Submission to the Senate Select Committee on Climate Policy on the Draft Bill to Establish the Carbon Pollution Reduction Scheme in Australia

Carbon Coalition Against Global Warming

15 April, 2009

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The Carbon Coalition is a grassroots organization with more than 800 members across Australia and New Zealand. Members are primarily farmers, graziers, scientists, agronomists and citizens. The Coalition was formed in 2005 and has led the public campaign for recognition of soil carbon sequestration as a source of tradeable offsets/credits to be used as an incentive to change land management practices to deliver the triple benefit of 1. regeneration of farm landscapes, 2. Boost farm incomes and secure local economies, and 3. Massive extraction of GHG from the atmosphere if applied globally.

Michael Kiely
Convenor
Carbon Coaliton Against Global Warming

Benefits flowing from the Recommendations in this Submission

Incentivised Agricultural Soil Sequestration would:

• allow the continued burning of coal for a 30-50 year period without the rate of growth of GHG blowing out.

• allow time for the investment in alternative energy sources to be made.

• allow time for renewable energy to reach baseload capacity.

• allow the transition to a low carbon economy to take place with the least disruption to the economy.

• allow rural economies to make the transition to low emissions practices with the least disruption to employment and grower incomes.

• turn Australian primary producers into landscape stewards in a single generation.

• encourage land managers to change their practices towards those that best buffer the land against the effects of higher temperatures and lower rainfall.

• result in greater water efficiency and higher productivity from lower rainfall.

• create a cooler micro-climate wherever it is practiced across the continent, through the cooling effect of more vegetation and more water held in the landscape.

Response to the Draft Bill to Establish the Carbon Pollution Reduction Scheme in Australia

Carbon Coalition Against Global Farming

15 April, 2009

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Introduction

The Carbon Coalition Against Global Warming thanks the Senate of Australia for the opportunity to have input during this period of consultation. This submission concerns the engagement of the Agriculture sector in Climate Change Mitigation with a sense of urgency:

We Recommend:

1. The immediate inclusion of the Sector in the CPRS; or
2. Its immediate and permanent exclusion; and
3. The inclusion of domestic offsets in the CPRS.

The reason: logic, everyday experience on the land, and leading edge opinion make it plain that the security of the world depends upon its ability to remove vast tonnages of Greenhouse Gases (GHG) from the atmosphere immediately in order to slow the rate of increase while alternative energy platforms reach critical mass. Only Agriculture has:

- *Critical Mass* (farmers command 60% of the terrestrial surface of the Earth)

- *Massive Capacity* (5 billion hectares, each capturing a tiny 0.25 tonnes of airborne carbon, would clean up 60% of the world's excess emissions), and

- *Instant Deployment Capability* (farmers can start sequestering tomorrow).

…needed to remove significant amounts of GHG.

And the only way to gain maximum conversion among farmers is to pay them – SOIL CARBON CREDITS.

The current legislation has targets that will not:

(a) remove any GHG,
(b) slow the growth of emissions; and
(c) meet the crisis in a way that will keep the public from reaching a tipping point of panic.

This submission also proposes an interim solution to the trading of soil carbon which would meet the Government's objectives for widespread adoption of change of land management behaviour overnight while protecting landholders from overexposure to risk and engaging consumers in a process that meets their need for 'doing something useful' about Climate Change.

How Bad Must It Get?

The Carbon Coalition's statements and recommendations in this paper are based upon its awareness of the consequences of the failure of the global community to act fast enough to manage the Carbon Pollution load in the atmosphere. We believe there will come a time – sooner rather than later – when policy-makers and the public will be more willing to trial a solution which is currently ruled out by 'business as usual' attitudes. That willingness to take a risk will increase as more tragedy and destruction is inflicted on the community by extreme weather events. The key question is: How bad does it need to get before the Government will act?

How Bad Is It Now?

- The Victorian Fires, the Heatwave Deaths, the Queenland Floods… national disasters now commonplace.

- More than 2000 climate scientists in Copenhagen appeal urgent for action because the indicators of a worsening situation are moving faster than the worse case scenario in the IPCC's latest report (2007).

- NASA's James Hansen, Director of the Goddard Institute for Space Studies, announced that the IPCC CO2 pollution target of 450ppm is now considered too high and that even the current figure of 385ppm is too high. The new target is 350ppm.

- James Lovelock, in his latest book The Vanishing Face of Gaia, reports that it is already too late to save the world as we know it.

- Three weeks of unprecedented hot weather on "Uamby", coupled with a westerly wind, sucked half the water from our dams.

Conclusion:

The decisions taken today about how best to confront the rapidly degenerating climate situation will reverberate down the generations.

Part 1: Coverage of Agriculture

Coverage of Agriculture Should Not Be Determined By Measurement Issues

We understand the official reasons for the delay in deciding about Agriculture: In or Out? The Science is Lagging the Politics.[1] The "scientific" problem has been framed in the following way: "How can we accurately measure emissions from all Agriculture's sources of major Greenhouse gases at enterprise level?"

The science-based methodology chosen to answer the question requires extraordinary levels of complexity that will make it almost impossible to find a cost-effective measurement method.

The decision by the Government to base all decisions on 'sound science' – whereby science becomes a proxy for making decisions – has made it almost inevitable that the final decision will be "It's Too Hard."

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[1] The reason for the Agricultural Sector's state of unreadiness is not clear. We have known about Climate Change since 1988 and the IPCC's processes started in the early 1990's. Successive governments failed to resource climate change science in a field so clearly relevant to something so contemporary as Global Warming. And when Agriculture was admitted, into the tent, it entered dressed in the costume of a big polluter and natural enemy of the environment. In 2006, the UN FAO wrote that Agriculture is, "one of the ... most significant contributors to the most serious environmental problems, at every scale from local to global" and that eating meat contributes to "problems of land degradation, climate change and air pollution, water shortage and water pollution, and loss of biodiversity." ("LIVESTOCK'S LONG SHADOW") The Chairman of the IPCC, who is a vegan, appealed to the planet's population to avoid eating meat as a mean as of mitigating Climate Change.

To demonstrate the inevitable choking detail, following is an partial listing of variables that will disaggregate and scatter when what is needed is to integrate and simplify. New thinking.

Methane (Variables)

The Government is investing vast amounts of money on seeking methodologies to measure methane emissions:

1. On an enterprise level.
2. Of an individual Greenhouse gas
3..From diverse sources;
    a. individual flocks and herds of animals
    b. soil organic matter oxidising
    c. labile fractions of soil organic carbon oxidising
4. Affected by so many variables
    a. Animals
        i. breed
        ii. age profile
        iii. feed
        iv. weather
        v. location
        vi. season
        vii. land management
            1. set stocking
            2. controlled grazing
            3. lot feeding
            4. shedded
            5. stalls
    b. Soils
        i. Soil organic matter (SOM)
            1. Living organisms (bacteria, fungi, roots, etc.)
            2. Dead vegetation; dead animals;
            3. Particulate Organic Matter/Light Fraction
            4. Active Fraction (food for microbes)

5. Labile Organic Matter – easily decomposed
6. Lignin compounds (hard to break down)
7. Recalcitrant organic matter: char, humus, lignin (few can decompose them)
8. Exudates (secreted by roots)
9. Humus, humfied matter (complex organic compounds enduring
10. Consumed by detritifier (maggot, earthworm, ant, termite)
11. Consumed by decomposer (bacteria, fungus, protozoa)

ii. Soil Organic Carbon (SOC)
1. Soil type
2. Climate
3. Location
4. Land management practices
5. Biology dominated by bacteria vs fungi

Nitrous Oxide (Variables)

1. At an enterprise level.
2. Sources
    a. Animal urine
        i. Type of animal
            1. Breed
            2. Age
            3. Gender
        ii. Number of animals
        iii. Climate
        iv. Season
        v. Location
    b. Volatilisation of N Fertiliser on application
        i. Vegetation
            1. Pasture
                a. Size

b. Climate
c. Season
d. Location

2. Crop
    a. Type
    b. Size
    c. Climate
    d. Season
    e. Location
    f. Land management

Soil Carbon (Variables)

Soils at National, Regional, Locality and Enterprise level

a. Soil type
b. Soil Individuals (Mapping)
c. Climate
d. Location
e. Land management practices
f. Soil Biology community dominated by bacteria vs fungi
g. Time of day
h. Time of Year
i. Soil organic matter fractions
    i. Living organisms (bacteria, fungi, roots, etc.)
    ii. Dead vegetation; dead animals;
    iii. Particulate Organic Matter/Light Fraction
    iv. Active Fraction (food for microbes)
    v. Labile Organic Matter – easily decomposed
    vi. Lignin compounds (hard to break down)
    vii. Recalcitrant organic matter: char, humus, lignin (few can decompose them)
    viii. Exudates (secreted by roots)
    ix. Humus, humified matter (complex organic compounds enduring)

Science breeds complexity

It is axiomatic: The more variables, the more complexity.

The more complexity, the harder the task of producing a cost-effective measurement methodology.

The more science that is applied, the more complex the problem becomes.

The reason: classic scientific methodology is Reductionist. It starts by separating and classifying the parts; it separates phenomena into finer and finer categories. Reduction to the smallest individual unit. Classical science does not consider whole systems.

The Government is seeking a cost-effective method for measuring movements in soil carbon. This can form the litmus test for whether "the science is still lagging the politics" and by how much.

> When seeking to measure soil carbon, the first question that should be asked is "For what purpose? Science or Trade?"

If there is emphasis upon the fractions of soil carbon – especially those fractions that cycle back into the atmosphere through respiration – it could indicate that the study is not aimed at producing an easy-to-use Measurement, Monitoring and Verification methodology for the purposes of soil carbon trade.

Focusing on the fractions is commonly used as proof that soil carbon is too unstable to be sold. Those of this opinion are convinced that, because a good part of the carbon captured in the soil won't be there in 12 months time, the grower will face a major liability.

But they forget that Carbon Cycles. It moves all the time, like water. How, then, can we capture and hold it? Apart from Humus and humic substances that can stay inert for 1000 years and more, the other fractions do what Carbon does. They cycle.

But in the Carbon market, a buyer is not interested in buying particular carbon molecules. They are interested in the gross number of carbon molecules that are extracted from the atmosphere. So what the grower can sell is the difference between Point C and Point C + X in period of time C. In other words X.

Traders and buyers care only about Total Carbon or, in some cases, the Humus fraction. Either are suitable for trading. But the Light Fraction, etc.

A time for ingredients, a time for cakes

The Scientific Method in Agriculture is divided into two systems: 1. Separating the element to be studied from its ecological context and subjecting it to tests. This is known as Reductionist Method, the basic principle being that, by isolating and studying individual elements of a system, the scientist can solve a problem involving those elements. A weed becomes prevalent. It is grown in pots or boxes in scientific isolation from the context in which it occurs and various substances are applied to it until one is identified that effectively kills the weed.

The substance becomes a product that is widely applied and it works. The weeds die. 2. The second system of scientific enquiry - called the Integrated or Ecological approach - tries to reproduce natural conditions, ie. the ecological context where is might play a part in the phenomena being studied. Ie., the weed dies, but new species of weeds take their place. And other unintended consequences occur, such as the death of microflora in the soil that are important to its fertility.

Classical science is likely to have trouble dealing with the complexity or scale of Soil Carbon.

The Science of Parts

Reductionist science "is a science of parts - e.g., analysis of specific processes that affect specific variables - populations of individual species, levels of nutrients, flux of gases. It emerges from traditions of experimental science where a narrow enough focus is chosen in order to pose hypotheses, collect data, and design critical tests in order to reject invalid hypotheses. Since it is experimentally based, the scale chosen typically has to be small in space - the plot of a few square meters, the bagged small tree - and short in time - certainly not longer than the professional life of the experimenter or grant."[2]

"The goal of the science of parts is to narrow uncertainty to the point where acceptance of an argument among scientific peers is essentially unanimous. It is appropriately conservative and unambiguous, but it often achieves that by being forced to be fragmentary and small in scale. In ecology, it provides essential bricks for an edifice but, by itself, not the architectural design."[3]

Soil carbon is more than the sum of its parts

Soil Carbon cannot be understood by reduction to its fractions science because it exists within a complex system of natural cycles and processes. It is both a cause and effect within the system. [4]

Soil carbon is reported to be an active agent that:

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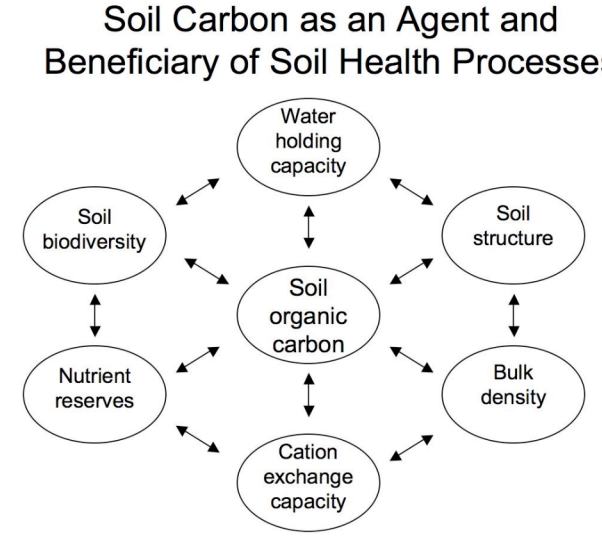
[2] Holling, C.S. 1998. Two cultures of ecology. Conservation Ecology [online] 2(2): 4. Available from the Internet. URL: http://www.consecol.org/vol2/iss2/art4/

[3] Further extracts can be found in Appendix 1.

[4] Kimble, J., Rice, CW., Reed, D., Mooney, S., Follett RF, and Lal, R., Soil Carbon Management, CRC Press, 2007.

- provides nutrients to plant roots systems
- increases cation exchange capacity of soil
- drives growth in species diversity above and below ground
- strengthens soil's structural resistance to erosion
- makes water more available to plants
- provides nutrients and energy to microbial organisms[5]



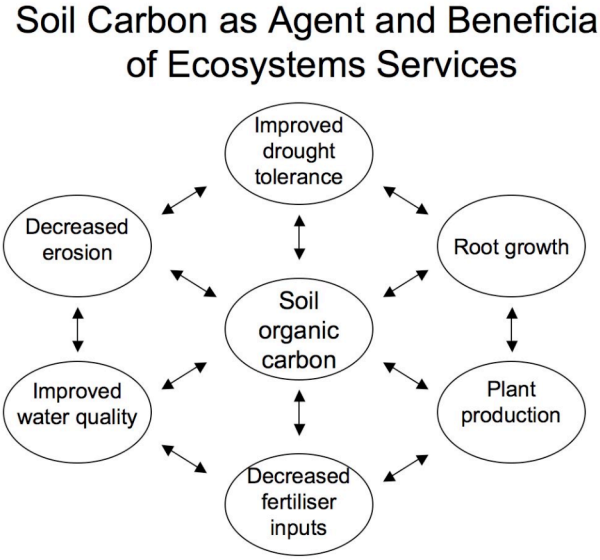
Soil Carbon acts as both Cause and Effect in a Complex Integrated Biological, Chemical and Physical Mechanism that generates new life from the death and decomposition of the old.

Soil carbon is itself impacted upon by:

- land management practices that
  - protect topsoil from wind and soil erosion
  - encourage fungi over bacteria in soil biological communities
  - drive inputs of soil organic matter
- water cycles
- mineral cycles
- nutrient cycles
- climate
- soil type
- micro-organisms

[5] ibid.

The disaggregation of reductionist scientific methodology is useful when it enables re-integration into a simple mechanism that achieves a level of confidence in its ability to indicate or predict the presence of an amount of a substance.



Soil Carbon is Contextual. It acts as both Cause and Effect in a Ecosystem that is multifaceted and matrixed.

For these reasons we do not believe that conventional scientific methodology will produce the new thinking necessary to provide not only the answer, but also the Questions that will lead us to a solution. As C.S. Holling observed: “the science of parts can fall into the trap of providing precise answers to thewrong question”.

Conclusion

The decision on Agriculture’s inclusion or exclusion should not be taken on the basis of the inflexibility of reductionist science. It should be based on the critical need we have as a world community for all farmers to change their land management

practices to start sequestering as much Greenhouse Gas as fast as possible.

Part 2: Take Action to Start the Sequestration (Extraction) Process Immediately

Even if Australia cut its greenhouse gas emissions by 100% of 2000 levels by 2010, the damage will continue...

This is because of the "airborne fraction" or the "Legacy Load" of CO2-e in the atmosphere. Unless it is addressed, the IPCC's and the Australian Government's Mission will fail.

How can it be done? Solar, wind, nuclear, thermal, methane flaring, herd reductions, urine splatter-boards?

No. They cannot extract. They can only avoid future emissions.

Only Photosynthesisers can extract.

Each year, they extract 100,000,000,000 tonnes of carbon from the atmosphere and turn it into biomass.

Before we look at the photosynthetic options, what are the fundamental success criteria? There are three:

1. Critical Mass – the solution is mature and widely distributed.
2. Massive Capacity – the solution is equal to the task.
3. Immediate Deployment.- the solution can be implemented without delay.

The GHG Extraction options:

Trees? How many would we need? To soak up just 7% of America's annual emissions, they would have to plant an area

the size of Texas every 30 years[6]. Put aside the cost to do it, how long before the new trees start sequestering? Plantation forest trees are often net emitters due to the way they are planted and the fact that they reach maximum sequestration capacity after 10 years. To plant the space required would take longer than Stern's Decade, and even longer for the trees to reach maximum sequestration capacity.

Forests fail the Critical Mass and the Immediate Deployment Tests.

Algae? Algae can grow 20 to 30 times faster than other vegetation, so has Massive Capacity. However the industry has not found a method of growing the algae in a controlled way and harvesting it efficiently in large quantities.

Algae fails the Critical Mass and the Immediate Deployment Tests.

Biochar? Watching the Biochar teams attracting high-profile supporters, media attention and endorsement of government scientists, we wonder why there are not more pilot units or even commercial operations underway. We suspect a business model problem.

Biochar fails Critical Mass, Massive Capacity and Immediate Deployment tests.

Agricultural Land Management? There are 450 million hectares already under management for vegetation in Australia. There are 5 billion hectares worldwide.

Agricultural Land passes the Critical Mass test.

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[6] William H. Schlesinger, dean of the Nicholas School of the Environment and Earth Sciences at Duke University, in Durham, North Carolina

Can this soil sequester CO2 at a rate commensurate with Massive Capacity?

To reveal the actual capacity of Australian soils to sequester, the Carbon Coalition has collected official data from scientists as well as the results of laboratory tests after farmers sent their samples away. (APPENDIX 2)

The scores are then extrapolated by the normal process of converting Carbon concentrations into Carbon tonnages and converting these in turn to CO2-e tonnages by the normal process. We then extrapolate this figure to the farm scale and the national scale.

Appendix 2 reveals a series of mainly lowest-end results, starting at a figure for rangelands that has been artificially discounted by the researcher to make allowance for his views that worst case scenario Climate Change will make sequestration near impossible. [7]

The lowest carbon increase naturally happens in the arid zone - the rangelands – yet the massive spaces involved make even the slightest increase in carbon significant. Even when the researcher's discount is applied, the 50,000 hectares sequestering a tiny 0.15tonnes Carbon/hectare/year. Over the space involved the enterprise sequestered 27,500 tonnes of CO2-e – which is enough to offset the emissions of a "big emitter". (The CPRS nominate 25,000 tonnes annual emissions as the floor for defining a 'big emitter'.) Without the discount for pessimism, the enterprise sequesters 125,000 tonnesCO2-e.

[7] The weakness in an imposed discount for pessimism is that it skews data as surely as if you fudge it for reasons of optimism. But it is more likely that farmers will shift their behaviour in response to the worst of Climate Change, as they have in Western Australia. The earlier they make the change, the more likely the landscape will be buffered by high carbon levels when the worst arrives. Researchers who have not been often to high carbon farm landscapes must have trouble imagining what they are like.

Optical Illusion

This is an example of the 'optical illusion' that many senior scientists fall into when considering the claims of Carbon Farmers about sequestration rates. They start with a belief in a small amount of carbon per hectare. But the calculation must step up the value twice: First from Carbon to Carbon Dioxide Equivalent, a multiplication exercise:

$$C \times 3.67 = CO2\text{-}e.$$

The second calculation is also a multiplication, from one hectare to the total area:

$$CO2\text{-}e/ha/yr \times Total\ ha = Total\ CO2\text{-}e/yr.$$

When 0.15C/ha can become 27,500tCO-e, no wonder scientists cry foul. But if they want to take part in a conversation which is not strictly scientific, they must observe the language of the event.

The actual smallest case comes from the slopes where properties are (2000ha average) smaller.

But if we extrapolate the lowest score of 0.15tonnes Carbon/h/yr over half the area used for Agriculture (225m ha) we shall see if soil, which already has Critical Mass, can also have Massive Capability:

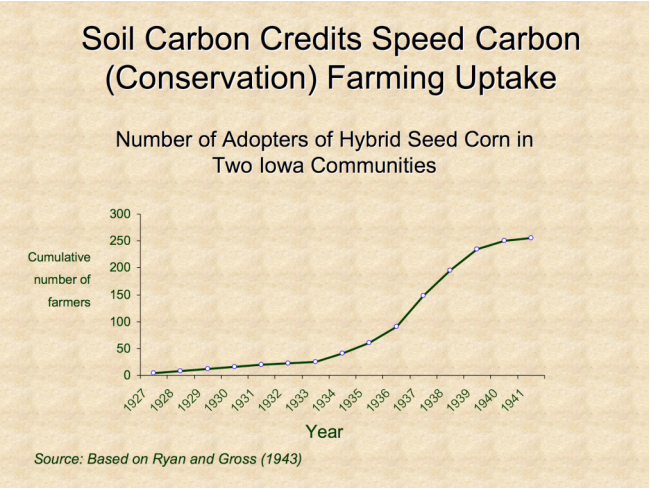
$$0.15tC/ha \times 3.67 = 0.5505tCO2\text{-}e$$

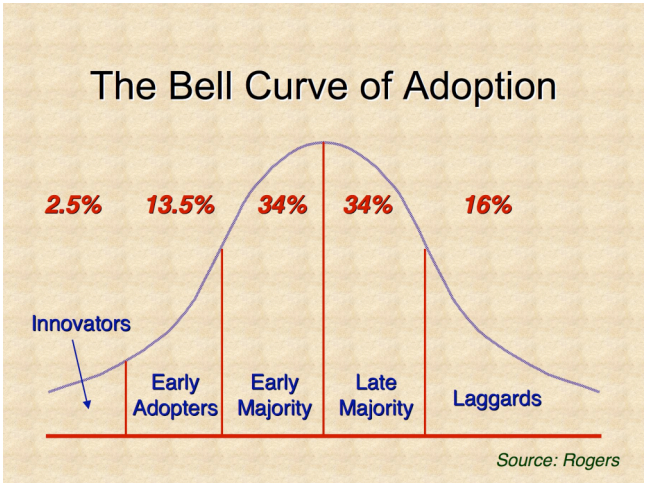
$$225m\ ha \times 0.5505tCO2\text{-}e = 123.8mtCO2\text{-}e.$$

The represents about a quarter of Australian emissions per year. (Using the lowest estimate, discounted for drought, Climate Change, and pessimism, and applying only half the area available.)

That is Massive Capability.

For Immediate Deployment, a solution has to be ready to roll out. If left to the normal processes of extension services encouraging farmers to change their ways, the evidence points to a 30year process. The Australian Farm Institute's Mick Keogh says there is a 20- to 30-year lag time between research being completed and results leading to on-farm productivity increases. Australian agriculture was only now benefiting from the research work done in the 1980s, he said.[8] The 30-year factor was first noticed by researchers in Iowa as the amount of time it takes farmers in a district to learn about and eventually change to a new approach. In 1943, Bryce Ryan and Neil C. Cross from Iowa State College plotted farmers' adoption of a new hybrid corn seed from the early 1930s onwards. It took 5 years on average between when a farmer became aware of the new strain and when he adopted it. It took 13 years for the majority to





[8] Mick Keogh, "US Shows the Science Way", The Land, 19 February, 2009

adopt it, and 25 years before universal acceptance. The bell curve they observed has since become known as the classic adoption curve for new products and services.[9]

30 Precious Years

If the adoption process is left to extension services promoting the innovation as a good economic decision, the process is likely to take 30 years. Unfortunately the world does not have 30 years to wait while extension services pursue the "Educate, Encourage and Extension" model.

It is precisely the next 30 years that soil can make its greatest contribution: The role that Agricultural Soil Sequestration can play is explained by Professor Rattan Lal, the world's leading soil carbon research scientist and IPCC lead author: *"Carbon sequestration in soil and vegetation is a bridge to the future. It buys us time while alternatives to fossil fuel take effect."*[10]

The World Is Waking Up To The Soil Carbon Solution

Consciousness of the need for a short term fix in order for the long term solutions to gain critical mass is growing among experts. NASA's Dr James Hansen was reported only this week As saying: *""We are actually going to have to decrease the amount of carbon dioxide in the atmosphere."*

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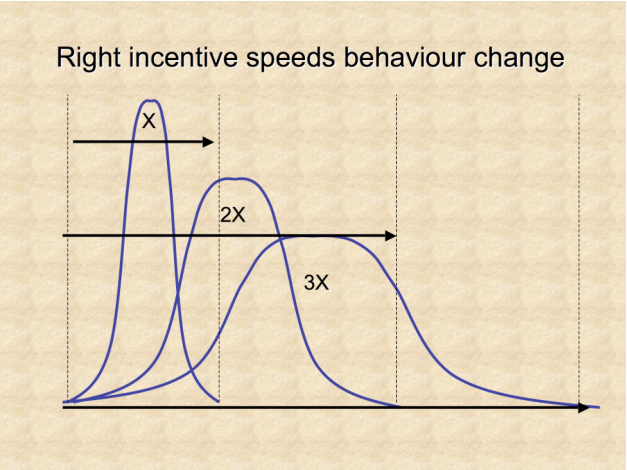
[9] ^ Bohlen, Joe M.; Beal, George M. (May 1957), "The Diffusion Process", Special Report No. 18 (Agriculture Extension Service, Iowa State College) 1: 56-77.

[10] Rattan Lal is director of Ohio State University's Carbon Management and Sequestration Centre, professor with the School of Environment and Natural Resources, and recipient of the 2006 Liebig Applied Soil Science Award. Lal has spent 18 years of his service with Ohio State's Ohio Agricultural Research and Development Center (OARDC) studying carbon sequestration. In 2005, Lal was the recipient of the Norman Borlaug Award, another international honor for his contribution to the sustainable management of soil and natural resources, specifically carbon sequestration and global food security. He has received over 14 other distinguished awards and has authored, reviewed and edited over 1,000 publications and journal articles throughout his career.

Professor William H. Calvin of the University of Washington, is a theoretical neuro-physiologist whose work covers the ways the human mind comes to term with Climate Change.[11] He writes:

"While fossil fuel emissions are what has gotten us into climate trouble, it does not follow that fixing them will get us out. Reducing emissions does nothing to reverse the climate problems. Until we create enough new carbon sinks to begin reducing the excess CO2 in the air, our problems will only get worse…. All of the climate talk in DC seems to ignore carbon sinks. When actually removing CO2 from the air is mentioned, it gets relegated to something to do after we clean up emissions. And since that is something that will take a century to accomplish, we are in serious "too little, too late" territory… For a safety factor, we must front-load our climate response, much as a course of antibiotics may include a double dose the first day. That's what it takes to back out of the danger zones for climate change and ocean acidification that we have blundered into, despite 50 years of serious scientific alerts."

"We must front-load our climate response, much as a course of antibiotics"



Therefore the Bell Curve which stretches over a 30-year period must, in the case of soil carbon, become *a spike*. At current rates of Climate decline, we would appear to need it deployed within five years or less. Such a deployment is possible, given he right motivation. Asking farmers to change land management practices is not a minor request. They are by

[11] His books include Global Fever: How To Treat Climate Change and A Brain For All Seasons: Human Evolution& Adbrupt Climate Change.

nature conservative, generally, and need something beyond the opinion of an extension officer to make a major move.

They are enthusiastic about change when there is financial reward. Chasing another market, for instance, because it is lucrative, is second nature to them. (Witness the movement from wool to fat lamb production in th last decade, purely driven by access to the US market.)

Immediate Deployment is possible if the incentive is large enough. Hence the carbon offset market.

It is a source of new revenue that can be used in two ways by landholders:

1. to boost income
2. to offset Greenhouse Gas liability.

The commodity market for soil carbon model is preferred to a stewardship payment model for the following reasons:

1. Farmers instinctively prefer to take a risk on a free market than take a risk on Government support. (Governments change their minds.)
2. Farmers prefer to be paid for what they grow. They are proud producers, not petitioners.

Recommendations

Hence the Carbon Coalition – which is the organisation closest to the grassroots farmer, and the farmer group closest to the soil science community, and the organization with the longest engagement with this issue – recommends the following:

1. That the Government support The International Federation of Agricultural Producers (600 million members), The US Department of Agriculture, and the World Bank in their

joint approach to the IPCC for Agriculture to be considered as a stand-alone issue. That the Government similarly support the UN Food and Agriculture Organisation's proposal to the IPCC that Agriculture be given special status for its role in food security and water management. Both approaches concern soil carbon trading as an incentive.

2. That flexibility be shown – under the aegis of The Precautionary Principle - with regard to the Permanence and Additionality principles, given the time frame and particular task Agricultural Soils can perform.

3. That the Prime Carbon model be considered for adoption not only in Australia but as far as Australia's influence extends.

4. That Agriculture be included in the CPRS as an 'opt-in' sector to enable farmers to decide and the "Spike" process occur.

5. That Agricultural offsets be allowed in the Voluntary Standard you have proposed.

Conclusion

There is no long term without a short term. Soil Carbon offers the world a short term solution – a Bridge To The Future.

Part 3:
Risk Management for Soil Carbon Trading: Protection for Growers and Buyers

Introduction

To provide the world community with the "Bridge to the Future" that Professor Lal believes the soil can be – while alternative energy sources reach critical mass – the world's farmers are going to be encouraged to change their soil management practices such that their soil becomes a carbon sink rather than a carbon source.

The incentive best suited to farmers is a payment for commodities grown. They understand this model and need no convincing to use it.

Seeking to change the land management practices that many farmers grew up with, as practiced by many generations before them, is not a simple or easy task.

No amount of advice, encouragement, or promises of better business performance will shift them far. But they react well to money – especially when it has no strings attached. Ie., they are happy to obey the market.

Therefore we believe it is imperative that the soil carbon sink project to activated as soon as possible.

However, there is some disquiet among scientists who say they are concerned about the concept of soil carbon trading and the potential risks farmers might expose themselves to in the process.

In order to facilitate the trade while addressing these concerns, the Carbon Coalition offers the following solution: a "Bridge to the Future"

Trainer wheels trading model

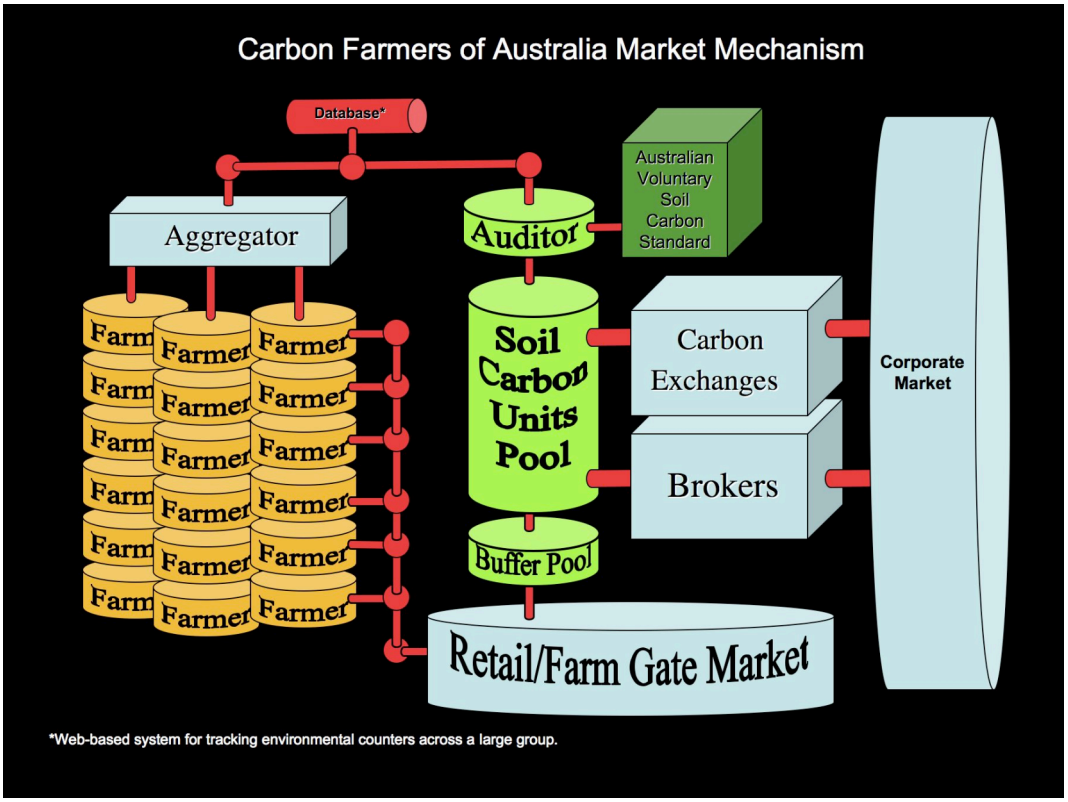
Trading carbon is an alien concept for most people and the 'new' always carries with it anxiety when the process is not understood.

In order to give Australian farmers a period of time to trial the concept and decide if it is for them, we recommend the following:

1. An opt-in system that runs for 5 years only.
2. Farmers sign a contract with the Commonwealth Department of Climate Change and the Department of Agriculture covering that period, under which they agree to manage their land in certain ways – including conservation farming, no-till, pasture cropping, etc., sewing native pastures, managing flocks and herds to maintain ground cover, fencing off riparian zones, building wildlife corridors, establishing native vegetation 'sinks', apply inoculants, etc.
3. Their methane and nitrous oxide emissions are calculated and their Carbon Balance Sheet maintained as an accounting exercise.
4. For every 'service' the farmer or grazier contracts to do, they are given "Australian Government Farm Soil Bonds" which have a monetary value. They are based on a calculation of the value of the 'service' in terms of soil saved from erosion and salination, water cleaned, turbidity avoided, biodiversity encouraged, and areas rehabilitated.
5. They can then use these Bonds as currency to pay the gap between their cap and their emissions after they have taken action to manage them downwards. The Bonds are Environmental Tax Credits.

6. For every “Bond” they earn, they are permitted to sell the equivalent value in “Australian Farm Soil Carbon Credits” on the Voluntary Carbon Market.
7. They can sell them direct – to the ‘farm gate’ market – or sell them via an aggregator to the corporate or other markets.
8. These Soil Carbon Credits are certified by the Government – for a fee – which employs an ‘on the run’ model development MMV consisting of baseline core sampling and ground-truthing aerial and satellite imagery which, combined with activity records which are checked during random visual audit vsits by CMA staff, enables the system to run an advanced CCX model system while other technologies come on stream.
9. At the end of 5 years the Government can elect to continue for another 5 years, or cancel the program, or extend it as a pure free market system.

This is a hybrid stewardship/trading model which enlists the Government to underwrite the first 5 years of trading by means of stewardship payments.



Various risk management measures can be instigated to protect both grower and buyer:

1. Buffer Pool: 30% of all tonnes submitted for sale via an aggregator are held in the form of a mutual fund- a form of self insurance should a disaster happen and there be a make good.
2. Delay gratification. Don't spend the proceeds. Invest them in an interest bearing account and spend the interest.
3. Diversify your carbon investments. Buy forest or land in other districts as part of a syndicate. Look to opportunities on-farm for wind, solar, algae, biochar, composting, etc.
4. Actively manage fire risk by grouping with your neighbours to identify hazard zones and treat them in the cool months.

The Carbon Coalition is actively seeking the widest array of options for the Government to consider because we aware of the urgency of the situation.

Conclusion

The Soil Carbon Solution has 5 serious benefits for the Department of Climate Change:

1. The numbers of farmers becoming land stewards are seriously big.
2. The area of land regenerated is seriously big.
3. The number a farm families who will be made more secure is seriously big.
4. The tonnages of GHG extracted by farmers can be seriously big.
5. The impact on the rest of the world will be seriously big.

No one will dare say this Government is not serious about Climate Change.

Appendix 1: Can the Science of Parts Create New Systems?

Putting together a new concept soil carbon measurement (MMV) mechanism demands of the Science of Parts that they get it together.

Extraction:

Holling, C.S. 1998. Two cultures of ecology. Conservation Ecology [online] 2(2): 4. Available from the Internet. URL: http://www.consecol.org/vol2/iss2/art4/

Reductionist science "is a science of parts - e.g., analysis of specific processes that affect specific variables - populations of individual species, levels of nutrients, flux of gases. It emerges from traditions of experimental science where a narrow enough focus is chosen in order to pose hypotheses, collect data, and design critical tests in order to reject invalid hypotheses. Since it is experimentally based, the scale chosen typically has to be small in space - the plot of a few square meters, the bagged small tree - and short in time - certainly not longer than the professional life of the experimenter or grant."

"The goal of the science of parts is to narrow uncertainty to the point where acceptance of an argument among scientific peers is essentially unanimous. It is appropriately conservative and unambiguous, but it often achieves that by being forced to be fragmentary and small in scale. In ecology, it provides essential bricks for an edifice but, by itself, not the architectural design.

The other science "is a science of the integration of parts. It uses the results of the first, but identifies gaps, develops competing causative hypotheses, and constructs and uses simulation models as devices for exploration and experimentation over scale ranges that are impossible to achieve by experiments in nature….

"The premise of this second [science] is that knowledge of the system we deal with is always incomplete. Surprise is inevitable. There will rarely be unanimity of agreement among peers - only an increasingly credible line of tested argument. Not only is the science incomplete, the system itself is a moving target, evolving because of the impacts of management

and the progressive expansion of the scale of human influences on the planet….

“Of course, knowledge should be mobilized to reduce uncertainty wherever that is possible. But ecosystems and the human activities associated with them are inherently uncertain. Part of that is because of incomplete knowledge of novel interactions across space and time, and of novel relationships between nature and human behaviors. Part is because management changes the system being managed. Successfully managed systems are ever-changing targets because they release the resources for new kinds of human opportunity and they expose new classes of human risk….

“In principle, therefore, there is an inherent unknowability, as well as unpredictability, concerning ecosystems and the societies with which they are linked. There is, therefore, an inherent unknowability and unpredictably to sustaining the foundations for functioning systems of people and nature….

“[S]cientists … to be sensitive to political and human realities, and to recognize how theories, different modes of inquiry, and different rules of evidence can facilitate, hinder, or destroy the development of constructive policy and action.

“Both the science of parts and the science of the integration of parts are essential for understanding and action. Those more comfortable in exercising only one of these have the responsibility to understand the other. Otherwise the science of parts can fall into the trap of providing precise answers to the wrong question and the science of the integration of parts into providing useless answers to the right question.”

Appendix #2: A Range of Indicators of the Potential of Australian Soils to Sequester Carbon

The figures given below are actual live soil carbon readings from the field or estimations based on models. The volume of Carbon by weight or the intensity (%) of Carbon in each individual case was supplied by the party reporting the results. To make a comparison, the results were "equalised" using the following methodology:

- A bulk density of 1.4 was assumed for arriving at tonnages (1% = 14tC/ha = 51tCO2e/ha)
- Conversion of tonnes of C to CO2e, multiply by 3.67 (and vice versa).
- The price of $25/tCO2e is the price proposed by the Commonwealth Government at the launch of the Carbon Pollution Reduction Scheme in 2010.
- The return on 200 hectares refects a test area on a property.
- Landholders are advised not to commit their entire holding until they have trialled the system.

NB. No source of data mentioned in Table 1. endorses the dollar amounts extrapolated below.

Details of the projects are given in the footnotes following.

Potential CO 2 seq-ed average property for region	Potential return on 200 hectares (200ha@ $25/t)	Potential return per hectare at $25/tonne CO2	CO2 seq-ed (CO2e/ ha/yr)	Carbon seq-ed (tC/ha/yr)	Δ%C	Data Source
Rangelands 50,000ha 27,500 tCO2e	$150-$2750	75¢-$13.75	0.034 to 0.55	0.01-0.15	-	Prof. Peter Grace, QUT*
Slopes 2,000ha av: 4,000 tCO2e	$10,000	$50	2	0.56	0.04%	Dr Peter Fisher VIC DPI[#]
Slopes 2,000ha av: 4,000 tCO2e	$10,000	$50	2	0.55	-	Dr Yin Chan, NSW[†]
Slopes 2,000ha av: 4,000 tCO2e	$10,000	$50	2	0.55	-	Dr Christine Jones ASCAS[§]
Rangelands 50,000ha av: 125,000 tCO2e	$12,400	$62.0	2.5	0.7	0.05%	Prof. Peter Grace, QUT**
Slopes 2,000ha av: 10-20,000tCO2e	$25,000	$125	5– 10	1.3-2.7	-	Tim Wiley, DAF, WA[††]
Slopes 2,000ha av: 10,800tCO2e	$26,800	$134	5.4	1.47	-	Professor Peter Grace, QUT*
Slopes 2,000ha av: 20,000tCO2e	$50,000	$250	10	2.8	0.2%	Col Seis, "Winona" Gulgong[¥]

Potential CO2 seq-ed average property for region	Potential return on 200 hectares (200ha@ $25/t)	Potential return per hectare at $25/tonne CO2	CO2 seq-ed (CO2e/ ha/yr)	Carbon seq-ed (tC/ha/yr)	Δ%C	Data Source
Slopes 2,000ha av: 20,000tCO2e	$50,000	$255	10.2	2.8	0.2%	Dr Yin Chan[≠] NSW DPI
Slopes 2,000ha av: 40,000-60,000tCO2e	$100,000-$140,000	$500-$750	20-30	5.5-8	-	Dr Christine Jones ASCAS[§]
Slopes 2,000ha av: 122,000tCO2e	$305,000	$1525	61	16.7	1.2%	Anne Williams, "Magomadine" Coonamble[##]
Slopes 2,000ha av: 204,000tCO2e	$510,000	$2550	102	28	2%	Microsoils and VRM[∞]

FOOTNOTES:

*Dr Peter Grace, QUT, gave a range of results for different soil types in Australia's rangelands at the 2008 Carbon Farming Conference, sourced from the SOCRATES model he developed. He gave two sets of figures: the "potential" and a severely-discounted "actual" set, reflecting his view of the effects of Climate Change, which he believes will make accruing soil carbon next to impossible. We have included his highest and lowest reading from both sets of data to show the range of possibilities.

[#] Dr Peter Fisher indicated that standard soil carbon models may need to be adjusted when he reported his results in a press release from the NSW DPI on 24 December, 2008. "Most carbon modelling indicates that increasing soil carbon is a very slow process, taking many decades to achieve significant changes. For example, modelling a 2 t/ha increase in organic matter input for the same conditions, results in a change in soil carbon value of about 0.13% after 20 years… I n contrast, the relationship developed between change in organic matter input and change in soil carbon at the 13 paired paddocks in the trial, suggested that a 2 t/ha increase in soil organic matter might result in approximately a 0.4% change in carbon level, after only 10 years." "This increase is greater than most carbon modelling suggests," Dr Fisher said.

[†] Dr Yin Chan gave this broad figure to the Garnaut Review in an interview. It represents the difference when cropping practices change. Dr Chan is in the world's top 10 most-cited authors in the field of soil science.

[§] Dr Christine Jones, the most prominent scientist and science communicator in the field of Australian soil carbon, gave this estimate to the Garnaut Review in an interview. She gives a much higher figure for 'ideal conditions'.

**Dr Peter Grace gave results for grain cropping in the Mudgee District of the Central West of NSW at the 2008 Carbon Farming Conference. The figure is produced by the Socrates model, based on stubble retained, and is a best-case scenario (clay soil, 6tonne/ha yield.)

[††]Tim Wiley, WA Department Agriculture & Food, reported that farmers in the South West were recording between 5t and 10t CO2e increases annually when they introduced perennial pastures and pasture cropping to the sandy soils there. This has been compared to sequestration of less than 1.5 tonnes CO2-eq/ha/yr by annual systems. (SENATE STANDING COMMITTEE ON RURAL AND REGIONAL AFFAIRS AND TRANSPORT, Senate, Final Report, December 2008). Tim spoke at the 2008 Carbon Farming Conference.

[¥]Colin Seis, Gulgong NSW saw his soil carbon rise from 1.8%C to 4%C in 10 years, or 0.2%/yr while he was developing Pasture Cropping, direct drilling a cereal crop into dormant perennial pasture. He believes he could halve the time given what he knows today. His soil performed 10 times faster than Dr Peter Grace's plot in Mudgee (the same district.)

≠ Dr Chan presented the results of a 3 year trial of mulching under vines in August 2008 and reported a 0.6% increase in soil carbon. The dollar figure given for this case is not tenable because an enterprise with 200ha of soil under vines is rare.

Anne and Ray Williams of Magomadine near Coonamble were named the 2007 Carbon Cockies of the Plains, held as part of the Carbon Farming Expro & Conference. Anne won a grant from the GRDC to study soil treatments and carbon. In the case in hand, they recorded a 1.2%C/yr difference between 'no-till' and 'no-till and compost tea"

∞Microsoils and VRM (Prime Carbon) report a case where soil carbon rose 2%C/ha between 12/2/07 and 25/04/07. This was on a Canberra pasture operation. The soil was inoculated with benign micro-organisms after they had spent a long period together in a nutrient rich bath (to avoid shock when distributed). The soil's friability changes rapidly under his regime. This is an extreme case, included to indicate the breadth of the range of responses by Australian soil.

Appendix 3: DPI Sequesters Soil Carbon 10 Times Faster than Models Anticipate

Australian soils can sequester carbon 6 to 10 times faster than the models allow.

The data was published by Dr Peter Fisher of the Victorian DPI.

(Relevant sections of the press release below.)

Tony Lovell of Soil Carbon Australia provides the following analysis of the data:

"This news is still incredibly good and should really help to shift the discussion. Peter is saying the modelling suggests a 2t/ha increase in organic matter input for the same conditions, results in a change in soil carbon value of about 0.13pc after 20 years. However his research indicates that a 2t/ha increase in soil organic matter might result in approximately a 0.4pc change after only 10 years. Lets do some super basic maths on this - 0.4pc is 3 times as much as 0.13pc, and 10 years is twice as quick as 20 years - so this is still a factor of 6 times better. But what does Peter's model suggest at year 10 rather than year 20? Is the difference even greater - maybe somewhere closer to an order of magnitude (10 times)? If someone could prove to me that I could do something 6 to 10 times faster than everyone else was saying was possible, I would be a damn happy camper. And this on places where the farmers were not even focussed on building soil carbon."

DR FISHER'S PRESS RELEASE: A key finding from the paired paddocks trial was that for every extra tonne per hectare of above-ground and below-ground organic matter – maintained on average for 10 years, the soil carbon percentage was found to be more than 0.2% higher. “This increase is greater than most carbon modelling suggests,” Dr Fisher said. “Most carbon modelling indicates that increasing soil carbon is a very slow process, taking many decades to achieve significant changes. For example, modelling a 2 t/ha increase in organic matter input for the same conditions, results in a change in soil carbon value of about 0.13% after 20 years. “In contrast, the relationship developed between change in organic matter input and change in soil carbon at the 13 paired paddocks in the trial, suggested that a 2 t/ha increase in soil organic matter might result in approximately a 0.4% change in carbon level, after only 10 years.

Appendix 4: Sound Science and Paradigm Change

The current controversy over the potential and nature of Soil Carbon has characteristics of a battle between Paradigms. The decision-maker seeking to base their decisions on 'sound science' cannot make 'sound science' a proxy for making a decision. They have got to choose. And the stakes are high, given that it will shape the Government's response to the greatest challenge any Government has faced since Settlement.

"If Science becomes a proxy for sound judgement, how do you judge sound science?"

Extracts from
'The Structure of Scientific Revolutions'.
By Thomas Kuhn, Scientist and philosopher

The function of a paradigm

"A paradigm is a universally recognised achievement that for a time provides model problems and solutions to a community of practitioners."

"A paradigm is what the members of a scientific community share, and, conversely, a scientific community consists of men and women who share a paradigm,"

"A scientific community consists of the practitioners of a scientific speciality. To an extent unparalleled in most other fields, they have undergone similar educations and professional initiations; in the process they have absorbed the same technical literature and drawn many of the same lessons from it... The members of a scientific community see themselves and are seen by others as the men and women uniquely responsible for the pursuit of a set of shared goals, including the training of their successors. Within such groups communication is relatively full and professional judgements relatively unanimous."

"The study of paradigms... is what mainly prepares the student for membership in the particular scientific community with which he will later practice. Because he there joins men and women who learned the

bases of their field from the same concrete models, his subsequent practice will seldom evoke overt disagreement over fundamentals. Men and women whose research is based on shared paradigms are committed to the same rules and standards for scientific practice. That commitment and the apparent consensus it produces are the prerequisites for normal science, ie. for the genesis and continuation of a particular research tradition."

Seeing the same thing differently

'No part of the aim of normal science is to call forth new sorts of phenomena; indeed those that will not fit the box are often not seen at all.'

"Paradigm changes do cause scientists to see the world of their research engagement differently."

'….a switch in visual gestalt'

"Practicing in two different worlds, the two groups of scientists see different things when they look from the same point in the same direction… That is why a law that cannot be demonstrated to one group of scientists may occasionally seem intuitively obvious to another."

"Equally, it is why, before they can hope to communicate fully, one group or the other must experience the conversion that we have been calling a paradigm shift."

Hearing the same thing differently

"The proponents of competing paradigms are always at least slightly across purposes. Neither side will grant all the non-empirical assumptions that the other needs in order to make its case…. They are bound to talk through each other. Though each may hope to convert the other to his way of seeing his science abd its problems, neither may hope to prove his case."

'"… the proponents of competing paradigms must fail to make complete contact with each other's viewpoints."

"Scientists debating the choice between successive theories… the vocabularies with which they discuss such situations consist predominatly

of the same terms… they must be attaching some of those terms to nature differently and their communication is inevitably only partial."

Defining science differently

'"… the proponents of competing paradigms will often disagree about the list of problems that any candidate for paradigm must resolve. Their standards or their definitions of science are not the same."

An argument between reasonable men and women

"If a paradigm is ever to triumph it must gain some first supporters, those who will develop it to the point where hardheaded arguments can be produced and multiplied… Because scientists are reasonable people, one or another argument will ultimately persuade many of them. But there is no single argument can or should persuade them all. Rather than a single group conversion, what occurs is an increasing shift in the distribution of professional allegiances."

"At the start a new candidate for paradigm may have few supporters, and on occasions the supporters' motives may be suspect."

"If the paradigm is one destined to win its fight, the number and strength of the persuasive arguments in its favour will increase…. Gradually the number of experiments, instruments, articles, and books based on the paradigm will multiply…"

Conclusion

The New Paradigm of soil carbon is informed by Soil Biology, Quantum Physics, Ecology. It builds upon the achievements of the Dominant Paradigm and employs the disciplines and structures. But it also needs new tools and new questions and new alliances in order to provide the answers needed for the new conditions.

Appendix 5

A Practical Guide to Slowing Global Warming

Capacity and time frames of available methods of reducing the severity of Climate Change

Two years ago SIR NICHOLAS STERN and James Hansen from NASA[i] warned that the global community had 10 years to take serious action that might avoid the worst of Climate Change. The following portfolio analysis by Carbon Consultant Michael Kiely reveals how and when the available methods for reducing atmospheric CO2 can be used.*

CARBON SOLUTION	Deployed	Active life	Extraction (Legacy Load[ii]) Capacity	New Emissions Capacity
Available methods of sequestering (capturing and holding) or avoiding CO2 emissions	*When they can start displacing tonnages CO2*	*Their useful life as CO2 solution*	*Ability to absorb CO2 already in the atmosphere.*	*Ability to absorb or avoid new emissions.*
Agricultural Soils	12 months[iii]	Saturation between 15 and 25 years[iv]	Estimated between 5%-100% global emissions[v]	Up to 100% before saturation
Forests	5-10 years after planting[vi]	Up to 70 years[vii]	15% - 20% Australian soils suitable for forest[viii]	15% - 20% soils suitable for forest
Clean Coal (Geosequestration)	15-20 years (to establish clean coal power stations)[ix]	200-250[x] years (coal supply)	N/A: Future emissions only[xi]	90% of current stationary power emissions[xii]
Nuclear Power	40-50 years (to reach economic critical mass)[xiii]	50 years (known economic uranium supply)[xiv]	N/A: Future emissions only	Limited capacity. Limited life expectancy.
Wind Turbines	20-30 years[xv]	No limit	N/A: Future emissions only	Support role only due to intermittent operation[xvi]
Solar Power	15 – 20 years[xvii]	No limit	N/A: Future emissions only	26% global power needs by 2040[xviii]

A Practical Guide to Reversing Global Warming

FOOTNOTES:

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[i] **"TEN YEARS":** •James Hansen, director of NASA's Goddard Institute for Space Studies. http://www.cbsnews.com/stories/2006/03/17/60minutes/main1415985.shtml

• The Stern Review on the Economics of Climate Change is a 700-page report released on October 30, 2006 by economist Nicholas Stern for the British government. www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/sternreview_index.cfm

[ii] **"LEGACY LOAD":** The Legacy Load is the existing CO2 overload (from 200 years of industrial emissions) which is enough to drive the global mean temperature through the critical 2°C level. Only vegetation can convert the CO2 to storable carbon.

• *""Twenty-first century anthropogenic (human) carbon dioxide emissions will contribute to warming and sea level rise for more than a millennium, due to the timescales required for removal of this gas."*[ii] Chair of IPCC Rajendra Pachauri, Yahoo News, 25 January, 2007

• *"The carbon dioxide that's in our atmosphere today – even if we were to stop emitting it tomorrow – would live for many decades, centuries and beyond,"* said Dr Susan Solomon, senior scientist of the of the Global Monitoring Division of the U.S. National Oceanic and Atmospheric Administration.

•[ii] *"A fraction of the carbon dioxide that we've put into the atmosphere today due to human activity would still be there in 1,000 years."*[ii] Global Response to Ozone Hole Is "Unprecedented" Success, Cheryl Pellerin The United States Mission to the European UnionAugust 24, 2006

• Britain's Chief Scientist said that, *"even if humanity were to stop emitting carbon dioxide today, temperatures will keep rising and the impacts keep changing for 25 years."*[ii] The Age, 4 June, 2006

• *"Much of the climate change likely to be observed over the next few decades will be driven by the action of greenhouse gases already accumulated in the atmosphere."* Climate Change: Risk & responsibility, Final Report, Australian Greenhouse Office, Department of the Environment and Heritage, March 2005

[iii] **SOILS AS CO2 TRIAGE:**• • *"Carbon sequestration in soil and vegetation is a bridge to the future. It buys us time while alternatives to fossil fuel take effect."* - Dr Rattan Lal, Director, Carbon Management and Sequestration Center, Ohio State University, Columbus, Ohio. Professor of Soil Science, College of Food, Agricultural, and Environmental Sciences, School of Natural Resources, Ohio State University. Liebig Applied Soil Science Award, World Congress of Soil Science 2006

• *"Unlike many other technologies to offset fossil fuel emissions, land management for soil carbon sequestration can be implemented immediately, provided there are incentives to do so. An immediate offset of CO2 emissions provides a significant delay in the rise of atmospheric of CO2 concentration. By the time that land management carbon sequestration begins to saturate the soil's capacity to store additional carbon, other methods of reducing emissions or sequestering carbon may be available or already in use."* - Professor Bruce McCarl, Agricultural Economist and Economist, Climate Change, Texas A&M University. Member of the Intergovernmental Panel on Climate Change.

[iv] **SOILS & FORESTS SATURATE**: • "*Carbon accumulation in forests and soils eventually reaches a saturation point, beyond which additional sequestration is no longer possible."* US Environmental Protection Agency http://www.epa.gov/sequestration/faq.html

[v] **SOILS' ENORMOUS APPETITE:** •"Soils with severely depleted SOC pool could have lost as much as 30–40 Mg C/ha, which also constitutes theoretical or potential sink caity. On the global scale, world soils have lost 66 ± 12 Pg C, of which ~50 Pg can be sequestered over 40–50 years through adoption of RMPs (IPCC, 1995). Editorial, "Farming carbon", Soil & Tillage Research 96 (2007) 1–5

• *"We could sequester over 8GT of CO2 with a 0.33% increase on 10% of agricultural land or a 1% increase on 3.3% of agricultural land. 3.3% of Australian agricultural land is about 15 m ha."*
." Dr Christine Jones, Soil Carbon specialist, www.amazingcarbon.com

• *"Recreating the richness of the soils of the American prairies could almost on its own normalize world carbon dioxide levels… With the right agricultural changes in place, that 8.5% of the world's area is easily sufficient to mop up the excess carbon dioxide causing our Global Warming."* Allan Yeoman, Priority One: Together We Can Beat Global Warming.

[vi] **FORESTS' LONG LEAD TIME:**

•The Potential for Large Scale Carbon Sequestration and Landscape and Biodiversity Rehabilitation in Australia, Professor Syd Shea, University of

Notre Dame Australia. Representing The Oil Mallee Company of Australia Ltd and CO2 Australia Limited. December 2003

• "A natural forest has a fairly constant C stock, whereas clearing the forest and establishing a tree plantation, for example, results in an initial large loss followed by a gradual re-accumulation of C. ASB data indicate that a typical tree plantation may eventually reach 50 to 80% of the C stock of the forest, but the time it takes to do so will vary according to the tree species, the management regime, the soils and the climate." - CarbonSequestration, "Best bet" Land-use Systems, Country reports, Alternatives to Slash-and-Burn in Brazil, Global Environmental Concerns http://www.asb.cgiar.org/data/dataset/IDADCMZB.htm#_ftn1

[vii] **FORESTS NET EMITTERS/MAX OUT:** • Investing in Trees as Greenhouse Sinks: An Overview For Industry, Australian Greenhouse Office, 2006

• "The preservation and restoration of forests outside the tropics will do little or nothing to slow climate change and could even accelerate warming," wrote Ken Caldeira, a professor at the Carnegie Institution's Department of Global Ecology at Stanford University. (Caldeira, K. "When being green raises the heat." The New York Times, January 16, 2007) Caldeira refers to a phenomenon known as the "albedo effect." Albedo is the degree to which the Earth's surface reflects sunlight. He argues that, by adding trees in northern forests, we are effectively dampening local reflectivity. In winter, for example, smooth, highly reflective snowfields are swapped for a more broken, darker surface. The net result is extra heat. "The absorption of sunlight by boreal forests means they exert a net warming influence on global temperatures," he says. http://www.conservationmagazine.org/articles/v8n2/that-sinking-feeling/

[viii] **FORESTS' LIMITED CAPACITY**:

• In 1788 Australia had 70million hectares of forest. There are 450million hectares of agricultural lands. Area of natural forestry 15% total area. Warnings From the Bush: Forests, Climate Action Network Australia, http://www.cana.net.au/bush/forests.htm

[ix] **CLEAN COAL LONG LEAD TIME:**

• "No large coal plants have to date operated commercially with integrated, full-scale, CO2 capture and storage systems," WEC- Fossil Fuels Leading the Clean Energy Revolution? (Nuova Fiera di Roma, First Floor Hall 10, Room H) Opportunities and Challenges for New Technologies and Deployment, 2008) http://www.usea.org/CFFS/CFFSRome2008WEC/Victor_Der_Opportunities_and_Challenges_to_New_Tech.pdf.

• The Electric Power Research Institute, a utility consortium, estimated that it would take as long as 15 years to go from starting a pilot plant to proving the technology will work. The institute has set a goal of having large-scale tests completed by 2020. "A year ago, that was an aggressive target," said Steven R. Specker, the president of the institute. "A year has gone by, and now it's a very aggressive target." "Mounting Costs Slow the Push for Clean Coal," New York Times, May 30, 2008

• In January 2008, the US Government cancelled its showcase project, FutureGen. About $50 million has been spent on FutureGen, about $40 million in federal money and $10 million in private money, to draw up preliminary designs, find a site that had coal, electric transmission and suitable geology, and complete an Environmental Impact Statement, among other steps. But in January, the government pulled out after projected costs nearly doubled, to $1.8 billion. The government feared the costs would go even higher. - "Mounting Costs Slow the Push for Clean Coal," New York Times, May 30, 2008

• "CCS is unable to achieve substantial reductions in global greenhouse emissions in the first half of this century, and will not be available in the critical period between now and 2020 when global emissions cuts are essential. Most studies predict that CCS will reduce the amount of growth in emissions until 2050, not reduce actual emissions levels." - Rising Tide Australia http://www.risingtide.org.au/cleancoal

• The Intergovernmental Panel on Climate Change has found that "With greenhouse gas emission limits imposed, many integrated assessments foresee the deployment of CCS systems on a large scale within a few decades from the start of any significant climate change mitigation regime," and that "notwithstanding significant penetration of CCS systems by 2050, the majority of CCS deployment will occur in the second half of this century". - IPCC Special Report – Carbon Dioxide Capture and Storage, Summary for Policy Maker and Technical Summary 2005

• CO2CRC Chief Executive Dr Peter Cook told the House of Representatives Standing Committee on Science and Innovation Inquiry into Geosequestration Technology. Appearing before the Committee in February, Dr Cook told the Committee that once the required policy settings were in place, a lead time of about five years would be needed to design and build a new power station with capture and storage." - www.co2crc.com.au/dls/co2futures/CO2FUTURES_Issue_02.pdf

[x] **COAL'S ABUNDANCE:** Australian Coal Association, http://www.australiancoal.com.au/resources.htm

[xi] **TECHNOLOGY CANNOT SOLVE THE PROBLEM:** • Only the process of photosynthesis can remove the 200 years backlog of CO2 that on its own can drive us through the 2°C average world temperature rise into climate crisis.

[xii] **CLEAN COAL IMPERFECT SOLUTION:**

• 'Clean coal' technologies promise to substantially decrease the level of greenhouse gas emissions, but resultant levels would still be about 10 to 100 times higher than for renewables Stewart Needham, "The potential for renewable energy to provide baseload power in Australia", Research Paper no. 9 2008–09, Parliamentary Library, Science, Technology, Environment and Resources Section, Parliament of Australia, 23 September 2008

• BEA Energy Workshop, Clean Coal – opportunities and needs following the 2006 Energy Review, Mike Farley, Director of Technology Policy Liaison, Chair TUC Clean Coal Task Group,, 24 October 2006 http://www.worldenergy.org/wec-geis/global/downloads/bea/bea_ws_1006_fa.pdf

[xiii] **NUCLEAR LONG LEAD TIME:**

• Coal-fired power plants could not be replaced fast enough with nuclear plants to make any real difference, said the research principal at the Institute for Sustainable Futures, Chris Riedy. "It would take 10 years to get one nuclear power plant up even if there was no public protest. And all of the evidence from where they have been built [overseas] shows they have had to have massive [government] subsidies to keep them going."

•. A 1000-megawatt nuclear power plant would generate between 2 and 3 per cent of Australia's current electricity consumption, said Dr Iain McGill, research co-ordinator for the Centre for Energy and Environmental Markets at the University of NSW: "Coal generation is about 85 to 90 per cent of national electricity market generation, so it might require around 30 to 40 such plants to replace coal-fired generation. Such a program would almost certainly take numerous decades."

• A 1000-megawatt nuclear plant would cost at least $3 billion to build - 2½ times that of a coal-fired power plant - and much more to operate than fossil fuel plants, says Dr Mark Diesendorf, a senior lecturer at the Institute of Environmental Studies at the University of NSW. To build a lot of nuclear plants, say, over 20 years, would emit so much greenhouse gas it would take 40 years to break even in terms of CO2, he said. Sydney Morning Herald 2/5/2007

[xiv] **NUCLEAR LIMITED USEFUL LIFE EXPECTANCY**:

• "Even a modest expansion of nuclear power at lower than historical rates results in the exhaustion of all known reserves of uranium in a few decades. The Hotelling rent for uranium is significant, suggesting that unless major new reserves of uranium are discovered, nuclear power may not emerge as a long-run alternative to coal, which is available in abundance. Even if the social and political problems relating to nuclear energy were to be resolved, it is unrealistic to expect an instantaneous expansion of nuclear capacity given the long lead times (about 7-10 years) involved in licensing, constructing and commissioning of nuclear power plants… In our model, nuclear capacity is endogenously determined, but these estimates are in the range of engineering feasibility studies (see MIT, 2003) which suggest that an expansion of electricity production from the present 367 billion to 1000 billion watts by 2050 is feasible and given known uranium reserves, this deployment can be maintained for about 40 years." CAN NUCLEAR POWER SOLVE THE GLOBAL WARMING PROBLEM? by Ujjayant Chakravorty, Department of Economics, University of Central Florida, Bertrand Magné, University of Toulouse, and Michel Moreaux, University of Toulouse
"We believe that the world-wide supply of uranium ore is sufficient to fuel the deployment of1000 reactors over the next half century and to maintain this level of deployment over a 40 year lifetime of this fleet." Massachusetts Institute of Technology (2003). The Future of Nuclear Power. An Interdisciplinary MIT Study. http://web.mit.edu/nuclearpower/.

[xv] **WIND LONG LEAD TIME TO CRITICAL MASS:**

• "And while concern about the environment has heightened, it could still be decades before renewable energy options reach critical mass. Much of the renewable industry's future will depend on improving economics." http://www.centreforenergy.com/silos/wind/windEnvironment/potentialImpactsEnvChallenges01.asp

• "Wind energy is likely to generate 10-20 per cent of the world's electricity by 2030, and is now regarded as a conventional energy source [DWTA; EWEA]." Sustainable Energy, Andrew Blakers,, Director, Centre for Sustainable Energy Systems, Australian National University Ph 61 2 6125 5905 Andrew.blakers@anu.edu.au Web: http://solar.anu.edu.au

[xvi] **WIND LIMITED CAPACITY:**

• "Australia is not particularly well-endowed with sites for wind farms, and development tends to be restricted to southern regions, which is where the windiest locations are. In addition, the 'NIMBY' ('not in my backyard') syndrome has caused some proposals for wind farms not to proceed. The risk of bird deaths has affected the final siting of some projects, and required

special monitoring and mitigation procedures which appear to have reduced the general level of concern." - Stewart Needham, "The potential for renewable energy to provide baseload power in Australia", Research Paper no. 9 2008–09, Parliamentary Library, Science, Technology, Environment and Resources Section, Parliament of Australia, 23 September 2008

• "Wind turbines installed at windy sites, for example, operate at between 25 to 35 per cent of full capacity. In comparison, coal-fired power plants usually operate at an average of 75 to 85 per cent of full capacity. This intermittent nature means that renewable energy is not a solution to all our energy needs and must play a supporting role in the larger energy mix." http://www.centreforenergy.com/silos/wind/windEnvironment/potentialImpactsEnvChallenges01.asp

• According to a study by the European Wind Energy Association and Greenpeace, there exist no technical, economic or resource barriers for the wind to provide 12 percent of the world's electricity by 2020. With strong government policies in place in a growing number of countries, wind power could meet 22 percent of global energy needs by 2040. Worldwatch Institute July 10, 2003 http://www.worldwatch.org/node/1771

[xvii] **SOLAR LONG LEAD TIME TO CRITICAL MASS:**

•TYPES OF LOW EMISSION TECHNOLOGIES, Climate Change and Energy, Australian Government, Department of Prime Minister & Cabinet, http://www.pmc.gov.au/publications/energy_future/chapter8/7_technologies.htm

• "Solar energy can eliminate the need for fossil and nuclear fuels over the next 50 years." Sustainable Energy, Andrew Blakers,, Director, Centre for Sustainable Energy Systems, Australian National University Ph 61 2 6125 5905 Andrew.blakers@anu.edu.au Web: http://solar.anu.edu.au

[xviii] **SOLAR LIMITED CAPACITY: "**Solar Generation: electricity for over 1 billion people and 2 million jobs by 2020 – a report by EPIA and Greenpeace", www.greenpeace.org