Carbon Pollution Reduction Schemes

Threats and opportunities for broad acre agriculture

A report for

by David Drage

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Contents

Foreword

Australian agriculture will be affected by carbon pollution reduction schemes regardless of whether agriculture becomes a covered sector under Australia's Carbon Pollution Reduction Scheme or not. Agriculture represents 17% of Australia's greenhouse gas emissions, and transport and manufacture of agricultural products increases this figure again. As the second largest emitting sector of the Australian economy it is very difficult for Australian agriculture to argue for being left outside of any Carbon pollution reduction scheme.

Despite its large carbon footprint Australian agriculture is not in a position to make reductions in the size of its emissions. Agricultural emissions are relatively fixed relative to units of production. Unless an intensity based system of emission allowance is used, Australian agriculture will be forced to downsize if a high carbon price and large reduction targets are forced upon it. As global population continues to grow and available agricultural land is forced to compete against other land uses, food security becomes a problem, and this should be seen as an issue that overrides agricultural GHG emissions.

Fundamentally global warming is the result of overpopulation, and overconsumption by the wealthy. Desires for global greenhouse gas reduction will create a number of ethical dilemmas for the world. What right does the developed world have to deny the aspirations of the developing world to consume the way the west has for the past few decades, and should the developed world be changing the way it behaves to show the less fortunate of the world that we realise the errors of our ways.

A very hard decision needs to be made in the developed world; do we want the next generation to have a lower standard of life than we had. The United Nations estimates that 40% of births in the world are the result of unwanted pregnancies, and a recent study by the Optimum Population Trust at the London School of Economics estimates that $7 spent on family planning will reduce CO2 emissions by one ton. Given that carbon currently trades around 15 to 25 dollars per ton, forced family planning makes sound economic sense but is morally unacceptable to many. Climate change refugees are already starting to make their way to new homes as a result of desertification and rising sea levels.

Against all these ethical and moral issues a cold economic system is being devised to produce market signals to hopefully reduce carbon emissions. The targets for greenhouse gas reduction set by the various international organisations have implications far beyond their impact on theoretical models; market failure of the agricultural application of carbon pollution reduction schemes is unacceptable. Food security is of utmost importance, and if global warming is as bad as it is meant to be, it is a threat to food security in itself. What happens in

regards to agricultures treatment in global greenhouse gas abatement is of fundamental importance. Whilst the average farmer cannot be expected to understand all the politics and science, it is imperative that they are aware of what the implication of the issue is to their livelihood.

A carbon pollution reduction scheme is not the end of the world for agriculture, but we must be fully aware of the potential implications. In the following report many of the key issues are raised, with some of the basic science. For more detailed information there are many documents available on the internet. The Australian Government Department of Climate Change website contains precise details of Australia's international obligations and in depth explanations of much of the science. Most agricultural lobby groups and state departments of agriculture also have good detailed information available. Please be pro active on this issue and educate yourself as much as possible. We may only get one chance to keep Australian agriculture viable in the face of commoditised carbon.

Acknowledgments

I must thank my family for giving me 16 weeks leave from their lives to pursue my dreams. I will be forever in debt to Narelle and Amelia. I must also thank my father and brother for working extra hard running the farm in my absence.

I also thank Nuffield Australia and the Estate of RC&EC Webb for the opportunity to travel the globe as a Nuffield scholar.

It is now up to me to return the favour of this great opportunity to Australian agriculture.

Abbreviations

ANREU Australian National Register of Emissions Units

CCX Chicago Climate Exchange

CDM Clean Development Mechanism

CO2e Carbon Dioxide equivalent

CPRS Carbon Pollution Reduction scheme

ECX European Climate Exchange

GHG Green House Gas

HR2454 The Waxman-Markey Bill, The US Clean Energy Act

NGGI National Greenhouse Gas Inventory

NGO Non Government Organisation (Lobby Group)

UNFCCC United Nations Framework Convention on Climate Change

Executive Summary

Global agriculture is facing the most serious threat it has faced in a generation. It is not climate change, it is not the effects of increased carbon dioxide in the atmosphere; the big threat is the legislative frameworks being developed to reduce the amounts of greenhouse gasses in the atmosphere. Poorly drafted legislation can have a massive impact on the financial viability of businesses, markets can drift to areas of the world that are less financially impacted by legislation, and day to day operation of businesses can be adversely affected.

A new market is being created around the world; the carbon market. Although taking many forms, carbon markets are all about commoditising the right to release carbon based pollution into the atmosphere. As agriculture is basically carbon cycle management it is affected by what happens in a carbon market, even if it is not participating in the market. There will be pressure for agricultural land to be used to capture carbon, and there will be those wanting to profit out of the carbon that daily cycles through our farms. As the majority of our energy comes from fossil fuels there will be pressure on energy prices, and agriculture will have the potential to be supplying renewable energy. In this whole process new technologies will come along that could change the face of agriculture. Further to this agriculture may be forced into this new trading market to purchase the right to continue emitting the gasses that cycle through our farms. Agriculture may also be forced to make emission reductions that are impossible to achieve.

Methane and nitrous oxide are also greenhouse gasses and both these gasses are released in significant quantities by many agricultural businesses. Through calculated levels of equivalence the release of both these gasses could also be a part of the carbon market, and management of these gasses at farm level will also potentially create liabilities or the opportunity for profit.

It is imperative that Australian agriculture is actively involved in the development of the legislative framework surrounding carbon emissions. It may seem simple to exclude agriculture from a CPRS but this will not be in the long term interest of agriculture. Spiralling energy costs will hurt Australian agriculture which is heavily dependent on fossil fuels. The assumptions of many proposed laws need to be questioned. The huge liability that soil carbon accounting creates also needs to be tackled. Australian agriculture needs to get these issues right first time; food security and livelihoods depend on this.

Introduction

As I write this report in October 2009 the world is at an unknown position in respect to emissions trading schemes and the control of greenhouse gasses. 186 nations around the globe have signed on to the United Nations Framework Convention on Climate Change. All developed nations have at least made partial commitments to reduce emissions of greenhouse gasses from their nations, most have signed the Kyoto protocol, and many have enacted or are drafting some form of trading schemes to deliver reduced emissions. The world is about to enter the next phase of negotiation on reducing emissions with the Copenhagen meeting in December 2009 being the start of work on the global agreement that will replace the Kyoto protocol within the UNFCCC. Note that Copenhagen is the START of negotiating the next phase of negotiated global greenhouse gas management. Some politicians would have us believe Copenhagen 2009 is going to deliver the answers and we must go there with our national position firmly set in concrete. As with the Doha round of international trade talks, Copenhagen talks this December will not create an instant solution. They will be the start of negotiating the shape of the future. While the Doha round of trade talks fail to reach conclusion it will be difficult for Copenhagen to reach conclusion as international trade in rights to release CO2 will surely be a large part of the agenda.

The aim of the Copenhagen round of meetings will be to develop targets for global GHG reduction for the next period, and development of international mechanisms to help the globe reach those goals.

Meanwhile in Australia, our legal position is quite clear, even if not confirmed. All businesses releasing over 25,000 tons of CO2 equivalent per annum are obliged to report their emissions to the Department of Climate Change's National Registry of Emissions Units, ANREU; our Carbon Pollution Reduction Scheme is currently before The Senate for a second time; and under that legislation agriculture is an uncovered sector with a decision being made in 2013 as to whether it will be a covered sector from July 2015. Australia is also obliged to keep its obligations to the UNFCCC.

Many will argue that the theory of global warming is flawed and that climate change has always occurred. It is true that the climate has always been changing, and there are flaws in global warming theory, but this is no longer relevant to the arguments of regulation. Public perception has changed and it is no longer possible for a business sector to argue against climate change without receiving serious negative backlash. We now need to place our

energies into finding sensible legislation that will show agriculture is concerned about its carbon footprint, and not arguing that it is all wrong.

Greenhouse gas counter, Madison Square New York. Such public displays of concern cannot be ignored by sectors of the economy that are perceived as polluters.

Global Warming

What is it?

Global warming and climate change are two things we hear often today. They are two different things but they are not mutually exclusive. Climate change is something that has been happening since day one on this planet. Climate change is simply that; a change in the climate. It is climate change that may have killed the dinosaurs, it is what caused lush vegetation to grow in areas of the globe that are now desert, resulting in the vast deposits of oil that now lie under the Middle East.

Global warming is a different phenomenon; it is the observation that average temperatures are rising. This global warming may be a part of a natural warming cycle, or it may be caused by the greenhouse effect. The greenhouse effect is the theory that increased levels of certain gasses in the upper atmosphere trap rays of sunlight reflected from the surface of the earth, resulting in a rise of global atmospheric temperature. This theory is not new; it was first published in the late 19th century, and has been confirmed by numerous studies since. Whether the current rise in global temperatures is caused by cycles of solar radiation or by the greenhouse effect we do not definitely know. What we do know is that CO2 levels in the upper atmosphere are rising, and that globally this concerns a lot of people.

At the end of the day the science is irrelevant. Society has changed, and it is no longer acceptable to not be accountable for what one releases into the atmosphere. Cities such as Los Angeles or London that have had major pollution issues in the past have shown us that it is possible, as well as necessary, to clean up the atmosphere.

The science of the greenhouse effect

There are four main recognised greenhouse gasses, three of which are common in agriculture. Carbon Dioxide, CO2, is the main gas. Methane (CH4), Nitrous oxide (N2O), and various HFC's and PFC's (fluoro carbons such as refrigerant gasses) are the other three. These last three gasses are found in much smaller quantities, but are considered a much more serious problem due to their persistence in the upper atmosphere. It is for this reason that the release of methane from ruminants and the nitrification of excess fertilizer are of great potential concern to agriculture. The four classes of GHG are generally referred to in terms of CO2e; carbon dioxide equivalent. "One ton of methane has the same greenhouse gas potential as 21 tons of CO2, even though it is 1/21 the weight, and would be referred to as 21tons CO2e." The science used to determine these equivalencies is debatable. Current methodology is based on amount of GHG remaining in the upper atmosphere after 100 years. Taking a longer term

outlook greatly reduces the loading of CH4. Other new studies could also see the CO2e of CH4 lifted to 25 at Copenhagen when Greenhouse Account Factors will be reviewed.

NOTIONAL GREENHOUSE ACCOUNT FACTORS

GREENHOUSE GAS (T)	**CO2 EQUIVALENT (T CO2e)**
CO2 Carbon Dioxide	1
CH4 Methane	21
N2O Nitrous Oxide	310
HFC, PFC (Various)	Between140 and 23,900

Ref. Notional Greenhouse Accounts Factors Dept. Climate Change June 2009

In theory these four gasses combine in the upper atmosphere and form a blanket over the earth. Rays of sunlight can pass through this layer and enter our atmosphere to perform their function of heating the earth. Usually these rays are reflected by the earth's surface and then float around in the ether of space, but they are less able to penetrate the layer of greenhouse gasses in the upper atmosphere. Some of these rays are then reflected back to the earth's surface, heating the earth up hotter than it otherwise would be.

We do not know definitely whether all the climactic changes we see today are caused by this effect. Populist thinking within the agricultural community is that what we see is cyclical in nature, but the reality is probably a combination of both natural cycle and greenhouse effect.

Mitigation efforts

In 1990 negotiations began that lead to the formation of the UNFCCC, United Nations Framework Convention on Climate Change. Australia was amongst the first nations to sign this convention when it was completed in May 1992. Over the next 17 years various reduction strategies have developed, and reduction targets and timeframes set. There was also a lot of work done to create inventories of greenhouse gas emissions from each country. An obligation of signing the UNFCCC is the need to maintain a national register of greenhouse gas emissions. From that obligation the Government has created the National Greenhouse Gas Inventory, and the legal requirement for all large emitters in Australia to report annually their emissions to the ANREU. Countries that have signed the Kyoto Protocol are obliged to reduce their greenhouse gas emissions along certain lines; basically to reach a certain reduction target by a certain date. Targets are generally a percentage of 1990 base line emissions. (global greenhouse emissions in 1990 were declared the base line for emissions. 1990 was chosen as

this is the year the UNFCCC began, and having a base year different would allow manipulation of project outcomes for unfair benefit.)

There are many ways a country can force reductions in emissions. A tax can be placed on products that release greenhouse gasses, discouraging their use. Direct legislation can be used to control release of greenhouse gasses and stop their release. Trading schemes can also be created, whereby market forces can be used to determine who gets the right to continue to release greenhouse gasses. In many western economies this has developed as the preferred approach to controlling greenhouse gas emissions.

For agriculture it is not easy to reduce GHG emissions, and even less easy to quantify them.

Emissions Trading Schemes

Cap and Trade

The term Cap and Trade market is a general term which covers many different markets where control of a reducing product is the main aim of the market. The first Cap and Trade market was developed in the late 1980's as a means of reducing the burning of sulphur coal to reduce the acid rain that was damaging forests across the Northern hemisphere. In this role the markets have worked well, and it is because of the Cap and Trade market system that we no longer hear of acid rain as a problem.

The principle of a cap and trade market is quite simple. If we need to reduce the amount of product X released into the environment each year we first find out how much is actually released each year. We then create a law that if you are to release product X into the atmosphere you must surrender one rights certificate for each unit released. In year one of the scheme we issue certificates equal to the amount of emissions released annually in the past. This is now the "Cap".

The pool of certificates equals emissions so all businesses have access to enough certificates to meet their obligations. In year two of the scheme the number of certificates issued will be reduced, meaning that businesses wanting to emit product X either have to reduce their overall emissions or purchase emissions right certificates from someone who has spare certificates. This creates the "trade". Over time the number of certificates issued will be reduced until annual emissions of commodity X are reduced to the desired level. Not all proposed cap and trade systems are identical, but all follow the same principle.

Whilst cap and trade has worked successfully to reduce the amount of sulphur coal burnt by industry, the number of participants in individual schemes has always been small, and all participants were on an equal level of sophistication. To ask individual small businesses, specifically farmers, to participate in a cap and trade market alongside big industry would be

extremely dangerous. Such markets can be extremely volatile, and businesses need to be able to pass costs on to consumers; something agriculture is not good at. A major criticism of cap and trade systems is that they do not reward efficient participants; that they actually transfer costs to those participants least able to pass costs on within their own businesses. It is also a concern that "Cap and Trade" is a free market tool developed in the 1980's, and is possibly no longer relevant to a more conservative post 2008 economic environment.

Base Line and Credit

An alternative to "Cap and Trade" is a system of base line and credits. Current emissions are set as a "base line", and any reduction in emissions below that level will create a credit. The advantage of base line and credit over a cap and trade system is that a business that is making no change to its operations does not have to physically participate in the carbon market. It is only when a change in practise creates a reduction or increase in emissions that a business needs enter the market to trade this surplus or reduced carbon emission.

Carbon Offsets

Carbon Offsets are a form of derivative product that have developed in voluntary carbon markets around the globe. Offsets take many forms but all follow one basic premise; somebody makes a change in practise that creates a reduction in carbon emissions. In broadacre agriculture the most common offset is soil carbon offsets generated from farmers changing to no-till farming practises. Cultivation reduces soil carbon, so by a farmer reducing the tillage he does, he has theoretically reduced the rate of decline of soil carbon, and hence reduced the amount of CO2 released into the atmosphere. Offsets usually have a low value relative to carbon units in a covered cap and trade market, as they are usually not directly measurable. Most offsets are based on assumptions based on modelling and accepted practises.

Clean Development Mechanisms

Clean Development Mechanisms, CDM's, are a mechanism created by the UNFCCC to allow work done in developing nations to reduce GHG emissions, whether directly or indirectly, to be available to developed nations as credits against emissions in developing nations. CDM's were developed to help cash flow to developing nations, to encourage clean development, to stop uncontrolled land clearing, and to bring nations into the environmental development system that may otherwise have stayed out. No aspect of the work of the UN on climate change has developed more criticism than the CDM. The process of getting approval for schemes is extremely difficult. I have spoken to non government organisations, philanthropists, and energy companies who have all shown disapproval for the CDM process.

Whilst it is good in theory, and outcomes have been reached, the process is obviously still far too onerous to be practical. CDMs currently operate covering the protection of tropical rainforests in New Guinea, Indonesia, and various South American countries.

To date only one CDM directly relating to agriculture has been approved; it relates to the use of an innoculant ending the practise of using nitrogen fertilizer on a legume crop. It is ironic that this CDM is simply the introduction of some basic sound agronomic advice packaged up as a great deal. Potentially Australian farmers could sell their management skills to developing nations packaged as a CDM and create offsets for Australia. If Australian agriculture is to be left as an uncovered sector by the Australian CPRS, then we should also be lobbying for CDM's to be extended to sectors of developing nation's economies that are outside CPRS's.

There is also a risk that nations will manipulate CDM's into a tool for transferring wealth from the developed world to the developing world. When it is considered that most nations that will benefit from carbon leakage are also those eligible to participate in CDM's, this could become a trigger for international tension.

Intensity based systems

Another method of determining what level of agricultural emissions should be allowed is to utilise an intensity based emissions accounting system. Under such systems a certain level of emissions will be allowed by a sector per unit of production. Annual reporting would be required from industry, and from those reports a credit or liability would be calculated. This would allow industries which expand and retract to not be detrimentally harmed in the expansion phase, but there would still be incentive to be efficient as there is a disincentive for emissions to grow relative to production. Use of intensity based systems is the preferred option of the livestock sector of New Zealand if agriculture is to remain a covered sector.

The problems with emissions trading schemes for agriculture

Past emissions trading schemes have always had only one commodity involved and a limited number of large participants. The first markets were trading sulphur release between large power generators and other large industries. Today the European Carbon Exchange only trades Carbon certificates, not equivalencies of other greenhouse gasses as is proposed under current Australian and US legislation. There is question over whether the ratios used to rate the different values of the other GHG's are ever likely to change, which would undermine one of the premises of the market.

In its current form the Australian CPRS would only require industries releasing over 25,000tons CO2e per annum to participate. This means there are around 1100 businesses

being forced to participate in the carbon market. As few farm businesses release more than 2000t CO2e per annum, Australian agriculture falls well short of the participation threshold. If agriculture was to be classified as a covered sector suddenly thousands of extra small businesses are forced to participate in the market. Alternatively, it could be decided to cover the agricultural sector with an upstream point of obligation. This would place the obligation on up-stream processors, grain handlers, abattoirs, dairies, packing sheds and farm input suppliers to be responsible for assuming the accounting role for on farm carbon emissions. Farm businesses would be at risk of having the costs associated with this unfairly added to ones costs, and the "market forces" that are supposed to stimulate change in a cap and trade system would not be passed on.

To cover the agricultural sector in a CPRS alongside large polluters is not fair or equitable. Most large industrial emitters of greenhouse gasses can easily and accurately account for their emissions through measurement devices. Emissions can also be easily cross referenced and re-verified by multiple inspections. It is impossible to accurately measure the emissions of every cow, every tree, and every square metre of cropping soil. It devalues industrial emissions trying to use assumptions to make estimates of agricultural emissions that will theoretically trade as an equal.

Furthermore, most agricultural businesses would have to trade certificates on a level well below the minimum trade parcel size. A farmer with 2000t CO2e annual emissions obliged to make a 12% reduction in emissions will need to purchase 240t of carbon permits if unable to make reductions. If the minimum parcel size for trade is 1000t, as it is currently on the ECX, that farmer will need to use an agent or a pooling service to access the small size of certificates required. At a price of $20/t this is $4800, but aggregation or pooling costs would need adding, as well as commissions.

Once a carbon market is established under a cap and trade system, day traders and hedge funds will move in to the market in an attempt to make profits. It is not desirable to ban non participants from the market, as these traders are required to add liquidity to the market. In the same way global grain markets went on a major roller coaster ride last year as the trader money flowed in and out of the market, so too would the carbon market rise and fall. Sitting in on the Senate Ag Committee hearing on HR2454 in Washington DC, it was clear that the biggest concern of the Senators was market volatility.

There was talk of the need for daily limit up and limit down restrictions, as well as other devices to remove volatility from a carbon market. Methods of guaranteeing transparency and trade reporting for price clarity are of paramount importance in any carbon market. The Australian Federal Police have already set up a unit to examine carbon fraud, and there has

been one multi million euro fraud on the ECX uncovered in the United Kingdom. Liquidity itself is already causing a problem in a number of voluntary markets around the world, as well as on the ECX. The global recession has reduced northern hemisphere emissions to a greater level than what is legally required so there has been very little need for trades to occur. In the English scheme DEFRA, as market operator, has stepped into the market and purchased a number of certificates to artificially tighten supply and create demand for trade.

In drafting the Australian CPRS the government has recognised the issue of adjusting some industries into a CPRS. These Energy Intensive Trade Exposed (EITE) industries will be given concessions in the early years of the CPRS to assist them to adjust. For many agricultural EITE industries there is no adjustment available. A dairy farmer has fixed energy requirements that cannot be reduced through market forces. Alternative sources of that energy are the only means available to a dairy farmer to reduce the carbon footprint of the business energy use. A cap and trade CPRS will detrimentally hurt a business that has no options to change.

Regulation

An alternative to using trading systems or other market mechanisms to reduce GHG emissions is to use regulation to bring this about. In the State of California the large population, high dependence on automobiles and the geography of the state combine to create a major pollution problem. Overlay that scenario with the idealistic nature of the ageing hippies left from the 60's and you have a major need to clean up the situation. Over the past 30 years California has lead the world in the introduction of legislation to clean up fossil fuel based emissions. Tough emissions rules on all engines, the classification of exhaust gasses as pollutants and many other rules have resulted.

This whole process has had results, as California's air quality today is far better than it was when I first visited the state in 1992. This has come at a regulatory cost. Farm managers must have detailed dust mitigation plans and keep chemical application records well beyond what is required in Australia. Rules controlling emissions on stationary engines and trucks have cost many considerable amounts of money and seen otherwise perfectly good machines sidelined and worthless as a result. Soon all industrial engines operating in California, other than self propelled farm machinery, will have to meet tier iv emissions standard. Exemptions exist for one off visits of trucks from other states and machines that see little use, such as farmer owned trucks that travel less than 10,000 miles per year. The process has now started to extend these emissions rules to tractors, but exemptions will be created to allow farmers to

keep older tractors that see little use. These rules are seen by some outside California as a trade barrier, but the effect is probably neutral as there has been leakage of operators relocating to state border areas to escape the California rules.

Tier iv diesel engines are proving to be less fuel efficient than older engines. It is ironic that more fuel is required to make a diesel engine run efficiently. US manufacturers have tended to use exhaust gas recirculation to reduce emissions, whereas most European manufacturers are using catalyst technology to reach the same emission reductions. Tractor manufacturers are retraining operators and more closely advising buying decisions in attempts to reduce the increase in on farm fuel consumption that often follows the purchase of a new tractor. When the US tier v emissions standard is introduced in a few years time it is believed that all manufacturers will have to use exhaust catalyst technology to reach the required level of emissions. The need to service catalyst filters and the cost of liquid catalysts will add to machinery operating costs.

Irrigation pump replaced under Californian emissions rules. Note the hole in the block as result of engine being "destroyed" as condition of owner accepting grant money to assist with the engines replacement.

In the United States there is a concern that the Environmental Protection Agency will be forced to regulate GHG emissions if HR2454 is defeated. Legal action in the past and government law will oblige the EPA to do this. The result of this could be taken to the level of

cattle producers needing a license for each cow as they are a source of methane emissions. The growth in the size of the EPA needed would be astronomical and would be a nightmare to enforce from both the farmer and EPA's side. It is a concern that special interest groups opposed to certain agricultural practises could use the EPA to help enforce agendas opposed to current agriculture as well.

UNFCCC obligations force all signing nations to meet greenhouse gas emission reduction targets. Whilst a trading system seems to be the preferred system for meeting these obligations in large emitting industries, it is not practical for smaller emitters such as individual farms. In a number of European countries the need for agriculture to be seen as making its contribution to the country's overall reduction has been achieved through negotiation. In the United Kingdom the farm lobby has been able to negotiate for agricultures commitment to GHG reduction to be a three million ton CO2e reduction by 2020. It is hoped that this can be achieved by voluntary reduction, with biofuel production and methane capture providing the bulk of this.

Fossil Fuels and Alternative Energy

Fuel Subsidy

The level of carbon dioxide in the atmosphere not attributable to natural processes is almost entirely due to the burning of fossil fuels. Almost all people I have spoken to during my travels have said that fossil fuels are too cheap relative to other forms of energy, so their use is abused. Reduction or elimination of all subsidies, both direct and indirect, on fossil fuels globally would be a major start in correcting this situation. Doing this would have an immediate effect on agriculture as not only would the barrel price rise, but we could see an end to the "duty free" fuel that farmers in most countries enjoy. Transport costs would also rise, producing another flow on effect to agriculture.

On the closing day of the G20 meeting in Philadelphia this September it was quietly announced that the G20 nations had agreed to phase out global fuel subsidies. This one action potentially could do more to arrest growing CO2 in the atmosphere than any other action to date.

Biofuel

There is nothing more appealing to a farmer than the thought of being able to grow one's own fuel. The technology to do this has existed for years now; in fact Rudolph Diesel imagined that the compression ignition engine that bears his name would run on vegetable oil when he developed it. Legislation and the strength of the big oil companies have stifled the adoption of

biofuel. In the United States there is now a mandated level of biofuel use, and sufficient ethanol plant capacity to meet the target, but oil companies are lagging behind in the provision of blending plants to enable the blended fuel to be created for market. In other markets where there are mandates on the use of biofuel, such as the United Kingdom, petroleum companies are also lagging behind their obligations.

There are a lot of questions hanging over the biofuel industry; the main ones being the impact on food supply, the true greenhouse gas footprint of biofuel, indirect land use change, and sustainability. Whether the internal combustion engine should remain as a major form of power also comes under question. New forms of biofuel, such as algae also come into the picture. Some markets that have mandated use of biofuels demand a declaration of origin of the biofuel to calculate the true benefit of the biofuel, the English Renewable Transport Fuels Obligation and California being two examples.

The calculations and assumptions behind these declarations are questionable and potentially can be used as trade barriers. One example is ethanol extracted from US Midwest corn will not be taxed in California, but ethanol from Brazilian corn in the same market will be; the assumption being that the mid west corn may at worst have displaced some CRP land whereas the Brazilian corn displaced cattle from rangeland and into freshly cleared rainforest. There is no scientific evidence of this, and the real issue of indirect land use change is far from this simplistic.

Recent evidence suggests that increasing corn and soybean acreage across South America have displaced cattle into feedlots, and further clearing of rainforest is a separate issue (Washington Post 10 Sept. 09). Likewise in Indonesia and Malaysia, not all new palm oil plantations are on illegally cleared land. Many palm oil plantations have replaced rubber plantations that have become liabilities to their owners since latex use has fallen. Simplistic assumptions of land use change should not be used as market signals.

Populist media tried to attribute the high food prices of two years ago in part to biofuels. Whilst biofuels were definitely part of the demand equation, they were no larger part of the equation than that portion of food that is wasted each year. The biggest cause of high food prices two years ago was the shift of money from banking and other investments into soft commodities creating demand at a futures level and hence dragging up the physical price.

Ethanol production from cellulose is also under research, and recent ethanol plants in the United States have been built to enable use of cellulose once the technology becomes viable. It is questionable whether cellulose will ever be a viable feed source for ethanol in Australia, as the value of wheat stubble as a source of moisture retention will have to be weighed against the value of the straw as ethanol. Energy costs of gathering and shifting straw to a central

processing plant is also prohibitive in low rainfall low yielding environments. Switchgrass is a tropical grass that produces large amounts of biomass, but also has a much higher yield of ethanol relative to cereal grain. Switchgrass may have the potential of being grown in warmer parts of Australia, most likely as an alternative to sorghum. It would be a less risky crop to grow as the end product is bulk, not grain, so a tough finish to a season would not hurt yield potential as much as conventional grain crops.

Biodiesel is possibly not economically viable in Australia in the current environment, as canola yields are not high enough to cover the fossil fuel inputs required to produce the crop. Even in the United States, high soybean yields are not adequate to make biodiesel viable from a fossil fuel replacement standpoint. In Europe, though, the numbers do stack up in favour of biodiesel, if the legislative framework is right. In Ireland Biogreen Energy Products Ltd has taken a slightly different approach to biodiesel production. They leave the crushed rapeseed oil as a vegetable oil, saving on the esterification process required to turn rapeseed oil into biodiesel. They then offer a conversion service to modify truck engines to operate on vegetable oil.

All the hardware to do this is available off the shelf; the equipment they use is supplied from Germany. Once converted, the truck has a new partitioned fuel tank; one small tank for diesel and one large tank for vegetable oil. The truck will start on diesel, and automatically start burning vegetable oil once operating temperatures are high enough, and will flush all fuel lines of vegetable oil once the truck engine is stopped. Running on pure vegetable oil there are virtually no nitrous oxide emission issues, no sulphur dioxide issues and much less particulate emissions. Running pure vegetable oil through diesel engines easily fixes most emissions problems of diesel engines. The adoption of such systems could easily solve the emissions issues of older diesel engines that pre date current emissions rules.

The potential of algae as a source of renewable hydrocarbon fuel has been getting a lot of publicity of late. Numerous commercial organisations and Universities are carrying out research into this around the globe at the moment. Pilot trials are also operating in Australia with promising results. The reality is, though, that commercialisation of the technology is probably still 15 to 25 years away. Opportunities for Agriculture to participate in algae based biofuel will be minimal due to the size of operation that will be required to create efficient plants. Large areas of land will be required for algae ponds and that will probably force businesses to operate in non agricultural areas such as deserts. Provision of feedstocks for algae will be a potential business for agriculture to participate in.

On the back of research into the biofuel potential of algae, universities such as Nova Scotia Agricultural College are researching the use of algae as a feedstock for aquaculture. As the

world's ocean fish stocks are being depleted, there is a move to factory farming of fish. For disease reasons factory farming of fish in ocean waters is not popular, but ocean fish struggle to convert cereal grains into food. In the near future we may have a fish industry based in rural Australia operating in a similar way to the poultry industry, based on the premise that algae has unlocked the method of using cereal grains as a feedstock. Such new industry could be of great benefit to rural Australia and the globe as ocean fish, a major source of protein to many communities, dwindles in supply.

Algae research has the potential to open many new opportunities to rural communities, and it is the biofuel potential of algae that is underwriting much of this research.

Biofuels have come into existence for a number of reasons, and the industry is being pushed for an equal number of reasons. The aim of the UK renewable transport fuels obligation is to reduce the carbon footprint of the transport sector, whilst in the United States the prime driver is now fuel supply security, whereas once it was about creating new markets for surplus grain. Biofuels may not be the answer to global warming, but they definitely have a strong role to play in the transition to a low carbon economy. It is imperative that agriculture is not prevented from playing its part in this transition process.

Other Renewable fuels

The rollout of smart meters across Victoria and many other electricity markets across the globe makes it very easy for consumers of electricity to become micro-generators of electricity. Kits are readily available to allow people to generate electricity from the sun or the wind and feed it back into the national electricity grid. Most farm businesses have plenty of room and the right environment to be installing such devices. The limit will be the ability of the national grid to handle the electricity. Methane based electricity generation from sewage ponds is also feasible.

Large scale wind farms are beyond the investment ability of individual farmers, but are a potential source of income from access fees and rental of sites for wind towers. In higher rainfall environments electricity generation from burning biomass is practised. It is questionable whether this would be viable in drier areas of Australia, even if done in conjunction with biochar sequestration. The energy costs of transferring the biomass from field to power plant is considerable, and in a dry environment a large supply area would be required to provide enough feedstock for an economically sized plant.

It is important that work continues on making electricity grids compatible with remote generation. Rural electricity generation can be rendered impossible if distribution grids are not adequate, or electricity companies are unwilling to deal with small generators. In Alberta covered lagoons are capturing large amounts of methane, but the captured methane is burnt

off as it has been impossible or uneconomical to feed into the state grid electricity produced from this methane.

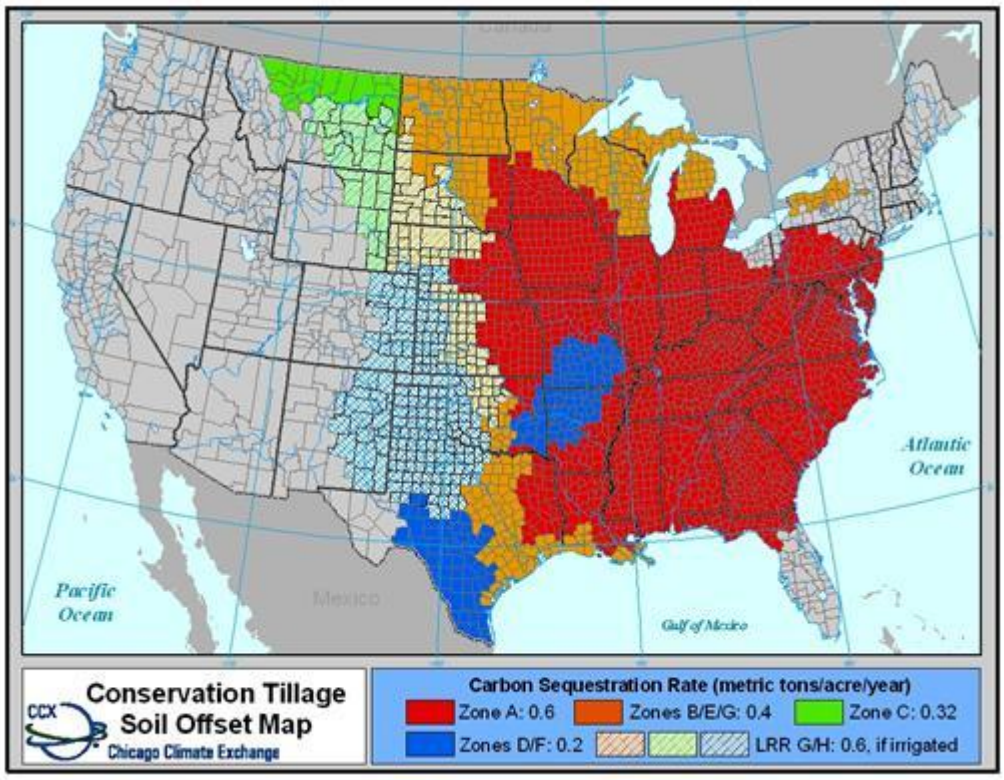
Soil Carbon

Soil has the potential to be used as a massive sink for sequestering CO2. Most agricultural soils have lost carbon over the years, so have the potential to have what has been lost put back. There is also the potential to push soil carbon levels beyond what they were originally. Unfortunately what sounds good in theory doesn't necessarily work out like that in practise. It is not simply a matter of changing management practises and sequestration automatically happening. Moisture, seasonal conditions, crop growth and harvest, fire and nitrification cycles are all complex processes that adjust levels of soil carbon. Furthermore, the dry sandy soils that dominate the Australian agricultural zones are naturally low in carbon content, and extremely inconsistent.

It is extremely difficult to quantify what the base line soil content is, and then accurately quantify the amount of carbon sequestered or lost across a season.

The Chicago Climate Exchange is the most prominent trader of soil based carbon offsets, and they admit that it is not an easy process. Firstly a large number of assumptions need to be made to create an offset. These assumptions are scientifically based, peer reviewed and independently verified. Without making these assumptions it would be prohibitively expensive to accurately quantify carbon sequestration in soil. CCX produce soil maps from USDA data that estimate the level of carbon sequestration a farmer can expect by changing from conventional tillage to no-till. The assumptions made in this process allow the farmer to "sell" only a small fraction of the carbon theoretically sequestered; this watering down to cover variables and inaccuracies in the assumptions. The Carbon offsets then also trade at a discount to the price of carbon on compulsory markets, though there really shouldn't be a direct price comparison as they are completely different products.

CCX soil carbon offsets are generally only viable in areas of soils with greater than 2% organic carbon and greater than 350mm annual rainfall. It has also been noticed recently by soil scientists in the US that the soils that offer viable offset potential are all in the winter freeze area, so there is starting to be research into whether the winter freeze halting microbes from breaking down organic carbon is part of the prerequisite for good soil carbon building. If this is the case Australia will be ruled out of using such modelling.



Map showing rates of assumed carbon sequestration resulting from conversion to no-till farming

Both the CCX and Alberta soil carbon credits have a change of cultivation practise as a central prerequisite. This can be a difficult condition for some to work with. For some farmers no-till produces worse gross margins than conventional farming, and as carbon prices have fallen those farmers have found themselves committed to a system that now costs them money. Advisors and the offset salesmen have also become scarce as carbon prices fell this year, leaving a large amount of confusion amongst farmer participants. Carbon offset trading is a brave new frontier, and there is a feel of the Wild West to the way it behaves. The motives and morality of a number of participants in US and Canadian soil offsets are questionable, and some are definitely no better than snake oil salesmen.

One carbon trader from a Canadian power generator said he “loses sleep” over soil carbon offsets. One change of policy or one study challenging a basic assumption and the whole soil carbon offset could be worthless. Likewise, other natural cycle based sequestration is questionable as permanence is not guaranteed and the base lines are not clear. Currently CCX offset contracts are basically worthless as it is an unknown whether the contracts will have any value if HR2454 becomes law.

Whilst most farmers understand the benefits of soil carbon it is not that easy to build it. In Western Victoria there are many farmers who have shifted across to “best practise” for

building soil carbon, but after a number of years of such farming have been unable to build their soil carbon levels. When dealing with nature we must accept that there are many factors at play, and that expected outcomes may not occur. Building soil carbon is not a continuous process. Some estimates see that soil based carbon offsets as a system may only have a 20 year life at best.

A big risk is that annual reporting of soil carbon levels may be called for. Such a request under NGGI is not out of the question, but would be extremely onerous and of questionable accuracy to implement. If trading of certificates based on shortfall/gains was then overlaid the financial implications would be unthinkable. A farmer may have 20 years of increase in soil carbon followed by 20 years of gradual decline despite using accepted best practises to retain soil carbon. These years of declining soil carbon content will create a liability if all increases have been sold. Such a scenario could break a farmer financially if the cost of carbon rises year on year as expected.

Not all cropping enterprises have the ability to build soil carbon. The cotton industry is one that finds it extremely difficult to maintain soil carbon, and likewise the rice industry releases massive amounts of methane and CO2 from fields post harvest. Horticulture also would suffer under regimes that account for soil carbon, as soil carbon is continually lost but the trees/vines are not sequestering carbon as they are not permanent from an accounting point of view.

Nitrous Oxide

As nitrous oxide has 310 times the GHG effect of CO2 very small amounts of nitrous oxide can have a profound effect on the environment. Many farms release quantities of nitrous oxide when unused nitrogen fertilizer is oxidised and released to the atmosphere as a gas. Luckily most on farm nitrous releases are the result of wastage so once identified can usually be stopped. Use of slow release nitrogen fertilizers and using variable rate technology can greatly reduce, if not eliminate fertilizer wastage. Fertilizer savings by such methods can easily be converted into offsets as a reduction in emissions is known as a result of fertilizer saved, and the base line is known through past practise.

There is also discussion in some countries about placing a nominal tax on fertilizer to account for potential nitrate release. When this is viewed in conjunction with rising energy costs there is potential for sizable rises in fertilizer costs to occur in the coming years.

Ruminant Emissions

Possibly the most difficult issue for agriculture to handle in a reduced carbon world is ruminant livestock emissions. The process of digestion in ruminants creates large quantities of

methane, most of which is then burped out. As methane is assumed to have 21 times the greenhouse gas potential of CO2, it is considered that one ton of methane is equivalent to 21 tons of CO2. This means that the carbon footprint of ruminants is extremely bad.

For rangeland grazing of ruminants there is very little means of reducing the carbon footprint. Modified grazing systems are able to generate small amounts of soil carbon offsets, but this not of the scale of the continuing methane liability. Feed additives that reduce the amount of methane created by the microbes in the rumen have been identified and are proven to offer some benefit. Commercialisation of such products has not happened as yet as quantifiable results are hard to ascertain, and hence offsetting potential is hard to price.

NEEM biotech of Cardiff is one such company who is currently in this position. Independent research by universities on two continents has shown that their garlic extract will reduce methane production, and slightly improve feed conversion, but a method of creating financial return is proving difficult. There is no financial incentive for a grazier to feed the extract to cattle as the cost is greater than the direct benefit. NEEM is developing a marketing system where a grazier is given the product for no cost, and the costs are paid by the emitting industry that requires the offsets. Monetary value of the generated offsets would be proportionally shared by all parties.

Intensive animal production has the ability to collect animal waste, put it through a methane digester and harvest the produced methane. In many environments this animal waste is already a regulated pollutant so the whole issue of controlling wastes is already a problem. Large quantities of methane can be captured in covered lagoons or effluent storage tanks, and used as an energy source. The production of energy is a money earner, and the reduced methane emissions can have a major improvement in reducing the carbon footprint of the operation.

In Alberta currently, a number of effluent lagoons have been covered to harvest methane, and the size of the emission reduction sold as an offset into the Alberta CPRS.

It will be much easier for intensive animal producers to make reductions in emissions due to their ability to harvest the animal waste. Graziers also have the added risk of releasing soil carbon if at any stage they change their land use practises, such as when perennial pasture is brought into a cropping phase. Depending on the treatment of soil carbon under a CPRS this could be a huge liability.

The theory that methane has 21 times the effect of CO^2 in the atmosphere is debatable, and should be questioned by all who raise ruminants. This figure is based on looking at cumulative emissions over a 100 year time period. If you look at global GHG emissions over a 500 year time frame methane then only has 6.5 times the GHG effect of CO^2. There is also

the issue of whether methane released in remote areas takes as long to break down as it does in the upper atmosphere as the rate at which CH4 breaks down is reduced as CO^2 levels rise. In the words of the 20th century philosopher Homer J.Simpson "Facts are meaningless. You can use them to prove things that are only remotely true."

Carbon Labelling and Food Miles

A few years ago English food retailers started labelling food with labels that indicated the distance the food had travelled to reach the supermarket shelf. This was a crude attempt at trying to inform the consumer of the carbon footprint of the product, but was often inaccurate as it did not consider the emissions of production. A tomato grown in Africa and air freighted to England would usually have a better carbon footprint than one grown in a hothouse in Southern England, but was not labelled so.

The issue of carbon labelling has now matured, and carbon footprints are calculated using ISO (International Standards Organisation) recognised rules. Since the global economic crisis of late 2008, the whole attitude to ethical buying changed. Differentiated products sold with an ethical premium have been hammered by the marketplace in Europe, and the main English supermarkets have not yet introduced the accurate carbon labelling they have been talking about for a few years now. Whilst certain wholesale markets are demanding to know the carbon footprint of products, it appears that this issue at a retail level may have gone away until there is an improvement in the global economy. There is currently one brand of crisps in England that is the only product in national distribution that carries a label indicating the carbon footprint of the product.

There is an indication that the carbon footprint of products is being used at the wholesale level as bargaining tool by supermarket buyers and processors. Whilst it may not have a retail value in the near future there is still a need for agriculture to keep a close eye on systems used to estimate the carbon footprint of products.

Supermarkets have a large role to play in determining what the carbon footprint of a product is. This is extremely apparent in fresh fruit and vegetables. The packaging demands supermarkets place on the suppliers of supermarket brand goods is a large source of waste. It is common for packing houses to throw out large quantities of unused cartons due to supermarkets suddenly changing carton artwork or package size without warning. Supermarket package size is also a source of waste. For example, in Ireland one supermarket will aim to sell pre-packaged fruit and vegetables for a constant price per pack all year round. As commodity price and supply changes the pack size is changed, so often the consumer buys much more than they need and end up throwing out the unused product. The level of food

wastage past the supermarket shelf in the United Kingdom is very high due to practises such as this. Whilst the consumer may want to see food miles type labels they are unwitting participants in a process that makes the carbon footprint of agriculture worse than it should be. Another phenomenon that is very common in other countries is the slow food movement. Consumers choose to purchase food that has been produced locally or on a lower scale than "factory farming".

Slow food has helped the growth of farmers markets and the like, but is dependent on people having the disposable income to pay the higher prices slow food producers demand and require. As discretionary spending power has declined with the global downturn, so has the profitability of slow food producers. Slow food does not necessarily always have a lower carbon footprint; cultivation and fuel use are much higher in organic or slow food production systems. Consumers are often not sophisticated to fully understand the implications of their buying decisions despite thinking they are doing "the right thing"

Currently the level of taxation on transport fuel used internationally (Aviation fuel and shipping fuel) is negligible. This is an issue that many governments and NGO's are looking at. Carbon pollution reduction schemes will eventually raise the costs of fuel used for international trade significantly. This will alter international trade routes and may make traditional trading partners uneconomical to continue doing business with.

How agricultural produce is transported can have a major effect on its carbon footprint. Rail has between one quarter and one seventh the emissions of road transport.

Conclusions

- The science of climate change has become irrelevant. Public perception and legislators are committed to the idea of carbon pollution reduction and this is now the relevant issue. It will do global agriculture no good arguing that global warming isn't happening
- Farmers must be prepared to accept higher energy prices, and the flow on effects of this. Loss of the fuel rebate scheme may also be a possibility
- Biofuel must not be blocked as an alternative to fossil fuels by regulation. Cereal grain based biofuel is not the answer to the worlds energy problems but it does have a part to play in reaching a solution
- It will be extremely difficult for Australian based ruminant industries to reduce their carbon footprint if currently accepted methane accounting methodologies are used. There is sufficient evidence that we should be questioning these accepted accounting methods, specifically the time scales used for estimating permanence
- Soil carbon sequestration is good in theory, but is not practical under Australian conditions. Annual accounting for changes in soil carbon levels would be impossible to achieve with any level of accuracy and would expose land occupiers to massive potential deficits
- Where potential for soil carbon sequestration exists it must be remembered that it is not a continual process and will eventually reach a limit. The process is also reversible
- Agroforestry for sequestration should not be a threat to broadacre agricultural land, as long as there are no corrupting rules in favour of agroforestry. Very little of the carbon sequestered is guaranteed permanent
- Emissions Trading Schemes carry a high risk of market failure, so their use as the prime tool for distributing the right to release greenhouse gasses should be questioned. Regulation could be equally as dangerous to producers. Hybrid models, including taxing consumption of carbon based products as opposed to production of said products, need investigating
- Intensity based accounting systems also require consideration as they would offer enterprises greater protection from the liabilities of increasing production
- The risk of "Carbon drift" , shifting production to unregulated countries, is high in agriculture

- There is a need for more discussion on whether there is a differentiation drawn between industrial carbon processes and biological processes in carbon pollution reduction schemes.
- There are many other important issues facing agriculture in the 21st century; most specifically water security. In focussing too much on emissions we may miss other key issues
- If climate change is as bad as predicted, Australian agriculture will bear the brunt of climate change. Australian agriculture must force Australian society to ask itself whether it is fair for the victim to provide the solution to the crime.

Industry Recommendations

Australian agriculture must not drag itself into public debate on the science of climate change. This is no longer a relevant issue to the public and will harm our image.

Whilst it may seem desirable for agriculture to be excluded from any carbon pollution reduction scheme, such an outcome would be detrimental to agriculture. Australian agriculture must remain part of the legal process of any scheme introduced in Australia. Single interest groups using the introduction of a CPRS for their own benefit, and public perception issues will all have to be faced as well.

Deregulation of transport and handling sectors of the Australian economy have created "market failures" in transport and logistics. These failures must be addressed before higher energy costs multiply the effects of this. For instance, grain transport has shifted predominantly from rail to road; a higher energy transport method.

Higher energy costs for fossil fuel dependent farmers are unavoidable; either due to peak oil or a CPRS. Industry needs to face this issue and promote efficiency improvements and alternative energy sources.

Soil carbon sequestration accounting will create massive liabilities for Australian agriculture. It is imperative that Australian agriculture maintain control of the soil carbon debate.

Likewise, methane accounting creates an equally large liability, and the accounting methodology that creates this liability is not exact. Australian agriculture must cooperate with ruminant producers in other nations to see that this issue is controlled for the lowest impact on global ruminant producers.

The resilience of Australian farmers is well known. It is imperative that Government is not allowed to rely on that resilience being what gets agriculture through the effects of a CPRS.

Plain English Compendium Summary

Project Title:	Carbon Pollution Reduction Schemes
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Scholar:	David Drage
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Objectives	To see what effects the introduction of an emissions trading scheme is likely to have on broadacre agriculture in Australia
Background	Australia will have an emissions trading scheme in one form or another within a few years due to international obligations and domestic public opinion. What form legislation takes could have a major impact on the profitability of Australian farm businesses.
Research	Legislators, non government organisations, farm lobby groups and producers were spoken to in a number of Northern Hemisphere markets. Some markets are similar in form to Australia, whilst others are different but have trading schemes already in operation.
Outcomes	Common problems have been identified in all markets looked at. The largest problem is the issue of regulators accepting that natural carbon cycles behave very differently to industrial cycles from fossil fuels. Few opportunities exist for agriculture other than in biofuel production.
Implications	Unless regulatory attitudes can be changed agriculture will be asked to achieve impossible outcomes or will wear a massive increase in operating costs
Publications	