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Attention : Dr Ross Garnaut

Re : Climate Change: Land-use, Agriculture and Forestry

Dear Sir,

Please find attached a short submission to the above mentioned aspect of your enquiry.

The attached submission has been prepared by

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Please feel free to contact the writer should you require any further information.

Regards,

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A Technological Opportunity for Emissions Mitigation in Agriculture and Enhanced Terrestrial Carbon Sequestration

Summary: *BEST Energies Australia Pty Ltd Slow Pyrolysis - an advanced Australian developed technology, offers a near term option for avoidance of emissions from several significant agricultural sources. Wide deployment of these systems would create the means for producing industrial scale volumes of stable bio-char, a material that promises long term and verifiable sequestration of carbon in soils*.

Introduction: BEST Energies Australia Pty Ltd (BEST), based in Somersby on the NSW Central Coast, has developed a world leading slow pyrolysis facility to a demonstration scale with a throughput of 300kg/hr.

BEST is now working on the development of a world first 4 tonne per hour facility.

The BEST slow pyrolysis process is essentially the accelerated decomposition of organic material at elevated temperatures and in the absence of oxygen. The organic feed material is dried at low temperatures to eliminate moisture and then fed into a reaction chamber – which in this case is an externally heated agitated kiln.

As the dry biomass passes through the kiln, it reacts and produces an off-gas (syngas) and a nearly pure carbon char material – biochar. The syngas is continuously removed from the kiln and combusted for its energy value.

The BEST facility is 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.

The BEST slow pyrolysis process therefore offers real potential to avoid significant methane emissions from manures at feed lots and dairies, poultry farms, wastes at abattoirs and at food processing plants among others.

Drier materials such as crop wastes, sawn timber waste from building and demolition, sawdust, woody weeds and other woody wastes can be processed as well.

Depending on the amount of drying required to remove moisture from the feedstock the BEST facility can be a net energy exporter by using the syngas either to provide thermal energy for associated industry (such as is required at food processing and feed rendering facilities), or by generating electricity in an internal combustion engine.

Depending on the feedstock used, and the process conditions established in the kiln by the operator, between 25% and 70% of the dry feed material can be converted to a high-carbon biochar, which can be used as a solid fuel or as a water filtration medium, amongst other applications.

As a solid fuel char could displace some fossil fuels in electricity production if it were available in sufficient volume to allow economic co-firing. It can also be used, and is sometimes preferred as a reductant in the refining of some industrial materials such as silicon. If available in sufficient quantities it is perfectly suitable to replace metallurgical coke in refining iron and steel.

However it is the use of this organic biochar as a soil amendment that raises the **potential for a 'virtuous' cycle of carbon management in agriculture and forestry**.

Biochar is a presently a subject of great interest among soil scientists, agronomists and foresters around the world because of its connection with the 'terra preta' phenomenon. It's believed that the highly fertile Amazonian dark earths, or terra preta, were created by pre-Columbian populations thousands of years ago through the addition of charred organic matter. In the Amazon today, these highly fertile soils are prized, and despite being intensively cultivated they remain staggeringly productive even without the addition of fertilisers. The possibility that such productive soils could be sustainably man-made presents a huge opportunity, and challenge, for agricultural land users, who largely employ systems that lead to soil loss and degradation.

Some of the best work in this area is coming from Prof. Johannes Lehmann[1] at Cornell University. However there are numerous researchers and institutions around the world developing the body of knowledge about the positive effect of biochar on soils including the NSW Department of Primary Industries.

Importantly, from the point of view of mitigation opportunities in Australian agriculture, the carbon in the biochar material is stable and is demonstrably persistent in soils for thousands of years. (Carbon dating techniques used in archaeology rely on this fact.) Therefore biochar has the potential to act as a long term store for carbon in soils – carbon that has been removed from the atmosphere by plants and is then captured and locked into soils.

This is a significant differentiator to the increasingly common process of utilising biomass for power production by combustion in air. While the use of biomass for power production may have displaced some fossil fuel use, the carbon in the biomass is only cycled back to the atmosphere as CO_2, not removed from it, in effect permanently, as in the case of biochar production from biomass and subsequent application of the biochar to soils.

[1] http://www.css.cornell.edu/faculty/lehmann/biochar/Biochar_home.htm

Besides the potential for direct sequestration of carbon in soils, there is evidence that biochar provides further mitigation of greenhouse gas emissions through reduction in nitrous oxide emissions from soils treated with nitrogenous fertilisers. Furthermore, biochar has been demonstrated to significantly increase plant growth and health and reduce fertiliser requirements overall, thus reducing the indirect greenhouse gas emissions from fertiliser manufacture.

In summary a BEST slow pyrolysis facility can;

- Utilise a wide array of agricultural and forestry wastes,
- Avoiding all methane that would have resulted from the natural decomposition of those materials,
- While producing various forms of renewable energy (either process heat or electricity), and
- Produce a stable form of carbon as bio-char that can either be used;
- To replace fossil fuels and metallurgical coke or,
- Be returned to the soil as an important soil amendment that evidence indicates,
- Enhances plant growth and thus the more rapid uptake of carbon from the atmosphere and,
- Reduces emissions of nitrous oxide from soils following application of nitrogenous fertilisers,
- Plus possibly reduces the need for nitrogenous fertilisers to achieve similar and possibly better yields.

This valuable combination of characteristics means that commercially viable slow pyrolysis plants have the potential to be a cornerstone technology in agriculture and forestry in a carbon constrained economy.

Verifiable Emissions Abatement

While the last three mitigation opportunities listed above suffer from some of the same technical and verification challenges of diffuse sinks and sources in agriculture and forestry, there is no technical question about verifying the quantum by which a BEST pyrolysis facility can directly avoid methane emissions that would otherwise have evolved from manures, crop wastes etc.

Because the materials going into a BEST facility can be weighed precisely, and all of the outputs can be metered, or in the case of the biochar, weighed, the BEST process can provide exact data on methane emissions avoided, energy sent out and carbon captured in the char.

At the same time a great deal of work is underway around the world and in Australia on the impact of biochar in soils and on nitrous oxide emissions. This work may yet prove that the abatement resulting can be quantified with a sufficient degree of certainty, given knowledge of the soils, climate and biochar and fertiliser application rates.

Any policy or regulatory measures introduced now that had the effect of precluding this process for reducing nitrous oxide emissions as a recognized mitigation pathway should be avoided if possible, at least until the research work has provided sufficient evidence to draw conclusions one way or the other on this process.

Technology and Economics

The BEST pyrolysis technology is possibly the most advanced slow pyrolysis system in the world in its ability to utilize 100% of a feedstock material as either syngas or char and avoid production of ash and complex organic oils (bio-oils) that can be toxic and are a waste management issue in their own right.

The operation of the 300kg/hr pilot plant has informed the design for a commercial scale 4 tonne per hour plant (~ 35,000 tpa). As it stands, using a range of estimates for operating costs and income from sales of either thermal energy or renewable electricity, and sales of char, the plants are not economic. However if certified emissions offsets are earned by the facility, based on the values attributed to avoidance of biomass to landfills, and a modest price on those offsets are assumed ($10 to $15/tonne) the plant becomes marginally economic.

These offsets would be based on the reduction in atmospheric forcing achieved by avoiding methane production from anaerobic decomposition of materials in landfills. Existing alternative treatments of the same materials still produce CO_2. Because the BEST pyrolysis system captures the carbon in biochar, the effective offset of pyrolysing the material is greater than that achieved by processes that simply avoid methane.

If an offset value can be attributed to the biochar produced at the point of production, as well as the methane offset, then the technology becomes much more economic. Recognition of the offset value of biochar production will also provide an important means of reducing the cost of biochar thus assisting entry into the market of biochar soil treatment product in competition with established soil treatments and fertilisers.

Conclusions

It is our view that slow pyrolysis, as epitomized by the BEST technology, given the right incentives, could make a very significant contribution to mitigation of emissions from agriculture in the near term.

Pyrolysis plants can attend directly to some of the major emissions sources in agriculture such as animal manures and food processing wastes.

While further research is required to determine if biochar does reliably reduce nitrous oxide emissions from application of nitrogenous fertilizer to soils, there is very little effort required to accurately measure and verify other emission offsets provided by avoiding methane emissions and capturing organic carbon in a stable form as biochar.

The technology is near to commercialization and near economic in the present economic environment. Deployment and further development would be greatly assisted and accelerated by supportive policy settings.

The first full scale plant is planned to be operational in calendar 2009. Once established and proven in Australian conditions the costs of the BEST pyrolysis technology is likely to come down and represent an opportunity for exports to agriculture and forestry sectors in other countries to assist mitigation efforts there.

The establishment of a successful pyrolysis system in Australian agriculture will foster further innovation in the field and encourage the development of new entrants with competing systems.

The widespread deployment of pyrolysis systems in rural areas in Australia, as well as contributing to local employment, renewable energy production and waste management, has the potential to establish a virtuous cycle of carbon management in agriculture and forestry.