

CO₂ to energy

Capture and conversion of CO₂ emissions for the sustainable production of valuable commodities



Tony St Clair
Commercial-in-Confidence



The Australian Leader in large scale, algae based bio-fuel and food production, and CO₂ bio-sequestration...MBD est. 2006

- Strong and experienced Board and Executive Management Team
- A compelling sustainable solution to 3 significant issues: oil, food and CO₂
- MBD's total-engineered approach is delivering a system that enables large scale industrial growth of algae in MBD's CO₂ to energy hybrid system
- IP owned by MBD: existing and growing patent portfolio
- Exclusive relationship, and access to proprietary algae libraries, with world leading algae research expertise at the James Cook University (JCU), QLD
- Existing large scale Research and Development Facility (5000m²) at JCU
- Signed Formal Agreements with 3 major Australian CO₂ emitters (Binding Contracts/MOUs)
- Advanced design work on fully automated 1 hectare (ha) module - insitu, Display Plant
- Partnerships with Key Tier-1 suppliers

MBD's CO₂ to energy Process Overview



CO₂ Emitter

Greenhouse gases from emitter collected at the base of the flue gas chimney and piped to MBD Algae Farm.

(CO₂ NO_x SO_x)

e.g.

- Power Plant ,
- Gas Plant & Refineries,
- Cement Kiln,
- LNG Facility,
- Coal Seam Gas Production,
- Other processes...

Sunlight



Waste Nutrient

N, P, K, S



- Sewerage
- Waste from feedlot
- Waste water
- *Supplemented with*
- Commercial fertilizer



Algae Synthesiser Farm

Land (low value buffer)

Each Million tonnes of CO₂ e sequestered produces the following outputs:

550,000 tonnes of algae:

- 180,000 tpa algae oil
- 370,000 tpa nutritious livestock feed

O₂

H₂O



Algae Oil 35% Oil Options Include

- Biodiesel Production
- Plastic Production
- Jet fuel, other fuels



Algae Meal 65% Meal Options Include

- Feed for livestock industry
- Feed for fertilizer
- Biomass for bio-plastic production
- Biomass for electricity production

100% of algae used as value added product

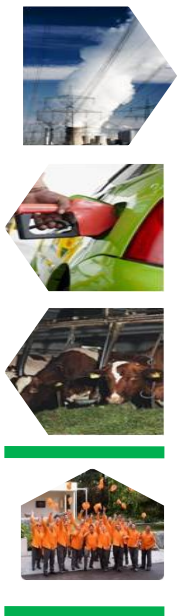
Typically, 1 ton CO₂ emitted per MWhr generated

Require ~2 tons of CO₂ per 1 ton of algae grown

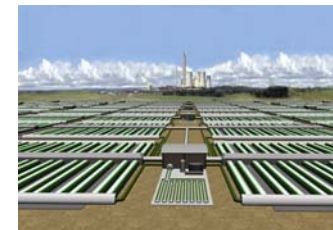
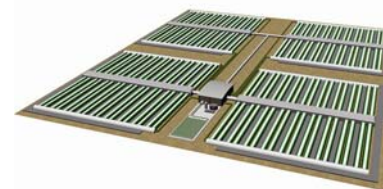
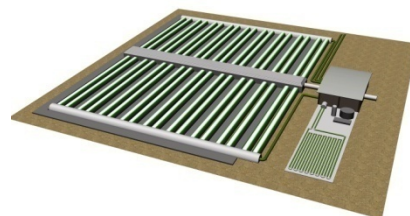
Require ~1000+ Ha Land per 1 M tons of CO₂

Scale Up 3 Stage Process

Display / Pilot / Demonstration



	Stage 2		Stage 3
	Display Plant (Proof of Concept)	Pilot Plant (Commercial Operation)	Demonstration Plant
	Phase 1 (1 Ha Module)	Phase 2 (80 Ha Expansion)	Large Scale Roll Out
Indicative Capital Cost (A\$M)	\$3.5M+	\$30M	\$300M+
Commence Operation	1Q 2011	Progressive Build: 2012 Full Operation: 2013	: 2014 : 2015
CO ₂ e Abatement p.a	800 T	70,000 T	>1.4M T
Algae Production (tpa) (productivity 120g/m ² /d)	400	35,000	700,000
Algae Oil Production	120 T (140,000 litres)	10,000 T (11 M litres)	250,000 T (300 M litres)
Algae Meal Production	280 T	25,000 T	450,000 T



MBD's R&D Facility (JCU Townsville)



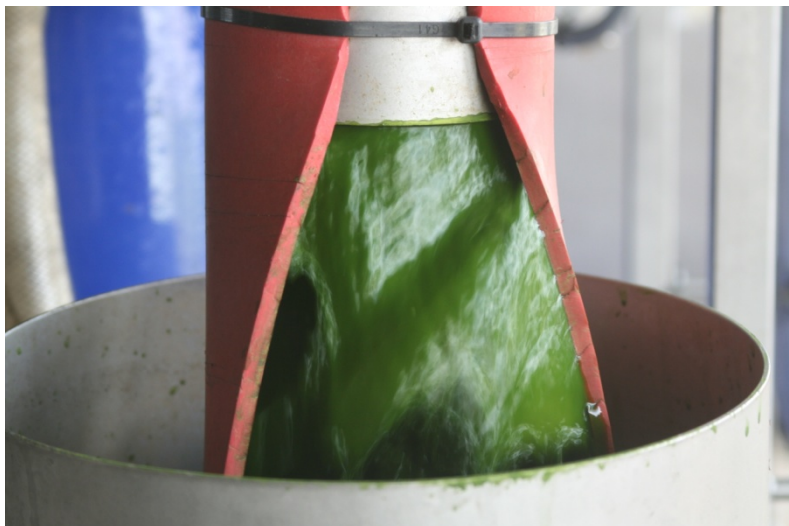
The expanded R&D facility is developing the following key development information:

- Optimisation of the algae growth systems, strains, nutrient levels
- Harvest and extraction process
- Base for support and assessment of MBD projects and algae operations
- Monitoring and automation of the growth and harvest processes
- Education and training associated with the project and processes
- International best practice in the Algae research and development.
- Central Control Centre for MBD's projects both in Australia and internationally.



R&D Facility: Photo-Bioreactor System

Centrifuge, Harvesting and Oil Separation



Productivity Data Chart

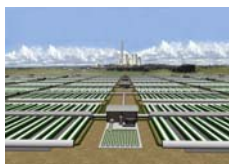
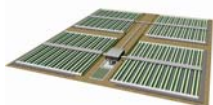
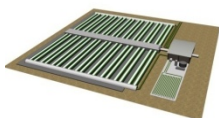
Base / Current / Target / Aspiration



	Base - Benchmark	Current	Design Target	Design Aspiration
Dry Weight Production (g/m ² /day)	20	30	60	120
Depth (m deep)	0.3	0.3	0.6	0.9
Carbon Fixing (CO ₂ /Algae Ratio)	1.8	1.8	1.8	1.8
Harvest %	25	25	50	75
Oil Content %	30	30	40	50

Current Yield parameters

- Wet Weight (g/l)	2	
- Dry Weight (g/l)	0.4	
- Depth (m)	0.3	
- Harvest (%)	25	
- Dry Weight production (g/m ² /day)	30	



Carbon Capture Comparison

Sequestration of all CO₂ emissions from 1000 MW Brown Coal Power Station



Post Carbon Capture and Storage

Collection, concentration, liquefaction of CO₂ and storage in ground

Emitter to fund large capital and operating costs
 No income from CO₂ based products.
 Feasibility at \$25/T appears questionable.

MBD's CO₂ to fuel Solution

Collection, consumption and use of CO₂ for Algae based value added products.

Emitter not required to fund costs.
 Significant value creation from algae products
 Project feasible independent of carbon price

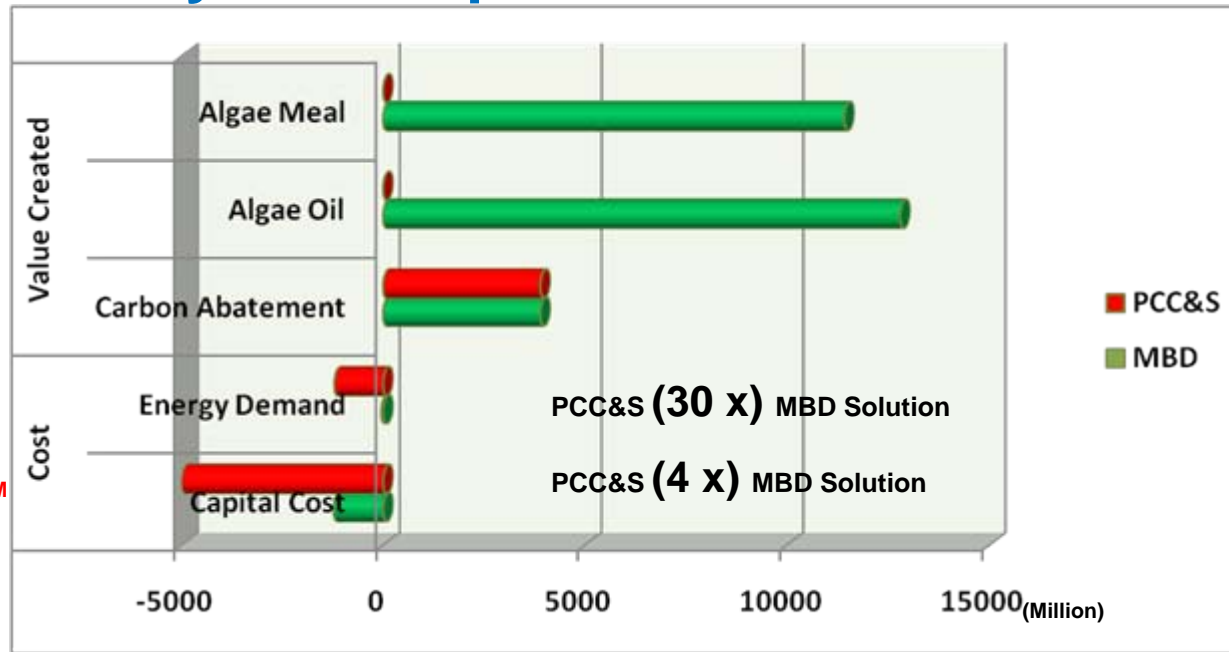
20 year comparison of value created

PCC&S Value Creation -\$2.2B

Annual Value Created
 - Carbon Abatement \$225M
 - Algae Oil income \$0M
 - Algae Meal income \$0M]

Annual Energy Demand 30%, 300MW
 \$79M p.a. (@ \$30 /MWh)

Capital cost over 20 years \$5000 M



MBD's CO₂ to fuel Value Creation \$26.8B

Annual Value Created
 - Carbon Abatement \$225M
 - Algae Oil income \$740M
 - Algae Meal income \$660M

Annual Energy Demand 1%, 10MW
 \$2.7M p.a. (@ \$30 /MWh)

Capital cost over 20 years \$1225 M

MBD developed comparison – figures are provided for quantum comparison only.
 Detailed comparisons to be developed for each specific site and operation.
 All figures in Million Dollars

Assumptions:
 Carbon Credit Value \$25/T, CO₂ sequestered 9MT, Oil \$800/T, Meal \$400/T,
 Value MW = \$30, 100% Plant operation (8760 hours per year), PCC&S 5 year scale up, MBD 5 year scale up
 All figures per tonne and based on 1 years operation.
 * Estimated plant capital costs for 20 year project.,

Sustainable Bio-CCS projects for 2020 & beyond

Biological Carbon Capture & Storage ready today for a cleaner tomorrow



Bio-CCS presents Australia with an immediately available bridge to a lower carbon future

It is within our immediate reach to transform three key regions in Australia, presently producing very high levels of industrial greenhouse gas emissions, into internationally significant examples of pragmatic major action on large-scale CO₂ mitigation. Harnessing and enhancing the Earth's natural capacity to consume and convert greenhouse gases, these proven Bio-CCS CO₂ abatement solutions are the only large-scale, viable, ready-to-implement clean-up technologies, available to Australia now.

Sequestration

Minimum 25% CO₂ abatement by the year 2020

Investment

- Approximately AU\$1 billion of regional investment per program (A total of AU\$3 billion)

Jobs

- 15,000 new long-term jobs;
- 10,000 existing jobs protected

Key project technologies

Soil Carbon - *Lawrie Co & Ignite Energy / Plantstone Technology / Adveco Fertilizers*

CO₂ to Energy - *MBD Energy*

Forests - *CO₂ Australia & New Forests*

Ocean Nourishment – *ONC Corporation*

Biogas – *Spectrum Renewable Energy*

Grazing Land Improvement - *Soil Carbon Australia*

Biomass to oil – *Ignite Energy Resources / Licella*

Environment

Reduced nutrients in rivers and lakes;
Millions of tonnes of fresh oxygen;
Increased soil carbon and soil repair.

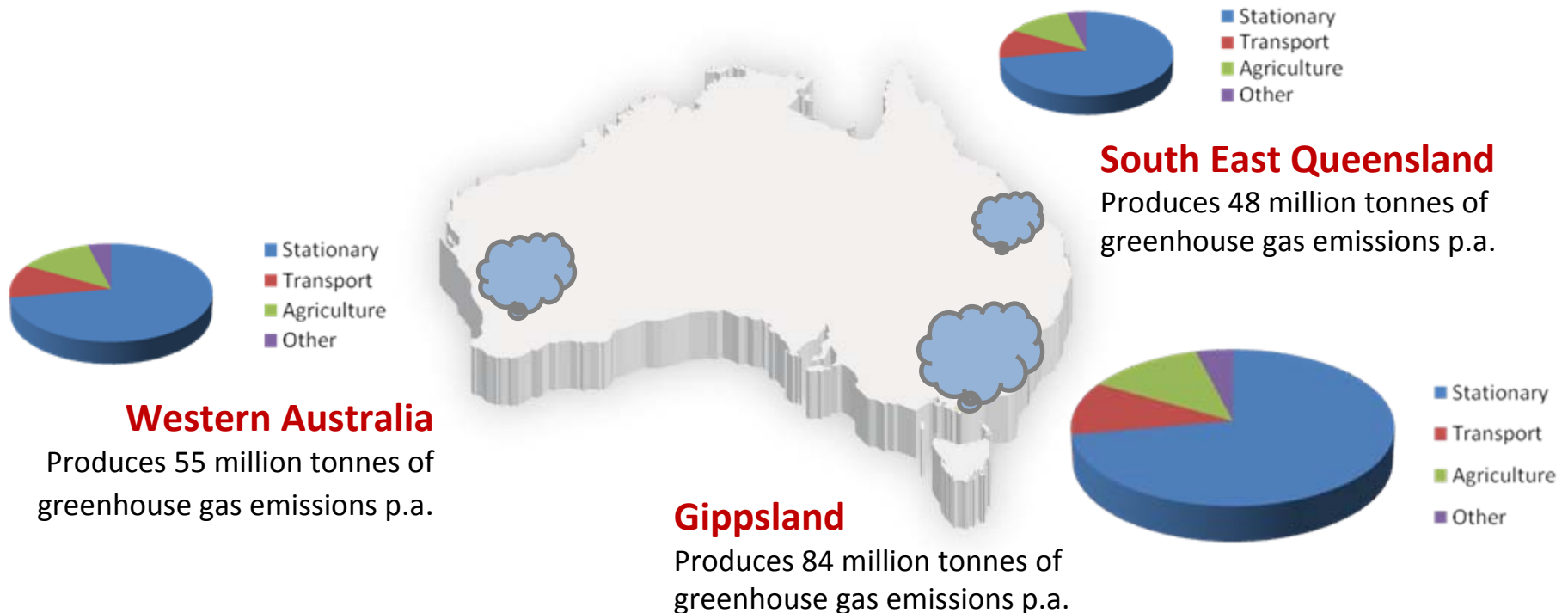
Offsets

- Increased oil & fuel security with 80 million barrels produced per annum;
- Feedstock security with production of 11 million tonnes per annum;
- Biogas for clean energy production;
- Carbon-based recycled fertilisers;
- 10-20% farm productivity increases

Bio-CCS can cut our CO₂ emissions by one quarter

Projects that value CO₂ as a feedstock, not costly waste

*Australia's total greenhouse gas emissions are currently 600 million tonnes per annum.
By initially focusing on just 3 regions with high emissions, Bio-CCS can cut Australia's total emissions by one quarter within just one decade.*



Bio-CCS major demonstration projects for 2020

No other clean-up technologies are as effective, affordable or ready



Australia is the world's biggest coal exporter . . .

Australia is the world's biggest coal exporter. Clearly it is very strongly in Australia's economic interest that the country demonstrate it's capacity to use readily available and affordable Bio-CCS emissions reduction solutions to cut greenhouse gas emissions from the countries coal-fired heavy industry and from other sources by a minimum of 25 per cent in each of the three project regions by 2020.

In all, more than 150 million tonnes of atmospheric CO₂ will be removed either by direct carbon capture and storage or by drawing down legacy emissions already gathered in the atmosphere.



Key environmental outcomes

- Improved air and water quality
- Millions of tonnes of O₂ added to the air we breathe
- Less stress on food producing farmlands
- Reduction of nutrients in waterways
- Retention of water in soil
- 0.15% increase in soil carbon per year
- Carbon based fertilisers to repair degraded soils

Carbon capture and storage success before 2020

Harnessing proven processes to engineer major CO₂ emissions reductions



Major jobs creating projects ready to start now



Investment
>AU\$1 billion per region



Jobs

- 15,000 new long term jobs
- 10,000 or more existing jobs protected



Carbon capture and storage success before 2020

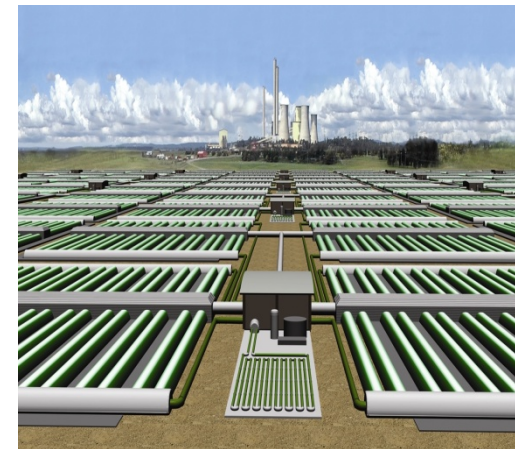
Harnessing proven processes to engineer major CO₂ emissions reductions



Project earnings to offset private sector investment



Investment
>AU\$1 billion per region



Earnings to offset investment

- Oil / fuel security, 80m barrels of oil p.a.
- Feedstock security 5.5m tonnes p.a.
- Reduced emissions coking coal
- Biogas energy production
- Carbon based fertiliser production
- 10 - 20% increased farm productivity

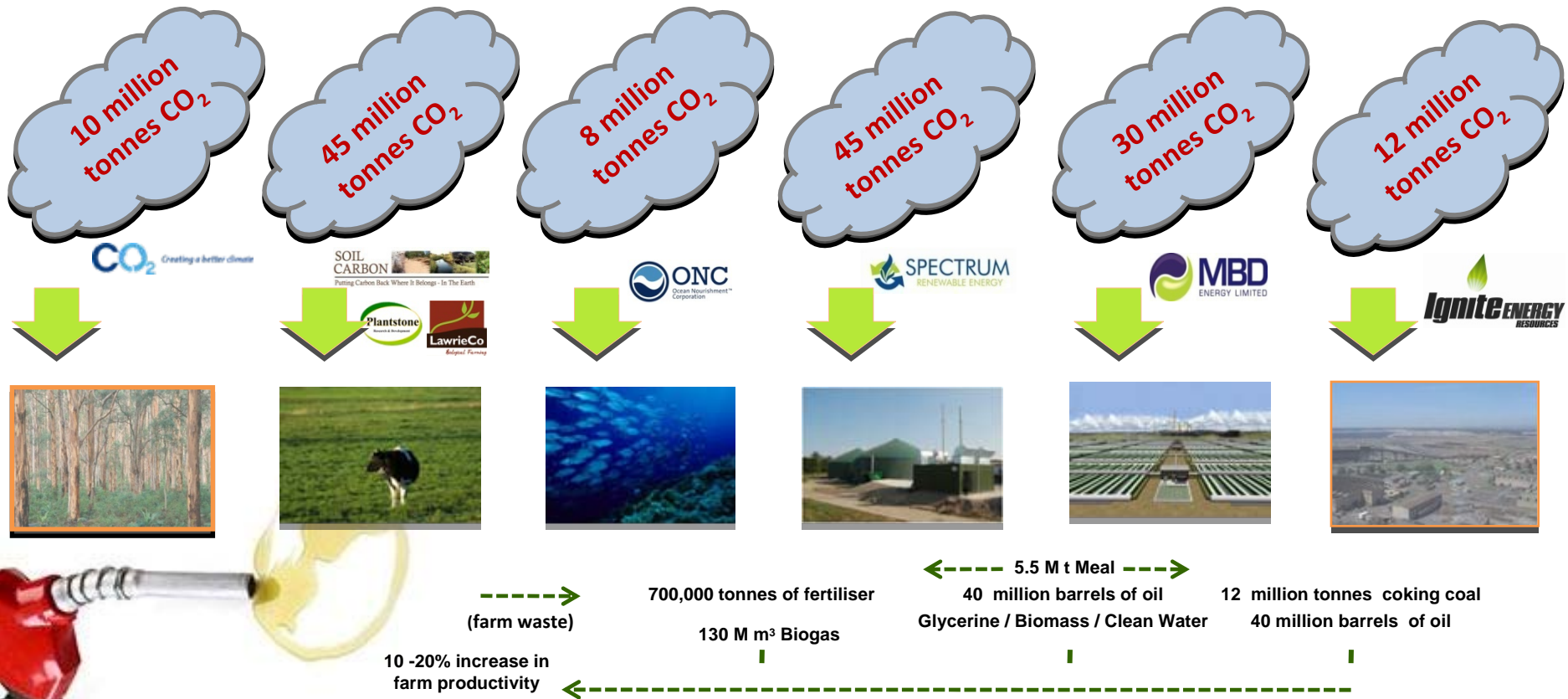


Carbon capture and storage success before 2020

Harnessing proven processes to engineer major CO₂ emissions reductions



Together these project-ready Bio-CCS technologies can cut CO₂ by 150,000 t.p.a by 2020



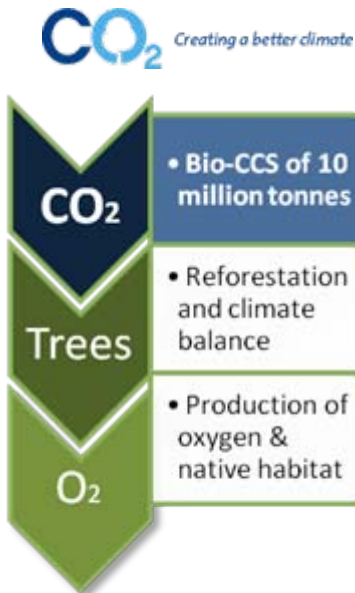
The algae oil produced will reduce net greenhouse gas emissions by use of CO₂ waste to make fuels and plastics.

Major regional projects that reduce CO₂ emissions

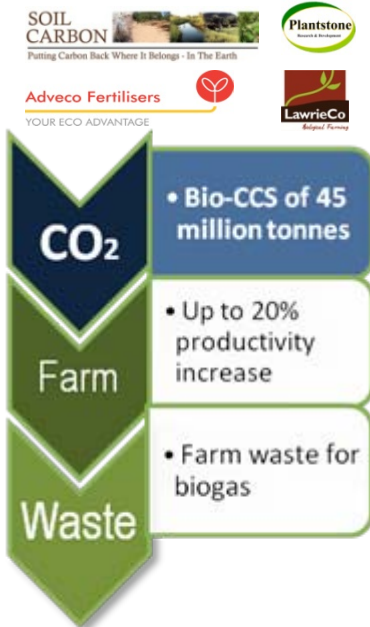
6 projects in 3 regions together offering cuts of 150 million tonnes of CO₂



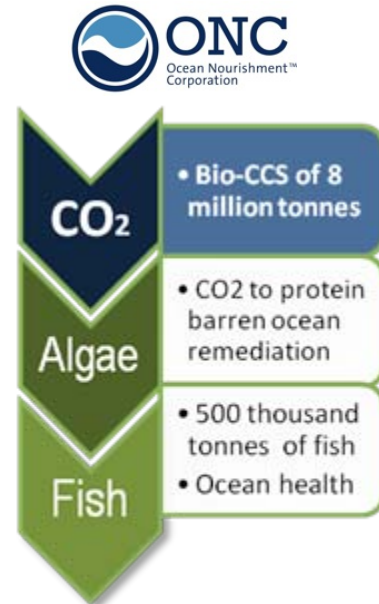
Forestry



Soil



Oceans

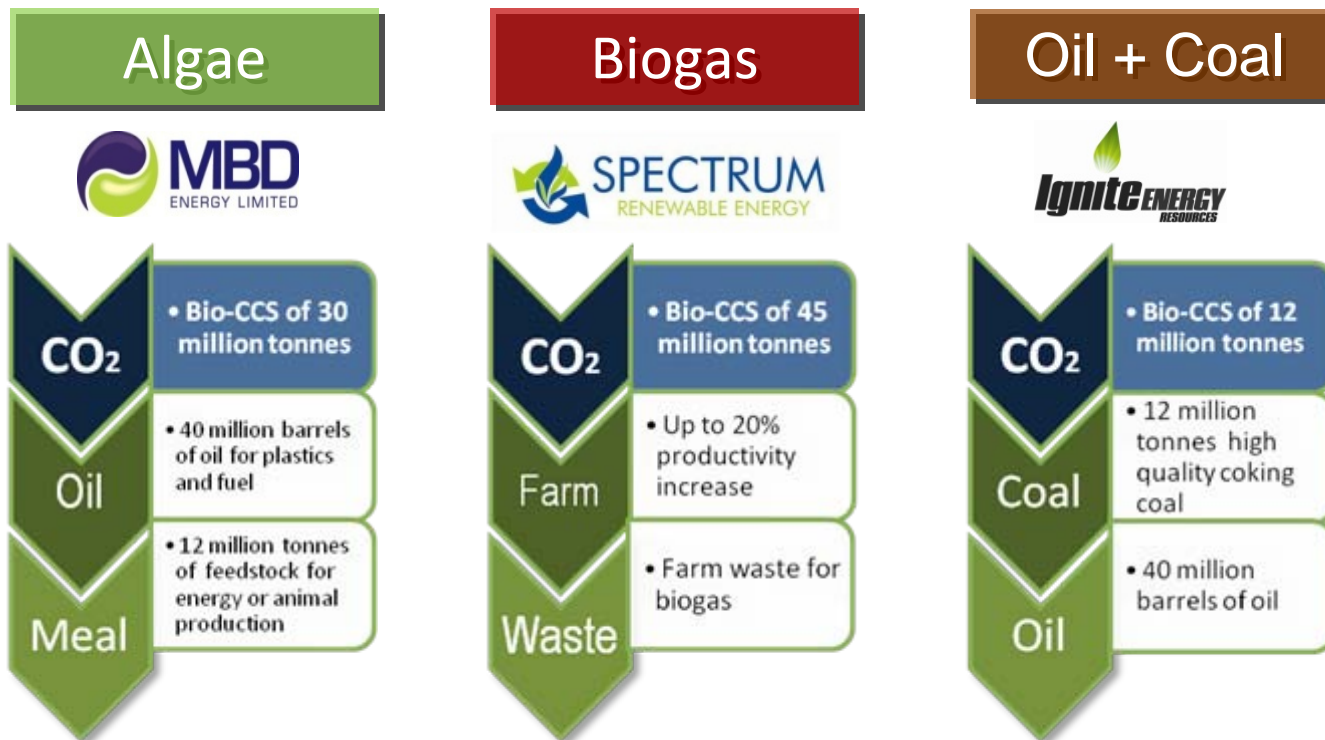


Commercial commodities to fund capital investment in Bio-CCS



Major regional projects that reduce CO₂ emissions

20 projects in 3 regions together offering cuts of 150 million tonnes of CO₂



Commercial commodities to fund capital investment in Bio-CCS



If the fast-track reduction of industrial greenhouse gas emissions really is the major challenge of our time – nothing will excuse failing to act on Bio-CCS.

Harnessing nature's solutions:

Throughout the history of technological advancement – a great many solutions to some of the greatest scientific challenges have been found by studying the example of nature. Biological carbon capture and storage (Bio-CCS) harnesses the Earth's natural capacity to consume and convert greenhouse gases in order to create industrial processes that can speed up this age-old cycle to a commercially viable timeframe.

Treats carbon as a valuable feedstock – Bio CCS takes CO₂ and creates commercial products:

There is no dispute about the science or effectiveness of Bio-CCS in efficiently and very effectively consuming and converting greenhouse gases, including CO₂. The world needs sizeable reductions in greenhouse gas emissions from stationary industry such as coal fired power stations, smelters and refineries – which account for the vast bulk of Australia's emissions.

Sustainable energy, fuel and food production:

Bio-CCS may not be as 'boldly interventionist' as some emissions reductions policy options; it is unashamedly about doing simple, obvious things like planting more trees, putting carbon back into soil for ecology enrichment and farm productivity. It is also about capturing industrial flue-gases and using them as feedstock to promote growth of oil-rich algal biomass to help secure future supplies of green energy, food and clean water.

The projects are ready.

The equivalent of one quarter of Australia's total greenhouse gas emissions can be cut with the creation of 15,000 new jobs and protection of 10,000 more with Bio-CCS.

The on-going debate over the cost and impact of the Government's emissions trading scheme is unnecessarily delaying action on CO₂ emissions reduction giving other countries a chance to pre-empt Australia's commercialisation of cutting-edge low carbon technologies and infrastructure.

Bio-CCS represents a ready to construct '**Carbon Bridge**' to a future lower carbon economy. If Australia is to avoid missing out on significant early emissions reductions and global commercial opportunity, then a very substantial shift of policy focus will be required from the Australian Government.

It is both feasible and highly desirable for Australia to commence several large-scale Bio-CCS greenhouse gas reducing projects in 2010 – even whilst complex issues associated with the Government's proposed emissions trading scheme or a possible tax on carbon remain unresolved.

The cost to Government and industry will be modest and off-set by commercial earnings from income producing Bio-CCS projects as well as large-scale jobs creation. No other suite of industrial emissions clean-up technologies is as affordable or capable of achieving such deep emissions cuts over the coming decade.

Emissions reduction pragmatism says '*act now*'

Bio-CCS offers everything that is out of reach with other solutions



Discussion

Questions?

Emissions reduction pragmatism says *'act now'*

Bio-CCS offers everything that is out of reach with other solutions



Background Slides attached

Bio-CCS can cut our CO₂ emissions by a quarter

Getting on with real projects to deliver a sustainable and rewarding future



Available large-scale abatement solutions



CO₂ to energy - MBD Energy

MBD technology uses algae to recycle captured industrial flue-gas emissions by conversion into oils suitable for manufacture of high grade plastics, transport fuel and nutritious feed for livestock. MBD has developed a fully operational research and development facility and is currently moving to full scale Display Plants at a number of Australia's major coal-burning power stations.



Grazing land management - Soil Carbon Australia

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

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Available large-scale abatement solutions



Soil carbon - *Plantstone Technology*

Plant selection based on carbon storage. Plantstone carbon (also known as silica phytoliths) is a practical and proven technology developed in Australia to enhance the secure and permanent biosequestration of carbon in silica that vegetation draws from the soil.

Research is underway to demonstrate the crop cultivars capable of maximum carbon sequestration. Grassy crops such as wheat, sugarcane and bamboo offer significantly high carbon sequestration in silica phytoliths. This form of biosequestered carbon can be readily quantified at plant/hectare level and the permanence of carbon storage is >1000 years as the silica 'shield' is impervious to fire or biological breakdown.



Soil carbon - *Lawrie Co / Ignite Energy Resources / Adveco Fertilizers /*

Biological farming/fertilisation systems (BFS). Use of lignite, other nutrients and biology to improve soil and increase soil carbon - enhanced natural fertiliser to catalyse CO₂ uptake by photosynthesis and increase agricultural productivity and resilience.

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Getting on with real projects to deliver a sustainable and rewarding future



Available large scale abatement solutions



Forests - CO₂ Australia/New Forests

Establishment of selected areas for forest/reforestation/native vegetation replanting; transfer of airborne CO₂ to cellulose .



Oceans – Ocean Nourishment Corporation (ONC)

Oceans are recognized as a key component in the sequestration of CO₂. ONC have developed an agricultural process that through nutrient delivery enhances plant growth in surface waters over deep ocean sites. This significantly increases the natural drawdown of carbon to the planet's largest carbon sink (the deep ocean), where carbon remains stored for an estimated 1,000 years. By enhancing the base of the food chain, the process stimulates marine productivity in barren areas of the oceans and thus can play an important role in development of fisheries.

Bio-CCS can cut our CO₂ emissions by a quarter

Getting on with real projects to deliver a sustainable and rewarding future

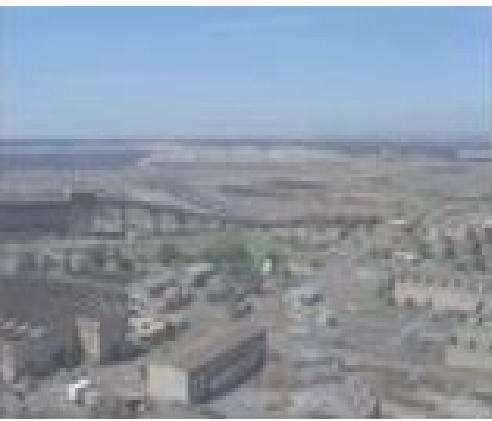


Available large scale abatement solutions



Biogas - Spectrum

Uses well established anaerobic digestion technology to treat wet organic wastes in the absence of oxygen to produce biogas for direct use or for the generation of electricity and heat. The process produces high quality natural fertiliser, reduces carbon emissions and odour and improves wastewater reuse.



Biomass to oil – Ignite Energy Resources/ Licella

Uses hydrothermal process to convert low-valued feedstocks [ancient biomass (coal) and modern biomass (plant)] into high-valued oil and coal products by photosynthesis and increased agricultural productivity.