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Carbon Trading and the Role of Trees and Woodlands

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Carbon Trading and the Opportunities for Trees and Forestry

1. INTRODUCTION

1.1 Background

I was brought up in rural Northumberland and at the age of twelve started working on the local mixed farm during my summer holidays. From there I moved into landscape gardening and building work before finally settling on a career in forestry after my school had organised a week's work experience with the Forestry Commission (FC).

I started work as a forest worker four months after my sixteenth birthday at Thrunton Woods (now part of the vast Kielder Forest District). Although not academic, I was encouraged to apply for a place at the National School of Forestry at Newton Rigg in Penrith, Cumbria and was lucky to be offered a place. After gaining practical experience for a couple of years I started my National Diploma in Forestry 1982 and graduated in 1985. I returned to work for the FC as a forester, which is the first step of the management structure of the organisation. As the Harvesting and Marketing forester I was responsible for a large felling programme on the coast near Woodbridge in East Anglia. A couple of years later in 1987 the 'Great Storm' flattened the forest resulting in extra challenges that kept me focussed and motivated.

I changed roles to have responsibility for Plant Health inspections at the busy east England ports that saw vast quantities of high quality timber imported from North America. At that time the job also allowed me to get involved in privately owned woodlands though the provision of advice and grant aid. It was an exciting time in forestry as new planting grants had been tailored to encourage farmers to plant trees on agricultural land – this was during the set-aside and food surplus era. The anticipated levels of tree planting were never achieved despite farmers also attracting grants for the loss of agricultural income. The lessons I learnt then would serve me well later in my career; particularly that the weeds can grow better than the trees on fertile agricultural ground and plough pans/poorly prepared soils can stop trees growing!

Almost two years on from the storm, my knowledge of windblown trees and grant aid saw me seconded to Kent where they still hadn't cleared up after their 1987 gale damage. My desire to travel had been stirred through the temporary move to Kent and six months later I joined the organisation's Education and Training team that enabled me to travel to forests throughout the UK to train forest workers, students and managers. During my time in the training role, I met Penny but was not to know that we'd marry some years later. After five years of working away every week I elected to change jobs and once again returned to a job working with private landowners and farmers through the provision of grants and licences in Cambridgeshire, Bedfordshire and West Norfolk.

Although having vowed never to return to academia, I returned to the Newton Rigg College 10 years after first starting there to revise for my Institute of Chartered Foresters entry exams before gaining Chartered Forester status in 1995.

Promotion took me north to Cheshire, taking on a new challenge of acquiring 1000 hectares of brownfield or under-utilised agricultural land and converting it into community woodland. This was primarily working on the urban edge around Liverpool and Manchester. Three years later another promotion took me to Cumbria as Operations Manager on the Grants and Regulations team. It was whilst in this role that I applied for my Nuffield Scholarship.

I still live in Cumbria but since November 2007 I have changed jobs which has seen me return to working in Cheshire, now managing the Newlands Project in Merseyside and

Greater Manchester for the Forestry Commission. Penny and I married in 2006. She is also a Nuffield Scholar (1992) and it is through her that I found myself applying for this Scholarship. We have two children, James and Rachel and live near Penrith on the edge of the Lake District National Park.

1.2 The Study

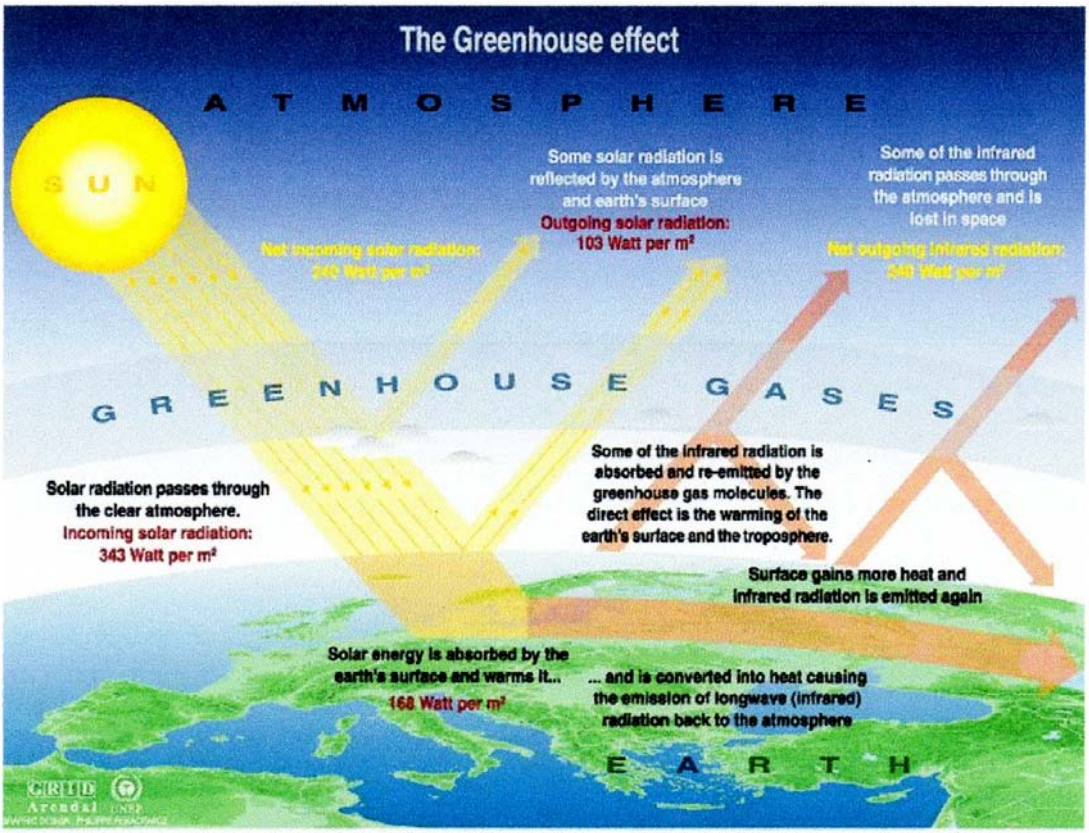
I have two main interests in life (excepting the aforementioned family!) and these are forestry, in which I have spent my career, and motorsport (I have raced motorcycles for the last twenty-six years and cars for the last five years) and have for some time been aware of the dichotomy between the two. This was brought into sharp focus in 1997 with the seemingly astonishing claim from the Federation Internationale de l'Automobile (FIA) that F1 racing was carbon neutral having planted an unspecified number of trees of indeterminate size in Mexico. Investigation revealed that the FIA were claiming that the carbon 'sequestration' (a term which means little more than storage but is for no good reason both unpronounceable and barely intelligible!) achieved extended to all its impacts not just the emissions from race cars at grand prix, but the whole gamut of the sport, from the carbon associated with the teams flying around the world to the car journeys made by spectators.

The discrepancy between the claim of F1 and the reality of the situation in that it would be several decades before the trees planted would make any meaningful contribution towards carbon absorption played on my mind, or moreover the problems associated with trading of an intangible commodity. Logic suggested that the problems of climate change could not be tackled by a system that appeared, at least at first sight, so open to abuse. I was also intrigued as to know to what extent trees could play a part in carbon trading. I was keen to identify an additional role for forestry given the dire state of the timber market at the time and the realisation that it doesn't pay and the constant need to add value. I felt that it was important to address the issue from the public's perception of what forestry can contribute within the environment and also for it to be seen as a valued profession and a contributor to society's needs.

Early on in my study, I realised that for me to look at the role of trees in carbon trading, first I needed to understand the background and context of the subject within the broader subject of climate change and how the activity of man was accelerating this process. Consequently, the early part of my report looks at elements of climate change and talks about how our use of fossil fuels and production of the so called 'greenhouse gases' plays a significant part in the process.

2. GLOBAL WARMING, CLIMATE CHANGE AND CARBON TRADING

2.1 Global Warming leading to Climate Change



Sources: Okanagan university college in Canada, Department of geography, University of Oxford, school of geography; United States Environmental Protection Agency (EPA), Washington; Climate change 1995, The science of climate change, contribution of working group 1 to the second assessment report of the intergovernmental panel on climate change, UNEP and WMO, Cambridge university press, 1996.

Figure 1. The Greenhouse Effect
Life on earth is made possible by energy from the sun, which arrives mainly in the form of visible light, about 30 per cent of sunlight is scattered back into space by the outer atmosphere, but the rest reaches the earth's surface, which reflects it in the form of a calmer, more slow-moving type of energy called infrared radiation (this is the sort or heat thrown off by an electric grill before the bars glow red). Infrared radiation is carried slowly aloft by air currents, and its eventual escape into space is delayed by greenhouse gases such as water vapour, carbon dioxide, ozone and methane. Greenhouse gases make up only around 1% of the atmosphere, but they act like a blanket around the earth or like the glass roof of a greenhouse – they trap the heat and keep the planet some 30^{o} C warmer than it be otherwise.

Human activities (often described as 'anthropogenic') are making the blanket thicker – the natural levels of these gasses are being supplemented by emissions of carbon dioxide from the burning of coal, oil and natural gas; by additional methane and nitrous oxide produced by farming activities and changes in land use; and by several long-lived industrial gasses that do not occur naturally. These changes are happening at unprecedented speed. If emissions continue to grow at current rates, it is almost certain that atmospheric levels of carbon dioxide will double from pre-industrial levels during the 21st century. It is even possible that they could triple!

The warming known as the 'enhanced greenhouse effect' is a warming of the earth's surface and lower atmosphere. The Intergovernmental Panel on Climate Change (IPCC) assess with very high confidence that the globally averaged net effect of human activities since 1750 has been one of warming. The 'best' case computer climate models estimate that the average global temperature will rise by 1.8^{o} C to 4.0^{o} C by the year 2100. A temperature increase of 0.74^{o} C occurred last century and fore the next two decades, a warming of about 0.2^{o} C per decade is projected should greenhouse gas emissions continue to rise at their current pace and are allowed to double from their pre-industrial level. A rise in temperature will be accompanied by changes in climate – in such things as cloud cover, precipitation, wind patterns, and the duration of seasons.

In its Fourth Assessment Report, the IPCC projects that heat waves and heavy rain precipitation events are very likely to increase in frequency in the 21st century. Carbon dioxide is responsible for 60 per cent of the 'enhanced greenhouse effect'. Humans are burning coal, oil and natural gas (so called 'fossil fuels') at a rate that is much

faster than the speed at which these fossil fuels were created. This is releasing the carbon stored in the fuels into the atmosphere and upsetting the carbon cycle, the millennia-old, precisely balanced system by which carbon is exchanged between the air, the oceans, and land vegetation. Currently, atmospheric levels of carbon dioxide are rising by over 10 per cent every 20 years.

Climate change is inevitable because of past and current emissions. The climate does not respond immediately to external changes, but after 150 years of industrialisation, global warming has momentum, and it will continue to affect the earth's natural systems for hundreds of years even if greenhouse gas emissions are reduced and atmospheric levels stop rising.

The Intergovernmental Panel on Climate Change (IPCC) issued compelling evidence in February 2007 stating that average temperatures are likely to rise by 4^{o} C by the end of the century. Their assessment which draws on the expertise of 600 authors, 620 expert reviewers and representatives from 113 countries, concluded with a high degree of confidence, that temperature rises were as a direct result of human action from the emission of the so called 'greenhouse gasses' (GHG). Six GHGs are generally included in the broader carbon discussions; Carbon dioxide (CO_2), Methane (CH_4), Nitrous oxide (N_2O), Hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs) and Sulfur hexafluoride (SF_6).

As a result of global climate warming, sea levels are rising as glaciers shrink (I saw the evidence for myself at the Franz Joseph Glacier in New Zealand). The polar ice caps are melting too; the plight of polar bears has been the thrust of media coverage. The number of storms and the ferocity of wind are both increasing (remember the 'Great Gale' in Southeast England 1987 or the winds that devastated trees in southern England and throughout Europe in 1990. Then there was Hurricane Katrina in the USA in 2005. The extreme flooding in Boscastle in the same year followed flooding in Germany and Austria during August in 2005. Last year it was Tewkesbury's turn and my mind is already asking where next? Even if we don't want to listen to the scientists surely all these examples must convince us – they have me! Planners and engineers used to design infrastructure to withstand extreme weather (known as 1:100 year events), but it seems the frequency of these 1:100 year events is happening every year…. So how can we affect the speed of this change? How can we reduce the amount of GHG released into the atmosphere? How can we lock carbon dioxide rather than release it to the atmosphere?

2.2 Policy Context and the Kyoto Protocol

The Kyoto Protocol (KP) is an international agreement linked to the United Nations Framework Convention on Climate Change. The major feature of the Kyoto Protocol is that it sets binding targets for 37 industrialised countries and the European community for reducing greenhouse gas (GHG) emissions. These amount to an average of five per cent against 1990 levels over the five-year period 2008-2012. The major distinction between the Protocol and the Convention is that while the Convention **encouraged** industrialised countries to stabilise GHG emissions, the Protocol **commits** them to do so.

Recognising that developed countries are principally responsible for the current high levels of GHG emissions in the atmosphere as a result of more than one hundred and fifty years of industrial activity (burning of fossil fuels), the Protocol places a heavier burden on developed nations under the principle of 'common but differential responsibilities'.

2.3 Kyoto mechanisms

Under the Treaty, countries must meet their targets primarily through national measures (reducing emissions at source). However, the Kyoto Protocol offers them an additional means of meeting their targets by way of three market-based mechanisms, thereby creating what is now known as the 'carbon market'. The Kyoto mechanisms are:

- Emissions trading
- The Clean Development Mechanism (CDM)
- Joint Implementation (JI)

It is helpful to look at each in turn to understand the basis of carbon trading and the terminology used:

2.3.1 Emissions trading

Parties with commitments under the Kyoto Protocol (Annex B Parties) have accepted targets for limiting or reducing emissions. These targets are expressed as levels of allowed emissions or 'assigned amounts' over the 2008-2012 commitment period (known or referred to as the 'first commitment' period). The allowed emissions are divided into 'assigned amount units' (AAU's).

Emissions trading, as set out in Article 17 of the Kyoto Protocol, allows countries that have units to spare (emissions they are permitted to emit but not 'used' [emitted]) to sell this excess capacity to countries that are over their targets. In this way, a new commodity was created in the form of emission reductions or removals. Since carbon dioxide (CO_2) is the principal greenhouse gas, people speak simply of trading in 'carbon'. Carbon is now traded like any other commodity and this is known as the 'carbon market'.

In addition to emission reductions, other units can be traded and sold under the Kyoto Protocol's emissions trading scheme. These are each equal to one tonne of CO_2 and are:

- A removal unit (RMU) on the basis of land use, land use change and forestry (LULUCF) activities such as reforestation (planting a successor crop after felling)
- An emission reduction unit (ERU) generated by a joint implementation project
- A certified emission reduction (CER) generated from a clean development mechanism project activity

Transfers and acquisitions of these units are tracked and recorded through the 'registry system' under the Kyoto Protocol. An 'international transaction log' ensures secure transfer of emission reduction units between countries.

2.3.2 Clean Development Mechanism (CDM)

The CDM defined in Article 12 of the Protocol allows a country with an emission-reduction or emission-limitation commitment under the KP (Annex B Party) to implement an emission-reduction project in developing countries. Such projects can earn saleable CER credits, each equivalent to one tonne of CO_2, which can be counted towards meeting Kyoto targets.

The mechanism is seen by many as trailblazing – a CDM project activity might involve, for example, a rural electrification project using solar panels or the installation of more energy-efficient boilers.

The mechanism stimulates sustainable development and emission reductions, while giving industrialised countries some flexibility in how they meet their emission reduction or limitation targets.

A CDM project must provide emission reductions that are additional to what would otherwise have occurred. The projects must qualify through a rigorous and public registration and issuance process.

2.3.3 Joint Implementation (JI)

'Joint implementation', defined in Article 6 of the Kyoto Protocol, allows a country with an emission reduction of limitation commitment under the Kyoto Protocol (Annex B Party) to earn emission reduction units (ERU's) from an emission-reduction or emission removal project in another Annex B Party, each equivalent to one tonne of CO2, which can be counted towards meeting its Kyoto target.

Joint Implementation offers Parties a flexible and cost-efficient means of fulfilling a part of their Kyoto commitments, while the host Party benefits from foreign investment and technology transfer.

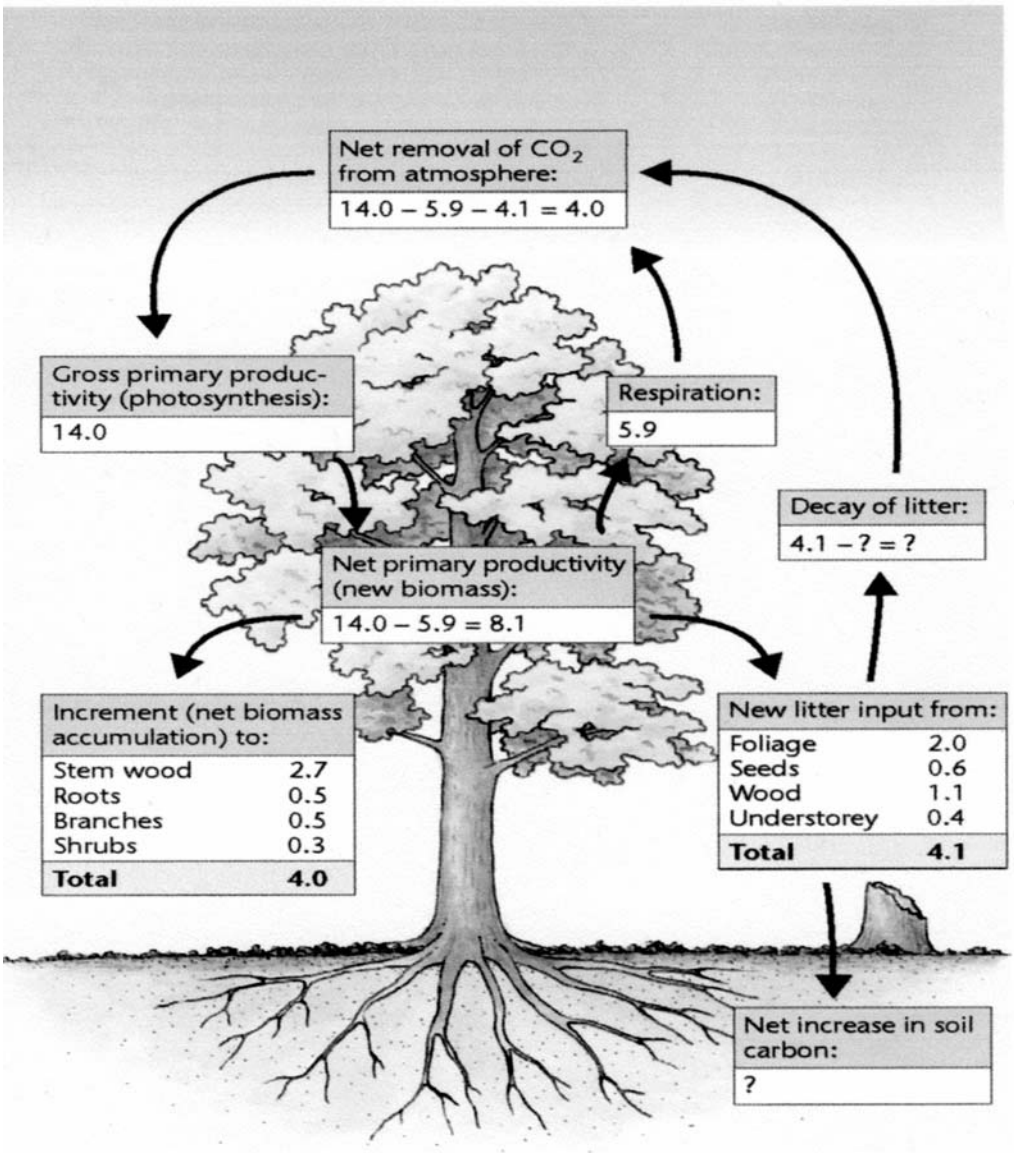
A JI project must provide a reduction in emissions by sources or an enhancement of removals by sinks, that is additional to what would otherwise have occurred. Projects must have approval of the host Party and participants have to be authorised to participate by a Party involved in the project.

Therefore, in simple terms the Kyoto Protocol is an agreement among governments, under which developed countries commit themselves to limit their emissions of GHG in order to fight climate change. Mechanisms include reductions in the consumption of fossil fuels (oil, gas, coal etc), projects involving technological improvements and options involving carbon sequestration through forestry activities. The international commitment aims to reduce greenhouse gas emissions by 12.5% on 1990 levels over the period 2008-2012, progressively increasing in later years. The Kyoto Protocol treaty was negotiated in December 1997 at the city of Kyoto, Japan and came into force 16 February 2005. The EU ratified the KP on 3 June 2002, meaning that all member states have to implement the commitments within the agreement.

3. THE ROLE OF TREES AND WOODLANDS IN THE CARBON CYCLE

3.1 The Carbon Cycle

Trees and woodlands have a vital role to play; as trees grow they extract carbon dioxide from the atmosphere through the process of photosynthesis (all green plants photosynthesise – this is the process of sugar molecules forming and then combine to produce cellulose and in woody plants lignin). Carbon is then 'fixed' (stored) by the tree in its green matter (everything from leaves and branches through to the woody trunk).



Source: Forests, Carbon and Climate Change: the UK Contribution. Forestry Commission Information Note 48 by Mark Broadmeadow and Robert Matthews (June 2003)

Figure 2 Tree showing carbon exchange

A summary of the carbon exchange (in tonnes of carbon per hectare per year) associated with the main components of oak woodland (general yield class $6m^3\ ha^{-1}\ yr^{-1}$) at the Straits Enclosure flux station in Hampshire. For comparison with the value for increment given here (4.0 tC $ha^{-1}\ yr^{-1}$), a value of 3.8 tC $ha^{-1}\ yr^{-1}$ was obtained for net ecosystem exchange in 2000 useing eddy correlation. Note that the quantity of carbon added to the soil carbon stock on an annual basis is unknown and, if significant' would reduce the quantity of carbon lost through litter decay.

While some of this carbon dioxide is transferred back to the atmosphere through respiration, the tree continues to grow and increases the woody material locking the increasing carbon content in until it dies and decays or is harvested and processed to another end use. Needles and leaves dropped by the tree contribute to the soil carbon store after decomposition. The process of oxidisation in soil can release carbon dioxide too. Trees can protect vulnerable soils by stabilisation, protection from drying out, intercepting water and slowing run off and hence help to maintain carbon stored in soil.

Natural processes are responsible for carbon exchange and cycling but human activities can accelerate the loss of carbon stored or by a change of work practise, increase the carbon

storage potential. Carbon emitted is referred to as a 'source' and carbon stored is referred to as a 'sink'.

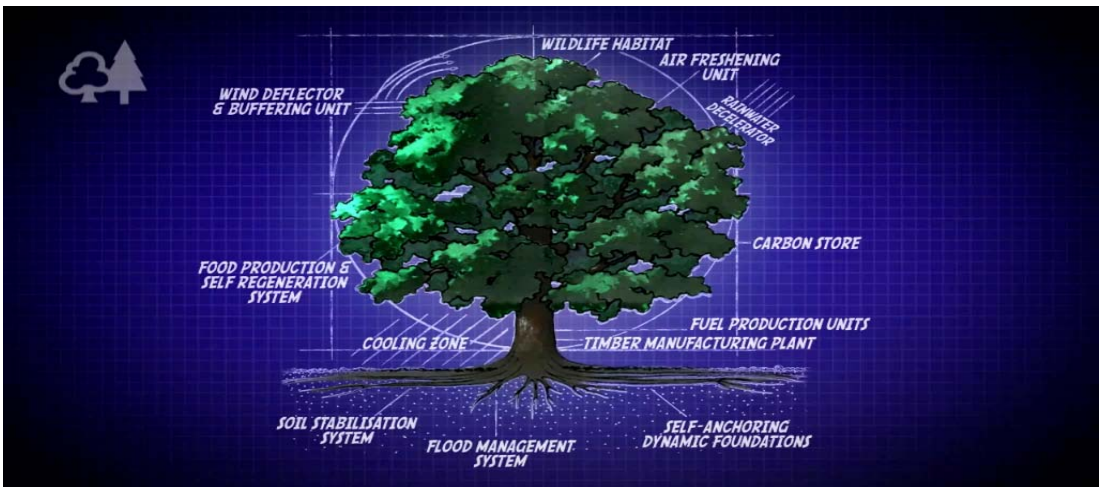
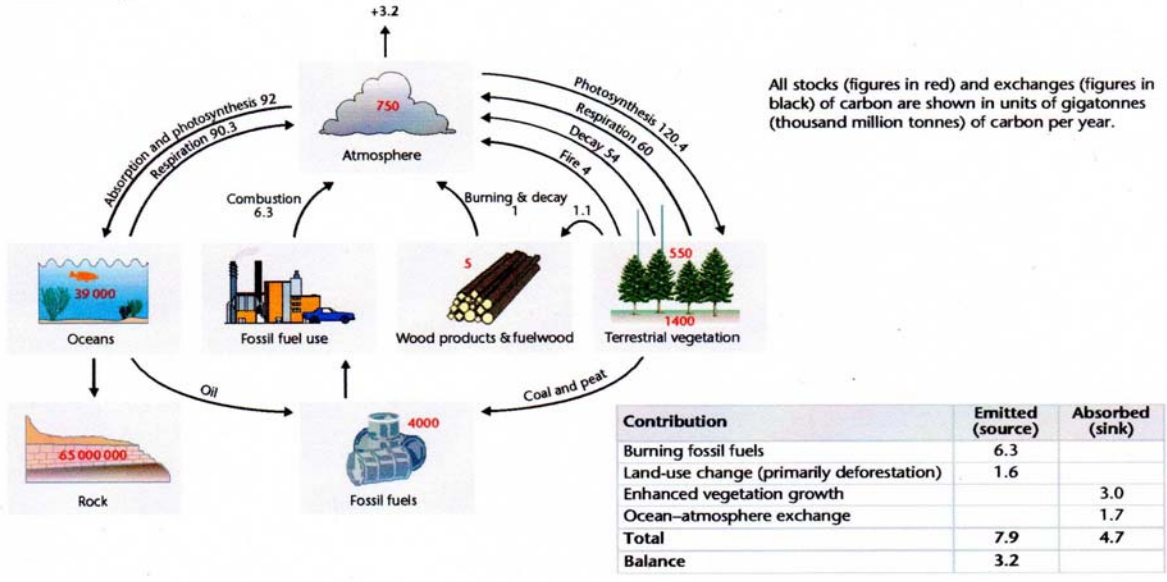


Figure 3 Role of Tree in the Carbon Cycle
Source: Forests and climate change: Capturing the truth leaflet, Forestry Commission

The global carbon budget for the 1990s. The net increase of 3.2 GtC yr^{-1} into the atmosphere is small compared to the total carbon stocks in vegetation, soil, rocks and the oceans, and also when compared to the quantity of carbon in terrestrial vegetation alone. A simplified summary of the global carbon balance is also given.



Contribution	Emitted (source)	Absorbed (sink)
Burning fossil fuels	6.3	
Land-use change (primarily deforestation)	1.6	
Enhanced vegetation growth		3.0
Ocean–atmosphere exchange		1.7
Total	**7.9**	**4.7**
Balance	**3.2**	

Figure 4 The Global Carbon Budget for the 1990's
Source: Forests, Carbon and Climate Change: the UK Contribution. Forestry Commission Information Note 48 by Mark Broadmeadow and Robert Matthews (June 2003)

3.2 Forestry and Climate Change Mitigation

Measures that help to slow down or prevent global warming or reduce GHG are known as 'mitigation'. There are a number of ways in which forestry can help by way of mitigation, these include:

- ***Preventing deforestation*** – considered to be one of the areas of greatest loss of carbon from forest sinks, preventing forest clearance to another land-use would have a dramatic effect on carbon stores

- ***Replanting (reforestation)*** – an important part of sustainably managed forests, replanting after felling ensures a continuous yield. Stocking with younger more vigorous trees can increase the carbon stored in a forest
- ***Afforestation*** – increasing the land area under woodland is a way of increasing the storage potential of carbon stocks but is dependant on the availability of land – greater opportunities in some countries than others. Careful species selection is needed here to select the appropriate species for future increases in temperature and changes in rainfall (and the incidence of strong winds)
- ***Management of existing trees and forests (including changes to silvicultural systems)*** – various options are available to the woodland owner and opinion is divided about which is the best option for increasing carbon storage potential. It is generally accepted that managed forests have greater potential and likely to be more sustainable in the longer term
- ***Protecting fragile soils and ecosystems*** – despite predictions that mean annual temperatures are due to increase in the UK as a result of global warming, and summer rainfall is predicted to reduce, in recent years we have seen many incidences of flooding (even in summer months). Trees planted on riparian zones and in flood plains can play an important part in slowing/lessening the impact of flash floods. On fragile exposed soils trees can help to stabilise soils and reduce the incidence of sediment in water catchment. Equally important though, is the sensitive management of woodland in these fragile landscapes and the choice of silvicultural system used

Changes in the way that we behave and the things that we do in a different way are known as 'adaptation', again forestry has something to contribute by deployment of the following measures:

- ***Product substitutions*** – there exists a great opportunity to increase the use of wood and wood products to replace materials that have a greater carbon requirement in their manufacture. More research and promotion alongwith changes in regulations and incentives is going to be needed. Wood has excellent properties and can be considered as being from a renewable resource when sustainably managed
- ***Woodfuel*** – as a renewable alternative to fossil fuel for the purposes of providing heat or energy or both. New technology in woodfuel boilers and the increasing cost of fossil fuels means that wood for heating is a real alternative for domestic housing. At the larger industrial scale new woodfuel/biomass power plants are now in place (eg Stevens Croft at Lockerbie) as an alternative and supplement to traditional fossil fuel powered plants. District heating systems are also being built (eg at Kielder and Alnwick in Northumberland)
- ***Education*** - the use of wood and its sustainability is being taught to children in 'forest schools', this approach from elsewhere in Europe and encouraging schools to use forests as outdoor classrooms ensures life long learning from an early age. Increasing the knowledge that woodlands are sustainable if appropriately managed is key.

3.3 Carbon (or Emissions) Trading with Trees

GHG emission reductions are traded in 'carbon credits' which represent the reduction of GHGs equal to one metric ton of CO_2 (tCO_2e), the most common GHG. Scientists within the IPCC have determined the global warming potential (GWP) of each gas in terms of its equivalent in tons of carbon dioxide (ie tCO_2e) over the course of one hundred years. Methane has a GWP approximately 23 times higher than CO_2, hence one ton of methane equals about 23 tCO_2e. Likewise, other gases have a different equivalence in terms of tCO_2e; perfluorocarbons for example, are worth thousands of tons of CO_2e.

GHG emissions reduction units/credits can be accrued through two different types of transactions. In project based transactions, the credits are the result of a specific carbon offset project. Allowance based transactions involve a cap and trade approach through a regulated system. This is an administrative approach to control pollution by providing economic incentives to achieve reductions in the emissions of pollutants or GHG, it is often referred to as a 'cap and trade' system. A government or an international body sets a limit (known as a cap) on the amount of pollutant (or emission of GHG) that can be emitted. Emission permits (known as allowances or credits) are issued to companies or sectors of industry (eg energy suppliers) and represent the right to emit a specific amount. The theory is that the total amount of allowances does not exceed the emissions cap. Those companies/sectors that do not use all of their allowances or credits are able to transfer or sell their unused units to others who exceed their allowance or cap. This sale or purchase is known as emissions' trading. Essentially, each company will seek to choose the cheapest option – that is, whether it is cheaper to reduce emissions by improvements to their working methods or by purchasing extra units in the marketplace. The principal is that the cap will continue to reduce to encourage a reduction in emissions.

3.3.1 Regulated Markets

The EU Emissions Trading Scheme (EU ETS) is the largest multi-national, greenhouse gas emissions trading scheme in the world; launched in January 2005 it operates on a cap-and-trade basis and is the core instrument for Kyoto compliance in the EU. Under the scheme, each participating country proposes a National Allocation Plan (NAP) including caps on greenhouse gas emissions for power plants and other large point sources. The European Commission must approve the NAP for each participating country. This first environmental market established in the EU involves thousands of operators who have obligations for limiting the carbon dioxide emissions from their plants. In an average week more than ten million allowances are traded, resulting in a market worth several billion Euro already in the first year of operation. The Appraisal of Years 1-4 of the UK ETS by Enviros Consulting Limited reported that the level of the cap (in the UK and EU ETS) was the key to the success of such schemes in promoting real emissions reductions. There is some doubt whether the level of the cap was set at the right level to force a reduction in emissions.

The UK Emissions Trading Scheme was a 'cap and trade' scheme that was a forerunner to the EU Emissions Trading Scheme. Both the UK and the first phase of the EU ETS did not allow for carbon stored in trees and woodlands to be included in the scheme. The second phase of the EU ETS does allow for trees and woodlands to be included through the Clean Development Mechanism (CDM) and Joint Implementation (JI) projects.

The UK scheme, which was one of the first emissions trading schemes in the world helped provide valuable lessons for the design of future similar schemes including the EU ETS. However, there is concern that as industry (principally the energy generators and large users of energy) largely set their own or were given a generous cap and, therefore, the impact on reducing emissions was compromised.

3.3.2 Voluntary Markets

Concern surrounds how these voluntary offsets will be dealt within a regulated market. The voluntary market is likely to continue as it is often more accessible to the general public who are keen to play their part, for example, in offsetting their air travel.

Although forestry has not been part of the regulated market it does play a role in the voluntary carbon trading markets. Whilst the voluntary market allows the inclusion of forestry there is concern amongst some that if/when the regulated market caters for forestry that this may supercede any existing voluntary arrangements. That being the case, there is an

element of risk associated with any voluntary transaction. The voluntary market may always have a place outwith the regulated market and is, therefore, an important component of carbon storage. Key questions still exist though about monitoring and measuring standards and how Additionality can be proven.

4. LESSONS LEARNT FROM THE COUNTRIES I VISITED

In preparing my original application for the scholarship I found it difficult to narrow down the countries to visit. Keying the words 'carbon trading with trees' into the Internet showed the greatest amount of activity in the following countries at the time and, therefore, these were the countries I chose to visit:

4.1 UK and EU

To ensure that I was fully briefed before embarking on my travels abroad, I visited DEFRA in London for a good introduction to the complex world of carbon and climate change. I was to learn more about the UK position and involvement in carbon trading and related policies whilst in other EU countries. One DEFRA official's name was to keep cropping up during my travels yet in all of my UK research his name had never been mentioned. With hindsight, I cannot help but feel that this summarises the state of the information about this subject – there appears to be an air of mystique surrounding it all and it is only the people who are actively involved who fully understand the subject. In my opinion, this is an area that needs to be improved if we want the general public to have more understanding about how their own actions can affect climate change and the practical things that they can do to slow down the changes leading to climate change. The UK Emissions Trading Scheme (UK ETS) was a forerunner to the EU Emissions Trading Scheme (EU ETS), although not well known about elements of this may have informed the EU equivalent.

4.2 Belgium – European Commission

I met with Valerie Merckx in the DG Environment section within the European Commission to learn more about the complexity of the Kyoto Protocol (KP) 2002 and the various 'Articles' (rules) that relate to it. Starting from my home in Penrith on a Sunday evening, I was impressed how I could travel the whole route door to door by train – initially to stay overnight at the Farmer's Club in London (thanks to complimentary membership from Nuffield) and then onto Brussels on the very fast Eurostar. The European Commission building was only a short walk from the local train. Valerie was an excellent host and I was grateful for the valuable time she gave up for me in her busy schedule. Valerie's job title of 'Climate Change Strategy and International Negotiation' was no less impressive! This was to be a regular theme – although not everyone I was to meet had heard of the Nuffield Scholarship before my visit, they were intrigued enough to meet me and I was also able to spread the word about the Nuffield Farming Scholarship Trust on my travels. From my own point, the Nuffield name gave me the confidence and mandate to approach business people in foreign countries that didn't know me.

'Industrial Countries' have signed up to Article 3.3 – this has a definition of woodland where tree cover is between 10-30% of a land parcel; in the UK this definition is 20% tree cover and in France, for example it is 10%. Other criteria relating to whether it can be considered as woodland relate to Crown Cover, Minimum Area and Minimum Potential Height.

Valerie's briefing helped me to understand more fully the Kyoto Protocol and the information recorded under the earlier section of this report is largely thanks to my visit to the impressive DG Environment office within the European Parliament.

4.3 Germany

From Belgium I moved onto Germany where I met Bernd Winkler from the Ministry of Agriculture in Bonn. It was through Bernd that I learnt that DEFRA official Jim Penman was negotiating on behalf of the European Union in respect o climate change and Land Use, Land Use Change Forestry (LULUCF) – this is normally done by the country holding the Presidency. Bernd's role has seen him taking an interest in climate change principally through the subject area of 'deforestation' (the felling/removal of trees where the intention is to convert to a land use other than forestry). A number of interesting facts came from my visit to the Ministries of Agriculture and Environment. Germany elected to include forestry under Article 3.4 of KP (this means that data to establish its level of carbon stocks in 1990 and to enable an estimate to be made of its changes in carbon stocks in subsequent years has to be produced); the Ministry of Environment opposed this due to risks from storm, drought, fire and disease affecting the carbon pool. However, these risks are being managed by each region setting its own Forest Bills, where felling coupes are restricted to a maximum of 4ha, much smaller than in the UK despite Germany having forest cover of 30% versus 12% for the UK.

Monitoring work was ongoing to assess carbon volumes in woodland based on timber volume and land area under trees. Interestingly, unlike the UK, the volume measured includes deadwood >20cm diameter. As in the UK, volume assessed was above ground with no attempt yet to account for the volume in the roots. Forest soil condition was also monitored and an assessment made of carbon stored here too – this is also carried out in the UK but up until now I had been unaware of this.

During my visit, a Federal Forest Bill was going through consultation which required that land currently planted with trees was to remain so in eternity, the exception being planted agricultural land. Proposals to reward forest owners for the wider benefits that forests provided included tree planting in upland areas to protect water catchments. Bernd felt that there was generally a poor dialogue between Government and the Private woodland owners, the Bill would also seek to provide access to privately owned forests for the purpose of carbon monitoring. Private woodland owners were seeking to share in any financial values associated with carbon values but were apparently unwilling to accept any risks associated with this. The analogy he used was with the motorcar – individuals generally don't have responsibility for reducing CO_2 but the Government does!

From Bonn I travelled to meet Katharina Huekelheim, an economist at the Ministry of Environment in Berlin. Katharina explained that Germany has been emissions trading since 2005. Electing to use Article 3.4 LULUCF of KP means that monitoring of forests' soils and agricultural crops is necessary and the Ministry of Agriculture carries this out. The monitoring results are included in the annual National Inventory Report presented to the EU Commission on the 15 March each year (this date is specific to each country).

Before leaving Germany I had a rare visit to see some trees in a forest; Peter Kaiser participates in a Leonardo da Vinci Training Programme that has an exchange programme with a forest training organisation back in Cumbria (Grampus Heritage and Training Ltd). Peter lives in the Dubener Heide Naturpark near Leipzig in the former East Germany. He had booked me into the local hostelry and after a grand tour of the spectacular forest area it was a surprise to be greeted by a group speaking in a broad Cumbrian dialect. The group were at the end of their first week's exchange and were carrying out forest operations in a sensitive environmental area as part of the exchange programme. Back in the UK they worked on the Bassenthwaite Lake Restoration Project that has received European funding for protecting Bassenthwaite Lake and surrounding water catchment area near my own office. It was great to see these young people learning about other cultures and working methods – all of them were really positive and eager to learn about my own travels and the

Nuffield Scholarship. The following day my German language skills were fully tested when I met Martin Plessow the Head Forester for the Blundesforstmates Westsachsen forest area. It was an interesting comparison with my own forest area; visitor pressures in this area were much less than in the Lake District and those that did visit here did so under very strict rules enforced by Martin! I saw examples of the small scale clear felling and continuous cover management which differs to the more common UK practise of clearfelling as well as some impressive timber trees.

4.4 Poland

The long train journey from Berlin to Warsaw gave me ample opportunity to appreciate the Polish scenery before arriving in the capital city. Here I met Tomasz Wojcik, Head of International Cooperation at the General Directorate of the State Forests. Tomasz was confident that carbon storage in forests could be increased and there was some potential value that could be realised for forestry. He recognised that things were at an early stage and agreed that this potential increase in value had yet to be realised!

Poland intends to issue carbon credits from forests in 2012. Only 12% of Poland's forest cover is privately owned with an average woodland size less than 1ha. State owned forests cover some 7.5m ha, 24% of land cover. New woodland creation policy is to replicate natural woodland and incorporate a small percentage of fruit trees. Incredibly, Poland is still planting 10,000-20,000ha of new woodlands each year compared to around 3,000ha in England. Under current EU regulations, Poland is not able to trade carbon credits from trees but they have a draft piece of legislation to change this.

Like other parts of Europe, Poland suffered storm damage in 2002 resulting in an area 15km x 120km being windblown. Legislation requires such areas to be replanted within five years of felling. Poland is looking at increasing management operations to increase the carbon stored in the forest; the following changes are proposed to increase carbon sequestration:

- minimise soil disruption during ground preparation
- increase rotation length
- decrease area lost to fire damage
- avoid clearfell siliviculture

I was surprised to learn that the country has between 7000-12000 forest fires each year, the average size of which is 0.4ha. In the UK, South Wales used to have similar problems but in recent years the problem of (deliberate) forest fires has reduced following investment and regeneration in the Valleys region.

Monitoring and reporting are key requirements of measuring carbon stored. Currently there is an existing system in place, this needs extending to include an assessment of carbon content of the forest soils and overground/underground biomass. The forest inventory system is based on permanent sample plots of 4km x 4km within 16km x 16km grids. Poland has 28,000 permanent sample plots each with sample points. Measurements are taken every five years and they are now in the second round of recording. There are thirty criteria that are assessed and this includes tree/stand volume, any foliage damage and soil carbon content.

4.5 France

The centre of Paris was my next port of call where I met Clement Chenost from the Office National des Forets (ONF). Legislation designed to protect the forests from over cutting, dates back to a Royal Decree in 1200. This helps explain its magnificent forests and the

long association with management compared to UK; our legislation protecting trees only goes back to when the Forestry Commission was established in 1919 to create a strategic timber reserve following several wars, including the Napoleonic War!
French forests have evolved from coppice management to high forest. In contrast to the Polish approach, French foresters and policy makers are looking to shorten the rotation length to encourage more vigorous growth and contribute towards rapid carbon uptake during a growth period known as the 'full-vigour' phase.

Peugeot is one French company that has opted for the voluntary carbon offsetting route. Peugeot has worked in partnership with ONF and local people in Brazil, to create 2000ha of afforestation on land previously cleared from forestry for agricultural use. ONF have also been instrumental in similar offsetting schemes in Columbia. They work in partnership with local people to help them understand the benefits that forests bring (soil protection, water quality etc). They work with local farmers who own the land and aim to create the necessary infrastructure and incentives to help them want to participate in tree planting schemes. Some of these projects are joint ones with USA (US Aid) and UK funding. It is the French though who stand to benefit from the carbon storage potential from the trees by using these trees to offset emissions back home. The question of 'leakage' was discussed; this is a KP term and a condition that has to be met for projects to be considered under CDM/JI. Basically, very complex to understand and to demonstrate, but simply means the consequences that your project has beyond the boundary of it on the ground. There seems to be an acceptance that an indicator can be used to account for leakage as a percentage. In an ideal world, projects would be developed that had no/minimal leakage.

On the question of producing biomass (fast growing species used for energy/heat production in power stations or smaller heat applications). Clement suggests that this will have to be carried out on land currently used for agriculture.

4.6 United States of America

My trip across the Atlantic was my first of many flights; I was conscious with my new found knowledge that I could be contributing to climate change from the aeroplane burning aviation fuel. However, I pressed on regardless determined that nothing was going get in the way of my Nuffield studies. I had just changed jobs some two weeks earlier and I wrestled with my mind to stop thinking about all of the challenges of my new job and start thinking about my studies again.

Arriving in Baltimore Washington International Airport late on a Sunday evening, I struck lucky and paired up with a couple of ladies wanting to share a taxi into the centre of Washington DC. One a Barrister was kind enough to explain to me how the street and avenue numbers worked alongwith the intricacies of the underground. My luck held out as I walked through the streets late and night and I arrived safely at my hotel – my Internet booking had come up trumps on this occasion. Even better news was that it was literally next door to the US Department of Agriculture - Forest Service (USDAFS) office of the International Programs team who had responded to my emails and offered me an office for the duration of my stay in Washington.

The International Programs (IP) team were perfect hosts and I can't thank the whole team enough for making me feel so welcome. Within 15 minutes of arriving I was whisked downstairs to Starbucks for that essential cup of coffee to start the day. Jerilyn Levi the Assistant Policy Director has worked closely with the FC's Director General and had co-ordinated birthday celebrations for one of his 'significant' birthdays recently. During my stay in Washington I attended their team meetings and had a slot to give them all an update on how my studies were progressing and what I'd learnt. I also attended a number of meetings and workshops and loved my time there.

Fred Norbury's appointment as Assistant Deputy to the Chief (of the USDAFS) one month previously to a new post focusing on where and what the USDAFS should be doing with Climate Change was indicative of the changing position at the highest level in the US.

Until last year, President Bush had refused to acknowledge that climate change was happening and steadfastly refused to sign up to the Kyoto Protocol although the country is one of the largest emitters of GHG's (the United States is the only industrialised nation under Annex 1 of Kyoto Protocol which has not ratified and, therefore, is not bound by it). Despite this, many states are taking the lead and working around the Federal government and are well advanced with their climate change work by having set up a register of carbon storage; the states of California and Georgia are active in this area. Over this last twelve months the President and the Country appear to be changing their stance on climate change issues.

California has some simple measures in place, such as a law against leaving commercial vehicles ticking over whilst unloading, whilst a simple action, imagine the combined effect of this if everyone world wide adopted the same approach. If you had stayed in the hotel I did in New York you would want to see wider implementation of this as my early morning sleep was disturbed!

The mayor of New York has pledged to plant 1million trees for city cooling as mitigation. Built man-made surfaces such as concrete reflect and absorb heat, they also speed water run off, by having more trees and natural green open spaces, there is more shade, better water retention and less flash floods. From the cooling perspective, if there is more shade then there can be less need and reliance on air conditioning units in buildings. This is a positive step towards reducing GHG emissions as air conditioning units need energy to power them and use some of the GHG's in the cooling process within the units.

Fred Norbury identified a number of areas that the USDAFS were looking at:

- ***Adaptation*** – there is a need to respond to changes; for example the 'fire' season was getting longer and hotter. Visible changes too were being noticed in the climate too, snow melting in areas where this hasn't previously happened.
- ***Mitigation*** – the primary purpose of forestry (he saw) was to sequest carbon. Currently US forests are considered to be a carbon sink. Commercially managed forests represent 20% of US forest cover. 60% of US forests are privately owned
- ***Biofuels*** – currently approximately one third of the US land is under tree cover, in the current climate there is a demand for land to used for crops that can be used as a biomass product or where oil can be extracted from the plant as a biofuel (eg, linseed, oilseed rape, wheat, barley etc). The use of land for growing crops for fuel is now competing with the production of crops for food. Wheat prices have doubled in the last twelve months for example. There is also an increasing threat of forest cover being reduced due to pressure from development, over the next fifty years this looks likely to increase (see 'Forests on the Edge' Report). Biomass if converted to ethanol, is reported to be able to provide 15% of the US energy requirements
- ***Forest Management*** – researchers have been looking at aspects and implications of climate change for the last twenty years but the next challenge is how to change current embedded management practises. Species selection is a key area that is attracting attention. The aim is to use more species mixtures to give options at the time of thinning crops. In the national forests the preference is to restock or plant by taking advantage of natural regeneration whereas private forests still prefer to do so by planting, particularly in areas managed on a commercial basis
- ***Urban trees*** – planting in cities is attracting more interest and there is a move towards more tree planting in the urban environment. Looking at where the people are, any

moves to have wood that could contribute to power generation closer to the population is a priority. Wood can be added to coal for energy and there are moves afoot to use the wood currently going into landfills too

Foresters and others wanted to know what the future direction would be and have a clear and consistent message from the Federal Government. In recent years there has been a move away from traditional clearfelling to continuous cover forestry silvicultural systems – this has largely been driven by nature conservation and landscaping reasons. The Spotted owl has been one of the main species that has contributed to almost banning clear fell silviculture in the US. Ironically, there is now some interest from the game and conservation lobby to have areas of clear fell again as they like the species diversity arising from the early successional growth from this cleared ground that is not seen in a continuous cover system.

Various Carbon trading schemes exist in the United States – the Chicago Climate Exchange, Western Climate Initiative and the Mid Western States. (Since my visit, the Western Climate Initiative (WCI) has announced a Draft Design of the Regional Cap-and-Trade Programme on 23 July 2008; the programme is due to start in 2012 and has a regional goal target for emissions reductions for 2020. The WCI covers emissions from electricity generation, industrial and commercial facilities. Carbon dioxide emissions from the combustion of biomass or biofuel are exempt. Three-year compliance periods are used from 2012 to 2020 and annual caps will be set in advance of the programme starting so reductions required in each 3-year compliance period are predictable. Residential, commercial and industrial fuel combustion below the WCI threshold and those from transportation will be included in the second compliance period). Federal guidelines exist to measure voluntary carbon credits (written by USDAFS and issued by the US Department of Energy).

Forests currently take up 10% of US carbon dioxide from industry but changes in management practises could see this double. The following changes in management practises are seen as areas to be considered:

- Move to more continuous cover forestry
- Increase the number of young trees and faster growing trees (in the full vigour stage as per the French approach) and reducing rotation lengths
- Increase the frequency of thinning crops to reduce the likelihood of more catastrophic loss due to fires and, therefore, carbon stored (includes potential damage to the forest soils too as a result of fire)
- An extensive employee education and training programme to reach every USDAFS employee. There is a desire to get more people involved with beetle and pest surveys and then to make the connection that these problems are coming about due to the affect of climate change
- More initiatives for schools and children to increase understanding and knowledge and articulate the message of what the USDAFS are doing to combat climate change
- Consistent single message that can be used from the top policy maker though practitioners to the public
- Budget changes and implications, for example the cost of fighting forest fires has risen from the traditional 30% of the total budget to 50% in 2007

In most carbon credit systems, it is important to show that the forests are being sustainably managed, the best way of doing this is through a recognised certification system. The private sector will respond to the market forces in a carbon market, but currently the paperwork to register a carbon credit from forestry amounts to three hundred pages!

Chris Farley was their Policy Analyst for USDAFS International Programs and during my time there he left for the 13th Conference of the Parties (COP) as part of the United Nations

Convention on Climate Change Convention (UNCCC) as part of the KP process in Bali. Had I planned things differently then it would have been fantastic to join him but sadly the new job didn't allow for me to fit this in!

Rob Hendricks is the Senior Policy Analyst with USDAFS International Program team, he summarised where the US forests were at; harvested timber being cut from 12 Billion board feet to 2 Billion now. This largely due to the environmental pressures and lawsuits that have followed various National Environmental Policy Acts since the 'timber wars' of the 1980's and 1990's. Following a huge investment, over 230k miles of new forest roads had been built and now it appears that these will largely be used for monitoring purposes rather than there intended use of extracting felled timber to markets.

Following the World Summit 10 years ago, the 'Sustainable Development' theme was adopted and forestry's interpretation of that was the 'sustainable forest management' definitions that followed. Carbon is considered in forestry circles to form part of sustainable development. Private forest owners will only consider accreditation to demonstrate sustainable management when they can see an increase in the values/returns to them. In other words, it is subject to market forces.

Much of Rob's work is on negotiating rules regarding the eligibility rule for afforestation and deforestation and what it means to the State Foresters on the ground. Rob also spoke about Social and Economic Values, specifically improving the quality and length of people's lives. He spoke of the desire to have cities full of satisfied citizens and helping to reduce social unrest. One of the challenges is measuring these values.

4.7 Australia

I started my Southern Hemisphere trip from the Forest Products Commission (FPC) office in Perth. We (I was joined by my wife Penny for this part of my study) toured the Perth area with Dr Richard Harper, Principal Research Scientist with the Technical Services team.

Richard explained that it is the coastal belts of Australia that are inhabited. The long-term average rainfall for Perth is 850mm per annum but this is falling. Further in land the rainfall is much less, apart from the hills just beyond the Swan Valley. Water is becoming one of the biggest concerns in the area and nearby at Ellenbrook, sixty year old Maritime pine (*Pinus pinasta*) forests are being felled to make way for new houses. Apparently the justification being that the trees are reducing the water availability in the area.

Over the next ten years it is planned to fell 20,000ha of trees because of the pressures on water availability. Although trees can improve water quality they have been proven to utilise more water than other land use (housing) in this area and the water engineers say its cheaper to treat to remove any contamination than find more water.

Mike McKelvie, Project Manager within the Investment Branch Business Development Division of FPC also gave a good insight into the Australian forest situation. Around Pemberton (to the south of Perth) the forest is largely native and following a change in federal law, the FPC harvesting programme shrunk from 650,000 tons/annum to 170,000 tons overnight. From the felled material, 20% was utilised as sawn material for furniture or flooring and the balance was previously unutilised. More recently, a 250,000 ton contract was let where this material was to be exported as fuelwood.

Natural resources are federally owned but private investors put a case forward for a long-term commitment that sees royalties paid to Federal Government, typically these arrangements are for a 25-30 year period. As things stand, FPC are unable to invest in

renewal of the timber resource as the return from the investors does not put sufficient money back to secure restocking. The agreements do not include restocking requirements and the payments are related to the value of the product sold and are not index linked.

Land availability for forestry is reducing so planting is moving further inland where there is water availability issues and the ground is suffering from salination. FPC has won a $60M Project looking at afforestation in these areas that has been affected by salt in the water catchment. A number of wider aspects will also be considered, these will include elements of climate change and carbon sequestration. Carbon storage may be the most financially lucrative and forestry may well prove to be a saviour in these affected areas but the results will not be known for a couple of years. In respect of carbon storage, there are thought to be risks associated with this due to uncertainty of how much carbon there will be and the ability to measure/predict values with confidence.

Whilst meeting with Mike, one of those small world coincidences came to light, it transpired that he was a family friend of a distant relative of Penny's who we were planning to visit that night. Truly a small world!

Whilst in Perth, we tried to visit Adelaide; I'd sold a racing MG to enthusiast Adrian Ackhurst and he was competing that weekend but sadly we couldn't get a flight in time for the race and it was simply too far to drive. A real shame but we ended up visiting Ian Hersford who had spent 12 months on an exchange from FPC to the FC in the Forest of Dean. We caught up with Ian and his family for the weekend in the beautiful Albany area.

From Perth we moved onto Tasmania where we stayed with Australian Nuffield Scholar James Walker who I'd met in Canada at the International Conference. James must get the prize for most travelled Scholar but despite him visiting the UK on three occasions I had managed to miss him every time! James had arranged with Scholar Andrew Jones who farms on the outskirts of Hobart to meet us at the airport and put us up in one of his holiday cottages. Whilst introducing myself I'd commented that he must be a very good friend of James Walker to put us up to which he had replied that he'd never met him before! Andrew had been treated so well when he did his own Nuffield travels some years earlier in the UK that he wanted to help us in return. In addition to being a thoroughly great guy he also raced a classic car, we had a common motorsport passion and I hope that he will stay with us when he next travels to the UK. This random act of kindness pretty well summed up the spirit of Nuffield for me.

Whilst still in Hobart I met Michael Wood from Forestry Tasmania, a Government Business Enterprise whose only shareholder is the State Treasury Department. Michael explained that Tasmanian foresters are still able to harvest old growth forests; one sixth of the forests in Tasmania are old growth national reserves. Since 1990 over 600,000ha of afforestation has occurred on previously agricultural land. There is less pressure on land availability for forestry as there is good land available. Michael's plea was that to measure carbon a simple method needed to be developed for measuring and reporting and it must be repeatable.

James Walker showed me some plantations that he had recently planted as a share farming arrangement with Gunns and Great Southern through Private Forestry Tasmania. There was a move away from the share farming to a straight lease arrangement. Private Forestry Tasmania felt that the country had great potential to contribute to carbon trading with trees:

- Availability of land to plant,
- Good climate (although some dry areas)
- Whole farm planning approach
- Global trading opportunities building on existing island trading mentality

They did have some concerns though from changing climate and the risks related to pests, disease and fire.

From Tasmania I visited the Department of Climate Change and the Department of Agriculture, Fisheries and Forestry in Canberra.

Following the change of Government in January 2008, new Prime Minister Kevin Rudd signed Australia up to the Kyoto Protocol values and targets. Under the former Prime Minister John Howard, the individual states had grouped together and worked on their own climate change agenda. I found it fascinating that here as in the US, the activity of individual states was influencing national policy (see 'The Tipping Point' by Malcolm Gladwell). Now the new National Policy is looking to take advantage of this earlier work and use the State developed policies as a platform for the National Policy. Foresters are keen to contribute and are looking forward to any carbon trading opportunities, an Emissions Trading Scheme is due to start in 2010. Draft policy was due out in June 2008, but at the time of my visit it was uncertain whether or not it would include forestry. The aim is for a 'cap and trade' scheme to cover 70% of all emissions. Australia's emissions are only 2% of the world's emissions. Voluntary Offsetting schemes have been operating with varying levels of governance and monitoring. As with other countries the voluntary sector has received some criticism and the Government is looking at standards for offsetting.

The current Abatement Scheme, the administration and standards of which are provided by the Department of Climate Change but they are not involved in verification nor are they involved in the sale of credits. There is also no guarantee that these credits will be transferable in the new Emissions Trading Scheme as this is likely to have rigorous requirements. Australia has yet to decide when agriculture and forestry will join the new ETS. Livestock in the country are the second highest emitter of GHG's.

Australia has also developed a National Carbon Accounting System (NCAS) that takes a modelling approach to both plantation and native forest, it has a default position that uses the maximum biomass production figure. NCAS is a system to account for GHG emissions from land based sectors. Land based emissions (sources) and removals (sinks) of GHG form a major part of Australia's emissions profile. Around 27 per cent of Australia's human-induced GHG emissions come from activities such as livestock and crop production, land clearing and forestry. The removal of CO_2 from the atmosphere by forests provides an important GHG sink. The NCAS accounts for these activities through a highly integrated system that combines:

- Remotely sensed land cover change (from satellite images)
- Land use and management data
- Climate and soil data
- GHG accounting tools
- Spatial and temporal ecosystem modelling

There is also a National Carbon Accounting Toolbox that provides a set of tools for tracking GHG emissions and carbon stock exchanges from land use and management. The Toolbox assists land managers to monitor emissions effectively and to identify more sustainable (less emissions intensive) land management practises.

This modelling approach can be used instead of measuring, it also means that the model can be adjusted at some point in the future to address changes in climatic factors such as a reduction in rainfall.

Phil Alcorn from the Department of Climate Change informed me about a 'Greenhouse Gas Challenge Programme' that operated previously, this encouraged industry to participate on a voluntary basis and helped them to understand and report on their emissions. It also afforded the chance to participate in green markets and was seen simply as good business by cutting costs and not necessarily focussing on cutting carbon.

4.8 New Zealand

I arrived in Wellington, the capital of the country and where the Government offices were. Pam Cromarty was good enough to provide office accommodation in the hugely impressive refurbished Department of Conservation (DoC) office. This former cinema had been converted into a new office for DoC with a strong focus on being sustainable. The open plan style was well designed with many clever design features to make it cheap to run and maintain. There is a strong recycling ethos and staff take it in turns to do 'waste audits' – this is where another section's bins are raided and material that could have been recycled weighed!

The organisation also reviewed there transport policy and implemented some changes to have a more sustainable and carbon friendly approach such as the provision of umbrellas and raincoats to encourage staff to walk or use nearby public transport. Ian Flux had spent a period seconded to a team doing Internet research on climate change. His alternative approach bordered on being cynical but he had some really interesting thoughts and suggested courses of action:

- ***Lifecycle carbon*** – need to look at lifecycle carbon as studies show that the military derived Hummer car had a smaller carbon footprint than the so-called Toyota Prius Hybrid powered car when comparing the whole life of the vehicle. One of the reasons for this is that the Toyota uses complex Nickel Cadium batteries that need replacing every 3-5 years. It just goes to show that it depends on how you measure but it certainly adds to the confusion.

- ***Compare costs*** - Ian's other stunning idea was based on the price to store a ton of carbon versus the price of coal. As the average price to store carbon was $240/ton versus for cheapest coal at $40/ton he maintained that it was more cost effective to keep the coal stored in the ground to prevent the release of more GHG derived from fossil fuels.

- ***Impact of buying manufactured goods from abroad*** - another interesting area is the one of exporting 'emissions' by moving manufacturing abroad. New Zealand, like many other countries have moved much of its manufacturing to China and then buys the manufacturing goods back. Consequently, China's emissions now exceed those of the USA.

John Scott from The Treasury has been working on the Emissions Trading Group providing advice to the New Zealand Government about their ETS. New Zealand has a formal objective for its ETS to meet its emissions obligations by the cheapest means possible. If they can purchase carbon credits more cheaply than reducing emissions then they will chose this route. They are also trying to meet their ETS objectives by diplomatic efforts and not by reducing emissions. Surely this identifies flaws in the current KP approach where countries can use offsetting to meet the KP emission levels without actually reducing current emissions?

Early calculations assessing carbon stored in forestry were flawed and after signing the KP, New Zealand faced embarrassment and penalty costs hence the ETS.

This said, New Zealand has an economy wide Emissions Trading Scheme covering all GHG, and industry sectors will be phased into the ETS. Agriculture is not required to take part until around 2013 (due in no small part to the industry's economic and political influence and despite it contributing approximately half of GHG emissions!).

The ETS has specific implications for forest owners concerning pre 1990 and post 1989 forests (the baseline years of KP).

Forests planted pre 1990 will be subject to emission liabilities if deforested. Normal harvesting and replanting/regeneration is not affected. The Government will give free emission units to owners of pre-1990 forests to cover exemptions although the number of units/ha cannot be predicted at this stage. The preliminary estimate is that landowners are likely to receive in the order of 39 units per hectare, worth approximately $585 per hectare, assuming a carbon price of $15 per tonne.

If forest owners established their forests post 1989 on eligible land, or if they intend to establish new forests on eligible land, they can choose to participate in the ETS and take responsibility for carbon stock exchanges that occur from 2008 on. If those participating harvest or deforest, or if there is any decline in carbon stock (eg as a result of fire), the owner has to surrender emission units to cover the amount of carbon released (that is, the reduced carbon stock). If stocks increase, the owner will earn credits in the form of New Zealand Emission Units (NZU's).

Legislation was put in place to stop the deforestation of forests in New Zealand as it was predicted that around 50,000ha of forest would be deforested (converted to mainly dairy farming) over the period 2008-12. This would result in about 40m tonnes of carbon being emitted resulting in a liability to taxpayers in excess of $651m. Ironically, from announcement in September 2007 until it came into effect 1 January 2008, vast areas were cleared anyway. South of Rotorua I saw vast tracks of pine forest cleared and converted to dairy farming (the Frontera organisation being particularly active in this area). Cattle contribute significantly to GHG emissions (particularly Methane); agriculture, as a whole is responsible for in excess of fifty percent of New Zealand's carbon emissions.

Since a change of Government in the 1980's, New Zealand has moved away from subsidies and looked to optimise performance. As a result, New Zealand became more competitive against the EU and the rest of the world. Similarly with its KP, it wants to meet its targets and objectives but at least cost to the economy.

David Rhodes who represents the private forestry sector through the New Zealand Forest Owners Association continues to lobby Government to get the best deal for forest owners, looking to share the risks when owners take the carbon credits.

Figure 5. Photograph showing the recently cleared Pine forest in the area to the south of Rotorura; the brash can be seen heaped up into windrows to break down. This area was one of many stretching for some miles that the Frontera dairy concern was responsible for.

5. ISSUES AND RECOMMENDATIONS FOR THE UK INDUSTRY

5.1 Conclusions

I calculated the amount of carbon my flights alone had emitted using one of the many online calculators – it's really quite simple; you type in your departure and arrival airports, select whether it was a single or return trip and the calculator does it all for you. My flights amounted to just under 4.0 tonnes of CO_2. I wanted to see how I could offset this carbon from my travels, again there are a myriad of websites telling you how to offset your carbon. Then it starts to get interesting as there is so much variability between countries, species selected, native or non native, are they permanent, is the planting additional to what was going to happen anyway. Typically I would need to plant an average of 5 trees per tonne of CO_2 so in my case I'd need to plant 20 trees. Again there was some variability in the rotation that the assumptions were made on. This all adds up to a confusing picture.

The simple truth is that when we talk about burning of fossil fuels that contribute to global warming, as individuals and/or as managers in businesses, minimising how much energy we use not only has an impact on the planet but also reduces energy costs incurred. Therefore, we all have an interest and a role to play in reducing how much damage we do to our planet and in the process operate more cost effectively in our personal and business lives.

So is carbon trading really an option? We can't think of carbon in a UK or EU context, we need to look at it as a global commodity which will become as important as oil or gold.

So what did I learn from all those countries? Well, nobody is approaching this subject in the same way, even within Europe. There are inconsistencies in approaches and differences of opinion over aspects such as stored carbon and rotation lengths of trees. It is a developing area still, open to much abuse with the risk of discrediting the industry but there is money to be made. There is no simple answers here, but a lot of 'ifs','buts' and 'maybes'. Therefore, I will conclude with the main issues and recommendations for UK forestry.

5.2 Issues

- No single standard relating to off-setting schemes
- A lack of transparency leads to confusion and mistrust with the public
- Forest owners could and are willing to do more if there was clear guidance and an agreed set of rules
- Many people want to act responsibly and offset their own carbon footprint but don't know how to; the lack of a single standard/regulator means that they could be misled
- Tree planting alone will not save the planet; a change in lifestyle and the way in which we use the planet's natural resources is needed. How do individuals sign up to play their part?
- The wider benefits deriving from trees need to be valued in addition to assessing carbon sinks and creating new carbon stores or off-setting
- Definitions such as 'permanency' and 'addtionality' need clarifying in practical terms

Can tree planting in the UK make a difference?

- Half a hectare of woodland over one rotation could compensate for the car fuel consumed over an average driver's lifetime
- The entire woodland estate contains only as much carbon as the UK emits in a single year

5.3 Recommendations

- The UK government needs to take the lead in developing a universal approach as to how trees and woodland are treated in carbon trading and offsetting schemes
- The UK forestry support mechanisms and grant schemes need to change to reflect mitigation and adapt to the needs of climate change
- There must be a scheme for carbon offsetting that is easy for the general public to access and understand
- FC/Defra to make clear the role of UK forestry in carbon storage, mitigation and adaptation and give examples of permanency and additionality
- The forestry sector is well placed to demonstrate their green credentials and this might be best done through carbon budgets
- Education programmes about climate change need to be broadened and the knowledge of sustainable forest management extended to the wider public
- Carbon must be considered a global commodity and valued/traded as such
- From the New Zealand example, we need a measured approach to inclusion of forestry in any ETS and the UK should study impacts of lessons learnt in other countries before including forestry in their part of EU ETS
- Forest owners and forest industry need to be consulted to seek their ownership and participation in forestry's role in climate change and carbon storage/trading
- A transparent and auditable mechanism to value the wider benefits of trees and forests needs be developed to reward forest owners. Reducing emissions must be the first priority

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Finally, I hope that new contacts and friends around the world will keep in touch and visit us back in Cumbria.