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PROJECT RAINBOW BEE EATER

A process which can deliver low cost, large, long term carbon sinks and renewable energy rapidly in Australia

Syd Shea, Peter Burges & Ian Stanley

It was inevitable, given the potential impact on the economy and the lingering questions about the scientific basis of the cause and scale of the projected changes in climate and its impacts, that the proposed Carbon Pollution Reduction Scheme (CPRS) would become a politically partisan issue in politics (causing strange alliances) and in the broader community. Given that climate change, if it occurs (and many serious skeptics concede there is a risk it will) will have extreme consequences and given the massive political momentum of the issue, it is inevitable that Australia will have an emissions trading scheme. When the issue is stripped of emotion the justification for action is risk avoidance.

The most desirable strategies, when the mode is risk avoidance but with rapid and large scale action, are those that are low cost and contribute other assets to the community. This approach means that even if climate change does not happen we have lost little and achieved objectives which may not otherwise have been possible. We believe Project Rainbow Bee Eater is one of these desirable strategies.

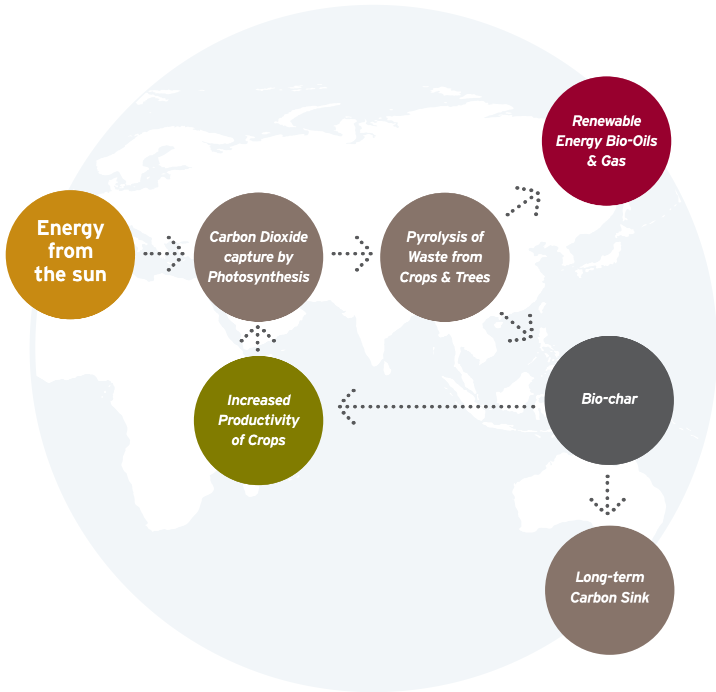


Fig.1. The Rainbow Bee Eater Process

The Concept

The components of the Rainbow Bee Eater process are not new and the concept is simple. Fig.1.

The centerpiece of the process is pyrolysis of biomass or, more simply, the conversion of plant material under anaerobic conditions to form Biochar (a special type of charcoal) and renewable energy. Charcoal is probably one of the earliest products manufactured by man. Its capacity to enhance plant productivity was demonstrated 2000 years ago in the Amazon basin, and has been used in Japanese agriculture for centuries. But Project Rainbow Bee Eater is not just biochar production. It is a systems approach based on integration of comparative advantages that exist in regional Australia to produce multiple environmental, economic and social benefits.

Key Elements of Project Rainbow Bee Eater

Pyrolysis or Carbonization of Biomass

While making charcoal is not new, the "old" methods – pits, drums, earth or metal kilns-are inefficient (low carbon recovery), dirty and often unsafe and, for anything but boutique or metallurgical uses, too expensive. There are a variety of new methods of producing charcoal but most that we have observed require large capital and operating costs and, to be efficient, they must be large scale. If biomass is to be used in product manufacture or power generation the manufacturing site or power station must be close to the biomass source because transporting raw biomass is expensive. The Rainbow Bee Eater Project is fortunate that it has access to the new Crucible Carbon Pyrolysis (CCP) process invented and patented by a Newcastle based company Crucible Group Pty. Ltd.

This process:

- Has low capital and operating costs and is clean and safe
- Is very efficient - the energy required to remove moisture from the incoming biomass is not lost to the atmosphere
- Produces a clean biogas requiring minimal treatment before its use for electricity generation
- Is modular so the scale or input of biomass can be adjusted to optimize the cost of delivering biomass.

Availability, Collection and Transport of Biomass

It is possible that "purpose grown" tree or agricultural crops could be used for feedstock. But when the constraints of transporting biomass are relieved large quantities of "stranded" biomass are available throughout regional Australia.

Our first target was the biomass by-product of Mallee Eucalypts that had been grown and harvested for eucalyptus oil. One of the attractions of this source was that only a small proportion of the energy derived from feedstock, that was a by-product of the distillation process, was needed to replace diesel fuel which is used to produce the steam for distillation. This still remains a potential source of feedstock, but a larger and immediately available source of largely stranded biomass exists in the form of the straw by-product of wheat harvesting. Other agricultural crops also generate stranded biomass.

Another potential source of biomass is the waste derived from tree crop plantations. For example, in the Albany region (WA) approximately 500,000 tonnes of waste are being generated each year from Tasmanian Blue Gum tree crops, which are being harvested for high quality woodchip feedstock for paper production in Japan.

The cost of harvesting and collection of biomass can be minimized by using existing systems. For example, wheat straw is already harvested and deposited on the ground behind the harvester where it provides a reservoir of seeds of weeds which are increasingly becoming resistant to herbicides. There is existing machinery that can collect the straw from the back of the harvester and bale it without it touching the soil. There are systems of harvesting blue gums which cut and transport the whole tree to a central landing where the waste (branches, bark and leaves) is stripped from the bole and deposited at the landing site. Transport distance will be minimized because of the capacity to scale the pyrolysis unit. In addition, most broad acre farms have a number of trucks which are not used for long periods during the year, leaving them available for transport of biomass and biochar.

We estimate there is the potential to convert existing stranded biomass together with increased planting of Mallee Eucalypts to offset 100 million CO_2e tonnes annually in Australia.

The Benefits of Biochar

The most important characteristic of biochar, in the context of bio-sequestration, is its permanence. Under existing carbon accounting rules, plantation forests can be used to offset greenhouse gas emissions – provided they are maintained, unharvested, for one hundred years after the "carbon credit" has been claimed. It is difficult to be confident that the assumption that "permanence" equates to a one hundred year sink will be sustained in the post Kyoto accounting system. But even if it is, maintaining the initial numbers in a tree plantation for one hundred years ignores simple forestry principles.

Individual trees within forest stands face increasing competition as the stand develops and a large proportion of the trees that are planted will die long before one hundred years. If the products from tree plantations are recognized as carbon sinks, then trees that would have died and oxidized can be thinned and the carbon sink losses partially avoided, provided the products have a long carbon life. But this requires institutional and legal mechanisms that will ensure rigorous management and accounting systems are maintained throughout the life of the forest sink - many years after the credit for the carbon sink is claimed.

Another simple forestry principle is that individual trees and stands of trees have an upper limit to their growth potential and, over time, their growth rates decline and can become negative. The carbon credit for an unharvested tree crop can only be claimed once in the rotation and will be equal to the maximum site potential which will be achieved relatively early in the rotation. Thus, increasing the sink can only occur by planting new tree crops.

In contrast biochar buried in the soil has a half life of thousands of years, is safe from fire and has no contingent liabilities. Feedstock for biochar production from annual crops, or tree plantations that are harvested on a short coppice rotation, can be sustained at a high rate of production and biochar production can be terminated at any stage without any carbon liability. This means that the area of land required for a sink is much less relative to an unharvested tree crop than that which is required for tree crops harvested for biochar with a short coppice rotation regime.

Biochar has other benefits. In experimental trials in the greenhouse, orchard and agricultural – trials in a large range of climatic and soil conditions in many countries – biochar soil amendments have increased the productivity of a wide range of agricultural and tree crops. Biochar has been shown to significantly increase (10% – 25%) wheat productivity in field trials undertaken in the Western Australian wheat belt. These increases have been achieved at fertilizer rates half of standard practice. There are many scientists around the world investigating why biochar can increase crop productivity. There is no single process which can account for the increase in soil fertility, but biochar does increase the population levels of beneficial microorganisms, increase the capacity of soils to retain nutrients and can increase soil moisture retention. We have not observed any negative effects of biochar on soil or crops (protein content of wheat has been significantly increased) at application rates ten times those that would be applied.

Biochar can be incorporated in bands below the crop rows using existing minimum tillage techniques which deliver seed and fertilizer under air pressure through hoses located behind the tynes. The current system does require modification for the larger quantities (10 – 20 tonnes per hectare) of biochar which will be applied. For our field experiments, we have only achieved these levels of application by multiple passes of the seeder.

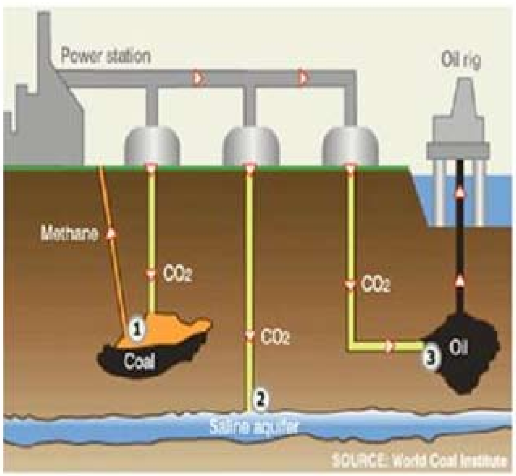
Renewable energy

An initial life cycle analysis of Project Bee Eater indicates that each dry tonne of biomass will produce 1/3 tonne of biochar and 1MWh of electricity from biogas. As the biochar is approximately 75% fixed carbon, it sequesters 1t CO_2e. Electricity generation will be continuous and at an estimated cost lower than wind power.

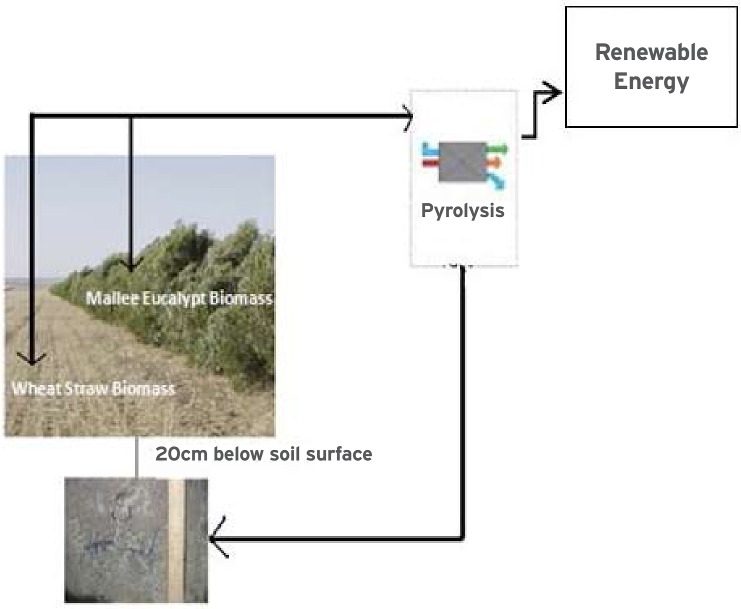
Conclusions

Sequestration using biochar and renewable energy production derived from pyrolysis of biomass is very similar to Carbon Capture and Storage (C.C.S) which is accredited as a carbon emissions reduction process. Fig.2. Unfortunately, under the perverse accounting rules which derive from the Kyoto Protocol, our advice is that biochar cannot currently be accredited. This is, firstly, because Australia has opted out of the agriculture emissions sector, but also because CCS avoids emissions whereas biochar, even though it is a carbon negative process, does not avoid the emissions from a point source.

We believe Project Rainbow Bee Eater could process 14 million tones of biomass in Australia by 2020, by integrating the process into the existing agricultural system in regional nodes. This approach capitalizes on stranded biomass, a byproduct of agricultural and tree crops, stranded capital invested in agricultural machinery which is not used when seeding and harvesting operations are not being undertaken and the skills and innovation of the farming community.



Carbon Capture & Storage



Biochar "Carbon Capture & Storage"

Fig.2. Two Approaches to Carbon Capture and Storage

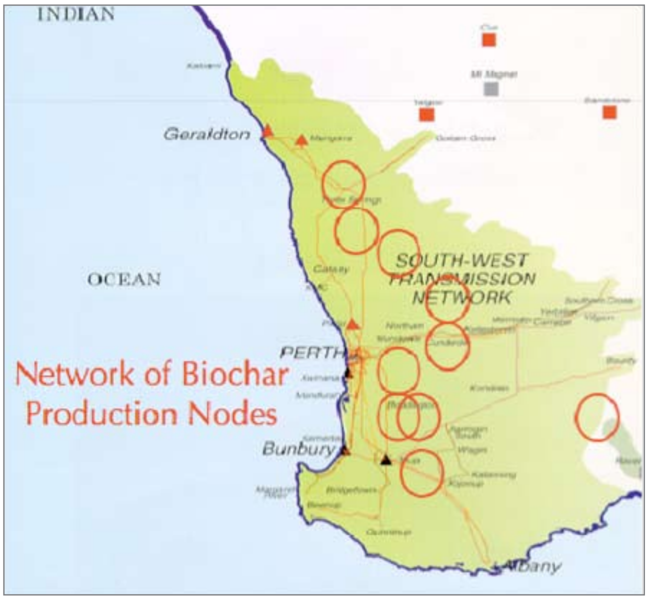


Fig.3. Project Rainbow Bee Eater will be integrated into existing agricultural areas

Pyrolysis of 14 million tones of biomass in Australia (1/2 in WA) would:

- Sequester 20 million tones of CO_2e annually as biochar at a cost of less than $20 per CO_2e tonne. by 2020
- Generate 12,000 GWh per year of low cost distributed energy. This is one third of Australia's renewable energy target.
- Create 1000 direct jobs in regional Australia
- Provide the profit motive for establishing trees on farms - which will reduce soil and water degradation

We acknowledge that research on biochar should be continued, but we are confident that the scientific knowledge of the process is sufficient to proceed.
We are not aware of any environmental or safety problem that would result from biochar and renewable energy production using the Rainbow Bee Eater system. There are commercial risks which cannot be tested until we have a pilot operational trial. While the project can proceed without accreditation of biochar as a carbon sink, failure to achieve accreditation of biochar at Copenhagen will severely constrain the potential of Australia to capitalize on its comparative advantage to use bio-sequestration as a significant component of its carbon pollution reduction target. CE

About the authors

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