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Carbon Pollution Reduction Scheme

Submission by Australian Biochars Pty Ltd

At the Government seminar to introduce the Government's Green Paper on the Carbon Pollution Reduction Scheme (CPRS) held in Brisbane on the 18th July, 2008 Australian Biochars was invited to present a submission as to whether, in its opinion, it would be a viable option to include the use of biochar in some way in the CPRS.

For the reasons set out below, it is submitted that such a use would be both viable and effective because:

- **Biochar sequesters and stores greenhouse gasses for far longer than forests are able so to do;**
- **Biochar does not require tending, watering or fertilising, unlike forests;**
- **Biochar is not subject to the vagaries of disease, fire or weather, unlike forests;**
- **Biochar increases crop yields;**
- **Biochar use makes for easy accounting;**
- **Biochar use is open to participation from multinational corporations down to individual users;**
- **Biochar has high water retention properties and is beneficial in drought conditions.**

The CPRS Green Paper makes reference to the inclusion of forestry in, inter alia, the following terms:-

“Reforestation (as defined under the first commitment period of the Kyoto protocol) could be covered by the scheme. Forest landholders would receive permits for net sequestration that is counted towards Australia’s international commitments and would be required to surrender permits for net emissions from the forest, should emissions exceed sequestration.

“Reforestation would differ from other covered activities because it provides a net carbon sink and carbon dioxide emissions (from harvesting or fire) typically match prior carbon sequestration in the forest. Therefore, whereas other covered entities would be required to surrender permits for their emissions, forest landholders would receive permits for their net sequestration. Coverage of reforestation would thus provide a mechanism for crediting increments in forest carbon.

“The Garnaut Review suggests that reforestation be eligible to generate offset credits. This would achieve a very similar outcome to scheme coverage – that is, crediting increases in forest carbon – but would involve additional compliance costs for both industry and government. These would arise because of the need to demonstrate that forest carbon meets international offset standards, namely that it will be permanently maintained and is additional to business-as-usual.”

The Green Paper states that the implications of covering reforestation “would create incentives to establish new forests. A shift towards less emissions-intensive activities, including farm forestry, is an intended consequence of the scheme, as it would reflect an efficient allocation of resources taking into account the carbon price.”

We submit that no lesser implications apply in the application of biochars to use in agriculture by farming families and in other industries where they have hitherto not been used thereby either creating carbon sinks or reducing reliance on greenhouse gas emitting activities or both. This is to be distinguished from situations where low or no till farming techniques allow carbon already sequestrated in the soil to remain there. We do not suggest that the inclusion of the use of biochar as a means of carbon sequestration worthy of attracting offsets should in any way accelerate the Government’s intended inclusion of agriculture itself in the CPRS.

Incorporating biochar into the CPRS would have an additional benefit in that it would provide an incentive for the conversion of trees already felled (and currently treated, pursuant to the Kyoto rules, as if all the carbon contained therein has been released into the atmosphere – which is not the case) into biochar by way of pyrolysis. There are many millions of tonnes of felled trees on stations throughout rural Australia.

Direct government payments or the award of offsets to farming families for biochar applications is easily justifiable, as the farmers would be providing critical environmental and ecosystem services to the rest of the population. In addition to sequestering carbon by adding biochar to their soils, farmers would be benefitting all by virtue of increased crop yields resulting from the use of biochar. This would enable farming families thus far excluded from the scheme to be at the forefront of the fight against climate change.

Other potential users of biochar such as mining companies (in the repatriating of mines); engineering companies (incorporation into land reinstatement in pipeline, rail, road projects and the like); fertiliser companies (in replacing traditional fertilisers in their products with biochar or by adding biochar to composts and potting mixes) and government departments, both state and federal, (specifying and requiring its use in a multitude of community golf courses, ovals etc. and infrastructural projects) would not only participate in the generation of numerous and innovative carbon sinks but should also be entitled to benefit by way of offsets from such innovations.

Mining and engineering companies may also wish to purchase the biochar purely for the offsets they attract and donate the biochar to farmers.

The Premier (Anna Bligh) and Deputy Premier (Paul Lucas) of Queensland have directed that the Queensland Departments of Main Roads and Public Works actively consider the incorporation of biochar into their projects. It remains to be seen if this comes to fruition.

The New South Wales Minister for Primary Industries has, recently, recognised the potential for the use of biochar to revolutionise climate mitigation and adaptation in Australian agriculture. He stated that biochar is a product being hailed as a possible saviour for Australia's carbon-depleted soils, that also has multiple greenhouse gas benefits. "Biochar holds particular potential for long-term carbon sequestration, improving soil health and water holding capacity, and further reducing emissions of greenhouse gases associated with fertiliser application" he said.

That industry is prepared to embrace the potential use of carbon sinks is clearly demonstrated by the recent purchase of large tracts of land by major companies for the planting of forestry to act as carbon sinks; this is highly laudable but, in our submission, not as effective as the use of biochar for the same purpose.

Although it is not mentioned in The Green Paper, The Garnaut Review did refer to the use of biochar stating, "As reliable measurement rules of thumb are developed, carbon stored in wood products and biochar should also be reflected in carbon accounting and under the scheme".

Establishing carbon sinks through the addition of biochar to both the soil and other projects as outlined above has a number of advantages over the use of forestry as sinks.

Firstly, whereas forests are subject to growth uncertainty under increasingly unusual climatic conditions and damage and destruction through disease (e.g. Dutch Elm) weather and fire, thereby releasing stored gasses back into the atmosphere biochar is not; it lies below the soil and even if runoff by flood into rivers or the ocean the carbon within it still remains sequestered.

Secondly, whereas forests are only as good as the people who look after them, a sink of biochar needs no-one to tend it or nurture it; requires no fertiliser or water to sustain it; is not susceptible to changes of mind or policy (cannot be felled to make paper or used for other industrial purposes) and is capable of storing greenhouse gasses for perhaps thousands of years.

Thirdly, carbon storage in soils by way of biochar far exceeds the potential carbon sequestration in plant biomass even if bare soil were, theoretically, restocked to primary forest (Sombroek et al., 2003).

Fourthly, biochar has the potential to sequestrate carbon for far longer than forestry alone with some academics suggesting that biochar has a half-life in soil of in excess of 1000 years (Glaser et al., 2002).

Fifthly, bio-char can act as a soil conditioner enhancing plant growth (obviously including the forests which may be planted therein) by supplying and, more importantly, retaining nutrients and by providing other services such as improving soil physical and biological properties (Glaser et al., 2002; Lehmann et al., 2003a; Lehmann and Rondon, 2005). Biochars generally hold a number of times their own weight in water and therefore may be of assistance in fighting drought.

What is biochar?

The Garnaut Review defines biochar as a charcoal product made through the anaerobic combustion of biomass (for example farm or wood waste) at high temperatures.

Biochar is non-graphitic carbon with an aromatic structure, which is a pyrolytic transition from a carbohydrate biomass to the graphitic carbon structure through the amorphous structure of carbon (Kishimoto 1998).

The term 'biochar' refers to black carbon formed by the pyrolysis of biomass i.e. by heating biomass in an oxygen-free or low oxygen environment such that it does not (or only partially) combusts. Traditional charcoal is one example of biochar produced from wood. The term 'biochar' is much broader than this however, encompassing black carbon produced from any biomass feedstock (Dominic Woolf Jan 2008).

How is biochar made?

Biochar is produced by a process of slow burning of biomass in the absence of oxygen (slow pyrolysis). There is an alternative of ‘fast pyrolysis’ where the biomass is exposed to a high temperature (in excess of 500°C) for a few seconds, but this has largely been focused on the production of gases or liquids as fuels, rather than on biochar.

Upon charring approximately 50% of the carbon contained in the biomass is immediately released, leaving a stable bio-char residue. Non bio-char material decomposing in soil will initially release carbon more slowly over time. However, release of carbon continues until almost all carbon is lost and can be estimated to be less than 10–20% carbon remaining in agricultural soil after 5–10 years (depending on carbon quality and environment). Thus ultimately the bio-char application leads to considerably greater amounts of carbon remaining in soil than application of un-charred organic matter - Lehmann, Gaunt & Rondon.

Whether created by slow or fast pyrolysis, it is the addition of biochar to soil that provides the means of permanently sequestering the carbon. This process has an array of beneficial effects namely that biochar increases the fertility of the soil, not in the form of organic carbon, but in the way that a coral reef increases the nutrients available to biota in the sea. Microorganisms that fix nitrogen, for example, are encouraged by the addition of biochar, and it has quite a spectacular impact on reducing the release of other greenhouse gases such as nitrous oxide. Thus, soils that are being impoverished by conventional fertilizer-driven agriculture have the chance to be regenerated through production of biofuels combined with biochar amendment to the soils. In terms of atmospheric carbon sequestration, Lehmann and others believe that gigatonnes of carbon can be removed - up to 4Gt per year, or as much as the carbon flux currently created through burning of all fossil fuels. There is already a legislative initiative in the US Congress to channel federal support towards biochar initiatives (Mathews 2007).

In a bioenergy system, the initial loss of carbon during charring can be used for energy production and can offset fossil fuel use. In addition to the much greater longevity, a key advantage of bio-char with respect to soil ecosystem functions is that it is more efficient in improving soil fertility and nutrient retention than un-charred organic matter (Sombroek et al. 1993; Lehmann and Rondon 2005).

Not all agricultural waste materials are suitable to produce bio-char, including many field or vegetable crop residues with the notable exception of rice husks, which has high concentrations of silica entrapping carbon during combustion (Raveendran et al. 1995). Rice husks are typically regarded as a waste product, but can be used to sequester carbon by producing biochar. Other crop residues such as nut shells (e.g., groundnut, hazelnut, macadamia nut, walnut, chestnut, coconut) but also bagasse from sugar cane processing, olive or tobacco waste are suitable and are in some locations available in large quantities. Forestry waste and sawmill residues are effective feedstocks in the manufacture of biochar.

Best Energies has a pyrolysis facility capable of using a wide range of materials including very high moisture feedstocks such as animal manures, abattoir residues, poultry litter and food processing waste in the production of biochar.

For how long will the carbon remain sequestered in biochar?

If biochar is to be useful for the purposes of sequestering carbon, it is necessary that it must be long-lived and resistant to chemical processes such as oxidation to carbon dioxide or reduction to methane.

There is no doubt that in certain environments, charcoal is indeed recalcitrant. In a study of marine sediments in the North Pacific Basin, Herring (1985) found that "charcoal in the marine sediment is stable for several tens of millions of years" and that "charcoal forms a large percentage of the carbon content in the sediments". Large accumulations of charred material with residence times in excess of 1000 years have also been found in soil profiles (Forbes *et al* 2006, Glaser *et al* 2001, Saldarriaga, *et al* 1986). Glaser *et al* (2003) attribute the presence of large stocks of pyrogenic black carbon in Amazonian dark earths, several hundred years after the cessation of activities that added it to the soil, to its chemical recalcitrance. Also, C ages of black carbon of 1000 to 1500 years from Amazonian Dark Earths suggest that it is highly stable (Glaser, 1999).

Deposits of charcoal up to 9500 years old have been found in wet tropical forest soils in Guyana (Hammond *et al,* 2007*),* up to 6000 years old in Amazonia (Soubies 1979), and up to 23,000 years old in Costa Rica (Titiz & Sanford, 2007).

The conclusion that biochar is long-lived is supported by Bird and Gröcke (1997) who found that a component of charred material is highly oxidation resistant under laboratory treatment both with acid dichromate and basic peroxide. The fraction of biochar that will exhibit such oxidation resistance will of course depend upon both the feedstock and pyrolysis conditions (Dominic Woolf Jan 2008).

Even if, as some authors suggest, biochar (or specific biochars) is more susceptible to decomposition than suggested above and has only a half-life of several hundred years we submit that this should not make it any the less deserving of inclusion in the CPRS. Forestry sinks may, in theory, last for much less than a century, dependent upon climatic conditions, disease or fire.

Obviously it would be preferable if biochar were to last relatively unaltered in soils, the sea and river beds and other, as yet unspecified, sinks for many millennia however, even sequestration for a few hundred years may serve the purpose in "providing a useful tool to manage the global climate while human society make the transition away from fossil fuel dependence provided that we replenish soil carbon stocks faster than they decompose" (Dominic Woolf Jan 2008).

Inclusion of biochar in the CPRS

Australian Biochars is not in a position to advise exactly how biochar would be incorporated into the scheme. Opportunities do exist, however, for the participation of carbon sequestration by the use of biochar, not only by the bodies set out above, namely mining corporations, engineering companies, farming families and State and Federal Government, but also but also by individuals wishing to participate in the fight against climate change. At the lowest level, biochar may be incorporated into the home garden in the same way as are composts and potting mixes, with fertiliser companies being eligible for the offset credits earned according to the quantity of biochars they use in their products annually. This would make both for ease of accounting and ease of participation by almost anyone wishing to become involved.

Although the low quantities of biochar used in home garden products renders it impractical to offer offsets to individuals for their use, such usage should nonetheless be encouraged and participants receive financial incentives by way of elimination of taxation on all carbon sequestration products, not restricted to biochar, used in activities mentioned above.

Again, we submit that the same incentives should apply to commercial fertilisers with the manufacturing companies receiving the offsets and the commercial users (farms) benefitting from taxation reductions.

In the case of mining companies and engineering companies offsets would be earned on the amount of biochar used in their respective projects (sinks). Government project requirements could require a specified percentage of biochar be used in appropriate projects with an entitlement to offsets based on the quantity of biochar used.

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Australian Biochars acknowledges referring to the following sources in the compilation of this submission. We apologise in the event that we may have inadvertently omitted to acknowledge any particular work or author.

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