CARBON IN FOREST PRODUCTS: THE OPPORTUNITY

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1) SUMMARY

Wood products can significantly extend the greenhouse gas mitigation benefits provided by forests. The greenhouse impact of wood products is measured to a large extent by the energy required in their extraction, manufacture and use and by their disposal strategies. There are significant opportunities to be realised under the proposed Australian National Emissions Trading Scheme to obtain credits for the long-term storage of carbon in forest products. The use of wood biomass to generate energy also represents an opportunity. Further greenhouse benefits can be obtained through the use of forest products instead of more energy and greenhouse-intensive materials. This opportunity can best be realised if life-cycle assessment is adopted in the design of current green building rating schemes.

2) INTRODUCTION

Forestry is the only industry sector that may constitute a net sink of carbon. Carbon is stored in trees and in the variety of forest products consumed in our society. If commercial forests are managed sustainably, the proportion of the carbon in the harvested trees that is emitted as carbon dioxide as a result of burning or natural decay of residues is absorbed by other growing trees, making the process effectively greenhouse-neutral. In addition, a significant proportion of the carbon leaves the forest and is stored in harvested logs, extending the greenhouse gas mitigation benefits provided by forests.

However, the greenhouse impact of the industry goes beyond the physical storage of carbon. It is expressed also through use of residues bioenergy obtained as a result of various forest products manufacturing processes, and through materials substitution in the built environment.

There are opportunities to realise the greenhouse mitigation potential associated with the forest products industry. The most obvious avenue is through participation in the proposed Australian Emission Trading Scheme (AETS). However, perhaps of similar importance is to ensure that comprehensive environmental impact assessment tools are utilised in the growing number of building rating schemes being adopted in Australia.

Below we outline some key issues associated with the current treatment of carbon in forest products in emissions reporting at international and national levels. We also include a brief discussion on the main parameters underlying accounting for the carbon in forest products (especially in the disposal stage), in the context of emissions trading. The paper also discusses opportunities associated with the use of wood biomass for energy, and in working with building rating scheme proponents to ensure that a comprehensive greenhouse footprint assessment of materials is an integral part of the selection of materials.

3) DISCUSSION

3.1. Carbon in forest products: national greenhouse inventories

Under the United Nations Framework Convention on Climate Change (UNFCCC), parties report the carbon sequestered by forests in their national greenhouse gas inventories. At harvest, the forest components that are not removed from the site – logging slash, stumps, litter and roots - are assumed to decay over time and are included in the estimates of net emissions or removals in the forestry sector (IPCC 2006a). Countries are able to also include carbon in forest products in their national inventories if they have the required data. Several approaches for estimating carbon in wood products are described by the Intergovernmental Panel on Climate Change - IPCC (IPCC 2008). The IPCC default method assumes that the stock of carbon in wood products is static and on this basis harvested biomass is assumed to oxidise in the year of harvest. In Australia, the Department of Climate Change (DCC, formerly Australia Greenhouse Office) includes carbon stored in forest products in the National Carbon Accounting System (NCAS, for more details about the forest products model in NCAS see Richards et al. 2007). Simulations carried out as part of the development of the forest products model under NCAS suggest that use of the IPCC default approach over-estimates emissions to the atmosphere compared to approaches that consider the fate of carbon in forest products in service and in landfills (Richards et al 2007).

Under the Kyoto Protocol to the UNFCCC, carbon sequestered by newly established forests (planted since 1990 on previously cleared land) can be used to offset emissions from other sectors, to enable countries to meet their emissions reduction targets. However, carbon in harvested forest products is excluded from accounting of greenhouse gases during the first commitment period of the Kyoto Protocol (IPCC 2006a). Although the IPCC has coordinated discussions on potential accounting approaches and methods for estimating carbon in forest products, no agreement has been reached so far. This has delayed the inclusion of forest products as legitimate carbon offsets under the Kyoto Protocol. The issues revolve around the accounting framework and tracking of the carbon. There are two mutually exclusive approaches that could be taken to accounting for carbon in forest products, namely to account for the fluxes of carbon, that is the direct emissions and removals of carbon, or, alternatively, to account for stock changes, as an indirect measure of emissions and removals. The debate over these alternative options has been hampered by different understanding of the terms used in the discussions, and by issues of compatibility with accounting across the forest sector, and equity in the allocation of credits, especially where forest products are traded across national borders.

3.2. Life-cycle of carbon in forest products

Each year approximately 25 million m^3 of logs are harvested from Australian forests, the equivalent of 8 million tonnes of carbon or 30 million tonnes of carbon dioxide equivalents. The proportion of the carbon in the logs that ends up in finished products and residues depends on various factors such as species, site conditions, harvesting technique, log grading and efficiency of conversion in wood processing plants (Ximenes 2006). It is important to understand the flows of carbon from harvested logs into different residues (bark, sawdust, offcuts, shavings) and product streams. Different product groups have different service lives, with domestic house framing typically having long service lives (50 years on average - Ximenes and Gardner unpublished data) and paper products having typically the shortest service lives (1-5 years).

The main application for sawn and panel forest products in Australia is the residential market. Approximately 75% of the sawn timber is used for residential purposes (BIS-Shrapnel 2000), with about 80% of the sawn pine used for framing applications in houses and approximately 50% of the sawn hardwood used as sub-flooring and fencing (Ximenes and Gardner 2005). As the average age of houses in Australia is approximately 50 years, a significant proportion of sawn products remains in service for around 50 years.

Disposal is a critical stage in the life-cycle of forest products, in terms of their ultimate greenhouse impact. The vast majority of forest products consumed in Australia are disposed of in landfills at the end of their service lives. Although some forest products may be recycled at least once, eventually a high proportion of them will also end up in landfills. It is assumed that wood and paper products account for around 50% of the volume of organic materials placed in landfills in Australia (AGO 2004).

As organic materials decay over time in landfills, carbon dioxide and methane are released. The decomposition factors used are critical to the calculation of landfill emissions , as methane is a greenhouse gas 25 times as powerful as carbon dioxide. In the IPCC Guidelines it is currently assumed that 50% of the carbon in wood products in landfill is released as a result of decomposition (IPCC 2006b). This factor is currently adopted by the DCC in Australia (DCC 2008). However, recent Australian research (Ximenes et al 2008) has demonstrated that sawn forest products in landfill represent a long term carbon store – at least 82% of the carbon originally in the sawn wood was still present after up to 46 years of burial, regardless of the species (Ximenes et al 2008). This result has important implications for Australia's national greenhouse gas inventory, for consideration on inclusion of forest products in the proposed AETS and also in the overall assessment of the greenhouse footprint of forest products. The IPCC recommends the use of country-specific decay factors rather than the suggested default values, provided they are based on well-documented research (IPCC 2006b).

Therefore, there is a strong argument for the DCC to adopt the Australian-specific decay factors for sawn wood products in landfills.

Not all the methane generated in landfills is released into the atmosphere – some is oxidised by soil microbes and some is flared or recovered to produce electricity. According to the National Landfill Survey about 14 million tonnes of putrescible waste were disposed of in landfills in 2005/6, including 7.5 million tonnes to landfills with gas collection and electricity generation (Inside Waste 2007). The greenhouse impact of forest products in landfill will depend on how much carbon is released as methane, and also on whether any methane generated is simply released into the atmosphere, flared or utilised to generate electricity.

Further research is required to determine the decay factors for the significant volumes of paper products that end up in landfills in Australia each year.

3.3. Carbon in forest products - Australian Emissions Trading Scheme (AETS)

The Australian government has announced that it will introduce a national emissions trading scheme (AETS) to commence by 2010, as part of a range of policy measures to address climate change. The details are yet to be confirmed, but it is likely that the national scheme will include the forest industry, either as an offset provider or as a covered sector[1]. Carbon stored in eligible plantations is accepted as an 'offset' in existing emissions trading schemes in Australia (the NSW Greenhouse Gas Reduction Scheme and Greenhouse Friendly). The methodology for carbon accounting in forests is well developed and an Australian Standard now exists for

[1] A covered sector must monitor and report their greenhouse gas emissions. In the case of forestry, these would exclude energy-related emissions, as those would be reported by the "Energy" sector. It is possible for a sector to be included initially as an offset provider and later become covered.

plantation sequestration projects (Australian Standard AS 4978.1 Quantification, monitoring and reporting of greenhouse gases in forest projects - Afforestation and Reforestation).

3.3.1. Carbon storage in products in service and in landfills

As mentioned earlier, a significant proportion of the carbon sequestered in commercial forests is retained in long-term storage in forest products, even after disposal in landfills. The development of the AETS provides an ideal opportunity to discuss practical methods and mechanisms to allow the crediting of carbon stored in forest products.

None of the existing national and international carbon trading schemes accepts long-term storage of carbon in forest products as an eligible offset. In the US, the voluntary Californian Climate Action Registry (http://www.climateregistry.org/PROTOCOLS/FP/) allows the inclusion of forest products as "Optional Pools", but does not certify them. There has been some discussion on possible methodologies to account for carbon in forest products (IPCC 2006a); however this discussion focuses on application at a national greenhouse inventory level rather than project level.

Australia has an opportunity to lead the world in the development of practical mechanisms for inclusion of wood products in emission trading schemes.

If forest products were included in carbon trading, there could be an immediate increase in revenues from carbon sequestration, providing further incentive to establish forests. It would also likely provide greater incentive for farmers to develop agro-forestry systems and for farmers and Catchment Management Authorities to improve the management of native vegetation on rural landscapes.

A new project funded by Forests and Wood Products Australia (FWPA) will suggest possible methods and mechanisms required for the inclusion of forest products in the proposed AETS. The methods may include factors based on national industry averages of volume of forest products manufactured and fate of the products after disposal. These are critical factors to determine the level of long-term storage in forest products.

One of the issues often raised as potentially problematic for the inclusion of wood products in ETS is the tracking of the carbon in the variety of forest products consumed in Australia. However, one does not need to precisely follow the life cycle of every individual sawn board, sheet of particleboard or piece of paper consumed. Calculations can rely instead on predictions of fate, based on knowledge of the industry. Forest growers must have good knowledge of the types of logs (pulp or sawlogs) that the forest will yield at the time of forest establishment, as that decision will govern the commitment to invest, and silvicultural treatments applied. When the commercial logs reach the sawmills or other processing plants, the fate of the products manufactured is either already known by the industry or easily derived. In the event that the final application of the product at the market place is not known, then conservative national industry averages can be applied.

Regardless of the level of inclusion of forest products in the future AETS, a key factor governing the extent of physical long-term storage[2] is the fate of the products after disposal. Clearly the period in which carbon remains stored in forest products in

[2] The most common definition of long-term storage as applied to carbon sequestered in forests implies sequestration of carbon for a period of at least 100 years

service is insufficient to claim long-term storage as defined here. As landfill has been the main disposal path for the majority of forest products (and is likely to remain so for the foreseeable future), the long-term storage of carbon in forest products in Australia is strongly linked to the extent of their decomposition in landfills. As mentioned above, a significant proportion of sawn wood ends up in products with service life of 50 years, and research shows that after disposal to landfill, at least 80% of carbon remains after 46 years. Thus, there is strong evidence that a high proportion of carbon is stored for at least 100 years. On this basis, sawn forest products can be claimed to be a long-term carbon storage option.

Thus, currently there is strong evidence to suggest that a high proportion of the carbon in the sawn forest products consumed in Australia remain stored in the product for a period of at least 100 years.

In devising a mechanism for inclusion of wood products in emissions trading it will be necessary to determine how credit for removals and liability for emissions will be allocated. Even if the slower rates of decay in landfill indicated by the research of Ximenes et al (2008) are adopted for estimating greenhouse gas emissions emissions in Australia, there will still be some greenhouse gas emissions as part of the decomposition process. It could be argued that the liability for emissions from landfill could be placed on either the forest industry or the landfill managers. The treatment of the respective industries in relation to whether they are included as "covered sectors" in the AETS will be a major determinant of the outcome. For example, if the waste industry becomes a covered sector, it will be faced with penalties for landfill methane emissions, and therefore will argue strongly to claim credit for storage in forest products in landfills[3].

The forest products industry will need to work closely with the landfill industry to ensure a fair outcome in the AETS, with recognition of the role that landfills play in storing the carbon in forest products, and the role that the forest products industry in manufacturing the various forest products.

Although the long-term storage in sawn forest products in service and in landfills is reasonably well-documented, the knowledge on the fate of the carbon in paper and composite products (particularly in landfills) is limited. Approximately half of the volume of round wood removed in Australia is used in the manufacture of pulp and paper. In addition, a significant proportion of the residues generated in the processing of sawlogs are used in the manufacture of paper (and composite products). Both paper and composite products represent the main utilisation options for young plantation material and thinnings. If some long-term storage of carbon can be demonstrated for those products (and assuming they are included in the AETS), then the returns from carbon trading will be increased.

Until more research is conducted on the fate of the carbon in paper and composite products from manufacture through to disposal, including analyses of their decomposition in landfills, the mitigation benefits of forest products may not be fully realised in carbon trading.

3.3.2 Energy from wood biomass : AETS and MRET

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[3] If a significant proportion of the landfill methane emissions are recovered to generate electricity or flared, then the emissions will be less of a problem.

In addition to the physical long-term storage of carbon in forest products, the treatment under the AETS of the use of wood biomass for energy generation may have important implications.

Currently about 50% of energy requirements in wood processing is supplied from bioenergy generated from residues remaining from processing. This high proportion of renewable energy usage in the processing of many forest products is unlikely to be directly acknowledged under the proposed AETS. However, it could be argued that the industry will benefit by the fact that the carbon dioxide emissions from renewable residues used to generate energy are considered greenhouse-neutral, and therefore, do not add to its greenhouse emission profile. This provides an advantage to the industry compared to competing materials which are typically reliant on the use of fossil fuels and may be faced with a requirement to progressively reduce their emissions or buy carbon credits. Under a hypothetical AETS design where all emitters pay the full costs of their emissions, the predicted increase in the price of material is less than 1% for sawn timber, as opposed to 10-18% for competing materials (George 2008). However, it is likely that measures will be implemented to shield some of the competing materials that are identified as trade-exposed from the full costs of their emissions. In this scenario, it is possible that the forest products industry may be disadvantaged in the market, resulting in a perverse environmental outcome where the use of alternative products with a high emissions footprint may increase due to their comparatively lower pricing. This is an important issue that needs to be addressed with the development of the AETS.

As mentioned earlier, carbon stored in eligible plantations is accepted as an ‘offset’ in existing emissions trading schemes in Australia. The use of wood biomass to generate energy in projects that are additional to business-as-usual scenarios results in clear and measurable greenhouse benefits where they displace the use of fossil fuel. These are real, permanent savings.

Consideration should be given in the design of the AETS to the inclusion of offsets from energy generation projects from wood biomass. That would provide greater incentives for the use of biomass to generate energy and also have a significant impact on the feasibility of energy projects involving wood biomass.

Currently there are opportunities to gain credits for the use of forest harvest residues, wood processing residues and urban wood waste in the generation of renewable energy under the Mandatory Renewable Energy Targets (MRET) scheme. The MRET scheme places a legal liability on wholesale purchasers of electricity to proportionately contribute towards the generation of renewable energy. The opportunities can be realised if it can be demonstrated that the energy generation projects displace the use of fossil fuels or provide other measurable greenhouse benefit. In the case of urban wood waste, the credit obtained would be the balance between the greenhouse outcomes of the project with that of a business as usual scenario (probably landfilling).

The utilisation options of residential forest products at the end of their service lives are severely restricted in Australia. Currently recycling of urban wood waste is heavily limited by the fact that a significant proportion of redundant wood products are treated with CCA (Copper Chrome Arsenate) and difficult to separate from untreated wood. Energy conversion processes such as fast pyrolysis may be able to handle both untreated and treated wood (Bridgwater 2001). The biomass is typically converted to bio-oil (70%), char (15%) and non-condensable gases (15%), (Morris et al 2000). Each product may have a variety of uses – the bio-oil may be used as fuel or chemical feedstock; the gas may be used as an energy input to the process and the char can be used as fuel, or in activated carbon activation applications.

3.4. Carbon in forest products – Building Rating Schemes

In addition to the physical storage of carbon in forest products (both in service and in landfills), and the use of processing residues to generate energy in lieu of fossil fuels, further greenhouse benefits can be obtained through the use of forest products instead of more energy and greenhouse-intensive materials (Ximenes 2006). Although unlikely to be realised in the context of the AETS, the greenhouse benefits associated with the increased use of sustainably harvested forest products can be significant and are generally well understood. Previous research conducted in Australia and New Zealand (e.g. Mclennan Magasanik Associates,1991; Buchanan and Levine 1999; Ximenes 2006), Europe (e.g. Gustavsson, et al 2006) and in the US (e.g. Perez-Garcia et al 2006) strongly suggests that the life-cycle greenhouse impact of forest products is typically significantly lower than that of competing, non-renewable products.

However, the focus of mandatory and voluntary building rating schemes in Australia has been primarily on building operational energy savings and thermal mass modelling. They do not take into account energy associated with the extraction, transport and manufacture of different products. This problem is not restricted to Australia. In the USA, the main green building programs were analysed on how environmentally preferable construction materials are defined and identified (Bowyer 2007). One of the common features of all the programs was the requirement on only one material (wood) to demonstrate responsible practice in the manufacture process, primarily through certification. This has resulted in a number of materials currently listed as “environmentally preferable” having greater environmental impacts than alternative materials. In addition, only one of the ten programs examined (Green Globes - www.greenglobes.com/) considered the energy requirements associated with the production of building materials. As a result, forest products are currently competitively disadvantaged, as their lower whole-of-life greenhouse impacts are not taken into consideration. Although it is widely accepted that the operational energy is a major component in the total energy budget of a house, the energy embodied in house construction can potentially represent up to 50% of the total when periodic maintenance and refurbishment are included (Treloar and Fay 1998). The adoption of life cycle assessment as a tool in the building rating schemes would more closely reflect the true environmental impacts of building materials. This would also ensure recognition of the greenhouse benefits of using wood products beyond the eligibility constraints likely to be imposed by the AETS.

In order to determine the greenhouse benefits associated with the use of forest products in buildings in Australia, current field-based data are needed on the energy required in their extraction, transport and use and associated greenhouse emissions. This information will provide a sound scientific basis for comparisons between building materials in the context of building energy rating schemes and for use in life cycle assessments (LCAs) of buildings (Ximenes 2006b).

The greenhouse benefits of the selection of materials with low emission profile represent measurable and immediate greenhouse benefits in addition to those obtained through a AETS.

4. Conclusion

To conclude, forests and forest products play a major role offsetting greenhouse emissions. It is essential now to obtain recognition for the long-term storage of carbon in forest products in the proposed Australian Emissions Trading Scheme, and to adopt a life cycle assessment approach in green building rating schemes. Adopting these practices will give recognition to the role of forest products in mitigating greenhouse emissions, and consequently further promote the use of forest products.

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