case assessments will allow a wider range of emission reductions to be captured and are likely to deliver stronger incentives for market participants to undertake or promote emission management research to develop new methodologies capable of delivering emission credits.

Importantly, these same processes can evolve to allow portfolios of offsets to be assembled and assessed – and to provide guidance as to how to create greatest value through portfolio development.

Rights to appeal a generic assessment via a case-by-case assessment, offer a way of balancing the effort – focusing the higher cost of case-by-case assessments on those initiatives with good prospects for offering additional benefits greater than these transaction costs. It would seem appropriate that at least some of the costs of exercising the right of appeal be faced by the appellants, to allow management of transaction costs. However, there might be a case for recognising some public or wider social value in successful appeals, in the way they support the evolution of the rules and allow later applications.
to ‘free ride’ on past appeals that have allowed for greater precision. Some sharing of costs across market participants and possibly with government, could be justified on these grounds.

Enterprise, region and national level models to test and assess leakage, additionality and permanence should be developed as soon as possible. The base of such capability already exists across much of Australian agriculture, though the scope for increasing refinement, and accounting for enterprise specific measures that could influence emissions intensity, would seem strong. It would seem sensible that access to these tools be easy and transparent, to encourage farm planning, and the assembly of offset portfolios, well-suited to performing well within these models. This may well also create signals for areas for priority treatment in advancing the models.

Initially, intermediaries (similar to mortgage originators, real estate and stock and station agents) would be encouraged to help buyers and sellers draw up and enact contracts and monitor and deal with disputes. We would expect strong reliance on standard contracts, with low transaction costs, for the bulk of transactions – but also an ongoing process of voluntary probing and testing for opportunities to create greater value from moving away from the standard approaches. It is to be anticipated that over time any persistent large-scale departure from the standard contracts would trigger reassessment of the offsets covered by standard contracts, and redesign of those contracts.

Effectively, decisions to exit from the standard contract will suggest that the value of the standard contracts across residual participants is falling (while being more than offset by the value of the new non-standard contracts). The tensions here should support sound incentives for the on-going evolution of the arrangements.

The intermediaries could be licensed under current financial regulations, and registered with the carbon credit issuing authority. Buyers and sellers need not be compelled to deal with intermediaries but it would be expected that many would to reduce transaction costs. It is likely that there would be considerable commercial incentives for these intermediaries to become established.

We see a potentially valuable role for an agricultural industry forum that would develop standard contracts, terms of trade and offer arbitration and dispute resolution services. This forum would be similar to, and might even be formed under the auspices of, Grain Trade Australia (GTA). However, there would probably be reasonably strong commercial drivers for the establishment of such processes, if the potential value of offsets is high enough – inclusive of the value of upside options.
Once the market becomes established, and trading volumes begin to increase, it is likely that a trading exchange would become established. It is likely that an existing exchange, such as the Australian Stock Exchange would offer this service. The exchange could offer a platform to trade some or all of the credits registered by the carbon credit authority. Such a central exchange is not essential, but could support substantial reduction in transaction costs.

An exchange could operate a primary market for credits in much the same way as equities are traded and/or establish a futures and options market.

To ensure an exchange does not monopolise the form of transaction, we see no reason for compulsion to use one form of transaction over another. Provided that the central registry is informed in a timely manner of any transactions, buyers and sellers should be free to seek each other out and conduct the transaction using any procedure they choose. Size economies may favour a high concentration of transactions – but it would not be surprising if some of the more creative developments occur amongst participants who see less value in the standard exchange arrangements – because of their own sophistication and because they are seeking to extend the boundaries of the markets to recognise new sources of value.

Initially sellers of credits might be restricted to those able to meet a minimum volume to achieve economies of scale and reduce transaction costs, as has occurred in the CCX for example. Individuals or companies able to meet this minimum requirement could be free to trade and register credits. Aggregation or pooling of credits should be established for those sellers and buyers unable to meet minimum trading volumes. However, a requirement to aggregate may be overkill. Provided the higher effective costs of small trades are reflected back to the buyers and sellers, it would seem preferable to allow scope for sellers to assess the trade-off – lower costs of a larger trade versus potentially higher individual benefits from a more differentiated product, whose value could be ‘watered down’ in aggregation.

‘Aggregation’ would be conducted differently from pooling. It would merely aggregate a parcel of trades, with the sellers and buyers retaining the rights to their parcel of credits. Pooling would require that the seller or buyer exchange their credits for an entitlement to the proceeds of the pool. Pooling would smooth out the volatility of the market but, probably of much greater importance, could also offer large portfolio management advantages and much stronger incentives to deliver offsets.

Pooling could be used to statistically manage the risk of some of the methodologies offered in the pool and could lead to a pool being issued with more credits than the sum of the parts, as was discussed earlier in Box 1 and Section 6.2. This is a central tenet in the approach to risk management that we
are proposing. Pooling would not, we expect, be compulsory, but the likelihood of its benefits posting strong incentives for most participants to pool is considered high. Competition between pools, to offer the strongest incentives to individuals proposing changes with high portfolio value, would then be a key driver of innovation in these markets. Specific arrangements to support pooling are discussed below in Section 7.8.

Box 10  
**Pooling: a well trodden track in agriculture**

Australian producers are familiar with the concept of pooling produce for collective marketing. In many instances pooling was undertaken to control supply and extract monopoly rents from the market. There is little evidence to suggest that this tactic has ever produced benefits in excess of costs.

However, farmers have also pooled their produce to share risk, and achieve economies of scale in purchasing risk management and marketing services.

Pooling to share risk and reduce transaction costs could offer smaller agricultural businesses a lower cost way of entering the carbon market. A small producer could undertake a series of emission reduction and/or sequestration activities that are verified and registered by the relevant authority. However, rather than enter the market directly, the farmer could place the carbon credits produced on the farm into a carbon pool. The pool could be run by any commercial provider but there are a number of large grain traders that may have the appropriate experience of pooling to offer a competitive service.

The concept of pooling is that the producer would commit credits to the pool and in return receive a right to share in the proceeds of the pool. Purchases of credits from the pool would not be buying specific credits produced by specific farms using particular instruments. Rather, the purchaser would be buying credits based on the probability that the emissions produced by the members of the pool collectively are higher than the probability of anyone pool participant producing the same level of abatement. In any one year there are likely to be producers that achieve higher levels of abatement than average and those achieving lower levels. By pooling, the risks are managed across farmers and regions, which is likely to be reflected in the price of the offsets achieved by the pool.

The pool manager may also offer premiums and discounts for credits that contribute or detract value from the pool, depending on the composition of the pool at the time. For example, if the pool were made up of a disproportionate amount of minimum tillage credits the pool manager may offer to pay more for biochar, perennial pasture or animal feed modification credits, to balance the portfolio and increase the average value of the credits in the pool. This is exactly how grain pool managers operate. They pay more for high protein wheat to increase the average protein content of the pooled grain if the average is below what the market requires of the pool. Also pool managers may offer a small increase in the price of high screenings wheat if the pooled grain is averaging a low level of screenings. The purchase cost of the additional high screenings wheat is below the expected average value of the pool less costs the average returns generated by the pool will increase.

A buyer could replicate the portfolio achieved by the pool but it is likely they would incur significantly higher transaction costs.

A number of other services could also be associated with the pool, such as research and development and extension advice.

Each of the market participants would be subject to standard corporate governance and Trade Practices Act obligations. In particular, any registration authorities or exchanges would, we envisage, be required to publish all relevant
information on trading volumes and values for each class of credit in a timely fashion.

Figure 2 below sets out a very broad overview of the relevant components of an early stage in suggested market development and how the components would broadly be expected to interact.

Note: Australian Carbon Exchange (ACX), National Carbon Offsets NCOS
The Australian Government’s proposed amendments suggest that a carbon offset market could be established as early as 2011, in line with the proposed commencement of a CPRS.

The initial mechanism of the market could be established within this time frame. A registering authority would need to be established and a set of protocols, based on the NCOS with some modifications (to permanence, etc.) would need to be developed and published.

Table 3  **Sample of agricultural emission reduction projects that could be immediately compliant or that are likely to comply with the NCOS with minor modifications**

<table>
<thead>
<tr>
<th>Category of activity</th>
<th>Description of activity</th>
<th>Additional requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Class 1</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Using non-fossil fuels in farm machinery</td>
<td>Using renewable fuels in farm machinery in place of fossil fuels (bio oils, etc.)</td>
<td>Maintain usage logs, etc. Key relevance if CPRS does not proceed</td>
</tr>
<tr>
<td>Reducing methane emissions from livestock</td>
<td>Adding methane suppressants to livestock feeds. Most likely in intensive animal industries such as cattle feedlots</td>
<td>Verify the amount suppressed and under what conditions. Need to address leakage if high cost</td>
</tr>
<tr>
<td>Reduced nitrogen use or emissions on farm</td>
<td>Reduce the use of nitrogen fertiliser used on farm as opposed to more efficient use</td>
<td>Would require assessment of leakage</td>
</tr>
<tr>
<td>Farm forestry plantations</td>
<td>Forestry plantations on marginal farm land as opposed to large scale forestry plantations</td>
<td>Leakage issues are not yet well addressed, and treatment of permanence biased</td>
</tr>
<tr>
<td>Reduced methane emissions from animal waste management</td>
<td>Intensive animal handling industries could cap and treat (burn off) methane from waste treatment systems</td>
<td>Verify amount of abatement and additional to EPA waste management standards</td>
</tr>
<tr>
<td><strong>Class 2</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use of coated N fertiliser</td>
<td>Cropping enterprises opting to use fertilisers coated to reduce volatilization of nitrogen as nitrous oxide</td>
<td>Development measure</td>
</tr>
<tr>
<td>Best management practices of nitrogenous fertiliser use</td>
<td>Adjusting source, rate and timing of nitrogen use in crops and dairy pastures</td>
<td>Would need to demonstrate additionality and the quantities of N emissions reduced under what conditions</td>
</tr>
<tr>
<td>Biochar, soil carbon build-up, etc.</td>
<td>Incorporation of biochar to agricultural soils, etc.</td>
<td>Deal with impermanence</td>
</tr>
<tr>
<td>Reducing livestock numbers</td>
<td>Reducing cattle numbers or reducing the age of turn-off</td>
<td>Prone to leakage and would need to be measured, possibly through enterprise equilibrium model</td>
</tr>
<tr>
<td>Minimum tillage</td>
<td>Intensive conservation tillage practices used over extended period to build soil carbon</td>
<td>Would need to demonstrate additionality if generic assessment used</td>
</tr>
</tbody>
</table>

Classifications here are certainly debatable.
7.8 Institutional arrangements for offset pooling

We have suggested (Section 6.2) that the pooling of offsets – and ideally the pooling of diverse offsets with low or negative correlations in relation to likely impact on abatement and sequestration levels – could have an extremely valuable role to play. This mechanism could allow a safe approach to be taken to issuing credits, in the sense of limiting risks of rewarding behaviour changes that fail to deliver on expectations, without introducing large biases against tapping the upside potential of these opportunities.

A range of approaches to the creation of offsets pools could be considered. We incline to the view that provision of good information to markets – on how a portfolio of offsets would be assessed and might fare, in terms of delivering a safe lower bound on abatement/sequestration value – could post adequate incentives to encourage markets, and agents within the markets, to undertake this pooling. The basic statistical principles highlighted in the stylised example in Box 1 underpin the potential for a dramatic increase in the value of initially recognised permits, for any given level of ‘safety’.

Pooling can occur across totally different measures, varying the nature of the change and the nature of the farming systems to which the change is applied, across forms within regions, across regions and countries. It can encompass different capacities for monitoring and adjustment. It can, in contrast to the stylised example, include a mix of measures with very different expected impacts and very different levels of uncertainty around those expectations.

The key principle is that the different measures should not be perfectly correlated. If the failure of one initiative in a portfolio implies that all the initiatives will fail, then pooling does not reduce risks and will not allow the trade-off between safety of lower bound and access to upside to be relaxed.

However, even within specific types of approaches – such as the application of biochar to soils – there is room for a wide variation in approaches that are not highly correlated. The duration of biochar in soil will depend on a wide range of factors – the nature of the biochar, the characteristics of the soil and rainfall where it is applied, the farming systems adopted etc. Indications that, in addition to sequestering carbon, biochar in soil may also help address methane and nitrous oxide emissions from cropped land, will almost certainly entail strong site specific factors – again pointing to lower correlations even within these opportunities, let alone relative to totally different initiatives, such as modifications to ruminant feed patterns, etc.

Working the arithmetic of pooling, in the way flagged in Box 1 does require some explicitness about the perceived potential and uncertainty. It depends principally on the three characteristics used in the example – the criterion for
‘safety’ in setting the lower bound, the risk-weighted or expected outcome from an individual component of the portfolio, and the level of uncertainty around that expected impact.

Some people will feel uncomfortable about being explicit on these matters – but the arguments developed earlier suggest that the cost of such reluctance, if it kills off this approach to risk management, could be huge for Australia and the globe. The decision to not allow a particular form of behaviour change to be recognised already entails implicit judgments about risk and opportunity – though it seems likely that there has commonly been a bias towards limiting the risk with little regard for the corresponding limitation in opportunity. We are suggesting a process that allows this to be redressed.

Any system that determines an emission factor is making an explicit statement about impact expectations – again often confounded with the way that risk of over-compensation is handled in setting the factor. In industrial processes (such as generation), the level of uncertainty is commonly small relative to expected impact on emissions, rendering the bias from being conservative also relatively modest. A real problem with agriculture is that the uncertainties in individual initiatives are commonly large relative to the expected impact and this makes the bias a central issue.

Serious development of the pooling instrument will require that the entity accrediting offsets be prepared to invest in processes to characterise opportunities, risks and ‘correlations’ or other indicators of interdependence, based on what we now know – and to work through to the stage where these can be used to guide decisions. The choice of the term ‘guide’ is deliberate – while it is possible to imagine an automated, model-based process, this would not necessarily be the best approach – and there would certainly be a case for allowing evidence-based challenges to the outcomes of any such automated processes. Few models of any substance are perfect and it is often possible to identify the direction of model biases ahead of being able to correct the models.

Many of the parameters involved here will be subjective – but again, the price of requiring full objectivity may be huge. Vast investment decisions have been taken in the past few years in relation to such matters as urban water supply augmentation, management of the Murray-Darling Basin and its water and commitment of funding to geosequestration initiatives. In the context of: highly uncertain (in its detail) climate science; inherent uncertainty in forecasting droughts, that has been greatly increased by climate change trends and risks; and of course policy uncertainty, these investment cases have necessarily had to rely on highly subjective assessments of needs and risks. Waiting till the uncertainties are resolved is not really an option.
Fortunately, there is no need to get these estimates right on the first attempt. The adaptive policy process that we support could allow a system that is pretty conservative initially, but that is focusing on moving forward, in expanding coverage, as rapidly as is cost-effective over time. This may imply that some initiatives are not able to access the benefits of pooling at first, or that the pooling will be based on assumptions that still entail significant bias. Here, the complementary instrument of issuing options over future determinations that value had been underestimated, offers a powerful tool to limit the biases.

Importantly, the very diversification process being envisaged offers another instrument for limiting the biases and risks. Provided that the assessments of expected impact and uncertainty (such as standard errors) are not systematically biased – towards overestimating expected impact or underestimating uncertainty – then pooling across a large enough and diverse pool can make the resultant errors largely cancel out. Access to the options instrument means that some conservatism in developing the parameters could be justified, while limiting the detrimental impact of such ‘biases’.

Approached from this direction, the development of defensible parameters to underscore guidance in the construction of portfolios would seem a tractable task, if undertaken on a sequential and adaptive basis. We would see this task as being a responsibility of the agency accrediting offsets – with the task progressively adding greater and greater value to the accreditation process.

There is a decision as to whether the process is to be proactive or reactive. Would the agency identify the range of possible pool components and proceed to assess their potential and uncertainty – or would these assessments follow an appeal against a low value attributed to a portfolio? Something of a hybrid would seem sensible (especially given the suggested market facilitation role flagged below). It would seem to be overkill for the agency to seek comprehensive coverage of all possibilities from the start.

The agency would naturally prioritise the work based on serious contenders already identified, identification of ‘gaps’ in the portfolios and how those gaps might be usefully filled by additional ‘self hedging’ measures.

However, private offset providers and agents could be expected to build demand to expand the coverage through either or both appeals and applications for pre-authorisation. These agents become a crucial part of the process for discovering smarter solutions.

The key decision then is one of whether the actual task of assembling the pools is undertaken by the same agency, by market forces or by some hybrid. As was flagged above, we see the role falling most naturally to market forces. The accreditation agency might sensibly offer some initial standard pool structures,
where it actively seeks out contributions to these pools to build and share value. However, this would seem better viewed as a market facilitation process – establishing and demonstrating capability that might then be taken up by private agents. The scope for competition between agents to create a set of pools of high value seems worth aiming for.

We have already flagged that pools could span countries, tapping into corresponding size and scope economies, with greater diversification being possible. The machinery to encourage this could also, of course, actively support Federal Government climate objectives in terms of international engagement processes. This could be a conduit for the transfer of knowledge gained from Australian offsets opportunities internationally – with a commercial driver.

Finally, we note that it is logically possible to pool portfolios to further reduce risk – the main issue is developing a sound basis for sharing the benefits that makes both pools see this as a gain. In theory, the portfolio that really matters to climate change strategy (given our suggested approach to goals) is the aggregation of all initiatives internationally. Any focus of the uncertainty in lesser portfolios still carries risk of under-investing in mitigation instruments.

We are suggesting for now a modest investment in reducing this bias, and an adaptive process that could allow gradual convergence on the broader, more appropriate, need in time.
8 Further comments on market mechanics

Choices will be needed between governments establishing the institutional and regulatory environment within which commercial offsets markets flourish, or intervening more strongly to establish a central market, possibly with some resultant monopoly power. There seems little case for preventing other markets and a good case for encouraging commercial exploration of opportunities to better ‘plug gaps’.

However, a case for a more central solution may emerge from the value in tapping size and scope economies effectively. This is still likely to be feasible through sound institutional arrangements, which encourage and reward the assembly of high-value diverse portfolios, including aggregation of portfolios across different commercial markets. A more hands-on role might be supported by a strong desire by government to move early to make major progress – though again this might also be achieved by governments agreeing to enter these markets as buyers, with a clearly understood demand profile, rather than seeking to run the market.

Governments are likely to have a more natural role in the formal accreditation processes. High credibility, internationally recognised standards for accreditation could deliver a lot of value to the markets, while advancing government objectives for demonstrating real abatement, and for demonstrating to other countries ways of delivering real abatement in agriculture.

If the proposed paradigm shift were adopted, then this has implications for the offset standard, for the accreditation processes and for how these would need to evolve over time.

Liquidity in markets is likely to favour the development of something like standard contract specifications – in terms of product, duration, etc. A focus on this is appropriate, but care seems necessary to prevent this from discouraging effective tapping of scope economies. It would be easy for standardisation to favour single instrument measures, and dealing with permanence via a requirement to roll over a similar instrument. It seems likely that any such bias could prove quite costly in the longer term.

For related reasons, we see little value in prescribing the duration of contracts. Better discovery of smarter solutions would seem likely to flow from a more flexible approach that handles uncertainty and impermanence soundly. This would not, of course, mean there could not be a standard contract – this could allow much lower transaction costs across multiple activities. It would seem
sensible, however, to allow opting out of the standard contract where greater value could be demonstrated. In time, the emphasis on large and diverse portfolios might actually prove more effective at containing transaction costs via size and scope economies, and the increased application of regional modelling methods to underscore value demonstration.

For single instrument measures, we would favour the use of realistic (and probably therefore fairly harsh) discounting for risks, coupled with options over future upside potential. These options would themselves be amenable to packaging into more diverse portfolios in the future, as a way of demonstrating greater value than was at first considered justified. Use of this approach would favour early effective communication regarding the nature of the investments that will be made in improving the science, establishing revised thresholds, changing limiting rules, and developing portfolio accreditation methods that will recognise the value of scope economies in managing risks.
Works Cited


CSIRO. (2009). An Analysis of Greenhouse Gas Mitigation and Carbon Biosequestration Opportunities from Rural Land. CSIRO.


A Current Federal Proposals

The following text sets out the modifications to its policy made following negotiations with the then Opposition, and in advance of introducing legislation to Parliament in early November. The legislation was rejected by the Senate but the Government has announced that it intends to reintroduce the legislation, in the current form, in May 2010. If rejected again, it would constitute a double dissolution trigger – but there has been no announcement of intent by the Government to use the trigger.

- The Government will introduce amendments to provide for crediting of abatement from agricultural emissions and other sectors not covered by the CPRS (for example, legacy waste) that are counted towards Australia’s international climate change obligations, with the following features:
  - a policy and legislative framework that ensures any domestic offsets meet internationally accepted principles of permanence, additionality, measurability, avoidance of leakage, independent audit and registration;
  - promotion of best practice standards;
  - an independent expert committee will be established to vet offset methodologies and recommend robust methodologies to the Minister for approval:
    … This means that the Minister would accept or reject methodologies, but would not be able to modify the committee’s recommendations
  - provisions for interested persons to refer methodologies for assessment by the independent expert committee;
  - approval of projects and crediting of abatement from commencement of the CPRS on 1 July 2011;
  - compliance requirements, including monitoring, reporting, record-keeping, auditing and appropriate enforcement mechanisms; and
  - legislation would be flexible and would allow new sources to be included once they are recognised in Australia’s international commitments.

- CPRS permits will be provided for abatement from the sources that are counted towards Australia’s international commitments, subject to the development of robust methodologies:
  - livestock
  - fertiliser use
  - burning of agricultural residues
  - avoided deforestation
  - emissions from closed landfill facilities.
  - manure management
  - burning of savannas
  - rice cultivation
  - legacy waste
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- The Government will continue its advocacy in the international climate change negotiations to ensure that post-2012 accounting rules only require countries to account for emissions and removals of greenhouse gases resulting from human activity.

- In the meantime, the Government will promote voluntary market offsets through implementation of the National Carbon Offset Standard. This will provide scope for a market for abatement from the following sources that are not counted towards Australia’s international commitments:
  - agricultural soils (grazing and crop land management), including bio-sequestration through soil carbon and biochar;
  - enhanced forest management; and
  - non-forest revegetation and vegetation management.

- Abatement from these sources will transition into the CPRS once abatement is internationally recognised and provided that other CPRS requirements are met.

- To facilitate this, NCOS methodologies would be assessed by the same independent expert committee responsible for advising the Minister on CPRS offset methodologies, and NCOS requirements would be consistent with those of the CPRS wherever possible.

- To further enhance the environmental outcomes from the CPRS, the Government will also:
  - provide credits for regrowth forests on deforested land (legally cleared between 1990 and 31 December 2008);
  - provide credits for soil carbon on deforested land (for land legally cleared between 1990 and 31 December 2008) from 2013;
  - include conditions for forests earning forest credits to have adequate water entitlements and planning approvals; and
  - require that offset projects do not involve, or include material obtained as a result of, clearing or harvesting of native forests.
National Carbon Offset Standard


The NCOS is to take effect from 1 July 2010, to supersede the Greenhouse Friendly program. The NCOS has been developed to provide guidance on what constitutes genuine, additional, voluntary offsets in the context of the CPRS. It has also been designed to provide guidance for genuine offsets for those individuals, businesses and other organisations who wish to voluntarily reduce or offset their GHG emissions.

The intent of the NCOS is to provide confidence to consumers in the integrity of the carbon claims being made by a product, firm or organisation. This is achieved by providing protocols for assessing the:

- carbon footprint of the firm
- emission reductions made by the firm
- emissions the firm offsets

Thus the NCOS guideline document is broadly divided into specifying the protocols against which offset methodologies will be assessed, and guidelines for making transparent to the public the steps taken to measure and reduce emissions, so that any carbon neutral claims can be objectively assessed.

While not directly relevant to this study, it is worth noting that the NCOS methodology for undertaking a carbon footprint calculation and making carbon neutral claims is based on:

- general principles and requirements for calculating the carbon footprint of a product or organisation;
- requirements for transparent recording of: the carbon footprint; measures taken to reduce emissions and the amount reduced; the emissions amount offset; and the type of carbon offsets purchased and retired; and
- requirements for auditing the veracity of carbon footprint calculations and offset claims (Department of Climate Change, 2009).

To enable companies or organisations to use offsets, the NCOS recognise six international offset standards in addition to the standard established by the Standard itself. Voluntary retirement of the following units will be accepted under the Standard for the purposes of voluntary carbon offsetting:

- Australian Emissions Units (AEUs)
- Certified Emission Reductions (CERs) except long-term (lCERs) and temporary (tCERs)
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• Emission Reduction Units (ERUs)
• Removal Units (RMUs)
• Voluntary Emission Reductions (VERs) issued by the Gold Standard\textsuperscript{10}
• Voluntary Carbon Units (VCUs) issued by the Voluntary Carbon Standard\textsuperscript{11}
• Offsets generated from emissions sources in Australia not counted toward Australia’s Kyoto Protocol target, where they meet eligibility criteria and use a methodology that has been approved under the Standard (Department of Climate Change, 2009).

Temporary CERs (tCERs) are not considered eligible offsets as they do not meet the permanence definition of the standard.

There appear to be two voluntary actions that the NCOS are predicated on. Those that are seeking to voluntarily reduce emissions and therefore are potential purchasers of offsets. The other voluntarism is the voluntary supply of the offsets, particularly by agriculture, a sector targeted by the NCOS.

The potential purchase of offsets could be categorised in three ways:
1. Those seeking a voluntary reduction in emissions
2. Those seeking to offset emissions covered by a carbon pricing policy
3. The Government wishing to purchase and retire GHG emissions as part of its national abatement strategy.

The potential sources of emission offsets demand is shown in Figure 3. The boxes in Figure 3 highlighted in red show where the greatest potential demand may come from for a voluntary market.

An offsets market provides the opportunity for Governments to participate directly to reduce carbon emissions. This may be to supplement a cap and trade policy, or where the Government is seeking to smooth out variations in flows of carbon emissions. Government activity in the market may serve two purposes, underpinning demand to provide a higher offset price than would occur without intervention, and genuinely reducing national greenhouse gas emissions by retiring credits.

\textsuperscript{10} Where credits are issued for reduced emissions from deforestation and degradation (REDD) and other agriculture forestry and land use (AFOLU) projects, they must apply methodologies approved under the Standard.

\textsuperscript{11} As above
A Government may wish to underwrite a carbon market, particularly in the initial stages, to assist the market to become established.

There are three broad sources of eligible offsets under the standard, they are:

- Forest management (forests established before 1990)
- Re-vegetation (establishment of woody biomass that does not meet the forest criteria)
- Cropland and grazing land management (net greenhouse gas emissions from soils, crops, and vegetation)

The NCOS specifies that domestic offset methodologies will be assessed against six requirements. Project must demonstrate that they are:

- Additional
- Permanent
- Measurable
- Transparent
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- Independently audited
- Registered

A more detailed discussion of the criteria is contained in Section 3 and in Attachment F. Leakage is not explicitly addressed in the NCOS but is mentioned as a desirable additional assessment criterion in the Australian Government’s proposed CPRS legislation amendments. At this stage, it appears that the NCOS will require the inclusion of a leakage assessment if it is to be consistent with the Government’s proposed amendments. We would expect that the Government would require correction for major leakage for any offsets measures considered for trading into the CPRS and probably for most measures.
C Further background on GHG offsets in Australia

Greenhouse gas policy development, both domestically and internationally, has grappled with both how to limit greenhouse gas emissions from agricultural practices, and how to exploit the opportunities that appear to be offered by agriculture and the land mass it occupies to sequester carbon and/or reduce emissions.

In broad terms, current proposals, including the design of the proposed CPRS, would allow major emissions of carbon dioxide associated with the production and use of farm inputs to be addressed through upstream treatment. There has, of course, been substantial discussion, and analysis, of the implications of such upstream treatment for the competitiveness of Australian agriculture – with this being heavily dependent on policies adopted by other countries, particularly key competitors with Australian agricultural production. The CPRS would also have limited application to the carbon emissions of some large downstream processors of farm produce.

In terms of agricultural emissions, the greater concern for special policy treatment has been with carbon emissions associated with land clearing and with emissions of methane, mainly from ruminant livestock, and of nitrous oxide, linked substantially to the use of nitrogenous fertiliser.

Reduced land clearing has already contributed very substantially to the containment of national emissions – and, indeed, to a significant real reduction, by some standards of measurement, in overall agricultural emissions, since 1990.

Both methane \((\text{CH}_4)\) and nitrous oxide \((\text{N}_2\text{O})\) are particularly potent greenhouse gases that collectively, across agriculture, account for about 16 per cent of Australia’s total assessed emissions, expressed on a CO\(_2\)-equivalent basis.

The current policy proposals would not compulsorily include these emissions directly within the CPRS – though scope for reducing them could be an important part of the offset opportunities explored in this paper. These emissions will remain as part of Australia’s greenhouse gas accounts, and will be part of any targets for national emissions reduction. The decision to preclude them from the CPRS is a decision to address them through either or both of: greater requirements for emission reductions from other parts of the economy, and other mechanisms to lower agricultural emissions.
It is notable that these agricultural emissions account for about two-thirds of all Australian emissions not proposed to be covered by the CPRS, that in total account for about a quarter of all emissions. To put this in context, consider the implications for commitment to a 2050 target of a 60 per cent reduction in Australia’s emissions. Were there to be no change in emissions from these areas not covered by the CPRS, this would require that the CPRS-covered emissions be reduced by 80 per cent if aggregate emissions are to be reduced by 60 per cent. If the uncovered emission activities were able to grow at just 1% per annum – supported by both their exclusion from the CPRS and their extra competitiveness as other sectors respond to the CPRS – then the level of reduction from within the CPRS would rise from 80 per cent to 96 per cent. This may not be impossible given possibilities for sequestration and for international trading, but it does suggest potentially very high costs.

Realistically, the levels of aggregate emission reductions being contemplated require serious consideration of ways to tap the potential for reductions in emissions, and/or for sequestration, from within the uncovered as well as the covered sectors.

Finding a way to tap into the potential to abate these emissions, in some cases almost certainly at lower cost than the likely marginal cost of abatement expected to emerge over time from the CPRS, could therefore be seen as helping plug an important ‘gap’ in the CPRS that might allow Australia to deliver on emission targets at lower cost and with greater confidence. These opportunities, and potential instruments, were discussed in some detail in Campbell & Barber, 2009 – in which a key function was suggested for a voluntary offsets market as part of a sound policy evolution process.

However, in addition to the opportunities for reducing levels of emissions caused by agriculture, there has been a lot of interest generated by the concept that agriculture could also deliver substantial sequestration of carbon. Tree planting – the reversal of land clearing – is probably the most widely recognised version of such sequestration, but the opportunities appear to be much wider – involving a range of measures to increase the average level of carbon contained within farm soils and vegetation. Biochar has come to symbolise this class of opportunities, though the class is much broader than this technology alone.

These sequestration opportunities are potentially also a source of offsets for emissions from other sectors.

However, there are significant issues to be addressed in relation to soil carbon. These include technical uncertainties, and the limitations of current international accounting rules that require, in order to recognise these contributions, that responsibility also be accepted for non-anthropogenic
Australian Agriculture as a Provider of Carbon Offsets

changes to soil carbon. Australia has an established position of strong opposition to these measures and Campbell & Barber (2009) argued strongly the case that this bundling represents poor policy, internationally. The fact remains, that there are compliance issues to be addressed. We also argue below that the way that questions of permanence and additionality are being approached, nationally and internationally, has created significant artificial impediments to the tapping of the real value that these technologies may offer.

Nonetheless, the Government does recognise, through the National Carbon Offsets Standard and its recently stated policy position, the potential value in initiatives that deliver real abatement or sequestration, even where they fail to comply with current accounting rules. The Government is promoting voluntary offset markets as a way of tapping into these opportunities – this being an important driver of the current study.

The policy position, as set out in Attachment A, is notable for a number of additional points:

• It proposes to treat offsets that comply with international rules and commitments separately and differently from the treatment accorded offsets that satisfy the National Carbon Offsets Standard but that fail to comply with current international rules.
  − The intention is to encourage National Carbon Offsets Standard-compliant behaviour change, even though the resultant changes in atmospheric greenhouse gases will not be available to offset enterprise responsibilities under the CPRS.
  − Campbell & Barber (2009) raised the possibility of such separate treatment but with the possibility of pushing the logic even further:
    … We flagged the possibility of making such behaviour change a lot more attractive earlier by building into the offsets a formal option to render reductions tradeable into the CPRS in the future, if and when the international rules change – i.e. past abatement/sequestration could be ‘banked’ for later trade, should the rules change, to deliver offsets to the CPRS; and
    … We also flagged the opportunity for Australia to announce targets for aggregate reductions, inclusive of both internationally compliant and National Carbon Offsets Standard-compliant measures. This target and reporting would be in addition to any targets and reporting within the international rules, but could be used to increase pressure for sensible modification to the rules.

• The commitment to continued advocacy of rule changes in relation to soil carbon, ties directly into the value of behaviour change now – but alignment of the incentives for behaviour change with the value of such change will depend strongly on the detail of the institutional arrangements.
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- The language ‘robust methodologies’ is interesting. It is probably meant to capture the notion of highly credible capacity to demonstrate that impacts are real for individual initiatives.
  - Equally, though, it is amenable to interpretation in the sense of clear positive contribution to the statistical characteristics of the overall abatement portfolio – reflecting the approach to risk management proposed by Campbell & Barber (2009) and developed again in Attachment H below.
  - This interpretation flows naturally from a consideration of managing the risks of failing to undertake a range of measures that collectively have very strong prospects for contributing to cost-effective behaviour response.
  - The difference between these two interpretations, in terms of the strength of incentives for behaviour change and the cost of delivering any given level of real abatement, is likely to be very large.

There are a number of facets that appear to complicate access to these opportunities:

- The fragmented production base of agriculture, where in Australia the family farm is the predominant, and some would say most resilient, basic business unit
  - The fragmented production base of agriculture creates potentially high transaction costs for instruments and approaches that seek to optimise the incentives for changes in farm management practices
  - Farm practice changes are the cornerstone of reducing agricultural emissions if production reductions are to be avoided as agriculture’s primary response to reducing emissions
  - The capacity to undertake site-specific monitoring of agricultural production is technically challenging, due to the complexity of the agricultural greenhouse gas cycle and the variations in this cycle across climatic zones, enterprises, soil types and management capability

- By and large greenhouse gases, particularly nitrous oxide and methane, represent wasted energy from farming systems. Therefore there appears to be a relatively strong negative correlation between productivity and GHG production that could be exploited, raising the prospect of achieving, at least initially, cheap sources of abatement or sequestration from agriculture.

- Food production, and the security of food production, have deep social roots that strongly influence the treatment of agriculture in climate change policy in Australia; perhaps even more so in countries that have experienced food shortages due to major wars, climate variations or domestic policies.

- There are large differences in the emissions and total economic contributions agriculture makes between the major agricultural producing
nations. Where agriculture is a relatively small contributor to GDP and total country emissions, it is less costly (in terms of meeting emission targets and the costs of achieving these emissions borne by other segments of the economy) to leave it out of national strategies to reduce emissions.

These aspects of agriculture and greenhouse gas policy were discussed in considerable detail in a paper that prepared the conceptual frame work that gave rise to the commission of this paper. Campbell & Barber (2009) identified a series of building blocks that established the basis on which agriculture’s inclusion in a national abatement strategy, but not necessarily a national cap and trade scheme, could be built. These building blocks are summarised as:

• The Australian agriculture abatement profile can be characterised as a portfolio of abatement and sequestration options. There is good evidence that that portfolio has:
  – a number of low cost, low risk options with scope for early implementation. Some such measures are already being implemented, based mainly on complementary productivity effects.
  – a significant proportion of abatement options that appear technically feasible, but may require further scientific verification and development to firm up their individual abatement impacts:
    … however, it is likely to be possible to be far more confident earlier about the aggregate impact of implementing a range of such measures across a range of farming systems.
  – a number of additional abatement options where the scientific pathways are well understood but require considerable additional research and development and, in many cases, are likely to be more costly to adopt:
    … though some may still prove to be competitive compared to the marginal cost of abatement in the coming years.

• Greenhouse gas emissions are positively correlated with increases in production but in many instances are negatively correlated with improvements in productivity as traditionally measured\(^\text{12}\), particularly for livestock production:
  – there may be significant synergies available for exploitation and cost containment.

• Agriculture, operating in open ecological systems has a long history of managing the externalities it produces, such as salinity, water, invasive pests and diseases, biodiversity, etc. Management of these externalities has created a rich experience of adaptation, voluntary action and government

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\(^{12}\) This qualifier is potentially of great significance. Measuring productivity exclusive of the value of abatement services is partial and potentially misleading in a world that is starting to price emissions. However, without a mechanism for rewarding the abatement impacts, lower productivity as measured traditionally is still likely to be a pointer to lower farm profitability.
intervention. This experience provides some indication of the likely success of prospective emissions policies:

− Some of these policies also impact on emissions management, such as drought, water, and R&D policy.

• There are a number of policy options that appear to offer some scope for managing agricultural emissions. They can be characterised as:

− Ranging from minimal intervention (light-handed) through to heavy-handed regulation.
− Ranging from low to high transaction costs.
− Ranging from low to high capacity to create incentives to modify behaviour and encourage adaptation.
− Ranging from low to high levels of intervention failure, such as incurring high, irreversible, costs prematurely.
− Delivering increasing risk of delaying certain emissions reductions that could be delivered by heavy-handed intervention.
− Having varying levels of compatibility with international accounting standards.
− Interventions that can be applied to inputs or outputs of production, based on imputed CO$_2$e emissions of the production process.

Based on these building blocks, possible ways forward were presented in the initial report that included:

• Reducing, as much as possible, indirect policy distortions from drought, biodiversity, environmental and water management:

− Moving to limit these perverse incentives ahead of posting strong incentives to modify behaviour.

• Pre-emptive signalling of clear policy intentions and assignment of risks:

− by providing information about how the process will work and who will be responsible for managing the risks that policy settings will need to be changed to provide incentives for farms to bring forward emission efficiency improvements to manage those risks.

• The establishment of a clear baseline of agricultural GHG management from which the adjustment process will commence.

− Providing a base for recognising and certifying early contributions to abatement and sequestration and encouraging farm participation, because of the risks associated with delay in establishing these baselines.
− Using these to encourage and support accreditation of portfolios of behavioural changes that offer safe abatement/sequestration, where this can be done cost-effectively.
− Potential winding back of the baselines over time – allowing alignment of the financial imperatives with the scope for rapid change.
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- Progressive calibration of signals via linkages to the evolving cost of abatement elsewhere in the economy (or internationally):
  - Likelihood of direct engagement with the CPRS via offsets markets, possibly evolving to later convergence of the two sets of arrangements.

While this report deals exclusively with only one policy instrument identified as prospective in the initial paper, the development of an agricultural based credit market, much of the policy ‘ground work’ will be required to maximise the effectiveness and efficiency of this instrument.

An agricultural credit market is often referred to as an ‘offset market’. However, this term refers only to one source of demand for the services (GHG credits) likely to be produced by this market. In the initial paper the development of voluntary or credit market had several objectives, only one of which was the provision of offsetting credits to covered sectors of the economy. In addition to the provision of offset credits, an agricultural credit market would:

- Provide the opportunity for agriculture to develop the technical capacity to manage greenhouse gases
- Develop the innovations and systems to reduce the transactions of trading agriculture and land use credits
- Facilitate a way by which agriculture can contribute to national greenhouse gas abatements
- Provide a demonstrable contribution to national greenhouse emissions reductions that can influence current biases in international treatment of LULUCF.
Some observations on the EU ETS

D.1 EU climate carbon emission commitment

On top of the Kyoto protocol the EU has adopted a policy to reduce emissions based on 1990 levels by 20% by 2020. If countries around the world can come to a similar commitment, the EU has stipulated that it will increase its reductions to 30% below 1990 levels. To assist in achieving these targets the EU has created a European Union emissions trading system (EU ETS). In the 20% reduction model, reductions will be achieved by a 21% reduction in emissions from sectors covered by the EU ETS, compared to 2005 levels, by 2020 and a 10% reduction compared to 2005 levels for those sectors not bound by the EU ETS. The system has been designed to share the burden between developed and developing EU members, which means that those less developed countries such as Bulgaria and Romania will be able to increase emissions. To compensate for this, countries such as Denmark are required to reduce their emissions by more than the overall EU target of 20%.

D.2 The EU ETS

The EU ETS is the largest multi-country, multi-sector greenhouse gas emissions trading scheme in the world. The EU ETS covers more than 10,000 installations in the energy and industrial sectors, these sectors contribute around 50% of total EU greenhouse emissions. Currently the system covers heavy industry and power installations, meaning agriculture is not bound by the scheme and cannot sell credits into the scheme.

Typical of a cap and trade scheme, emitting companies are given emission allowances at the beginning of each trading period. If they emit more than allowed they must buy credits; conversely if they emit less than allowed, they are able to sell their surplus credits.

What makes the system unique is its preparedness to acknowledge credits from different countries. It allows companies to buy credits from the Kyoto Protocol’s project based mechanisms to help them comply. This allows other countries to sell credits into the EU ETS if their projects fulfil Kyoto requirements. However, to limit the leakage from the EU system, the amount of externally produced credits is limited in all phases. Also credits from CDMs based on LULUCF are banned from use in the EU ETS. The reason for not using land-based CDM credits appears to be concerns about permanence, capacity to monitor and reporting requirements, and costs and potential price impacts. The concerns about potential price impacts appear to largely relate to the flooding of the market with cheap LULUCF CDM credits.
The scheme is focused on industries where emissions can be easily quantified with a high level of accuracy. This means that the system covers large emitters from the aeronautical, energy-intensive industries and the power and heat generation sectors. This desire for accuracy is replicated in the system’s views on offsetting programs; credits are not granted for land use, land-use change or forestry. This effectively means that Agriculture is not bound or advantaged by the system. The only way that agriculture will be affected is through slightly higher input costs, or methane capture.

D.3 Agriculture

The EU aims to reduce agricultural emissions by 10%, however the industry is not included in the EU ETS. There is considerable commentary on reasons why agriculture should be included in phase III but the EU has not formally specified their position. Originally, agriculture was left out of the system for a number of reasons:

• It is difficult to quantify emissions/reductions made by agricultural projects with any level of confidence
• The European agricultural sector is one of the most protected in the world, the added cost of compliance would further destabilise the industry
• The farm lobby within the EU is quite powerful

Critics claim that there is now greater research into, and knowledge of, emissions quantification than there was when the system began operation. However, this unpreparedness has meant that countries have to look at other methods to achieve emission reduction in agriculture. In Ireland a cow tax is proposed, charging farmers 13 Euros per cow per year, while Denmark is discussing a levy as high as 80 Euros per cow. Such taxes will allow the country to buy credits to negate the emissions or fund research into emission reduction technology.

Despite difficulties that countries face in handling this problem, there is no mention by the EU that agriculture will be included in phase III which starts in 2013. Furthermore, the European commission has stated that livestock taxes are not their preferred options.

D.4 Structure

The EU ETS does not specify how and where trading of allowances should take place. This means that participants can trade directly with each other or buy and sell via a broker. A number of exchanges have developed within the EU to handle this trading. The price of allowances is determined by supply and demand. The commodity traded is European Union Allowances (EUAs) which are distributed by the EU to countries who will then allocate the allowances to
companies. Each EUA represents an entitlement to emit one tonne of carbon dioxide equivalent.

**D.5 System phases**

The system has been operating in three different phases; this is to create uniformity and ease of management.

**D.5.1 Phase I 2005-2007**

This was the start up period of the system; 95% of the EUAs were given out free of charge, reducing the burden on industry. The industries covered were:

1. Energy – combustion installations with a thermal input exceeding 20 megawatts including mineral oil refineries and coke ovens
2. Production and processing of ferrous materials – concerns operations involving metal ore and the production of iron and steel
4. Other activities – industrial pulp plants and facilities that produce paper and cardboard in quantities of more than 20 tonnes per day.

Each member state must submit a National Allocation Plan (NAP) to the EU; such a plan sets out the proposed emissions cap for each sector within that nation. If the EU agrees that these reductions are appropriate, it will grant the country EUAs equivalent to the NAP predicted emissions.

**D.5.2 Phase II 2008-2012**

This phase is very similar to phase one in terms of who it affects, however from January 1, 2009 aircraft operators landing in European airports will have to comply with the system. Similar to phase one is the use of NAPs where countries will have to tell the EU what their emissions will be to be given EUAs. During this phase, 90% of emission allowances were given out and 10% were auctioned. This, together with increased fines for rule infringements, puts more money into the system.

**D.5.3 Phase III 2013-2020**

Unlike phases one and two, phase three will not use NAPs; instead there will be EU wide caps, which will be distributed according to harmonised rules. It is proposed that the system will apply to the following additional sectors.

5. Production and processing of ferrous metals
6. Mineral industries; and
7. Other activities including the production of cardboard.
E International GHG market lessons

E.1 Broad structure

GHG markets generally fall into one of two categories, allowance or project based markets.

Allowance markets are those that are based on the trading of ‘overs and unders’ where emissions are capped for all or part of an economy. The name of this type of market is derived from the allowances an emitter covered by the cap is usually allocated by the Government (or whoever is setting the emission cap). The allowances may be provided by the Government up to the level of the cap. These allowances are issued at the discretion of the Government. If a company’s emissions deviate from the number of allowances, the company is often free to sell their allowance if they are surplus to actual emissions. If the company’s emissions are, or are likely to be, above the volume of allowances, the company must acquire additional allowances either from the Government or from companies that have a surplus of allowances. If the Government has established a cap on the number of allowances, additional allowances will have to come from surplus allowances already issued.

Examples of allowance-based markets are the proposed Australian CPRS, the EU ETS, and the Chicago Climate Exchange (CCX). Several allowance markets have been operating overseas for some time.

As indicated, allowances can be issues by any market maker. The Chicago Climate Exchange is an allowance market, as it sets a base line for a single farm’s emissions (which can be aggregated up). Farmers that have surplus emissions can sell to farmers in deficit, or to others seeking to acquire GHG credits. Non-farmers may have a variety of reasons for seeking to purchase these credits. However, once a credit is purchased by a non-farm buyer, the total available credits available to the group of participating farmers’ declines.
Table 4  **Annual volumes and values of transactions on the main allowances markets (2007-08)**

<table>
<thead>
<tr>
<th>Market</th>
<th>2007</th>
<th>2008</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Volume (MtCO₂e)</td>
<td>Value (MUS$)</td>
</tr>
<tr>
<td>EU ETS</td>
<td>2,060</td>
<td>49,065</td>
</tr>
<tr>
<td>New South Wales</td>
<td>25</td>
<td>224</td>
</tr>
<tr>
<td>Chicago Climate Exchange</td>
<td>23</td>
<td>72</td>
</tr>
<tr>
<td>RGGI</td>
<td>na</td>
<td>na</td>
</tr>
<tr>
<td>AAUs</td>
<td>na</td>
<td>na</td>
</tr>
<tr>
<td>Total</td>
<td>2,108</td>
<td>49,361</td>
</tr>
</tbody>
</table>

Data source: (Capoor & Ambrosi, 2009)

Project based markets are where credits are traded that are produced by a particular activity that reduces atmospheric greenhouse gas concentrations by either sequestering carbon or reducing emissions. Project based credits become available when an organisation demonstrates it has reduced emissions, or stored carbon consistent with a set of rules.

Table 5  **Annual volumes and values (2007-08) on the projects based markets**

<table>
<thead>
<tr>
<th>Market</th>
<th>2007</th>
<th>2008</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Volume (MtCO₂e)</td>
<td>Value (MUS$)</td>
</tr>
<tr>
<td>Primary CDM</td>
<td>552</td>
<td>7,433</td>
</tr>
<tr>
<td>JI</td>
<td>41</td>
<td>499</td>
</tr>
<tr>
<td>Voluntary Market</td>
<td>43</td>
<td>263</td>
</tr>
<tr>
<td>Sub total</td>
<td>636</td>
<td>8,195</td>
</tr>
<tr>
<td>Secondary CDM</td>
<td>240</td>
<td>5,451</td>
</tr>
<tr>
<td>Total</td>
<td>876</td>
<td>13,646</td>
</tr>
</tbody>
</table>

Data source: (Capoor & Ambrosi, 2009)

International examples of project based markets established under the Kyoto Protocol include:

- Carbon Development Mechanisms (CDM): the mechanism provided by Article 12 of the Kyoto Protocol, designed to assist developing countries in achieving sustainable development, by permitting industrialised countries to finance projects for reducing greenhouse gas emissions in developing countries and receive credit for doing so.
  - Certified Emissions Reductions (CERs): a unit of greenhouse gas emission reductions issued pursuant to the Clean Development Mechanism of the Kyoto protocol, and measured in metric tonnes of carbon dioxide equivalent.

- Joint Implementations (JI): Mechanism provided by Article 6 of the Kyoto Protocol, whereby a country included in Annex I of the UNFCCC and the Kyoto Protocol may acquire Emissions Reduction Units when it helps to
finance projects that reduce net emissions in another industrialised country (including countries with economies in transition) (Capon & Ambrosi, 2009).

It is not surprising that the highest traded markets are those where credits are compliant with the Kyoto protocol as they are valued on their capacity to be traded widely now. Part of their value is also derived from the markets expectation that signatories to the Protocol that implement trading schemes will grow over time.

Some blocs with allowance markets accept certain project-based credits as tradable in their emission trading schemes. This appears to be the case under the EU ETS. However, in the EU ETS there are limits placed on the amount, by volume of credits generated outside the scheme that can be claimed by market participants and hence traded.

An underlying concern about LULUCF CDM projects is that they would not meet the development aspect of the CDM process – that is they may favour industrial biomass production that crowded out local industries and have an adverse social impact (Larson, Ambrosi, Dinar, Rahman, & Entler, 2008, p. 15).

Several important aspects of these markets are immediately apparent: they are overwhelmingly dominated by one market in each category; and there has been a dramatic rise in the volumes and values traded between 2007 and 2008.

### E.2 Chicago Climate Exchange

The Chicago Carbon Exchange (CCX) is a voluntary carbon trading scheme which commenced operation in 2003. The CCX cap and trade system currently has more than 300 participants (and growing) ranging from electricity providers to county councils. Members are segregated into different classes depending on their reason for involvement.

Market participants who emit carbon dioxide are given an emission allowance based on their baseline figures. The time at which a company becomes a member will affect their reduction obligations. Phase I runs between 2003 and 2010, members of this phase are to reduce their emissions by 1% p.a. Phase II has run between 2007 and 2010, subsequent members and phase I members are to reduce their emissions by 6% by 2010.

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13 The baseline figure is the average quantity of emissions made by the member during an evaluation period prior to becoming a member. For example, phase I members were evaluated between 1998 and 2001.
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The market consists of numerous different parties who are involved for different reasons. Exchange participants are those who will buy credits and then retire them, either out of goodwill or to offset isolated events. Liquidity providers are professional traders who buy and sell credits to make a profit rather than to offset their carbon emissions.

Emitters who reduce emissions by more than required are able to sell their surplus or accumulate it for the future. Conversely, if members emit more than allowed, they are required to buy credits from the open market to make up the short fall. They can buy these extra credits from companies that have reduced their emissions by more than required. Alternatively, they can buy those credits from offset providers. These participants are not necessarily required to reduce emissions but can be granted credits if they reduce, sequester, or destroy carbon dioxide or equivalent. The prices paid on the market are dictated by supply and demand.

From the above it can be seen that the system provides clear incentives to farmers to undertake projects to offset carbon emissions. Issues involved with such undertakings are outlined below.

E.2.1 The commodity traded and basis for CCX carbon credit entitlement.

The commodities traded on the CCX are Carbon Financial Instrument (CFI) contracts. Each CFI contract represents an entitlement for that company to emit 100 metric tonnes of carbon dioxide equivalent.\(^{14}\) Currently, the government has no involvement with the system. Instead, the CCX grants CFI contracts to market participants in one of two ways:\(^{15}\)

a. **Exchange allowances:** These are granted by the CCX to emitters based on their baseline figure of emissions. For example, if company ‘A’ emits 1000 metric tonnes of carbon dioxide equivalent on average during the years proceeding membership, it will be given ten CFI contracts.

b. **Exchange offsets:** These CFI contracts are granted to those who undertake a project to reduce, destroy or sequester carbon dioxide (or equivalent). Unless the owner of the offsetting project is a

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\(^{14}\) Carbon dioxide is effectively the currency that the CCX uses to quantify different greenhouse gases. For example, one metric ton of methane is considered to be twenty one metric tonnes of carbon dioxide.

\(^{15}\) Note: The way in which these CFI contracts are granted does not affect the value of the contract.
‘significant’\(^{16}\) polluter, owners who are granted such CFI contracts are not required to commit to reducing their emissions as specified under the CCX reduction schedule. These CFI contracts are awarded on a retrospective basis; although the CCX began in 2003, it acknowledges offset projects completed on or after January 1 1999.

**E.2.2 Ways in which farmers can become involved.**

The CCX provides incentives for farmers to become offset providers. Provided farmers are not ‘significant’ emitters, they can agree to do one of the following to be awarded CFI contracts, which can be traded on the open market:

- **Conservation tillage:** This is a contractual agreement that requires the farmer to use continuous no-till or strip-till farming practices across the enrolled acres for no less than five years. The offset quantities awarded are issued at standard rates, depending on the project and its location (offsets awarded range from 0.12 to 0.52 metric tonnes per acre per year). Although a standardised CFI is awarded per acre, these projects must be evaluated by a third-party CCX approved assessor.

- **Grassland conservation project:** The CCX will grant CFI contracts to farmers who make a commitment to increase soil carbon stocks by increasing ground cover. Such cover must be planted on or after January 1 1999 on the condition that the grasses remain until 2010. Generally, the amount of carbon dioxide (or equivalent) saved is determined on a rigid basis depending on the project and its location. However, if a project owner can present evidence contrary to the standardised figures, the CCX may increase the amount of CFI contracts granted to them. Farmers who take part in grassland conservation will be required to place 20% of awarded offsets earned into a CCX carbon reserve pool. This pool is to be used as insurance against natural disasters such as fire or drought. In cases of extreme drought or fires, the amount of soil carbon lost will be deducted from the reserve pool. At the conclusion of the project, any CFI contracts remaining in the reserve pool will be able to be traded on the open market.

- **Agricultural methane:** This method rewards farmers for the methane that they trap and diffuse, using methods limited to slurry storage, pit storage or anaerobic lagoons. The quantity of credits granted is taken as the lesser amount of the following:

\(^{16}\) Note: No meaning of ‘significant’ was provided in the CCX rulebook. Most farmers do not meet the 10,000 metric tonne benchmark (outlined below). Thus, it could be assumed that most agricultural operations would not be classified as ‘significant’ polluters.
The theoretical amount that would have been emitted in the absence of the capture system; and

The amount of methane that is actually captured.

Such a method is most suited to intensive operations, such as dairies and feedlots, where methane can be captured more readily than on the open plains.

The above operational changes provide farmers with opportunities to increase the profitability of their business. However, for several reasons, farmers are yet to fully embrace the CCX system. Firstly, the low CFI prices indicate that regulations imposed by the CCX are not stringent enough to exert real pressure on the consenting companies. Secondly, low prices also reduce the incentive for farmers to change their farming practices. Thirdly, the CCX advises that those projects that offset less than 10,000 tonnes of carbon dioxide equivalent should register using an aggregator. The vast majority of farmers would not exceed this benchmark and so cannot freely trade on the open market. For example, if one were to use conservation tillage it is estimated that 25,000 acres of cropland would be needed to reduce emissions by 10,000 tonnes. This can lead to one of two scenarios:

- Farmers may employ an aggregator, who typically charges hefty commissions between 8 and 10%. Effectively reducing the profits and incentives to farmers; or
- Farming bodies service their members by acting as an aggregator, such costs would be covered in the membership costs (e.g. Iowa Farming Bureau).

Many of the above impediments are related to the fact that the CCX is voluntary. A compulsory system may increase the cost of carbon and encourage greater competition amongst aggregators.

### E.2.3 The process of verification, registration and ultimately carbon crediting.

The CCX provides quite a detailed outline of the process that is involved with crediting a certain offset project. In summary, this process operates as follows:

- Submit proposal of the project to the CCX who will review it and may give preliminary approval, or refer the matter to a scientific technical advisory committee.
- Obtain independent project verification: External accredited verifiers have to approve the project and determine the amount of carbon offset by it. This is achieved using industry figures, visits to the project and information that is provided by the developer.
- Register as a CCX offset provider or aggregator. One can join the CCX as an individual or may use an aggregator. Although project owners may
register an unlimited number of projects, each distinct project must be enrolled separately unless they are enrolled by an aggregator.

- Receive CFI: Upon approval the CCX issues the offset provider or aggregator with CFI contracts equal to the amount they are offsetting. The CFI is given a vintage year, which is the year in which the reduction was made.

### E.2.4 The CCX futures market

The Chicago Carbon Futures Exchange (CCFE) is a wholly-owned subsidiary of CCX. It is an exchange that offers standardised and cleared futures and options contracts on emission allowances and other environmental products. It appears that the CCX is predicting federal legislation will cover the area by 2012, and so they have developed the futures system based around the date of the futures contract expiration:

- Expiration before 2012: Prices are listed at $0.25 increments. Listings are based on a quarterly cycle. At expiration of the option, the deliverable commodity is a CFI contract of no less than 100 CFI contracts.
- Expiration after 2012: If the Government has created legislation covering emissions, the deliverable instrument is allowances from the registry of the Government-appointed program administrator equal to 1,000 metric tonnes of carbon dioxide. Initial listings will be January 2013, December 2013, and December 2014, with options listed in $1.00 increments with 8 listed below the strike price and 16 above the strike price.

The options that are ‘in-the-money’ at the close on the last day of trading will be automatically exercised unless specific instruction has been given. In relation to agriculture, it does not appear that farmers will be granted options for increased, unexpected offsets that may be realised in the future but not counted in the original quantification of reductions.

### E.2.5 Benefits and burdens involved with participation

- Benefits to emitters:
  - Many companies see the government enforcing regulations on emissions in the near future and want to start complying before such legislation is introduced.
  - Some companies are required to comply with the Kyoto protocol to trade with other countries. Being involved with the CCX fulfils such a requirement.
  - Those companies that can easily reduce their emissions have the opinion that selling excess credits is a good way of making money.
  - Reducing emissions is good for public relations.
- Benefits to offset providers
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- The carbon price produced by the CCX is supposed to reward innovation and efficiency
- Encourages investment and risk taking that stimulates development of better environmental technologies.
- Greater marketing options.\(^\text{17}\)
- Embraces better yields involved with the conservation system while benefiting from being able to sell CFI contracts.

\(^{17}\) Although there appears to be no specific market for produce that complies with the CCX requirements.
F Further insights into permanence concerns

The National Carbon Offsets Standards contain what appears to be a straightforward, unambiguous definition of permanence:

Greenhouse gas emissions reductions must be permanent. In the case of sinks, this requires that the carbon stored is sequestered and will not be released into the atmosphere in the future (Department of Climate Change, 2009, p. 5).

However, this standard may not be as simple to achieve as it appears and there are reasons for questions about whether its achievement should be accorded the status it has received in the public policy debates. The generally accepted definition of permanence (reference) appears to be withholding GHG for the equivalent time the gas would otherwise be active in the atmosphere. The carbon cycle is often cited as 100 years. Therefore if a project withholds carbon emissions from the atmosphere for at least this period, then it is considered to have completely prevented any warming effect that may have been caused by the emissions sequestered.

The definition used in the standard tends to establish a more abstract definition of permanence that is strongly biased against sinks.

Even if this standard were not applied literally, it does not take into account the timing effects of temporary carbon abatement (Section 3.4). Nor does it take into account the value of removing GHG gases for a short period, reducing the rate of warming over this period, and creating the option for more cost effective ways of reducing anthropogenic climate warming through the development of new technologies and techniques.

There has been a long history of concern over the permanence of the emission reductions created by LULUCF, as illustrated by the quote below.

Rule-making for sinks and land-use projects proved difficult and it was not until the Bonn Conference of the Parties in 2003 that guidelines for LULUCF CDM projects emerged. The projects are complex and involve measuring the net change in carbon stocks for particular sites and any related increases in emissions off-site, taking into account above-on-and-below-ground biomass and soil organic carbon. The projects are also long-lived and subject to reversibility because of human activity such as logging or natural events such as forest fires or disease. Because of these characteristics, many feared that the projects would not deliver sound environmental benefits. (Larson, Ambrosi, Dinar, Rahman, & Entler, 2008, p. 15)

In the first instance LULUCF projects have not been considered permanent because of the potential of the sequestered carbon to be released back into the
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The threat of release is considered to come from two sources, those that result from of human intervention such as the cessation of the activity that stored the carbon (an end to minimum tillage or maintenance of forests) and those that are caused by natural events.

This distinction between anthropogenic and non-anthropogenic release of stored carbon has been the subject of considerable debate. On the one hand some argue that there should be no difference and accounting rules should not distinguish carbon emissions on the basis of their cause. An alternative view is that emissions should be delineated by cause of the release. Under Article 3.4 of the Kyoto Protocol no distinction has been allowed. This effectively means that land managers should be held accountable for all emissions from the land they occupy irrespective of the cause of the release.

In Australia the dominant non-anthropogenic causes of carbon release from the land are bushfires and drought. In both instances, the effect of these events can be modified by land managers but they lay largely beyond their control.

A market that held land managers liable for the release of carbon beyond their control is likely to fail as the risk margin that would be built into the asset price would be a significant burden. However, there are a number of approaches that could be considered that may reduce the impact of non-anthropogenic release of carbon and hence the discount required to accept the risk. This is discussed in more detail in the next section.

Below is a hypothetical example of the how terrestrial carbon sequestration lacks the permanence of a reduction in emissions from modifying an input, in this case fuel used on the farm.

Table 6

<table>
<thead>
<tr>
<th>Activity</th>
<th>Year</th>
<th>Net emissions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Baseline emissions</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Change to baseline emissions from mitigation activities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reduced fuel use</td>
<td>-1</td>
<td>-1</td>
</tr>
<tr>
<td>Expand no-till</td>
<td>-1</td>
<td>-1</td>
</tr>
</tbody>
</table>

Data source: (Lewandrowski, et al., 2004)

The example shows how, after a certain period the stored carbon is emitted as CO₂ once the practice that has stored the carbon ceases. However, reduced fuel...
use is permanent at the enterprise level as the emissions saved by the fuel reduction activity cannot be released.

The USDA example appears not to value the delay in the emissions stored. In effect there is no discount rate to adjust for the value of emissions released at a later date. The value of withholding carbon from the atmosphere for a period of time reduces the amount in two ways:

- It reduces emissions for the period that they are stored pushing back the GHG accumulation curve and delaying GHG peaks
- It reduces emissions for a period during which cheaper emission reduction technologies may become available.

When considering the role of offsets in a national or international trading system, Kim et al (2005) concluded that offsets are not fungible due to permanence issues, such as saturation and volatility. They go on to say that permanence considerations ‘could affect the terms of trade for (potentially) land-based carbon sequestration and permanent emissions reductions (fuel change, direct reduction, etc.)’ (Kim, McCarl, & Murray, 2008)

**Overcoming concerns about permanence**

There are a number of approaches that could be considered to deal with the risk of non-anthropogenic release of carbon from agriculture in Australia. Some of these also provide a robust argument for including in the accounting rules a distinction between carbon emissions based on the cause. Some of the approaches to deal with non-anthropogenic emissions include:

- Buffering
- Portfolio (forestry)
- Discounting
- Insurance
- Recognition of the cyclical nature of non-anthropogenic release of carbon (cycles and natural hedges)

One of the ways to manage concerns about permanence is to discount the value of the credit compared to a permanent credit. This could also be viewed as an exchange rate between permanent and non-permanent credits. According to Kim et al, calculating a discount for permanence requires knowing:

- The buyback price of the carbon released \( B_t \)
- An estimate of the current and future carbon price \( P_t \)
- The cost of maintaining the offset \( M_t \)
- The quantity of the offset \( Q_t \)
- A constant carbon price \( P_0 \)
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These factors are assembled into an equation to derive a carbon price discount, PDisc, (or exchange rate) between permanent non permanent credits:

\[
PDisc = \sum_{t=0}^{T} \left( \left( Bt + \frac{Mt}{P_0} \right) (1 + r)^{-t} - 1 \right) / \sum_{t=0}^{T} Qt * (1 + r)^{-t}
\]

The results calculated by Kim et al when using this equation are quite large and appear sensitive to length of expected sequestration and maintenance costs. Some examples of their results are:

- Agricultural soil carbon sequestration:
  - 25 year lease with 100% buyback – approximately 49% price discount
  - Maintenance cost at $5/acre – approximately 36% price discount

- Afforestation
  - Harvest year 20 without reforestation – 52%
  - Harvest year 20 with reforestation – 23%
  - Harvest year 50 without reforestation – 20%
  - Harvest year 50 with reforestation – 7%
Accounting for permanence, leakage and additionality

To decide whether to supply carbon credits a farmer or land manager would first need to determine if it is profitable to do so. To determine if a project is profitable the farmer will need to combine the farm level cost and benefits of the project with the credits that may be sold.

To calculate the profitability of the project the farmer will need to combine all of its various costs and benefits. The following equation, from Murray, Sohngen and Ross (2006) sets out how these factors combine, logically, to deliver the project’s profit, $\pi_p$.

$$\pi_p = \pi_p^{AG} + [pq(1 - \tau^P - \tau^L - \tau^A) - C_p]$$

Where:
- $\pi_p^{AG}$ = The projects profit from agricultural production using the agricultural soil carbon sequestration (ASCS)
- $p$ = The market price of a permanently sequestered tonne of carbon
- $q$ = The quantity of carbon sequestered
- $\tau^P$, $\tau^L$, $\tau^A$ = The discount factors for permanence, leakage and additionality
- $C_p$ = The cost of the project – implementation and additional labour costs (Murray, Sohngen, & Ross, 2007)

This equation will establish at what price of carbon, adjusted for permanence, leakage and additionality, the farmer is willing to supply the credit. However, implementation costs of the abatement project II$^A_G$, $C_p$ will vary from farm to farm and region to region.

What may emerge is a correlation between the profitability of implementing the project: Pre credit returns $=$ II$^A_G$, $C_p$ and the additionality discount rate.

The relationship is likely to be positive as the higher the pre-credit returns the more likely the farmer is to implement the project independently of the credits, and therefore the higher the additionality discount is likely to be. However, if the pre-credit returns are high, the risk of reversion of the project at the end of the credit contract is likely to fall.

The Murray, Sohngen and Ross (2007) equation specifies an ex ante discount rate, to adjust for the lack of permanence of the sequestration of the carbon by the project. Discounting is only one type of treatment for permanence. Other ways to account for permanence in a credit contract include (Murray, Sohngen, & Ross, 2007):

- Comprehensive
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- Temporary crediting by using one of three methods:
  - Expiry
  - Renting
  - Leasing

A comprehensive method provides credits as carbon is stored and debit as carbon is released into the atmosphere. The standard approach to this calculation is to periodically measure stocks and impute net credit (debit) quantities as the stock changes between periods. This method is likely to have high transaction costs but is consistent with national GHG accounting practices (Intergovernmental Panel on Climate Change, 1996) as currently used by Annex 1 countries. Longer periods between measurements would lower the transaction costs, but increase the need to address the shape of the loss curve between measurement points. Assuming all the loss occurs just before the measurement, entails a bias towards overestimating the value of the services delivered, if they are valued at the starting level of sequestration.

Temporary crediting is predicated on the assumption that all of the abated GHGs will be returned to the atmosphere at the end of the credit contract. This means that the credits will either expire or have to be replaced. Renting and leasing are variations on a similar theme, where the project owner is paid to produce abatements for a short period of time. At the end of the lease or rental period the credits are returned to the project owner who can allow them to expire by discontinuing the project or continuing it if a new renter/lessee is found.

Temporary crediting could be moved towards the comprehensive method by accepting the original baseline, and reasserting credit over residual sequestration at the end of the contract. In other words, the notional credit would be based on an assumption of 100 per cent loss on the day the contract ends, but there would be implicit or explicit options over the non-zero prospect for there being residual retention of some of the carbon. If the period used for reassessment of the carbon retained under comprehensive treatment were to match the term of the contract, the two approaches would effectively converge. In either case, there would be freedom to choose an alternative abatement/sequestration technology or site, in the event that there is a decision to replenish lost carbon.

Renting and leasing though, are not dependant on the permanence of the sequestration. Rather they could also be applied to long term or permanent sequestration. Fishing ITQs are often leased out to other fishers. Renting or leasing would be useful for someone looking for a short term sequestration requirement and who may not want to be exposed to the price variations of the underlying credit.
Leasing would require the temporary transfer of the credit to the lessee. As with leasing other assets, there would be a residual value that would have to be paid to the owner of the credits at the conclusion of the lease. The residual value of the lease could be pre-determined, whereas the actual value of the credits may have changed. If the market rate for the credits is higher than the residual, the lessee would pocket the difference. If the credits are worth less than the market rate, the lessee would have to pay the lessor the difference between the two amounts. Alternatively, the residual value could be subject to explicit measurement and payment – at either the current market price or at a pre-determined price, with these choices affecting the assignment of risk.

The impermanence of sequestration and its implication for leasing or renting can be seen in Figure 4. The red squares represent the formation of the credits (when the carbon is stored) and the yellow squares represent when the carbon is released back to the atmosphere.

Figure 4  Carbon sequestration life cycle and leasing

Another aspect of leasing and renting contracts of relevance to this paper is that they are not generally traded on an exchange. They are more likely to be transacted through an intermediary on a case by case basis, with some standard contract terms and conditions.

However, were the paradigm to shift towards diverse portfolios of self-hedging credits, these leases might usefully be tapped as a way of helping to shape more valuable portfolios, with better overall risk management.
Portfolio diversity & risk management

The following is drawn from ACIL Tasman (2009). It is intended to set out the basic reasoning underscoring the proposition that diverse portfolios of abatement measures can afford dramatically improved risk management relative to project-level accreditation processes, or relative to aggregation of fairly homogeneous (and therefore highly correlated) abatement measures.

To keep things simple for a moment, suppose there are two possible changes to Australia’s farming, each with a chance of lowering aggregate abatement. Assume they are totally independent. One might entail a change to drought management in WA and the other to applying biochar to a property in SWE Australia. They rely on different science and are being applied to different land. This is just to keep the key argument as clear as possible – these assumptions can be relaxed.

We also assume that both measures can be implemented for a cost of $5 per tonne, and that in both cases the hope is that the investment will capture or abate one tonne of CO$_2$-e. Success is not guaranteed, with an estimated 50 per cent chance of success, and a 50 per cent chance of failure with no impact on atmospheric carbon.

Policy makers worrying about being able to guarantee that they reach a target level of abatement would be understandably suspicious of each measure in isolation. What if they back the changes and they do not deliver – there would be a 50 per cent chance of not making the assumed contribution. In general, and presumably largely as a result of this reasoning, and a view that the climate change threat is big enough to support some form of precautionary principle – such measures are not recognised.

Note, however, this conclusion flows from a strong policy emphasis on targets – which are a policy means not a policy end. If we stood back and said that we can deliver a 50 per cent chance of taking a tonne of CO$_2$-e out of the atmosphere for $5, and assessed this in the same ‘doomsday’ context that supports the precautionary principle, the measure might look like good insurance. This would seem particularly true in a world in which we are moving to a CPRS that will encourage abatement actions that cost well over $20/tonne of CO$_2$-e, and could rise towards $100/tonne (based on Treasury estimates and other modelling). Statistically, each of these actions offers an ‘average’ half a tonne of abatement for $5 – or a marginal cost per tonne of expected abatement of $10. Yes, the abatement is uncertain, but to an extent that uncertainty is factored into this $10 figure.
But what happens if both actions are performed. At best, we achieve two tonnes of abatement for $10 – $5 per tonne. At worst, there is no abatement – despite spending $10. In between, there is the chance of one delivering and not the other – one tonne of abatement for $10.

The probability of each outcome can be mapped out here – it is a simple binomial problem:

- 25 per cent chance of 2 tonnes of abatement @ $5/tonne;
- 50 per cent chance of 1 tonne of abatement @ $10/tonne;
- 25 per cent chance of no abatement, costing $10/tonne.
- Averaged across both possibilities, 1 tonne of abatement @ $10/tonne.

Already, the combination of measures looks better than each individually. The risks of not delivering abatement at all have been halved. The prospect of delivering abatement at a price competitive with the CPRS marginal cost of abatement has been increased by 50 per cent (from 50 per cent to 75 per cent). The ‘shape’ of the distribution of possible outcomes is being squeezed – both away from zero and away from the most optimistic abatement cost. Importantly, the chances of real abatement have risen.

Of course, a 25 per cent chance of failing to deliver might still be considered unacceptable. What if there were three such changes that could be used. It is again possible to work the arithmetic and conclude:

- 12.5 per cent chance of abating 3 tonnes @ $5 per tonne
- 37.5 per cent chance of abating 2 tonnes @ $7.50 per tonne
- 37.5 per cent chance of abating 1 tonne @ $15/tonne
- 12.5 per cent chance of no abatement at a cost of $15
- Averaged across all possibilities, 1.5 tonnes of abatement @ $10 per tonne.

As the number of such activities rises, the trend continues – shrinking risk of no abatement, increasing likelihood of tonnes of abatement close to half the number of such changes. What if there were 100 such changes, costing $500. The chance of no abatement is miniscule – \((1/2)^{100}\), or about \(10^{-30}\). The average level of abatement would be 50 tonnes, at an average cost still of $10 per tonne. Not all possible outcomes that deliver abatement would be judged as cost effective. For example, there is a tiny chance (about \(10^{-29}\)) only one would deliver abatement, and at a cost of $500 this would be expensive. There is of course a matching chance that it would deliver 499 (and even 500) tonnes of abatement for $500 and this would look extremely cost effective.

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18 This conclusion is actually true even if the changes are not all independent – provided they are not perfectly correlated. Even if perfectly correlated, the same ‘average’ result applies, but the reduction in the risk of no abatement would stay at 50 per cent.
However, given the uncertainties, this backward looking perspective has little relevance. The fact is, that under the above assumptions, 21 of the 100 chances would have to work out to deliver an abatement cost of no more than $25/tonne – used here as a crude indicator of ‘break even’. The probability of this not happening can be calculated as approximately three chances in a billion. For an abatement cost of $50, the chances of this not being achieved would be about 1:10$^{15}$.

In brief, a large number of initiatives can combine to deliver very high probability of delivering significant and cost effective abatement. The same principles could place a statistical lower bound on the level of abatement. In the above example, accepting a one chance in a million risk of failing to at least meet a proposed quantum of abatement, would allow the combination of the 100 activities to be associated with abatement of at least 26 tonnes. One in a thousand would increase this to 34 tonnes. Each of these abatement levels would be associated with a portfolio strategy with an expected cost of $10 per tonne.

The same logic applies if the probabilities are different – as long as each initiative has an individually risk-weighted cost that would be competitive if it could be guaranteed. As was noted before, correlations can alter the calculations, but would not cut across the core principle – that weighing risks initiative by initiative can be seriously misleading relative to taking a whole of portfolio approach.
I Market mechanics

This attachment provides a discussion of the mechanics of an agriculture and land use credit market in Australia. Essentially the discussion is divided between the operations of the market and the asset classes being traded.

Box 11 An example of the current Australian carbon market

Carbon Conscious listed on the Australian Securities Exchange in May 2008 (ASX code: CCF) and is a related party to Australian Agricultural Contracts Limited (AAACL).

Carbon Conscious has been established to participate in the emerging carbon credit markets by using AAACL’s relationships with broadacre farmers and land to plant native mallee eucalypt trees. Carbon Conscious’s “Carbon Capture Program™” aims to plant mallee trees which in turn capture and store carbon dioxide from the atmosphere as they grow. Over time, a significant amount of carbon is expected to be stored by the mallees which will be measured by Carbon Conscious and sold as a carbon credit on a carbon exchange (which will operate much like a stock exchange).

All trees capture and store carbon, but the mallee tree has been selected by Carbon Conscious due to its suitability to Australia’s low rainfall climate. In addition, the mallee is generally a long-lived species and has the capacity to regenerate after fire. There are also significant environmental benefits to farmers from planting mallees, including the potential to reduce the impacts of salinity.

Carbon Conscious aims to attract significant investment from large scale polluters and emitters of carbon (such as power companies) who will pay to plant the mallees on suitable broadacre land provided by farmers. Various options are available to farmers to participate and benefit from the Carbon Capture Program.

Recently Origin Energy has signed a $26m contract with Carbon Conscious to plant large scale native Mallee Eucalypt trees to generate credits in anticipation of the introduction of an ETS.


The operations of the market could be described as standard market practices, or ‘off the shelf’, with modifications to meet the characteristics of the participants and the objectives for establishing the market. It is almost certain that as soon as the market is established, the objectives for this market and the expectations of the participants will change. Therefore the operations of the market will need to be responsive to the changing demands of the market participants and the GHG management policy environment in which it operates.

This attachment is divided into three specific sections: what is a market, a discussion of the types of buyers and sellers, and what assets could be traded.

It is also worth noting that there is an active market for carbon credits already operating in Australia. It is not a formalised market with standard contracts...
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and centralised selling. Rather, there are a number of buyers and sellers trading emissions reductions from various activities mostly based on plantation forests.

The current market is largely operating on the expectation of a national approach to emissions reductions being established by the Australian Government. However, there is also an active, although apparently small in value terms, part of this market for voluntary credits; it is driven by firms seeking to gain some commercial advantage by demonstrating to consumers their environmental credentials. An example of the active market already underway in Australia is the recent activities of Carbon Conscious, described in Box 11.

I.1 What is a market?

A market is an amalgam of a number of parts. A common misconception is that an exchange such as the Australian Stock Exchange (ASX) constitutes a market. The ASX is a vital part of the equities market in Australia but is only one part. The role of the ASX is largely to reduce the transaction costs of participating in the equities market by its many participants, and increase market transparency. To do this it standardises contract terms and conditions, establishes trading rules, provides a clearing function (matching buyers and sellers) and publishes trading information. The ASX also provides training and education for those unfamiliar with trading equities.

However, a market can be far simpler. A market is made up of buyers, sellers, and mechanisms for allowing buyers and sellers to undertake a transaction.

As a general rule, as economists see it, in open (market-based) economies resources are allocated amongst uses by two methods - the price mechanism and agreements between entrepreneurs. In its purest form, an allocation by the price mechanism will occur via a spot sale – where the terms are cash and the price and quantity of the product exchanged are determined instantaneously and once-off. The equivalent polar case for an allocation by agreement is a long term contract. Clearly there are many intermediate forms of allocation in between. The choices along the spectrum between each pure form are what determine business organisation.

The way choices are made between the price mechanism that operates in spot sales and contractual agreements for the exchange of goods and services was explained in 1937 in a much quoted article by Professor Ronald Coase (Barber and Cutbush, 2005). The article was entitled simply “The Firm” because it concentrated on explaining how a firm decides to buy its inputs and sell its outputs, particularly who to hire as employees (on contract) as part of the internal command structure of the firm and who to deal with alternatively in a moment-by-moment market way (Coase 1937). In 1994, 54 years later, Coase
was awarded a Nobel Prize for this and related work on the determinants of economic organisation.

Coase noticed that the productive processes that go on in firms could all be carried out in a completely decentralised way by means of contracts between individuals. But he noticed too that there are costs to those contracts: information costs, search costs, negotiation costs, monitoring costs and enforcement costs. He referred to them collectively as transactions costs (Barber and Cutbush, 2005).

Coase argued that firms emerge to organise what would otherwise be market transactions whenever their costs are less than the costs of carrying out the transactions through the market. This determines what the firm buys, sells and produces. The explanatory power of this idea was extraordinary (Barber and Cutbush, 2005). Not only did it explain why firms exist and what activities they are likely to undertake; it also explained how the firms, and by definition markets, expand and contract in concert with each other.

The realisation that firms continually compete against the alternative of decentralised market transactions has implications for what managers do. It shapes judgments about such things as when a firm will prefer outsourcing. It also determines when a firm will widen its boundaries to include functions formerly left to market transactions (Barber and Cutbush, 2005).

The processes that occur inside firms cannot all be replicated easily outside. The firm provides a team environment. That environment provides a different set of “non-market” benefits to employees than those they would receive as independent external contractors (Barber and Cutbush, 2005). The question is whether people can be more creative or productive within a contracted environment.

Perhaps the single most important message to draw from Coase’s insights in the present context is that there is a continual contest between allocating resources within a firm and through a market. To sustain efficiency, evolution could occur in either direction, and this has probably been the case throughout history.

The relevance of the Coasian framework for this study is that:

- A market is defined by what managers assess is more efficient to undertake internally as compared to relying on market transactions. In a carbon market a firm seeking to offset emissions through modifications to agricultural practices could achieve this by:
  - expanding its operations into agriculture by buying farms and planting trees etc
  - buying credits in an open market
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• The extent of a market is dynamic and will be influenced by transactions costs. Transaction costs have proven to be a significant barrier to agriculture’s anticipated inclusion in an ETS.

• Transaction costs will also largely determine how a firm decides to trade in a market. At one extreme, a firm may decide to contract the production of carbon credits from one provider, while at the other extreme a firm could enter into an open market where multiple buyers and sellers are active.

• While not explicitly covered by the Coasian framework as presented above, transactions costs will be influenced by the types of credits traded in a carbon market.

Therefore, in the absence of government intervention, a carbon market can take a number of forms depending on relative transaction costs. Allowing competition between various forms the market may take, is likely to lead to lower transaction costs over time and a market more responsive to the needs of buyers and sellers.

If left to its own devices a carbon credit market will evolve a number of ways of organizing itself. A broad set of examples, with a brief description of certain aspects of each market organizational option is present in Table 7. It is likely that a combination of market forms will form over time and will be dynamic depending on the relative costs of each form of transaction.
### Table 7 Various forms a carbon market may take

<table>
<thead>
<tr>
<th>Buyers and sellers dealing direct: <strong>spot market</strong></th>
<th>Buyers and sellers dealing direct: <strong>vertically coordinated</strong></th>
<th>Intermediary markets with over the counter <strong>products</strong></th>
<th><strong>Highly centralized and standardised</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Need to seek each other for out for each transaction</td>
<td>• Buyers and sellers enter into long-term contracts</td>
<td>• Level of standardization increased</td>
<td>• Standardised contracts traded on central market</td>
</tr>
<tr>
<td>• Establish contracts on a case-by-case basis</td>
<td>• Buyers could deal with multiple sellers through pooling of credits</td>
<td>• Intermediaries develop a range of 'credit products' (bundling certain features of credits such as compliant non-compliant, options, etc)</td>
<td>• Buyers and sellers do not have any knowledge of the other party</td>
</tr>
<tr>
<td>• Monitor and enforce contracts</td>
<td>• Buyers and sellers locked into longer-term agreements reduces flexibility but likely to increase technology and cost sharing</td>
<td>• Innovative product bundling but fewer incentives for new credit methodology development</td>
<td>• Market cleared daily</td>
</tr>
<tr>
<td>• High level of flexibility to develop new types of methodologies</td>
<td></td>
<td></td>
<td>• Futures and options used to manage risk</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Low levels of flexibility</td>
</tr>
</tbody>
</table>

### Transactions costs

<table>
<thead>
<tr>
<th></th>
<th><strong>High</strong></th>
<th><strong>High but less frequent</strong></th>
<th><strong>Medium</strong></th>
<th><strong>Low</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Buyers and sellers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Governments role</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low after initial standards are set</td>
<td></td>
<td></td>
<td></td>
<td>Initial standards will need to be set</td>
</tr>
<tr>
<td>Could provide ongoing R&amp;D support</td>
<td></td>
<td></td>
<td>Likely to regulate product development, but through existing agencies such as ASIC, ACCC, etc.</td>
<td></td>
</tr>
</tbody>
</table>

An example of what a highly standardised and centralised carbon market may look like is presented in Figure 5. While a number of forms of transactions will evolve and it is unlikely that the carbon market will at any stage be entirely reliant on one form or another, it is likely that a centralised market will evolve only after significant credits are already trading in an offset market.
I.2 What are the components of a GHG credit market?

This section looks in detail at the various components of a carbon credit market. It draws on the experience of the offsets market within the CCX (discussed in more detail in Appendix Chicago Climate Exchange of this report). In particular, this section looks at two projects of the CCX, continuous conservation tillage and conversion of crop land to grass lands, as they are the two most relevant CCX projects for this discussion paper.

I.2.1 What will be traded

The basic asset is likely to be a tonne of carbon dioxide or an equivalent gas that is prevented from entering or is extracted from the atmosphere.

However, depending on the objectives for the establishment of the carbon market, a number of permutations of this basic asset are possible. It is also likely that a number these permutations will be traded in the market simultaneously, in much the same way as other commodities are traded with delineation based on quality characteristics:
The potential for different values of commodities with heterogeneous characteristics is an important consideration in many markets. Commonly, grading standards have evolved to differentiate among heterogeneous products as discussed in Tomek and Robinson (2003)... Grading standards are generally defined based on key components that differentiate consumers’ preferences. In turn, the market reflects the different prices that consumers are willing to pay for commodity units of different qualities. In the context of a carbon market, the purchaser’s willingness to pay may be determined, in part, by rules established by the market’s governing entity to ensure that impermanence risks are properly remedied (Kim, McCarl, & Murray, 2007).

While the quote from Kim, McCarl and Murray (2007) raises the concept of differential carbon credit prices based on an evaluation of the permanence of the credit, there are a number of other factors buyers will take into account when assessing their willingness to pay for credits produced by agriculture and agricultural land managers.

It is likely that the market will differentiate credits based on the standards established by the government, as this will determine if the credit is, or is likely to become compliant, with national abatement policies such as an ETS. Compliance has three important effects that will drive up the value of the credit compared to non-compliant credits. Compliance means that the carbon credit:

- Can or could be used to offset emissions covered by national emission management policies which means that:
  - The demand from organizations covered by national policies is likely to be less elastic than a purely voluntary market (although this is not without some political risk)
  - The government itself could purchase the credits, in a similar fashion to water buybacks
- Greater international sovereign and private demand is likely.

In the 2009 proposed ETS amendments the Government proposes to promote the voluntary offsets market through implementation of the National Carbon Offsets Standard (NCOS). The NCOS stipulates that for a credit to meet the standard it must be:

- Additional
- Permanent
- Measurable
- Transparent
- Independently audited
- Registered.
In addition to these criteria, the Government has also indicated that avoidance of leakage will be used to assess credits (Australian Government, 2009). Of these factors additionality, permanence and leakage are considered in more detail in this report. Measurable, transparent and registered tend to be mechanistic and part of the operations of any standard market, although they do have implications for transaction costs, which is discussed in more detail in section I.2.6.

The CCX offset standards are based on principles not dissimilar to those in the NCOS. The CCX rules stipulate that an offset must demonstrate that it is:

- Rare (e.g. best-in-class actions)
- Voluntary (e.g. not legally required)
- Recent
- Verifiable
- Properly addresses permanence
- Avoids the creation of perverse incentives that would result in increases in GHG emissions on or off the project site
- Conservative.

Additionality of credits is discussed in detail throughout this report. If additionality is to be dealt with in an offset market each methodology accepted by the market authorities will have to demonstrate that the credit would not be generated in the absence of the transaction.

The CCX appears to address additionality through a combination of rare (best practice activities) and voluntary actions (where activity is not otherwise required under US laws dealing with carbon emissions or any other farming practice).

Rare or best practice activities suggest that the activity is not likely to have been undertaken without the added incentive of a carbon credit that can be sold.

The CCX protocols are based on a generic assessment of common and best practices within an industry, to determine if the proposed project is rare and therefore likely to be additional:

Professional soil scientists from both the USDA and academia estimate that between 5% and 10% of U.S. farmland is currently managed under continuous conservation tillage. While the occasional use of conservation tillage is more widespread, continuous conservation tillage remains rare. Only continuous conservation tillage (i.e. year after year on the same planted acres) is eligible to earn offsets under CCX rules.

Given the common practice as defined above, voluntary continuous conservation tillage in the United States is clearly not common practice. Therefore, a project that
meets the regulatory criteria above [not compelled to undertake this practice by any other law or formal obligation] can be considered beyond business as usual (Chicago Climate Exchange, 2009, p. 14).

Similarly the CCX considers conversion of crop land to grass is not common practice in America. The CCX protocols do not appear to require that a farmer must also demonstrate continuous conservation tillage is not a common practice on the farm where the offsets are anticipated to be generated.

In an attempt to reduce perverse incentives (reduce gaming of the system) the CCX protocols do not require a start date for the continuous conservation tillage project. Also grass land conversion projects can be eligible if it can be demonstrated that they were sown after January 1, 2003.

Therefore it appears that any currently voluntary practiced continuous conservation tillage practices could be registered as an offset project. Similarly, any voluntary conversion of crop land to grass land could also be put forward as a credit.

Therefore the CCX appears to address the question of additionality, and reducing gaming, by using industry wide measures of common and best practice as the base line. This type of assessment is also likely to reduce transaction costs as industry wide assessments are applied to project specific cases.

The approach chosen by the CCX appears to have been adopted to reduce transaction costs.

This approach may preclude minimum tillage projects in Australia, as the practice is wide spread. The downside of this approach is that it would preclude those farmers from claiming credits for minimum tillage, where they do not currently practice minimum tillage, but where the practice is common practice across the industry. However, there are likely to be a range of other potential projects in Australian agriculture that may satisfy these criteria, for example nitrogen fertilizer coating, biochar incorporation into soils, and methane inhibitors added to animal rations.

**Permanence**

Permanence is discussed in detail in section 0 of this report. The definition of permanence used in the NCOS would, if interpreted literally exclude virtually all forms of sequestration as they all have some risk of impermanence through:

- Volatilisation over time
- Large release events from outside the project such as bushfires or even floods
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- Discontinuation of the practices that maintain the sequestration of the carbon (e.g. conversion of pastures to crops, reversion to conventional tillage, etc.)

However, removing carbon from the atmosphere does have some value even if it is partially or fully released over time. As this section demonstrates, permanence can be dealt with in a number of ways which means that if an infinite value is placed on permanence a number of valuable projects would be overlooked in an offset market.

As discussed in section 3.3 a delay in carbon entering the atmosphere does have a value by:

- Reducing the rate of global warming
- Creating time for other more effective and efficient technologies to emerge.

Impermanence can take a number of forms that can be managed in different ways. Impermanence can be due to:

- a non-zero probability of release at some point due to an unforeseen event such as a bushfire, drought or flood;
- anticipated and expected release of carbon from a project (such as volatolisation of biochar over an extended period); or
- a cessation or reversal of the activity that sequesters the carbon

Market-based measures to deal with impermanence could include:

- insurance;
- buffering;
- discounting of the credit; and
- dealing only with credits that satisfy an established level of risk of impermanence.

To deal with one form of impermanence, the issue of non-continuance of the project and a subsequent release of GHG gases, the CCX has established a permanence reserve. The permanence reserve is accumulated through discounted crediting (Chicago Climate Exchange, 2009, p. 18). That is, each credit approved issues to the owner only up to 80 to 90 per cent of the expected amount of GHG sequestered. The rest of the credits are held permanently in a reserve. The reserve effectively extinguishes the credit.

The size of the credit reserve has been established to approximate the amount of carbon that would be release by farmers reverting to conventional tillage once the offset credit contract expires. Holding only 10 to 20 per cent of the credits in reserve suggests that most farmers who begin continuous conservation tillage will continue to do so indefinitely.

The relatively small size of the reserve suggests that farmers have strong incentives to maintain conservation tillage once it has commenced. This may...
conflict with the additionality test, unless there are factors such as high switching costs associated with conservation tillage that prevent wider adoption or reversion once the credit contract has expired.

This is the same as only issuing a forest owner 80 to 90 per cent of the value of the carbon stored in the plantation to offset the risk that this much of the forest will destroyed by bushfire.

The CCX permanence reserve does not account for other types of impermanence such as volatilisation over time, which could be dealt with in the initial credit calculation.

The CCX approach is essentially a form of buffering or discounting of the credits to reflect the impermanence expected of the project. Other forms of impermanence can be dealt with in a similar way.

**Leakage**

As discussed in section 3.8, credits that negatively impact on production are prone to inducing production increases on other farms. The example given is a credit generated by a reduction in cattle on one farm, which in turn induces an increase in the number of cattle (fully or only partially equivalent to the reduction) on another farm not participating in generating the credit.

There are several ways of dealing with this type of leakage. These can be summarised as:

- Accrediting only those projects with demonstrably little negative impact on production
- Allowing the project to be accredited but adjusting the credit based on the risk of leakage using enterprise and industry based equilibrium models (making the credit worth a portion of a non-leakage prone credit the proportion being commensurate with the risk)
- Allowing the market to ignore leakage and dealing with it through supplementary policies.

Leakage is dealt with by the CCX by accepting only those projects not considered to be prone to inducing additional emissions ‘outside the project boundary’:

Affected GHG Sources and Sinks are those that are influenced by the continuous conservation tillage and grassland conversion projects and result in new or changed activities outside the Project Boundary that actually increase GHG emissions. This concept is commonly referred to as leakage. The CCX does not expect continuous conservation tillage or grassland conversion projects to result in new or changed activities that increase the GHG emission outside of the Project Boundary and, therefore, no project specific leakage assessment is required (Chicago Climate Exchange, 2009, p. 16).
Further it appears that credit providers are contractually obliged to ensure that
the credit they produce does not leak. The CCX contract specifies, amongst
other things, that:

The project owner will adhere to:

A declaration indicating that the Project has not resulted in an increase in emissions
relative to the without project scenario (Chicago Climate Exchange, 2009, p. 10)

It appears that the CCX does not consider that the introduction of continuous
conservation tillage or conversion of crop land to grassland would induce
additional cropping to be undertaken that would emit significant additional
GHG gases. The CCX position appears to be predicated on a belief that
continuously conservatively tilled crop land does not significantly reduce crop
production. Australian conservation tillage research tends to support the CCX
position, and there is some evidence that conservation tillage increases
productivity over time as increased soil carbon improves water holding
capacity and soil structure.

However, conversion of cropping land to grass land may induce additional
crop production off site, similar to the displacement of cattle referred to
earlier. If grass land is converted to crops there may be no net gain in GHG
emissions.

Classifying projects based on a generic assessment of their propensity to
leakage will reduce the risk of leakage but would be highly conditional on a
number of factors, assumptions about which may not hold over time. Generic
leakage assessments could be significantly improved if supported with
equilibrium modelling incorporating within and across agriculture sector level
assessment of supply and demand elasticities and the potential for leakage by
production changes incorporating reduced emissions.

Carbon leakage modelling could be publicly funded as it would also improve
consistency between assessment methods, signal to applicants specific areas of
interest of the market and policy, and assist in public policy formulation. The
availability of these models would also assist in testing additionality and
contribute to an assessment of permanence. Testing permanence with these
models would include an assessment of the likelihood of the discontinuation of
the abatement practice following the expiry of the contract. For example, once
a conservation tillage project ends what proportion of the conservatively tilled
land will be converted to conventional tillage.

Reversion to previous practices at the expiration of a contract or the adoption
of low GHG farming practices will be impacted on by a range of external
policies, the effects of which will have to be monitored. For instance, how
would changes to the diesel fuel rebate affect the expansion of conservation
farming?
I.2.2 Options over future recognition of abatement

A feature that would be relatively simple to include but would produce a powerful set of incentives, would be an option, attached to a credit, to recognise in the future additional abatements generated by the project.

The assessment process could issue a lower bound credit (based on a standard level of confidence, using well defined assessment methods) with an option allowing any additional credits to be realised from the date they were generated (not the date they were recognised).

This would be relatively simple to attach to a credit, could be traded separately and would be valued on:

• The underlying carbon credit price
• The probability of additional credits being identified
• The probability that the additional credit would be accepted by the market authority.

It would create strong incentives for those that felt they were generating more credits than were being recognized, to invest in R&D to demonstrate within the trading standards that they had generated additional abatements. Once verified the options would be converted into normal credits adjusted using standard market definitions of leakage, additionality and permanence.

This incentive for demonstrating and getting accreditation for additional credits would fall to those holding the options. It is conceivable that specialist research companies may spring up, or existing research organisations redirect some of their activities, to exist on buying these options and undertaking R&D to prove that the additional abatements occurred.

I.2.3 Dealing with opportunities outside the protocols

An appeals mechanism would be an important addition to an offset market and is a feature of the CCX offset approval process. Appeals mechanisms are based on the squeaky wheel concept, where those who believe the protocols are too narrow and have excluded an opportunity they have developed, can get a hearing.

An appeals mechanism is likely to be best serviced by an independent expert panel not generally associated with the development of market protocols. The provision of tools such as models, consultancy services and experts, both privately and publicly funded would be a useful addition to an appeals process to ensure those appealing are consistent with the expert assessment process.

The CCX has three classes of application:

• Within the protocols
• Within the protocols with some modifications to the protocols
• Non-compliant with the protocols.
The appeal of this type of assessment process is that it creates the incentives for a wide range of projects to be presented for assessment, provided the costs of doing so are not prohibitive.

An appeals process will also work better if the basis of the assessment is well known and the appeals process itself is transparent and independent. Recognition of the appeals process has been made in the Governments ETS amendments, where an expert panel is proposed to advise the Minister on offset methodologies.

I.2.4 Buyers

There are likely to be four broad sources of demand for the credits that could be generated by Australian agriculture and land managers. They are:

1. Those seeking to offset emissions under the CPRS or similar scheme
2. Those acting altruistically and wanting to retire the credits
3. Companies wishing to achieve a competitive marketing advantage over rivals by claiming a reduced carbon footprint of their products and/or services
4. Government directly participating in the market by buying and retiring credits for much the same reasons that water buy backs are undertaken.

All of these sources are related and are likely to converge, as international, domestic and voluntary trading rules adopt increasingly common accounting principles and rules.

One source of demand for agricultural GHG emission credits could be from those seeking to offset emissions covered by the Australian Governments emissions management policy, where the use of offsets is permitted. At this stage the Governments policy is to introduce an ETS, but offsets could conceivably be used to offset an emissions tax if this instrument is used and offsets allowed.

Thus one source of demand for offsets would be created by the capability of enterprises, covered by a trading or tax system to meet their emissions obligation by purchasing reductions from other sectors of the economy not covered. This is likely to create three key GHG credit demand side price drivers:

- The cap on emissions of those sectors covered by the policy
- The marginal costs of mitigation with the covered enterprises
- The transaction costs associated with acquiring offsets outside the covered sector.

The amendments proposed by the Government in November 2009, establish what appear to be two levels of emission offsets:
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- Those that are compliant with international trading rules and therefore the proposed CPRS
- Those that are non-compliant with international trading rules but recognised as robust verifiable offsets which could become compliant if international trading rules are modified in line with Australia’s international climate change position. (This appears to be consistent with a two-part accounting system, where both compliant and non-compliant emissions reduction are reported).

The retirement of credits by the Government, or by other interested parties, would allow the offsets market to contribute to net reductions in national emissions. An example of a benevolent fund buying entitlements in a cap and trade market is the Acid Rain Retirement Fund, which purchased sulphur dioxide emissions entitlements in North America (see Box 12).

**Box 12** **Acid Rain retirement fund**

The Acid Rain Retirement Fund was founded to prevent air pollution by buying it right out of the sky. The U.S. Environmental Protection Agency issues pollution allowances or permits that enable companies to emit sulfur dioxide (SO2). These permits are auctioned off to the public and a permit for one ton of sulphur dioxide was recently sold for about $130 (note: $126 in 2000, the prices have risen since then). The Acid Rain Retirement Fund raises funds and bids alongside polluters for as many pollution allowances as our funds can buy. We then retire that pollution credit permanently.

As we buy pollution allowances we remove that amount of sulfur dioxide from our ecosystem forever. As we retire more pollution allowances, the price will go up. Polluting companies will need to bid larger amounts of money to continue polluting. As the price of polluting goes up, companies will be more inclined to invest money in technologies that remove pollution before it reaches the smokestack.

Source: http://www.usm.maine.edu/~pos/arrf.htm

**I.2.5 Sellers**

The critical question relating the providers of credit is who should be able to generate and sell them? The proposed structure of the market in this paper is to direct the assessment process at the credit methodology and its application, not those that generate the credit. Provided the abatement project meets the standards and is independently verified and monitored then it is not relevant who produces it.

However, as transaction costs of verification and monitoring are high then it is likely to be efficient, and commercially sensible, to ensure that each project
produces sufficient credits to make producing them, net of transaction costs, worthwhile. Therefore it is likely that a threshold level of credits would be established. If a single project is able to produce enough credits to meet the threshold then there should be no restriction on the originator of the credit being able to trade them.

For those that are not able to meet the threshold, aggregation with other credit providers should be encouraged. The CCX uses aggregators to put together parcels of credits of sufficient size to allow them to be traded on the CCX. A similar aggregation role could be part of the Australian market.

However, the trading threshold should not be static and should reflect the evolution of credit trading and associated transaction costs.

1.2.6 Transaction costs

Transaction costs and the costs of operating the market should be commensurate with the anticipated volumes and values of the trading to occur in a market. If the market is based on demand from voluntary participants only, the value and volume is likely to be lower than if the market were offering credits to those wishing to meet their obligations in an ETS or similar market (or other policy instrument).

If the value and volumes are likely to be low then the market should be constructed to have low trading and transaction costs (where trading costs are those costs incurred by the market operator and transactions costs are those incurred by all participants).

If the value and volume are likely to be low but are anticipated to grow over time as national policies are introduced that increase future demand, there may be some justification for partial public compensation for private operators to establish the market. This argument is strengthened if one of the objectives of the market is to increase agricultural carbon management capability.

However, there are strong incentives for market participants and existing market operators in other sectors, to establish a market to make profit from operating it. There are also strong incentives for participants to develop voluntary standardised trading terms and conditions, monitor market activities and provide arbitration services, to reduce transaction costs.

The Australian grain industry is a good example of how participants in a market have incentives to collectively agree on a series of voluntary arrangements that are introduced to reduce transactions costs (see Box 13).
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Box 13  **Grain Trade Australia**

The grains industry in Australia has developed: (i) a series of grain quality standards, (ii) standard contract terms and conditions, and (iii) dispute resolution processes, for virtually all grain grown and marketed in Australia. The mechanism under which this has been achieved is with Grain Trade Australia (GTA and formally the National Commodity Marketing Association (NACMA)). It was formed to allow the Australian grains industry to formulate and agree on a wide range of tools to facilitate trade, discuss industry issues, and reduce the cost of marketing grain in Australia.

NACMA has over 300 grains industry members, including AWB, ABB, CBH, GrainCorp, and numerous smaller grain exporters, GGA and the GCA. NACMA is the Australian industry’s self-regulatory body, representing and servicing the commercial interests of the Australian grains industry. It is an independent, and non-commercial, body that operates to ensure the smooth facilitation of trade and commerce within the grains sector.

NACMA’s core functions at present are:

- standardising grain quality specifications, contracts and trade rules, enabling smooth facilitation of trade (discussed in more detail at 5.1.3)
- the provision of a cost-effective mediation and dispute resolution service for the entire industry, not just NACMA members
- trade information services that include the latest trading tools, education programs, etc.

It is possible the GTA would be able to provide valuable services to the development of this offset market, based on this organisations experience in grain marketing in Australia.

Source: (Barber & Wearing, 2006)

Transaction costs can be affected by a number of things. One is the size of the parcel of credits being traded, which is discussed in section I.2.5. The other is the term of the contract. The shorter the term the more times it has to be negotiated. The CCX uses a 5-year contract. That is, the activity that generates the credits needs to be conducted for 5 years for it to become an approved activity.

It is not clear that requiring a minimum term is sensible – relative to an approach that simply passes through to market participants any higher costs of shorter terms. We would be inclined not to prescribe a minimum, but recognise that this could sacrifice some simplicity – that might have value at least early on.

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19 Providing commercial rules and standards for the Australian Grains Industry, NACMA 2006. More information on NACMA can be found at www.nacma.com.au
It is also not clear what the optimum length of contract is for the types of credits that could be traded in an Australian offsets market. For example in our drier climate, the accumulation of carbon in the soil from conservation tillage may take much longer than five years. For projects considered permanent, timing is largely irrelevant, as the emissions reduction is locked in for all time. A credit generated by feeding cows a supplement that reduces methane emissions produces permanent emission reductions. In these cases transactions costs will determine the optimum term of the contract.

What might a standard contract look like?

A standard contract between buyers and sellers would need to be drawn up either on a case-by-case basis or a standard contract could be developed that could be used as is with modifications.

A standard credit contract is likely to contain the following information.

• Name of the seller
• The quantity of the emissions abated
• Where the emissions are abated
• The method used to abate the emissions
• How long the emissions have been reduced and the form of the emissions reduction or sequestration ($CO_2$, $CH_4$, $N_2O$)
• The classification of the abatement as approved by the registering authority and the registration number(s) of the credits, if needed
• The term of the contract
• The price of the credit agreed to
• The responsibility of the supply to maintain the credit and refund or replacement clauses, if the seller does not meet the terms of the contract
  – The process by which the replacement value would be calculated if the supplier fell short of providing the contracted activity during the term of the contract
• Methods by which any disputes would be settled
• The name of the buyer
• How the credits will be verified over the life of the contract specifying the name and qualification of the verifying agent
• Provisions for access by the supplier to conduct audits of the activity generating the credits.
I.3 The development of a derivatives market

A derivatives market will emerge if there is a reasonable level of standardization of the primary market and sufficient volumes are traded.

The main benefits of a derivatives market are:

• Transparent price discovery
• Valuing inventory
• Pricing and transfer of risk.

Virtually all major grain markets in the world that are open to competition have developed secondary markets, where risk can be traded by growers, members of the supply chain and end users. The development of secondary markets, such as the Chicago Board of Trade, the Kansas City Board of Trade or Winnipeg Commodity Exchange, significantly improve the ability of all grain market participants to discover the price of a commodity and transfer price risk to those willing to accept it.

The operation of derivative grain markets in Australia and their use by Australian farmers means that many farmers are familiar with the trading terms and how to use these markets to improve their business performance. These skills would be readily transferred to a carbon derivatives market.

I.4 Who would establish and run this market?

Initially there would need to be a central authority that would:

• Develop the protocols used to assess and approve credit generating projects
• Register and maintain a process of tracking credits
• Hear appeals from those wishing to generate credits using projects based on modified or new protocols
• Publish market statistics and liaise with the Government and other regulatory authorities.

In addition to this authority, a number of independent accredited verifiers and auditors would need to be appointed. These appointees are likely to come from the private sector but would need to be recognized by the Authority.

An industry body similar to, and possibly under the auspices of GTA would likely form to develop standard terms of contracts in parallel with the Authority.

Intermediaries would also be established to facilitate transactions between buyers and sellers.

Over time a central market is likely to form; most likely developed as part of the ASX or one of the regional markets.
1.5 Application of completion, trade practices and corporations law to a carbon market

All participants would be subject to general financial and market based laws, such as the Trade Practices Act and regulatory authorities such as APRA, ASIC and the ACCC.

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<th>Box 14</th>
<th>Trade Practices Law already active in the carbon market</th>
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| The Australian Competition and Consumer Commission has commenced legal proceedings in the Federal Court against Prime Carbon Pty Ltd. Prime Carbon sells a ‘soil carbon and sequestration program’ to farmers which aims to sequester carbon from the atmosphere and store it in agricultural land. In signing farmers up to this program, Prime Carbon provides the following services:
| 1. | design and facilitate carbon sequestration and other greenhouse gas abatement and offsetting projects for customers, |
| 2. | assist in the creation and management of specific amounts of carbon dioxide sequestered or abated from the environment (carbon credits), and |
| 3. | assist in the registration and marketing of those carbon credits. |
| The ACCC is alleging that Prime Carbon made false or misleading representations about the National Environment Registry (NER) and the National Stock Exchange of Australia Limited (NSX). Specifically, the ACCC alleges that Prime Carbon made representations to the effect that:
| • the NER registry is the sole registry that meets the standards required of carbon credit registries by the Australian Government and the carbon credits listed on the registry, were specifically supervised or regulated by the Australian Government, |
| • the NER registry was the place where domestic and international buyers go to source carbon credits, |
| • the NER had a relationship with the Chicago Environment Registry which would assist NER-listed Australian carbon credits being traded on the international market, |
| • it was a broker and aggregator with the NSX, and |
| • enquiries about the purchase of carbon credits aggregated by Prime Carbon have been, or are likely to be, generated by or through the NSX, when this was not the case. |
| Source: ACCC: http://www.accc.gov.au/content/index.phtml/itemId/908275 |

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