27th September 2021

ANZBIG SUBMISSION:

2021 Soil carbon method: proposed new method under the Emissions Reduction Fund

September 2021

INTRODUCTION

Thank you for the opportunity to provide comments on the **proposed new method under the Emissions Reduction Fund (ERF) - *Carbon Credits (Carbon Farming Initiative—Estimation of Soil Organic Carbon Sequestration using Measurement and Models) Methodology Determination 2021***, on behalf of the ***Australian New Zealand Biochar Industry Group (ANZBIG)***. ANZBIG[1] was launched at the 2020 ANZ Biochar Conference as a formal industry cluster to facilitate the growth of the Australian biochar industry and represents over 200 members from individuals through to multi-national companies.

In late 2020, the Minister for Energy and Emissions Reduction tasked the Clean Energy Regulator with developing a new soil carbon method under the Emissions Reduction Fund. A soil carbon project eligible to use this method will store additional carbon in agricultural soils by undertaking eligible management activities. These include improving fertiliser application, re-establishing pasture or modifying grazing practices. The Emissions Reduction Assurance Committee (ERAC) is subsequently seeking stakeholder feedback on the proposed new method.

BACKGROUND

Biochar has been recognised by the Intergovernmental Panel on Climate Change (IPCC, 2018) as one of six key Negative Emissions Technologies to help remove over 1,000 Gigatons of excess carbon dioxide in our atmosphere by 2100. Nature has perfected the capture of CO_2 through plant growth, however plant organic matter normally biodegrades back into the atmosphere via the carbon cycle. Modern technology can be used to sustainably convert excess biomass into long-term stable biochar via pyrolysis, providing a carbon-rich solid product for numerous applications. These include applications in agriculture, construction and roads, steel reductants, and biomaterials for the new carbon economy - replacing fossil-fuel derived carbon in solid carbon materials. Pyrolysis of biomass can potentially produce hydrogen from syngas, further facilitating transition from fossil fuels and subsequent avoided emissions in key areas such as transport. Biochar applications are now globally recognised as an important mechanism for climate change mitigation via Carbon Capture, Utilisation and Storage (CCUS), particularly in Europe, China and the US. Large organisations such as Microsoft

[1] *formerly known as the Australia New Zealand Biochar Initiative (ANZBI)*

are now investing in carbon credits specifically from biochar Negative Emission Technologies to meet their strategic Net Zero 2050 commitments (see here and here). Renewable energy and bio-oils are potential co-products and co-benefits of biochar production, enabling recovery of the full resource value of feedstocks in commercial scale operations. Biochar production globally is rapidly expanding, including in the USA, the EU and China. Production in China alone had been estimated at well over 300,000 tpa as of 2018, when construction had commenced on building capacity over 2Mtpa, with plans to ~6Mtpa (IBI/Draper et al 2018).

Decades of intensive research in Australia and worldwide has produced over 15,000 published papers (as of 2020) demonstrating the ability of biochar to enhance soil productivity, sequester carbon, reduce GHG emissions from organic residues, and immobilize heavy metals and organic pollutants in soil. Production of biochar reduces emissions from open burning of biomass residues. Biochar production could be used to efficiently manage agricultural/forestry residues and woody weeds, and reduce fuel loads, for bushfire management. Over 70 Mt of potentially available biomass is estimated in Australia each year from agricultural crop stubble, grasses and forestry alone[2].

Biochar production can support nutrient recovery, beneficial use of otherwise wasted biomass resources, and implementation of the circular economy. Applications beyond agriculture include roads, construction and in various carbon products. Organisations such as the **European Union** have now drafted frameworks to enable biochar use in agricultural fertilisers.

Carbon Abatement Potential

The growth of biomass is considered the most efficient and feasible method currently available to extract carbon dioxide from the atmosphere. However, fresh or untreated biomass is easily degraded by microorganisms, releasing carbon back to the atmosphere in the form of greenhouse gases (the *carbon cycle*). Alternatively, when biomass is pyrolyzed, the organic carbon is converted into **solid** (biochar), **liquid** (bio-oil/wood vinegar), and **gaseous** (pyrogas/syngas) **carbonaceous products for various uses**.

Depending on the specific technology type and process settings, **for every tonne of biomass pyrolyzed** around **a third (and up to a half)** of the carbon **can be sequestered into solid biochar**. Biochar bioenergy systems are currently the only available technologies that can concurrently provide both energy (and/or feedstock for valuable industrial derivatives including ammonia that can be produced from syngas) ***and*** significant long-term carbon sequestration.

Significant biomass resources are currently wasted (e.g. by in-field burning or landfilling), or are used sub optimally, that could be utilised instead for biochar plus energy. For relative current context,

[2] *Spatial Assessment of Potential Biomass for Bioenergy in Australia (CSIRO, 2016); National Bioenergy Roadmap Submission (ANZBIG, 2020)*

global biochar production capacity (led by China) is ~<1% of the volume of biomass being wasted annually in Australia alone.

A comprehensive study of the global potential for abatement through biochar, published in the prestigious journal *Nature*, found that producing **biochar from biomass** (such as organic waste that does not compete with food production or increase land use) **could sequester the carbon equivalent to 12% of total global CO_2 emissions**, which is **on par with offsetting emissions from the entire global transport sector**.

The **feasible abatement potential** of biochar in NSW alone has been estimated at **1.6 Million tonnes CO_2e per year** (Waters et al., 2020), equivalent to 1.2% of NSW total annual emissions or taking nearly 350,000 passenger vehicles off the roads (USEPA, 2018). This is based on the conservative assumed use of 10% of crop residues, 50% of feedlot manure and poultry litter, and 90% of processing residues (nut shells, gin trash, rice hulls) and urban greenwaste.

The most comprehensive study to date specifically explaining the interrelated processes which determine soil and plant responses to biochar (including detailed analysis of carbon sequestration) was provided by Joseph et al. 2021, and synthesized two decades of global biochar research. The following figure illustrates soil organic carbon growth with repeated biochar amendment, in contrast with adding the same quantity of carbon as unpyrolyzed organic matter (eg compost).

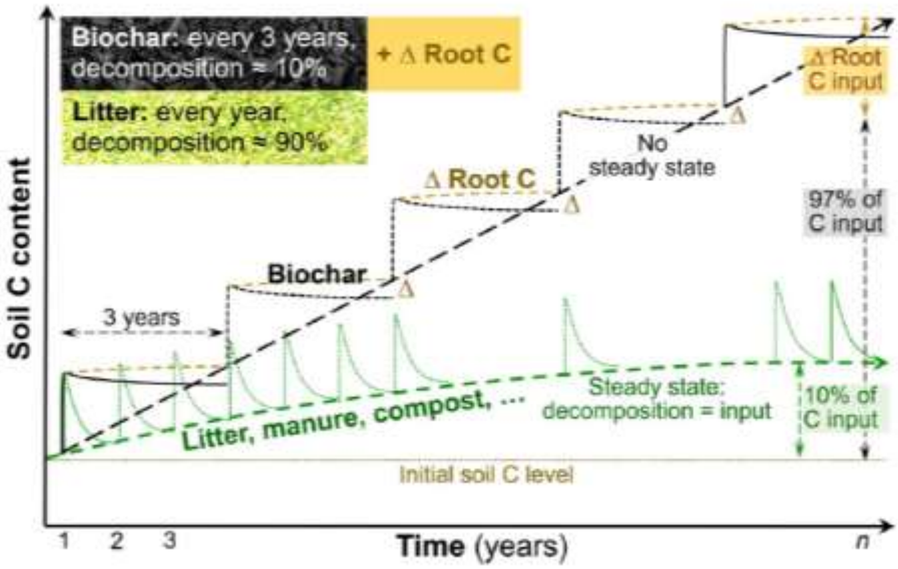

Figure 1 Accumulation of SOC stocks with sequential biochar addition, due to i) the highly persistent carbon in biochar, ii) biochar-induced negative priming, and iii) additional C input from plant roots through retention of rhizodeposits (Δ Root C), compared with limited SOC stock increase with addition of unpyrolyzed organic matter. Conceptual example for scenario where biochar is added every three years and decomposes at 3% per year, compared with annual additions of unpyrolyzed biomass, of which 90% decomposes each year. (Source: Joseph et al., 2021)

The IPCC has also stated that ***lack of action to address land degradation will increase emissions and reduce carbon sinks, and is inconsistent with the emissions reductions required to limit global warming to 1.5°C or 2°C. Better management of soils can offset 5–20% of current global anthropogenic GHG emissions****. Measures to avoid, reduce and reverse land degradation are available but economic, political, institutional, legal and socio-cultural barriers, including lack of access to resources and knowledge, restrict their uptake.* Joseph et al (2021) describe how biochar can improve land productivity, and the Biochar for Sustainable Soils project demonstrated the role of biochar in sustainable land management.

Soil carbon (Soil Organic Carbon) plays a key role in soil productivity and represents the largest terrestrial sink for carbon. Improving agriculture to build soil carbon is one of the best options for reversing climate change while supporting sustainable farming. ***A 1% increase in SOC in the top 30 cm of soil translates to sequestration of approximately 165 tCO_2e per hectare*** assuming bulk density of 1.5t Soil/m^3 *(Soil Carbon Industry Group, 2020)*.

Importantly, biochar has also been shown to **increase soil carbon in excess of the carbon added in biochar itself** ('negative priming'), as demonstrated in this decadal study published in the respected scientific journal *Nature* (Weng et al 2017).

Theoretical Potential For Biomass to Biochar and Bioenergy in Australia:

The theoretical potential for unused biomass conversion to biochar and its co-products in Australia is estimated below (ANZBIG 2020):

Up to ~50-100 Million metric tonnes per year of **residues no longer burned/landfilled***

- **Up to ~15-30 Million** metric tonnes per year of **biochar potentially produced**
  - Biochar saleable economic value **$7.5B-$15 Billion** (@AUD $500/t)
  - Additional carbon credit value (current market value) **$1.5-$3 Billion** (@ AUD$100/t)**
- **>Up to ~30-60 Million** metric tonnes/y CO_2e of **CO_2 removal (Negative Emissions/Drawdown)**

  (i.e. equivalent of **up to several % of Australia's 2019 total GHG emissions**)
- **Up to ~50-100 PJ/year** of Biogas (syngas) for national energy security
- **Up to ~50, 000 jobs** (rural and regional focused)

** Australian Energy Resources Assessment estimated in 2016 that biomass residues/waste nationally were >75M tpa. Crawford et al 2015 estimated biomass residues conservatively at 80Mtpa, which could grow to 110-115Mtpa by 2050.*
***** Conservative estimate on current markets.*** *Puro Earth CORCs credit value June 2020: Euro €30/t CO_2e (~AUD $48/t CO_2e @ exchange rate 1.6) and typical >3t CO_2e per tonne of biochar, ➔ i.e. current credit value June 2020 AUD* ***~$140/t biochar****. For further relative context, the Stripe project in USA recently paid over* ***USD $100/t CO_2e*** *for (non-biochar) voluntary market carbon sink products,* ***nearly triple*** *the conservative estimate above. https://stripe.com/blog/first-negative-emissions-purchases*

Permanence

Detailed studies have been completed over the last decade to address the question of permanence of **pyrogenic carbon**, particularly in soil application (refer Appendix 4 in Part 1 of ANZBIG's submission on the Bioenergy Roadmap). The **Mean Residence Time (MRT)** of biochar carbon ranges from 100->10,000 years, with most estimates in the range 300-600 years (Joseph et al., 2021). MRT of biochar carbon is strongly related to its **H/Corg ratio** (which depends mainly on the pyrolysis temperature) and to the environmental conditions of its storage (Braadbaart et al., 2009; Camps-Arbestain, Amonette, Singh, Wang, & Schmidt, 2015). **H/Corg is a simple, practical and economical test** which allows the stable carbon sequestered *within* biochar to be reliably quantified, and would be suitable for quantifying abatement under the ERF. This approach forms the basis for the IPCC method for quantifying persistent carbon in biochar, presented in Appendix 4 of Chapter 2, Volume 4 of the 2019 refinement of the 2006 IPCC Guidelines for national GHG inventories, and for the recently proposed Verra Standard for Biochar in Soils and Non-Soil Applications (2021).

In a meta-analysis of **111 experiments on biochar persistence**, Lehmann et al. (2015) estimated that **biochars with a H/Corg ratio of <0.4 have**, when applied to soil, **an MRT of >1,000 years**, corresponding to half-life times of ~700 years. However, it has been recognised that the soil environment can also potentially play a key role in persistence of biochar carbon. While more research about mechanisms of biochar degradation and the fate of the degradation products are needed, three meta-analyses of published studies on biochar persistence in soil (based on **>120 experiments**) **confirmed that biochars are much more recalcitrant than their precursor materials and natural SOM**, and that **MRTs exceed the centennial scale (i.e. conservatively biochar persistence in soil exceeds >100 years)**. In their review, Joseph et al. (2021) collated MRT estimates for biochar carbon ranging from 100->10,000 years, with most estimates in the range 300-600 years. The European Biochar Certificate (EBC) has adopted an average degradation rate of 0.3% per year for biochar in soils, meaning that after 100 years after soil application, 74% of the original carbon in biochar would still be sequestered, considered very conservative as studies have determined significantly *lower* degradation rates. ANZBIG has adopted testing of H:Corg (and many other parameters) in our industry Code of Practice to characterise different commercial biochars.

Additionality

Additionality requirements of the ERF ensure that abatement would not have occurred under the normal course of events. Whilst biochar is advancing globally and has been promoted by the IPCC, it is still maturing globally toward its significant potential (and particularly in Australia) and requires assistance to scale and accelerate, bringing down product costs for broader uptake, as has occurred in other renewable sectors such as solar.

Cost, availability and awareness remain challenges in Australia, leading to minimal adoption to date. Indeed, whilst holding key resources and world leading expertise in biochar production and applications, Australia currently lags the world significantly in both investment and production. As of 2018 Australia produced <5,000 tpa of the estimated global production of ~500,000 tpa (and growing rapidly overseas such as in China as noted earlier above). Thus, there is no question that biochar projects would meet the additionality criterion. The development of methods for biochar applications in Voluntary Markets for carbon credits, such as the recently proposed Verra Standard for Biochar in Soils and Non-Soil Applications (2021) also address additionality positively.

Recommendations

The biochar industry is eager to work with the Clean Energy Regulator to identify appropriate improvements to regulations and policy to support the deployment of beneficial biochar production systems and applications of biochar to soils. The following points are made in response to the proposed new method for the ERF:

1. **Section 12 Clause 5: ANZBIG's main point of interest is with Section 12 (Clause 5) of the Soils Method: "(a) the biochar was sourced or created from (i) CEA's that are part of the project" or (ii). "organic matter that previously formed part of a designated waste stream".**

   Provision (a) **constrains land regeneration potential** through taking surplus biomass from where it's available in excess ("waste" or sustainably grown) and using it elsewhere to regenerate degraded soils that currently do not support production of biomass to make biochar.

   - For example, biochar produced from forestry or agricultural residues (and potentially co-processed with manure or municipal biosolids to embed nutrients into a slow-release bio-fertiliser) from areas where biomass is in excess could be sent to inland farmers to improve soil carbon and subsequently reduce reliance on synthetic fertiliser products, increase drought resilience and reduce farming costs.

1.1. The regulations should **allow for "farm to farm" or 'biochar production plant to farm" transfer** as long as the biochar in question is produced in accordance with that particular States environmental legislation and relevant industry standards/codes, including the ANZBIG Code of Practice. For example, this issue could be suitably addressed through the inclusion of a third category in 5 (a) as ***"(iii) Sustainably sourced biomass and biosolids".*** Should this recommendation not be accepted, we recommend at least doubling the specified application rates in condition 5 b) to permit application of biochar at a rate that is likely to be effective. We welcome further discussion on this to clarify and justify this further.

1.2. **Separation of Sub-clauses 5a and 5b** - We interpret clauses (a) and (b) as independent alternatives. To avoid ambiguity, we recommend insertion of the word **"or"** between the two sub clauses to provide full clarity.

1.3. In 5(b) carbon content should read as **persistent carbon content** (not total carbon content, as a small fraction is labile), as outlined for Section 25 in detail below.

2. Section 25: "Change in soil organic carbon stock for a project area for a reporting period"

"The change in soil carbon due to biochar addition is subtracted in quantifying the change in soil carbon for the project area, as follows:

"$Q_{B,CEA1}$ is the sum of the following:

(a) if the carbon content of any biochar applied in CEAi in the project area in the relevant period defined in subsection (2) is known—the amount obtained by multiplying the carbon content of that biochar, expressed as a proportion, by the total quantity of that biochar, in tonnes, applied in the CEA in that period;

(b) if the carbon content of any biochar applied in CEAi in the project area in the relevant period defined in subsection (2) is not known—the amount obtained by multiplying the default carbon content of biochar specified in the Supplement multiplied by the total quantity of that biochar, in tonnes, applied in the CEA in that period."

2.1. **The requirement to subtract biochar carbon should be removed.** There needs to be capacity for the project proponent to choose to include the carbon content (CO_{2e} removal value) of biochar in a soil carbon project where suitably measured and justified. There is ample science to support this with cost effective and reliable measurement as follows:

- Total carbon content in biochar includes persistent and labile components.
- **Only the persistent carbon content should be included,** as the small "labile" carbon component of biochar is rapidly decomposed. Accounting instead for total carbon gives an inaccurate estimate of the change in SOC due to biochar addition.
- ***Persistent carbon*** content **should be measured by the** [$H:C_{org}$ ratio] (hydrogen to organic carbon ratio).
- **Biochar carbon should only be included if** persistent carbon has been measured, biochar feedstock is sustainably sourced or produced from a waste material, and the biochar carbon has not been counted in another scheme (to minimise leakage, avoid over-crediting, and double counting).
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2.2. If recommendation 2.1 is not accepted, **use the persistent carbon content to quantify QB,CEA1.** As explained in 2.1, the using the total carbon is inaccurate (overestimating the carbon stock change due to biochar)

2.3. Where not known/measured, a conservative default value of 85% persistent carbon should be used instead of 100% currently in Table 12 of the Supplement. (Assuming biochar contains 100% carbon is overly conservative, reducing the credited soil carbon change unnecessarily, thus providing a disincentive to use of biochar despite its demonstrated benefits to climate change mitigation and land productivity.

2. **Definitions:**

Designated waste:

- **General Comment** - A *prescriptive* approach has been taken for inclusions on this list which may unnecessarily (and significantly) limit the potential outcomes of the method, as compared to taking either an *exclusion* approach (i.e. specifying materials that are not permitted), or preferably, an *outcomes-based* regulatory approach (e.g. *organic materials which meet all relevant regulatory requirements (federal, state, local) and industry standards/codes to be considered safe and fit for purpose in land application*).
- **The existing definition excludes important sustainable biochar feedstocks such as:**
  - agricultural crop residues
  - fire hazard reduction from sustainable forestry and thinning on farms needs to be specifically included, as that would also be consistent with these being permitted to be undertaken within a CEA under Section 12 (2).
  - Other sustainable forestry residues (in addition to sawmill residues in part (d))
  - Invasive plant species and weeds (including Invasive Native Scrub/woody weeds)
  - *"Other vegetation permitted elsewhere in this document"* should be added to the list, in order to permit use of biomass cleared or thinned in accordance with Section 12(2) and 12(3) to be used for biochar production.
  - The list of *designated waste* should be regularly reviewed and updated in consultation with relevant stakeholders (including ANZBIG, relevant industries, govt resource recovery & circular economy depts and EPA's etc).
- **Specific clarification is sought** that municipal biosolids and manures are included under parts (a) and (e). This is important due to direct reference in Clauses 5 (biochar) and other clauses and related definitions;

"Non-synthetic fertilisers"

- Biochar has significant potential in organic bio-fertilisers and should not be restricted where it meets regulatory requirements for direct application to land and is considered "fit for purpose". This definition requires revisiting and further consultation with industry as it currently specifically excludes *any* biochar content.

3. ***Restricted Activities*** Section 12 (2) and 12 (3) prescribes specific rules for vegetation management **within** a CEA, including clearing woody biomass or thinning vegetation.

- *Woody vegetation* permitted for clearing under 12(2) should be specifically permitted for biochar production (for example by adding in section 12 (5)).
  - It is unclear whether the vegetation cleared in accordance with 12(2) could be used for making biochar. i.e. clearing of woody biomass for *fire hazard reduction* or

under a formal government *resource management plan referred to in 12(1)*) are currently both permitted in 12 (2)..are these then permitted under 12(5)(a)(i)?

- *Biomass harvested through thinning of the land* permitted under 12 (3) should also be permitted as a biochar feedstock (currently only allows firewood).
- ➔ Woody vegetation referred to in section 12(2) and vegetation thinning permitted under 12(3) should be permissible biochar feedstocks for use in other ERF soil carbon projects, for example by including as a designated waste streams for biochar production (ie added to/cross referenced in the definition of designated , or by adding an additional class of feedstock "Sustainably sourced biomass"

4. **Also for ERAC/CER Awareness & Consideration** - In addition to soils, there are literally scores of other non-soil biochar applications across multiple sectors of the economy (including commercial and industrial applications) that also offer long term carbon sequestration which could be considered for inclusion in ERF methods. For example, biochar in roads and construction, feed chars, and in carbon-tech among many others. International voluntary markets are already leading on this (e.g. Verra, Puro, Nori, Carbon Future and others). Following significant impacts of recent fires seasons in Australia and globally, biochar applications present significant opportunities for diversification/risk reduction in carbon credits and security, with interest building globally for such. ANZBIG is seeking support for demonstrating multiple applications of biochar at commercial scales and welcomes discussions with the CER/ERAC and all interested parties.

Thank you for taking this submission into account and we look forward further ongoing discussions with the CER and ERAC.

Kind Regards,

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