Biological carbon capture and storage (*Bio CCS*) demonstration projects

Outline

Bio CCS offers large-scale and commercially viable sequestration of carbon dioxide from point source emitters as well as drawdown of legacy CO2 from the atmosphere.

The demonstration projects in Gippsland, Queensland, Western Australia and imminently in China and India, offer significant benefits to all levels of Government, to large industrial emitters, and to agriculture and the broader community.

Big and broad benefits

- Governments benefit by being able to support and meet high international targets for greenhouse gas reduction
- Industry benefits by having access to abundant, economic offsets and a 'carbon bridge' to cleaner sources of energy and production
- Agriculture benefits as the CO2 is returned to soil (as beneficial soil carbon) and is available for accelerated plant photosynthesis
- Communities benefit from cleaner air, water and soil as well as new job prospects and economic stimulus to their region
- Next generation industry benefits from the shaping of new markets for 'green' products and services that appeal to investors and consumers.

The projects are relatively low cost at the capex stage, offer considerable operational expenditure savings and significantly reduce 'externality damage' to health, soils, waterways, and food production.

A short outline of what is included in *Bio CCS*

Some of the approaches used in the demonstration projects (as outlined in the attached schematic) are:

Soil carbon – using improved farm management processes based on biology and non-synthetic chemical fertilisers *Biological Farming/Fertilisation Systems* (BFS); use of lignite and nutrients to repair degraded soils, rebuild carbon and mineral levels; natural sequence farming; reduced tillage; plantstone (phytosilica) crops; this increases CO2 uptake by photosynthesis and increases agricultural productivity and resilience

CO2 to energy - algae sequestration of point source CO2 emissions with by-products of oil, biodiesel, plastics, animal meal, soil fertilisers

Forests – appropriate site selection for forest/reforestation/native vegetation replanting; transfer of airborne CO2 to cellulose

Biogas – biological breakdown of organic matter in the absence of oxygen; production of biogas and concentrated nutrient fertiliser

Biochar – pyrolysis (including by microwave) of natural wastes/organic matter to create biochar providing permanent carbon storage in soil

Grazing land management – rotational grazing patterns to restore soil's ability to store carbon via photosynthesis. Additional benefits include improved water retention, greater drought tolerance, increased biodiversity and decreased cost of production leading to improved profitability and sustainability

Biomass to oil – uses hydrothermal process to convert low-valued feedstocks (ancient biomass (coal) and modern biomass (plant material and algae)) into high value oil and coal products

Depending on the process used carbon becomes a feedstock of value as opposed to a 'waste' and/or is safely sequestered in soils.

Biodiesel production has particular importance to agriculture as algae synthesised fuels do not compete with food crops for soil or water. It is also important to recognise that in developed and many developing countries diesel is essential for on-farm activity and supply chain delivery - any global shortages of diesel would have an immediate and dangerous impact on food productivity.

Clearly in the above projects some of the CO2 will be released back to the atmosphere but is after recycling and replacement of further emissions from fossil fuels. However, depending on the processes in each project a large percentage of the CO2 is stored productively and beneficially in soil.

Recommendations for Government action

Bio CCS should be considered an integral part of the CPRS and as an applicable abatement/mitigation offset in international carbon accounting.

Even if only considered as a 'carbon bridge' *Bio CCS* will help offset fossil fuel emissions at very low cost, safely, at considerable scale, and profitably, until such time as geological sequestration of CO2 is proven viable at scale and in time to make a material difference to atmospheric concentrations of GHGs (and at the time of writing this is not expected to occur before 2020 at the earliest and more likely 2030+ which may be too late to avoid excessively high peaking of GHGs in the atmosphere).

The proponents of *Bio CCS* believe this approach provides an excellent opportunity for all levels of Australian Government and a broad cross section of Australian business to make Australia the lead developer of terrestrial and biosequestration of CO2 alongside geological CCS demonstration.

Such *Bio CCS* projects can deliver the required GHG reduction needed by Australia by 2020 and through to 2050. And, as low cost offset they free up funding for economy wide energy efficiency measures and the development of large scale renewable projects.

In this context it is recommended that the Global CCS Institute also embrace *Bio CCS* alongside trialling geological storage (*Geo CCS*) as part of the national and international GHG reduction solution. Many large Australian GHG emitting companies are very interested in such *Bio-CCS* demonstration projects as they recognise the potential to deliver low cost, high-confidence carbon credits/offsets that can insulate their businesses and employment from future price volatility in the carbon market.

Independent analysis of terrestrial and biosequestration potential

CSIRO have confirmed the possibilities for large scale biosequestration of CO2 in the rural landscape - in the August 2009 CSIRO 'National Research FLAGSHIPS' report on *'Sustainable Agriculture – An Analysis of Greenhouse Gas Mitigation and Carbon Biosequestration Opportunities from Rural Land Use'*. This report was commissioned by the Queensland Government and states that Queensland could 'attain' 77% reduction of its annual greenhouse gas emissions (being 140 Mt CO2e/yr) through change in rural land use, in particular via forestry, land-clearing avoided, and better management of cropping and rangelands (not including change of land use, such as crops/pasture to trees). The report notes a technical potential of 293 Mt CO2e/yr abatement from terrestrial GHG management, in Queensland, for the next 40-50 years (after which saturation of soil carbon may reduce sequestration).

The same potential (scaled accordingly) exists for all States, using a range of natural biological sinks as outlined above

Project background
Industry has developed the prototype for three *Bio CCS* commercial scale demonstration plants (Gippsland, Queensland, Western Australia). The Gippsland project was the first selected because of the high concentration of brown coal-fired power plants impacting on the area; the vast deposits of lignite (brown coal) which while having a high concentration of water, does not contain mercury or other heavy metals making it suitable for the large-scale manufacture/distribution of *Biologic Fertiliser* because of its unusually high humic/fulvic content.

The proponents are also working with China and India to simultaneously develop projects in those countries and are seeking the support of the United Nations, the Clinton Foundation and others. The reason for China and India being the first international projects is because of those countries' short-term reliance on coal for energy and the foreseeable food shortages because of soil degradation and erosion.

Conclusion
These *Bio CCS* demonstration projects will prove internationally important in the battle against climate change. Commercial deployment of Australian innovation designed to reduce legacy CO2, and offset the emissions from current economically essential industry, will be the basis for *'new markets, new industries and new jobs'*. The knowledge and systems will be applicable and exportable to countries/continents like China, India, Africa, Middle East and the Americas, as a global solution for the next half century to enable safe transition to low emissions energy sources.

Appendix note
Two further papers by CSIRO are relevant:

- *A CSIRO paper from 1997, recommends that "There is considerable potential to sequester carbon into agricultural soils in Australia and it is suggested that Australia should argue for their inclusion in the allowable sources and sinks." (Estimates of soil carbon depletion/sequestration-opportunity are very low and have been upgraded by orders of magnitude in subsequent science papers)*
- *The second is an article by CSIRO's Dr Jeffery Baldock talking about mid-infrared (MIR) spectroscopy "A new simple, fast and inexpensive technique for measuring carbon in soils"*

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