## Carbon Rescue: value from woody debris via pyrolysis for cyclone recovery

Cyclone Gabrielle has led to large quantities of forestry biomass being mobilised, strewn across productive lands, and is now targeted for disposal. Other plantation forests in the central North Island have experienced severe wind damage. Woody biomass from damaged orchards will also require disposal. These combined woody debris present an opportunity when viewed as misplaced resources.

**Woody Debris Disposal Pathways**
Current options for disposal are open burning to ash; burial, landfill or chipping / mulching; and land application – all of which incur costs in terms of handling and logistics, and all have potential impact on greenhouse gas (GHG) emissions.

- Open burning to ash is often poorly managed and results in high methane, CO2 and particulate emissions.
- Disposal to landfill often requires transportation, incurs tipping fees and leads to decomposition of organic matter in anaerobic conditions, leading to additional methane emissions.
- Chipping / mulching requires energy input and specialised machinery, but may suppress growth when land-applied where there is insufficient supply of organic nitrogen and microbial decomposers to kickstart nutrient cycling.
- Burial has variable outcomes depending on methodology and context. Burial can be beneficial when buried shallow hügelkultur-style with sources of nitrogen to aid aerobic degradation, or have outcomes similar to landfill.

**Document purpose**
This document has been prepared to highlight an alternative opportunity that may lead to much better environmental, social and economic outcomes for the communities affected by these events. **This opportunity will disappear unless steps are taken to divert woody biomass resources from existing disposal pathways, while finding ways to safely stockpile the biomass residues until they can be beneficially used.**

**Greenhouse gases**
Woody biomass is made up of ~50% carbon, taken up from the atmosphere via photosynthesis. This carbon is returned to the atmosphere as CO2 and methane when biomass decays or is partially burnt, part of the “fast carbon” cycle in which plants and trees are merely placeholders. The CO2 is effectively neutral in its global warming potential, but the methane generation is an outcome we can ill-afford as we struggle with ever increasing rainfall and flooding events.

**Carbonisation through Pyrolysis**
The carbonisation of woody biomass can slow the fast carbon cycle while providing a cascade of other benefits. Woody biomass can be processed by a number of methodologies to produce biochar (charcoal destined for multiple uses while acting as a carbon sink rather than fuel):

Distributed, mobile production methods which can convert geographically dispersed biomass sources:

1. Modified air curtain burners (ACB’s) are based on an established technology for the clean disposal of large volumes of biomass. ACB’s that extract biochar will take some time and investment to bring this equipment into NZ.
2. Cleaner *Conservation burns* as deployed by US Forestry Service can be employed for biomass piles to significantly reduce the pollution issues associated with typical pile burns. Smoke, particulates and other emissions will be greatly reduced and some of the carbon in the biomass will be retained as biochar. This burn technique could be promoted by Regional Councils and adopted by landowners as a matter of good practice to look after our airsheds.

3. Flame cap kilns are a proven method for biochar production using a wide range of vessel designs and capturing up to 50% of the carbon from the biomass that would otherwise be lost. Flame cap production can be carried out at large scale.
4. Large scale trench / pit production could combine 2. and 3. above to process large volumes of biomass at landscape scales using heavy equipment.
5. Transportable retorts

Location-static methods which are more suited to agglomerated biomass sources

6. Large scale batch retorts
7. Continuous-feed pyrolysis systems

Methods 6 and 7 utilise advanced technology, pyrolysis and gasification systems that can process biomass in more efficient ways, but these generally require work to transport biomass, pre-processing and major investment (and are not yet widely deployed in NZ). While relocatable, this is at significant cost and lead time.

**Biochar benefits**

Carbon rescued as biochar in the options listed above could be measured and recorded as long term carbon sequestration (100s to 1000s of years). Disposal of biomass via pyrolysis into biochar will in most cases provide better outcomes for local communities and reduce our carbon footprint versus other disposal pathways. A cascade of benefits and opportunities arise from this biochar production and use:

- biochar use in animal feed and water filtration
- biochar incorporation into locally damaged soils for rapid remediation and permanent lifts in soil fertility
- better air quality through avoided particulate emissions from any typical open burning of biomass
- avoided burial costs and/or landfill costs (and avoided associated methane emissions)
- training and employment opportunities in biochar production and application businesses
- reduced operating costs and improved profitability for farmers and Councils
- revenues from the sale of biochar and co-products can offset processing costs
- potential future revenues from established international voluntary carbon markets when processing at a scale of thousands of tonnes of biochar annually

**Biochar market**

There are fledgling biochar markets in New Zealand, selling 5,000 tonnes per annum of 400,000 tonnes from readily available, sustainable sources. These markets are best developed in areas of ample supply (Auckland, Waikato and Western Bay of Plenty). The markets for biochar in Tairawhiti and Hawkes Bay are underdeveloped and extremely limited.

**Capturing benefits**

Capturing these benefits will require immediate actions. The recommended actions are:

1. Identifying and classifying excess woody biomass across catchment areas into 3 categories:
    a. Treated timber - unsuitable for pyrolysis without Resource Consent and strict emissions controls
    b. Salt-contaminated timber - suitable for conversion to biochar via conservation or pit burns, but has corrosive effect on steel equipment and may not be suitable for some end uses such as animal feed
    c. Untreated and not salt-contaminated

2. identifying suitable space for biochar production crews to operate, ideally with sufficient space and supply of hundreds to thousands of cubic metres of biomass materials
3. redirect sorted, untreated biomass for pyrolysis-based disposal activity at suitable locations
4. investment in trials to optimise production methodologies and practices
5. agree a "buyer of last resort" contract for guaranteed revenue for a proportion of the biochar produced, or fund biochar production directly to give confidence for biochar producers to invest and mobilise at the desired speed and scale demanded by stakeholders

**Our request:**
**That central government, via the relevant ministries, and in collaboration with regional and district councils, mana whenua, and landowners, direct and coordinate the cleanup and remediation efforts on the ground in affected areas with a short-term goal of capturing as much biomass as possible and preventing it from being landfilled or burned via polluting means. This salvaged material then becomes a resource that can be processed and turned into a valuable product with land restoration attributes and climate benefits.**

**Addendum**

- Biochar from 'beached' forest residues (2019 effort to find support for trials)
- https://soilcarbon.org.nz/focus-on-forest-slash/
- Converting shelterbelt biomass to biochar (A Feasibility Analysis for North Dakota Forest Service By Kelpie Wilson, 2017)
- *List more recent similar studies & reports...*

**High-level considerations for stockpiling and pyrolysing biomass**

- *Stockpiling*
  - *Land availability*
  - *Available stockpile areas – access, areas, contours.*
  - *Need for stockpile land where there is no area immediately available.*
  - *Moving of operations to other areas*
  - *Potential hazards, remobilisation*
- *Charring and end use*
  - *Salt content – effect on equipment, end product*
  - *Dirt and other contaminants with wood*
  - *Moisture content and time for biomass to dry to the required moisture content*
  - *Fire hazards - sparks containment, water supply for complete extinguishing. Fire insurances*