ENERGY TRANSFORMED:

SUSTAINABLE ENERGY SOLUTIONS FOR CLIMATE CHANGE MITIGATION

MODULE C

INTEGRATED APPROACHES TO ENERGY EFFICIENCY AND LOW EMISSIONS ELECTRICITY, TRANSPORT AND DISTRIBUTED ENERGY

This online textbook provides free access to a comprehensive education and training package that brings together the knowledge of how countries, specifically Australia, can achieve at least 60 percent cuts to greenhouse gas emissions by 2050. This resource has been developed in line with the activities of the CSIRO Energy Transformed Flagship research program, which is focused on research that will assist Australia to achieve this target. This training package provides industry, governments, business and households with the knowledge they need to realise at least 30 percent energy efficiency savings in the short term while providing a strong basis for further improvement. It also provides an updated overview of advances in low carbon technologies, renewable energy and sustainable transport to help achieve a sustainable energy future. While this education and training package has an Australian focus, it outlines sustainable energy strategies and provides links to numerous online reports which will assist climate change mitigation efforts globally.

CHAPTER 9: INTEGRATED APPROACHES TO ENERGY EFFICIENCY AND DISTRIBUTED ENERGY

LECTURE 9.3: BEYOND ENERGY EFFICIENCY AND DISTRIBUTED ENERGY: OPTIONS TO OFFSET EMISSIONS

The Natural Edge PROJECT

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The Natural Edge Project (TNEP) is an independent non-profit Sustainability Think-Tank based in Australia. TNEP operates as a partnership for education, research and policy development on innovation for sustainable development. TNEP's mission is to contribute to, and succinctly communicate, leading research, case studies, tools, policies and strategies for achieving sustainable development across government, business and civil society. Driven by a team of early career Australians, the Project receives mentoring and support from a range of experts and leading organisations in Australia and internationally, through a generational exchange model.

The International Energy Agency forecasts that if policies remain unchanged, world energy demand is set to increase by over 50 percent between now and 2030.[1] In Australia, CSIRO has projected that demand for electricity will double by 2020.[2] At the same time, The Intergovernmental Panel on Climate Change (IPCC) has warned since 1988 that nations need to stabilise their concentrations of CO_2 equivalent emissions, requiring significant reductions in the order of 60 percent or more by 2050[3]. This portfolio has been developed in line with the activities of the CSIRO Energy Transformed Flagship research program; '*the goal of Energy Transformed is to facilitate the development and implementation of stationary and transport technologies so as to halve greenhouse gas emissions, double the efficiency of the nation's new energy generation, supply and end use, and to position Australia for a future hydrogen economy*'.[4] There is now unprecedented global interest in energy efficiency and low carbon technology approaches to achieve rapid reductions to greenhouse gas emissions while providing better energy services to meet industry and society's needs. More and more companies and governments around the world are seeing the need to play their part in reducing greenhouse gas emissions and are now committing to progressive targets to reduce greenhouse gas emissions. This portfolio, *The Sustainable Energy Solutions Portfolio*, provides a base capacity-building training program that is supported by various findings from a number of leading publications and reports to prepare engineers/designers/technicians/facilities managers/architects etc. to assist industry and society rapidly mitigate climate change.

The Portfolio is developed in three modules;

Module A: Understanding, Identifying and Implementing Energy Efficiency Opportunities for Industrial/Commercial Users – By Technology

Chapter 1: Climate Change Mitigation in Australia's Energy Sector

Lecture 1.1: Achieving a 60 percent Reduction in Greenhouse Gas Emissions by 2050

Lecture 1.2: Carbon Down, Profits Up – Multiple Benefits for Australia of Energy Efficiency

Lecture 1.3: Integrated Approaches to Energy Efficiency and Low Carbon Technologies

Lecture 1.4: A Whole Systems Approach to Energy Efficiency in New and Existing Systems

Chapter 2: Energy Efficiency Opportunities for Commercial Users

Lecture 2.1: The Importance and Benefits of a Front-Loaded Design Process

Lecture 2.2: Opportunities for Energy Efficiency in Commercial Buildings

Lecture 2.3: Opportunities for Improving the Efficiency of HVAC Systems

Chapter 3: Energy Efficiency Opportunities for Industrial Users

Lecture 3.1: Opportunities for Improving the Efficiency of Motor Systems

Lecture 3.2: Opportunities for Improving the Efficiency of Boiler and Steam Distribution Systems

Lecture 3.3: Energy Efficiency Improvements available through Co-Generation

[1] International Energy Agency (2005) 'World Energy Outlook 2005', Press Releases, IEA, UK. Available at http://www.iea.org/Textbase/press/pressdetail.asp?PRESS_REL_ID=163. Accessed 3 March 2007.
[2] CSIRO (2006) Energy Technology, CSIRO, Australia. Available at www.det.csiro.au/PDF%20files/CET_Div_Brochure.pdf. Accessed 3 March 2007.
[3] The Climate Group (2005) Profits Up, Carbon Down, The Climate Group. Available at www.theclimategroup.org/assets/Carbon_Down_Profit_Up.pdf. Accessed 3 March 2007.
[4] Energy Futures Forum (2006) The Heat Is On: The Future of Energy in Australia, CSIRO, Parts 1,2,3. Available at http://www.csiro.au/csiro/content/file/pfnd.html. Accessed 3 March 2007.

Module B: Understanding, Identifying and Implementing Energy Efficiency Opportunities for Industrial/Commercial Users – By Sector

Chapter 4: Responding to Increasing Demand for Electricity

Lecture 4.1: What Factors are Causing Rising Peak and Base Load Electricity Demand in Australia?

Lecture 4.2: Demand Management Approaches to Reduce Rising 'Peak Load' Electricity Demand

Lecture 4.3: Demand Management Approaches to Reduce Rising 'Base Load' Electricity Demand

Lecture 4.4: Making Energy Efficiency Opportunities a Win-Win for Customers and the Utility: Decoupling Energy Utility Profits from Electricity Sales

Chapter 5: Energy Efficiency Opportunities in Large Energy Using Industry Sectors

Lecture 5.1: Opportunities for Energy Efficiency in the Aluminium, Steel and Cement Sectors

Lecture 5.2: Opportunities for Energy Efficiency in Manufacturing Industries

Lecture 5.3: Opportunities for Energy Efficiency in the IT Industry and Services Sector

Chapter 6: Energy Efficiency Opportunities in Light Industry/Commercial Sectors

Lecture 6.1: Opportunities for Energy Efficiency in the Tourism and Hospitality Sectors

Lecture 6.2: Opportunities for Energy Efficiency in the Food Processing and Retail Sector

Lecture 6.3: Opportunities for Energy Efficiency in the Fast Food Industry

Module C: Integrated Approaches to Energy Efficiency and Low Emissions Electricity, Transport and Distributed Energy

Chapter 7: Integrated Approaches to Energy Efficiency and Low Emissions Electricity

Lecture 7.1: Opportunities and Technologies to Produce Low Emission Electricity from Fossil Fuels

Lecture 7.2: Can Renewable Energy Supply Peak Electricity Demand?

Lecture 7.3: Can Renewable Energy Supply Base Electricity Demand?

Lecture 7.4: Hidden Benefits of Distributed Generation to Supply Base Electricity Demand

Chapter 8: Integrated Approaches to Energy Efficiency and Transport

Lecture 8.1: Designing a Sustainable Transport Future

Lecture 8.2: Integrated Approaches to Energy Efficiency and Alternative Transport Fuels – Passenger Vehicles

Lecture 8.3: Integrated Approaches to Energy Efficiency and Alternative Transport Fuels - Trucking

Chapter 9: Integrated Approaches to Energy Efficiency and Distributed Energy

Lecture 9.1: Residential Building Energy Efficiency and Renewable Energy Opportunities: Towards a Climate-Neutral Home

Lecture 9.2: Commercial Building Energy Efficiency and Renewable Energy Opportunities: Towards Climate-Neutral Commercial Buildings

Lecture 9.3: Beyond Energy Efficiency and Distributed Energy: Options to Offset Emissions

Integrated Approaches to Energy Efficiency and Distributed Energy

Lecture 9.3: Beyond Energy Efficiency and Distribute Energy: Options to Offset Emissions[5]

Carbon emissions offsetting is one of the alternatives available to business to manage their climate risk. It is not the solution to climate change but it has the potential to make a contribution when used as part of an overall carbon strategy. A comprehensive carbon strategy will include CO_2 emission assessment, avoidance, reduction and offsetting.

Leonardo Ribón, and Helen Scott, Report by Global Sustainability, RMIT University, May 2007[6]

Educational Aim

The aim of this lecture is to present current information about greenhouse gas (GHG) offset initiatives and opportunities. GHG offsets are beginning to be understood as key mechanisms that can be used to assist Australia to achieve at least 60 percent GHG emission reductions by 2050. This lecture will specifically cover issues and opportunities in forestry, soil, agricultural, and black soil offsetting initiatives.

Essential Reading

Reference	Page
1. Ribón, L. and Scott, H. (2007) *Carbon Offset Providers in Australia 2007*, Global Sustainability at RMIT University, Australia. Available at http://www.global.rmit.edu.au/CarbonOffsets2007.pdf. Accessed 10 August 2007.	pp 1-12
2. Global Sustainability at RMIT website - *Greenhouse gas Offset Online Guide* at www.carbonoffsetguide.com.au. Accessed 12 November 2007. This site will be launched early December 2007.	
3. NSW Environmental Protection Agency website - *What is Emission Trading?* at http://www.environment.nsw.gov.au/licensing/emissionstrading.htm. Accessed 10 August 2007.	
4. David Suzuki Foundation website - *What is a Carbon Offset?* at http://www.davidsuzuki.org/Climate_Change/What_You_Can_Do/carbon_offsets.asp. Accessed 10 August 2007.	

[5] Peer review by Leonardo Ribon – RMIT Global Sustainability, and Rob Gell – President Greening Australia.
[6] Ribon, L. and Scott, H. (2007) *Carbon Offset Providers in Australia 2007*, Global Sustainability at RMIT University, Australia. Available at http://www.global.rmit.edu.au/CarbonOffsets2007.pdf. Accessed 24 July 2007.

Learning Points

1. Atmospheric carbon dioxide (CO_2) levels are higher now than at any time in the last million years. Planetary greenhouse gas (GHG) levels in the atmosphere have already overshot the thresholds of what has been ecologically normal for the last million years. This is shown by the bleaching of coral reefs and other forms of ecological collapse which has occurred in the last ten years with just a modest increase in global temperature.
2. Scientists such as James Hansan from NASA warn that we only have ten years left to reduce GHG emissions, as rapidly as possible, to avoid dangerous climate change tipping points. Many companies, organisations, and community groups are now adopting targets to become climate neutral by reducing GHG emissions through energy efficiency, low carbon technologies and carbon offsetting. While some criticise carbon offsetting schemes, the fact is that it is impossible to reduce any individual's, household or organisation's GHG emissions by 100 percent. Thus, carbon offsets are becoming recognised as an important avenue for reducing GHG emissions in addition to energy efficiency, fuel switching, and behavioural changes.
3. Globally there bas been a significant shift towards the goal of 'carbon neutral' as a way to take responsibility for the greenhouse gas emissions we create every time we drive our cars, take a plane, or turn on our computers. It's based on the principle that, since climate change is a global problem, an emission reduction made elsewhere has the same positive effect as one made locally. Carbon/Greenhouse Gas offsets are credits for emission reductions achieved by projects elsewhere, such as wind farms, solar installations, or energy efficiency projects
4. There are many GHG offsetting initiatives now offered in Australia and overseas. Offsetting initiatives include those that are based on energy efficiency measures, renewable energy projects, forestry activities, soil sequestration activities, and methane sequestration activities. Offsetting greenhouse gases is now an official part of all major emission trading schemes, such as the European Union Emission Trading Scheme and the voluntary Chicago Climate Exchange.
5. The Kyoto Protocol has sanctioned greenhouse gas offsets as a way for governments and private companies to earn greenhouse gas credits which can be traded in an emissions trading scheme. The Kyoto Protocol established a Clean Development Mechanism (CDM) which allows industrialised countries with a binding greenhouse gas reduction commitment (called Annex 1 countries) to be able to invest in greenhouse gas offset projects in developing countries.
6. Carbon offsetting schemes that invest in energy efficiency or renewable projects in theory can provide a definite carbon reduction that can be easily quantified. Third-party-accredited sustainable plantation forestry and sustainable revegetation projects provide legitimate forms of offsetting. However, there are risks through bushfires or drought of the carbon stored in trees being released within decades rather than being stored for centuries.
7. Sustainable plantations, which are not affected by bushfires or extreme drought, offer a plausible way to increase biosphere capacity to naturally store greenhouse gases. Timber products and paper products from sustainable plantations can be used in buildings, window frames, flooring and thus store carbon for decades. The latest research from the ANU CRC for Greenhouse Accounting shows that carbon is released from these timber products and paper far slower than previously assumed. When timber or paper products go eventually to landfill the carbon is

released over 1,500 years rather than over ten years as previously thought.[7]

8. It is essential that governments continue to acknowledge the importance of protecting existing native forests, since the loss of these resources will only exacerbate the GHG problem. The recently released *Stern Review* showed that 20 percent of global greenhouse gas emissions arise from deforestation of native forests around the world.[8] There are many kinds of forestry offset projects, including reforestation, forest preservation/avoidance preservation, and forest management. Each strategy is useful for creating carbon sinks, though afforestation (planting trees on lands not previously used in forestry) and reforestation (re-establishing forest where it originally occurred) creates the most positive difference. It is important to note in these instances that it is highly desirable for the plants to be native to the local area, thus increasing the local biodiversity and habitat for native fauna.

9. A less well known, but very important form of carbon offsetting is soil offsetting. This initiative involves farmers committing to reduce the amount of soil disturbance (e.g. tillage) that occurs on their farm, thereby reducing the amount of GHGs emitted from the soil via oxidisation. This process also assists the enhancement of soil fertility and reduction of soil erosion. Black soil or *Terra Petra* is getting a great deal of attention in the research community as a potential way to effectively capture carbon before it's released from biomass into the atmosphere. Made from biomass, the black soil is created in such a way that the carbon is captured, then the black soil may be returned as organic matter, but in a form that does not release GHGs for a very long period of time. Black soil may provide a potential future strategy for offsetting carbon emissions.

10. Urban forestry projects present another avenue for increasing the capacity of the environment to assimilate greenhouse gas emissions, while enhancing the aesthetic and ecological attributes of the built environment. Planners and designers may now begin to consider the sequestration benefits of existing vegetation and potential revegetation areas, and communicate these benefits to the client.

[7] Smith, M. and Hargroves, K. (2006) 'Wood – another low carbon footprint solution', *ECOS Magazine,* pp 12-13. Available at http://www.publish.csiro.au/?act=view_file&file_id=EC129p12.pdf. Accessed 2 June 2007.
[8] Stern, N. *et al* (2006) *Stern review on the economics of climate change*, HM Treasury, London. Available at http://www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/sternreview_index.cfm. Accessed 10 August 2007.

Brief Background Information

Towards Climate Neutrality

Communities can help Australia achieve a 60 percent reduction in greenhouse gas emissions by 2050 if business, industry, governments, schools, churches and other organisations seek to achieve significantly greater than 60 percent. Lecture 1.2 mentioned that many companies and governments are currently seeking to achieve greater than '60% by 2050', and have adopted targets to become climate neutral. The range of organisations now committing to becoming climate neutral is significant. The David Suzuki Foundation[9] listed the following organisations and businesses as just some who have made this commitment:

- The Olympics, World Cup Soccer, US Super Bowl, the AFL sporting league and other major sporting events are going carbon neutral, as are many athletes.
- Airlines including Virgin Blue and travel agents such as STA Travel and Intrepid Travel, in partnership with Origin Energy, are starting to offer customers the option to offset their flights, and some airlines such as SilverJet (British) are offsetting all of their flights. Many hotels are also providing carbon neutral accommodation.
- Movie studios have offset the emissions from the production of feature films (including George Clooney's film *Syriana*) and documentaries. Media companies such as NewsCorp Ltd and MTV are offsetting the emissions associated with their broadcasts.
- Major conferences and events have offset their emissions, including the 2007 WOMAdelaide Festival.
- Organisations as diverse as Ilysis Web Hosting, the first hosting company to provide carbon neutral hosting, and the US Environment Protection Authority have purchased large quantities of renewable energy certificates to offset their electricity use.
- Large companies and banks like HSBC, Swiss Re, News Corp, National Australia Bank, and ANZ have committed to making their entire operations carbon neutral. Companies such as MyRate are offering such things as 'carbon neutral' home loans.
- Many businesses are now offering carbon neutral products or services such as carpeting, clothing, flower deliveries, fabrics, etc.
- Rock bands like the Rolling Stones, Coldplay, Dave Matthews Band, Pearl Jam, and The Dixie Chicks have offset the emissions associated with their concerts and albums.
- Many people are now offsetting their weddings (including air travel by guests).
- The list continues to grow – best-selling books including Tim Flannery's *The Weather Makers*, retail chains and outlets, and even entire towns, cities and nations like New Zealand and Norway are all committing to offsetting their emissions.

In this lecture series, Modules A, B, and C have discussed the many strategies that industry, commercial building, and residential sectors can employ to reduce greenhouse gas emissions – namely through energy efficiency gains and the use of low carbon technology opportunities. This lecture discusses a further option, which is reducing greenhouse gas emissions indirectly by purchasing 'carbon credits' - allowing carbon and other greenhouse gas emissions to be offset. All of

[9] See David Suzuki Foundation - *Solving Global Warming: What you can do: Go Carbon Neutral* at http://www.davidsuzuki.org/_pvw370829/climate_change/what_you_can_do/carbon_neutral.asp. Accessed 10 August 2007.

the above-listed organisations are seeking to achieve carbon neutrality by all three of these approaches. The option to offset greenhouse gas emissions by purchasing carbon credits is a particularly important one because it is a key mechanism that allows companies to become 'carbon neutral'. This is achieved by paying for 'carbon credits' which are invested in the creation of 'sinks' for the remaining or unavoidable emissions caused by operations and travel – thereby removing those emissions from the atmosphere. Currently for every single carbon credit that is purchased, one metric ton of carbon dioxide equivalent (CO_2-e) emissions are sequestered.[10]

There are three primary types of greenhouse gas offsets schemes offered that provide carbon credits, including energy efficiency, renewable energy and forestry carbon offset projects.

In Australia the most common carbon offset projects involve renewable energy, energy efficiency and forestry/revegetation (bio-sequestration).

Offsets from Renewables

Renewable energy projects include wind, solar, geothermal, landfill gas capture, biomass, and some hydro generation. Under the Australian Mandatory Renewable Energy Target (MRET), a Renewable Energy Certificate (REC) is equivalent to 1 MWh of renewable energy generation, which offsets approximately 1 ton of CO_2.

The key benefits of renewable energy projects are that they provide a measurable way to clearly reduce emissions which would otherwise be produced from burning fossil fuels. Investments in new renewable energy projects also last decades, ensuring that the money invested makes a lasting difference.

Offsets from Energy-Efficiency Projects

Energy Efficiency projects offset emissions by reducing the amount of energy needed to provide services and meet society's needs. The difference between energy use before and after a particular energy efficiency measure is implemented is what is measured to create a carbon offset.

It is true that energy efficiency projects, once implemented, will provide long-term reductions in energy usage and greenhouse gas emissions. The National Framework for Energy Efficiency (NFEE) research shows that there is significant potential in the economy for energy efficiency to make a difference. NFEE's publications show that 30 and 70 percent potential energy efficiency savings exist throughout the Australian economy.[11]

However, critics of carbon offsets from energy efficiency projects argue that companies, governments and home owners should be investing in energy efficiency opportunities anyway. Investments in energy efficiency usually pay back with a four year or less period and hence most organisations' should invest in energy efficiency anyway.

Forestry offset initiatives can create carbon credits, as well as improve biodiversity and soil health, and Greening Australia[12] has launched, in 2007, a premium biodiversity carbon credit product called 'Breathe Easy'.

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[10] See NSW Department of Primary Industries: Forests - *Frequently asked questions on carbon trading*
Sydney Futures Exchange Paper, 2000 (used with permission): What is the Kyoto Protocol and emissions trading? at http://www.forest.nsw.gov.au/env_services/carbon/trading/faq/Default.asp. Accessed 24 July 2007.

[11] Energy Efficiency and Greenhouse Working Group (2003) *Towards a National Framework for Energy Efficiency – Issues and Challenges Discussion Paper*, NFEE. Available at http://www.nfee.gov.au/about_nfee.jsp?xcid=64. Accessed 25 October 2007.

[12] Greening Australia (2007) *Greening Australia Breathe Easy*, Greening Australia Pty Ltd, Australia. Available at http://www.breatheeasynow.com.au/html. Accessed 14 April 2007.

Other offset initiatives include agricultural methane offsets, landfill methane offsets, and coal mine methane offsets.[13] Currently, towards the end of 2007, there are 29 companies in Australia[14] offering greenhouse gas offset services. A number of these offsetting activities will be discussed in more detail in the remainder of this lecture. Since the rest of the modules have focused on opportunities to reduce carbon emissions through energy efficiency and renewable energy technologies this lecture will focus on the opportunities to offset through forestry and soil options.

Forestry Offsets

Few people realise that 20 percent of the world's annual CO_2 emissions result from deforestation[15] due to land use change in the tropical regions of Central and South America, Africa, and Asia. These lands are being transformed from relatively high-carbon stock, natural forests to generally lower-carbon stock, crop, agro-forestry, grazing, or wood-fuel lands and urban areas. While these changes through land clearing, forest harvest, and fire provide short-term economic benefits to rural livelihood, in the long term it leads to devastation of these rural economies as soils that receive tropical rainfall are quickly leached of nutrients. There is a great opportunity for forestry projects to compensate for the loss of natural forests by enhancing the capacity of the biosphere to naturally assimilate increased levels of greenhouse gases in the atmosphere. Effectively the world can pay to protect and vegetate these areas to stabilise climate change, but also to provide income.

The current Federal Minister for the Environment, Malcolm Turnbull announced on the 24th of July 2007 the Federal Government's commitment to funding forestry management projects that will reverse the rate of deforestation and greenhouse gas emission increases,

> *Australia is* [providing] *a $200 million Global Initiative on Forests and Climate to reverse deforestation and by doing so, gives the world the breathing space it needs until the technologies are able to deliver us abundant, zero or near zero emissions energy.*[16]

Forestry offset projects are those that invest in planting projects to remove CO_2 from the atmosphere. A greenhouse gas or carbon 'sink' is a term often used to describe vegetation communities, particularly forests, that can act as repositories for CO_2 and other greenhouse gases. Forestry offset projects can help prevent global climate change by increasing the amount of terrestrial plant matter, thus increasing the opportunity for carbon sequestration by plant matter, thereby reducing levels of CO_2, methane (CH_4) and nitrous oxide (N_2O) in the atmosphere. Traditional commercial forestry practices are regarded as offering minimal carbon sequestration value. This is because greenhouse gases are released when a) the valuable old growth forest timber is logged to make way for the new plantation, and burning and decaying timber remnants release gases into the atmosphere; and b) during routine harvest periods a significant proportion of the carbon stored in the young forest's biomass is released every time the timber is harvestedinto the atmosphere as the residual timber remnants decay. Essentially, traditional commercial forestry practices are not beneficial because the old growth forest (which is an ecologically functioning, stable carbon sink) is replaced with a young monoculture that is not particularly ecologically valuable and is not a constant carbon sink. The various forms of forestry projects that are regarded as effective greenhouse gas sinks are recorded in the table below.

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[13] Chicago Climate Exchange (2007) *CCX Offsets Program*, Chicago Climate Exchange, USA. Available at http://www.chicagoclimatex.com/content.jsf?id=23. Accessed 14 July 2007.

14 Ribon, L. and Scott, H. (2007) *Carbon Offset Providers in Australia 2007*, Global Sustainability at RMIT University, Australia. Available at http://www.global.rmit.edu.au/CarbonOffsets2007.pdf Accessed August 2007.

[15] Food and Agriculture Organization of the United States: Forestry (2007) Forests and Climate Change, FAO, USA. Available at http://www.fao.org/forestry/site/11480/en/page.jsp. Accessed 16 July 2007.

[16] Turnbull, M. (2007) 'Save trees for green future', *The Daily Telegraph*, News Ltd, Australia. Available at http://www.news.com.au/dailytelegraph/story/0,22049,22119735-5001031,00.html. Accessed 24 July 2007.

Table 9.3.1. Key forestry offset project types and their effect on greenhouse gas

Key Forestry Offset Project Types	Explanatory note	Effect on greenhouse gases
Afforestation	Tree planting on lands previously not in forestry.	Increases carbon storage through sequestration.
Reforestation	Tree planting on lands, such as restoring trees on severely burned lands that will demonstrably not regenerate without intervention.	Increases carbon storage through sequestration.
Forest preservation or avoided deforestation	Protection of forests that otherwise would have been cleared.	Avoids CO_2 emissions via conservation of existing carbon stocks.
Forest management	Modification of forestry practices, such as lengthening the harvest-regeneration cycle.	Increases carbon storage by sequestration.

Source: US EPA (2006)[17]

Forestry and Revegetation Offset Accounting

One of the challenges of Forestry and revegetation carbon offset programs is accurately accounting for the changes. The AGO has sent thousands of its free National Carbon Accounting Toolbox CDs[18] to farmers and landholders.

The toolbox enables users to track greenhouse gas emissions and 'carbon stock' changes from different land use and management options. It provides access to a comprehensive carbon accounting model for Australia, and includes all supporting technical documentation. Users can view carbon accounting data, i.e. for a range of plant species and land management systems; historic climate records; or technical reports relating to development of the national carbon accounting system.

As a result, land managers can now monitor greenhouse gas emissions effectively and identify more sustainable (less emissions-intensive) land management practices.

The former CRC for Greenhouse Accounting[19] has also developed simple online calculators that allow farmers and plantation managers to accurately calculate how much CO_2 they are sequestering through changing land use patterns and through afforestation, reafforestation and revegetation efforts.

[17] US Environmental Protection Agency (2006) *Forestry Practices that Sequester or Preserve Carbon*, US Environmental Protection Agency, USA. Available at www.epa.gov/sequestration/forestry.html. Accessed 4 November 2007.
[18] See Australian Greenhouse Office's National Carbon Accounting Toolbox at http://www.greenhouse.gov.au/ncas/ncat/index.html Accessed 25 October 2007.
[19] See CRC for Greenhouse Accounting Calculators at http://www.greenhouse.crc.org.au/counting%5Fcarbon/ Accessed 25 October 2007.

Soil Offsets

The disturbance, or tillage, of soil due to farming practices has been recognised as a significant source of CO_2 emissions, as well as a major cause of soil erosion.[20] Greenhouse gas emissions released from agricultural soil may be reduced by minimising tillage, erosion control, irrigation management, changes in field/crop rotations, and crop cover. The Intergovernmental Panel on Climate Change (IPCC) estimates that improved productivity and conservation tillage can allow increases in soil carbon content (i.e. carbon sequestration) at an initial rate of around 0.3 tons of carbon/ha/yr.[21] The potential of carbon sequestration, on a global scale, is about 0.6-billion tons to 1-billion tons per year.[22] In acknowledgement of the importance of soil as a carbon sink, the Chicago Climate Exchange has determined that soil offsets may be gained by farmers that commit to continuous conservation tillage, which maintains an increase in soil carbon stocks.[23]

The idea of using soils for absorbing CO_2 was introduced by Professor of Soil Science at Ohio State University, Rattan Lal. Ever since humanity began to farm, soils have been losing carbon due to ploughing, which opens-up the soil and mixes oxygen into it, leading to oxidation of the carbon in the soil. In addition, ploughing the soil decreases structural stability, making it more vulnerable to erosion by wind and water. Wind and water remove the finer soil particles which usually contain the most nutrients (including carbon content). Ploughing, therefore, makes the soil vulnerable to carbon loss via both chemical and physical mechanisms. To reduce carbon loss from soil, alternative methods of farming are needed, including new methods of ploughing and new agricultural systems that require less ploughing. Ploughing in a way that doesn't turn the soil, or not ploughing at all, is called 'reduced tillage' or 'no-tillage' respectively. It is now a respected method for preventing soil erosion that also involves using plenty of mulch and manure, and planting appropriate crops to enhance the soil. Professor Lal believes that applying these techniques around the world would sequester a significant amount of carbon.

Former chief executive of the Australian CRC for Greenhouse Accounting, Ian Noble, says sequestering carbon in soil offers a distinct advantage,

> *Carbon stored in the soil is actually much safer for reversibility than, for example, trees and other vegetation. However, there are some risks. Say, for example, the farmer has been carrying out… a minimum tillage for 10, 15 years or more, and then for one reason or another they go back to deep ploughing. Even for a few years, that can release a lot of the carbon that's been stored. So any monitoring system has to be accurate enough to detect that, and make sure that that's properly accounted for.*[24]

For more information please consult Professor Lal's homepage at Ohio State University,[25] and the US EPA's website that provides extensive resources for calculating baselines regarding soil carbon offsets.[26]

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[20] Reicosky, D. and Archer, D. (2007) 'Moldboard Plow Tillage Depth and Short-Term Carbon Dioxide Release', Soil & Tillage Research, vol 94, Issue 1, pp 109-121. Available at http://www.ars.usda.gov/research/publications/Publications.htm?seq_no_115=178744. Accessed 17 July 2007.
[21] Watson, R.T. et al (eds.) (2000) Special Report on Land Use, Land-Use Change, and Forestry, Intergovernmental Panel on Climate Change, Cambridge University Press, London, p 204.
[22] Aedy, R. (2000) 'Can Soils Soak Up Greenhouse Gasses?', Earthbeat, Radio National, Australian Broadcasting Commission, Australia. Available at http://www.abc.net.au/rn/science/earth/stories/s226590.htm. Accessed 4 November 2007.
[23] Chicago Climate Exchange (2007) CCX Offsets Program, Chicago Climate Exchange, USA. Available at http://www.chicagoclimatex.com/content.jsf?id=23. Accessed 14 July 2007.
[24] Noble, I. (2000) 'Can Soils Soak Up Greenhouse Gases', Earthbeat, ABC. Available at http://www.abc.net.au/rn/science/earth/stories/s226590.htm. Accessed 10 August 2007.
[25] Wagner, H. (2004) No-Till Farming Offers Fix to Global Problems, Ohio State University, USA. Available at www.ag.ohio-state.edu/~news/story.php?id=2880. Accessed 4 November 2007.

Summary of Farming Offsets

Table 9.3.2. US EPA on Representative Carbon Sequestration Rates and Saturation Periods for Key Agricultural and Forestry Practices

Activity	**Representative carbon sequestration rate in U.S.** (Metric tons of C per acre per year)	**Time over which sequestration may occur before saturating** (Assuming no disturbance, harvest or interruption of practice)	**References**
Afforestation	0.6 – 2.6	90 – 120+ years	Birdsey 1996[27]
Reforestation	0.3 – 2.1	90 – 120+ years	Birdsey 1996[28]
Changes in forest management	0.6 – 0.8	If wood products included in accounting, saturation does not necessarily occur if Carbon continuously flows into products.	Row 1996[29]
	0.2		IPCC 2000[30]
Conservation or riparian buffers	0.1 – 0.3	Not calculated	Lal et al. 1999[31]
Conversion from conventional to reduced tillage	0.2 – 0.3	15 – 20 years	West and Post 2002[32]
	0.2 i)	25 – 50 years	Lal et al. 1999
Changes in grazing land management	0.02 – 0.5 j)	25 – 50 years	Follet et al. 2001[33]
Biofuel substitutes for fossil fuels.	1.3 – 1.5 k)	Saturation does not occur if fossil fuel emissions are continuously offset.	Lal et al. 1999.

Source: US Environmental Protection Agency (2006)[34]

(Note: for table notes and additional information, please refer to original table).

[26] US Environmental Protection Agency (2006) Carbon Sequestration in Agriculture and Forestry, US EPA, USA. Available at www.epa.gov/sequestration/tools_resources.html. Accessed 4 November 2007.
[27] Birdsey, R.A. (1996) 'Regional Estimates of Timber Volume and Forest Carbon for Fully Stocked Timberland, Average Management After Final Clearcut Harvest', in Sampson, R.N. and Hair, D. (eds.) Forests and Global Change Volume 2: Forest Management Opportunities for Mitigating Carbon Emissions, American Forests, USA.
[28] Ibid.
[29] Row, C. (1996) 'Effects of selected forest management options on carbon storage' in Sampson, R.N. and Hair, D. (eds.) Forests and Global Change Volume 2: Forest Management Opportunities for Mitigating Carbon Emissions, American Forests, USA, pp 27-58.
[30] Watson, R.T. et al (eds.) (2000) Special Report on Land Use, Land-Use Change, and Forestry, Intergovernmental Panel on Climate Change, Cambridge University Press, London, p 184.
[31] Lal, R., Kimble, J.M., Follett, R.F. and Cole, C.V. (1999) The Potential of U.S. Cropland to Sequester Carbon and Mitigate the Greenhouse Effect, Lewis Publishers, USA
[32] West, T.O. and Post, W.M. (2002) 'Soil Carbon Sequestration by Tillage and Crop Rotation: A Global Data Analysis', Soil Science Society of America Journal, vol 66, pp 1930-1946. Available at http://cdiac.ornl.gov/programs/CSEQ/terrestrial/westpost2002/westpost2002.html. Accessed 10 August 2007.
[33] Follett, R.F., Kimble, J.M. and Lal, R. (2001) The Potential of U.S. Grazing Lands to Sequester Carbon and Mitigate the Greenhouse Effect, Lewis Publishers, USA.
[34] US Environmental Protection Agency (2006) Representative Carbon Sequestration Rates and Saturation Periods for Key Agricultural & Forestry Practices, US EPA, USA. Available at www.epa.gov/sequestration/rates.html. Accessed 10 August 2007.. # Important Note: Any associated changes in emissions of methane (CH4) nitrous oxide (N2O) or fossil CO_2 not included.

Black Soil or Terra Petra

An emerging opportunity for carbon sequestration is a new product that has been termed black soil or terra petra. Black soil is produced by converting biomass (e.g. crop residues) into char via a process known as pyrolysis. Pyrolysis is a process whereby biomass is heated strongly, in the absence of oxygen, causing the carbon content of the biomass to be effectively 'locked up' so that it can be safely returned to the soil without the risk of emitting carbon in the short to medium term. It is estimated that carbon stored in black soil takes hundreds to thousands of years to be naturally re-released into the atmosphere, which would mean that it is a very promising long-term mode of carbon sequestration when compared with other strategies.[35] Black soil is additionally beneficial because when added to soil it increases water retention, mineral content, and biological health, thereby improving the soil's fertility and structure, resulting in increased plant yields.[36] Furthermore, the gases produced from the pyrolysis process are suitable to be captured and used to create a clean form of bioenergy.[37] The process appears to offer significant potential and warrants further large-scale immediate research.

Agricultural Methane Emission Offsets

Australia currently contains approximately 20 million cattle and 130 million sheep, producing approximately 12 percent of Australia's greenhouse gas emissions.[38] Australia's CSIRO is exploring ways to help sheep and cattle digest rough and low nutrient pastures more efficiently. The CSIRO scientists have found that by varying the bacterial populations in the animal's rumen, livestock can yield more meat, wool and milk while producing less methane.[39] Trials have shown live weight gains of about 20 percent in sheep and cattle, and nine percent fleece weight gains. In digesting more of their food, the animals release 18-80 percent less methane through belching.[40] Other ways of reducing animal methane emissions include methane capture and combustion methods. In the United States, the Chicago Climate Exchange (CCX) offers carbon credits for these kinds of agricultural methane emission offsets.[41]

Carbon Offsetting in the Urban Environment

There is a great opportunity for forestry offsetting initiatives to occur within the setting of the urban environment. The environmental side-effects of urban settlement include a loss of biodiversity, 'heat island' effects, dramatically altered water cycle, and minimisation of carbon sinks (existing vegetation). Revegetation projects can assist in mitigating these side effects by increasing habitat area and biodiversity, providing natural shade, allowing for natural filtration of stormwater and by increasing the size of the urban greenhouse gas sink, while beautifying the urban environment. However, it should be noted that urban planners and designers should consider revegetation planting as an inferior option to retaining existing vegetation from a carbon offsetting perspective because revegetation plantings currently requires CO_2 input to be established and maintained (e.g. fuel consumption of machinery and the embedded energy in fertiliser and water). Opportunities and issues for urban GHG sequestration should be recognised and committed to at the earliest stage of

[35] Lehmann, J. (2007) 'A Handful of Carbon', Nature, Issue 477, pp 143-144. Available at http://www.nature.com/nature/journal/v447/n7141/full/447143a.html. Accessed 24 July 2007.
[36] Ibid
[37] Ibid
[38] CSIRO (1997) CSIRO: Solutions for Greenhouse, CSIRO, Australia. Available at http://www.csiro.au/news/issues/greenhse.htm. Accessed 10 August 2007.
[39] Ibid
[40] US Environmental Protection Agency (1998) Small Steps Make a Difference: Improving your Cow-Calf Business and the Environment in the Southeastern US, US EPA, USA. Available at www.epa.gov/sequestration/pdf/smallsteps.pdf. Accessed 1 November 2007.
[41] Chicago Climate Exchange (2007) Agricultural Methane Emission Offsets, Chicago Climate Exchange, USA. Available at http://www.chicagoclimatex.com/content.jsf?id=103. Accessed 24 July 2007.

the project so as to inform other aspects of the design (e.g. location of open space and conservation areas etc).

Urban forestry is just one example of the many opportunities for politicians, scientists, businesses, industry, engineers, designers, and citizens to creatively reduce and offset society's greenhouse gas emissions and benefit from doing so.[42]

Greenhouse Gas Offset Critiques

The greenhouse gas offset industry and offset projects have their critics, who say that the practice is encouraging individuals and organisations to keep generating greenhouse gas emissions in a 'business-as-usual' fashion, rather than making genuine efforts to rapidly reduce emissions.[43] Others have criticised the lack of regulation and quality assurance in this new market.

But a recent *Financial Times*[44] report on the UK market found 'widespread failings in the new markets for greenhouse gas offsets, suggesting some organisations are paying for emissions reductions that do not take place'. In addition the report found that:

- Industrial companies are profiting from doing very little, or from gaining greenhouse gas credits on the basis of efficiency gains from which they have already benefited substantially.
- Brokers are providing services of questionable or no value.
- A shortage of verification exists, making it difficult for buyers to assess the true value of greenhouse gas credits.

In fact, critics argue that the carbon offsets industry is allowing individuals, organisations and countries to think that it is alright to keep polluting.[45] Chris Martin, the famous lead singer of UK rock band ColdPlay is an example of this. In an interview for the Guardian in 2005,[46] while espousing the need for us all to play our part to preserve the planet, Chris revealed that he drives a fuel inefficient sports car and frequently travels in his own private jet. He said that he had bought the private jet partly so that his daughter Apple, when she is older, could fly and join him at his concerts whenever she wished to do so.[47] Chris's excuse for this highly carbon intensive behaviour was that he and ColdPlay offset their emissions. In 2002, Coldplay paid British company Future Forests to plant 10 000 mango trees in India to offset the emissions from creating their second album. In 2006, the UK *Daily Telegraph*[48] reported that at least 40 per cent of the saplings had died as a result of water shortages – negating the greenhouse gas storage they were meant to provide. Further, several failures around the world have fuelled criticism of offset schemes under the Clean Development Mechanism.[49] The Clean Development Mechanism (CDM), established by the Kyoto Protocol, allows industrialised countries with a binding greenhouse gas reduction commitment to invest in greenhouse gas offset projects in developing countries. Failures of the CDM include carbon offset

[42] More information about urban forestry can be found at this website: http://www.urbanforestrysouth.org/Resources/Library/Citation.2004-07-20.1358/view. Accessed 24 July 2007.
[43] Smith, K. (2007) 'The Carbon Neutral Myth: Offset Indulgences for your Climate Sins', *Carbon Trade Watch*, Transnational Institute, pp 29-42. Available at http://www.carbontradewatch.org/pubs/carbon_neutral_myth.pdf. Accessed 12 November 2007.
[44] Harvey, F. and Fidler, S. (2007) 'Industry caught in greenhouse gas smokescreen', *Financial Review*, London. Available at www.ft.com/cms/s/0/48e334ce-f355-11db-9845-000b5df10621.html. Accessed 12 November 2007.
[45] Smith, K. (2007) 'The Carbon Neutral Myth: Offset Indulgences for your Climate Sins', *Carbon Trade Watch*, Transnational Institute, pp 29-42. Available at www.carbontradewatch.org/pubs/carbon_neutral_myth.pdf. Accessed 12 November 2007.
[46] Chris Martin Interview with Craig McLean, 28th May 2005. The Importance of Being Earnest. The Guardian.
[47] Monbiot, G. (2006) 'Greenwash Exposed – Chris Martin', *Turn Up the Heat*. Available at http://www.turnuptheheat.org/?page_id=12 Accessed 13 November 2007.
[48] Dhillon, A. and Harnden, T. (2006) 'How Coldplay's green hopes died in the arid soil of India', *Sunday Telegraph*, 30 April 2006.
[49] Smith, K. (2007) 'The Carbon Neutral Myth: Offset Indulgences for your Climate Sins', *Carbon Trade Watch*, Transnational Institute, pp 29-42. www.carbontradewatch.org/pubs/carbon_neutral_myth.pdf Accessed 13 November 2007.

projects in South America[50] and Africa[51]. As a result of failures such as these, a number of new non-government organisations[52] have been set up with the sole purpose of monitoring GHG offset projects.[53] However, it's important to note that offsets are *not* the solution to reducing GHG emissions. Rather, they should be seen as one component of a broader GHG reduction approach that requires, first, that society uses energy more efficiently, and secondly, that it shifts to using low-carbon energy sources. Virtually all businesses and households in Australia can now purchase 100 per cent renewable energy from an accredited green power supplier,[54] and most Australians can easily make other lifestyle changes, such as buying locally grown food. Only then does it make sense to offset the remaining balance of our emissions using greenhouse gas offsets.

In its 2007 review of the Australian greenhouse gas offsets industry, the Global Sustainability Institute at RMIT University argued that,

> *… criticism of the greenhouse gas offset industry is justified, as only some Australian greenhouse gas offset service providers communicate on their websites that greenhouse gas offsetting emissions is only one element of a comprehensive greenhouse gas strategy. Only a few organisations do encourage their clients to measure, reduce and then offset, rather than purely offering the offset service*.[55]

The greenhouse gas offset industry is starting to address these criticisms proactively. Founder of Climate Positive Brendan Condon states, *'I think that offsets can play a part in the climate protection strategy, but they cannot be used as a mini licence to pollute. We must reduce our footprint dramatically before we offset. At Climate Positive we're very clear; we want passionate partners in reducing global warming; not passive consumers of a product.'*[56] Also initial steps are being made to improve quality assurance standards. Most Australian carbon offsets are either accredited or in the process of getting accredited with the Australian Greenhouse Office's Greenhouse Friendly program (see Table 9.3.3).

Quality Assurance Standards

This is an important development because offset purchasers need to have confidence that the greenhouse gas offsets they pay for are generated from projects that are accurately and reliably verified.

In Australia's voluntary market, it is difficult to ascertain whether claims being made by greenhouse gas offsetting companies are genuine. So Ribón and Scott, authors of the *Global Sustainability Report,*[57] have developed a set of criteria (adapted below) that can help customers choose between numerous greenhouse gas offset products:[58]

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[50] Patricia Granda (2005) *Carbon Sink Plantations in the Ecuadorian Andes: Impacts of the Dutch FACE-PROFAFOR Monoculture Tree Plantations,* Project on Indigenous and Peasant Communities, Patricia Granda. Available at www.wrm.org.uy/countries/Ecuador/face.pdf Accessed 13 November 2007.
[51] Lang, C. and Byakola, T. (2006) *A funny place to store carbon: UWA-FACE Foundation's tree planting project in Mount Elgon National Park*, Uganda World Rainforest Movement. Available at http://www.wrm.org.uy/countries/Uganda/Place_Store_Carbon.pdf. Accessed 4 November 2007.
[52] See Greenhouse gas Trade Watch at www.greenhouse.gastradewatch.org. Accessed 4 November 2007.
[53] See SinksWatch at www.sinkswatch.org/. Accessed 4 November 2007.
[54] See Australian Government-accredited green power options at www.greenpower.gov.au/home.aspx Accessed 25 October 2007.
[55] Ribón, L. and Scott, H. (2007) *Greenhouse gas Offset Service Providers in Australia 2007*, Global Sustainability at RMIT. Available at http://www.global.rmit.edu.au/Greenhouse gasOffsets2007.pdf. Accessed 25 October 2007.
[56] Lester, B. (2007) 'Smoke and Mirrors', *GMagazine* 3rd Edition, May/June, pp 50-53. Available at http://www.lunamedia.com.au/samples/ Accessed 10 November 2007.
[57] Ribón, L. and Scott, H. (2007) *Greenhouse gas Offset Service Providers in Australia 2007*, Global Sustainability at RMIT. Available at http://www.global.rmit.edu.au/Greenhouse gasOffsets2007.pdf. Accessed 25 October 2007.
[58] Ibid.

Table 9.3.3. Comparison of Carbon Offset Providers

Table 1. Comparison of Carbon Offsets Service Providers							
	Nature	Project Types*	Standards / accreditation **	Price per tonne of CO_2	Carbon calculation	Links with NGOs	Major clients
Australian Providers							
Australian Carbon Traders	profit	BS & broker other	Greenhouse Friendly, NSW GGAS if requested	NA#	NCAT	NA	NA
Carbon Neutral	nfp ##	BS	towards Greenhouse Friendly	$13	AGO, IPCC	Men of the Trees	WA Gov., Water Corp.
Carbon Planet	profit	BS & broker other	NSW GGAS	$23	GHG Protocol	NA	NA
Climate Friendly	profit	RE	Gold Standard, GreenPower	$22, $34	AGO, IPCC, GHG Protocol	WWF	Westpac, Vic Super
Climate Positive	nfp	RE + bonus BS	RECs under MRET, VCS pending	$20, $25, $35	AGO, IPCC	NA	Daimler Chrysler, SLF 2007
Easy Being Green	profit	EE	NSW GGAS, Greenhouse Friendly	$20	AGO, GHG Protocol	NA	BHP Billiton, EPA Vic
Elementree	nfp	BS	towards Greenhouse Friendly for wholesale	$10 for retail	AGO	NA	NA
Future Climate Australia	profit	BS, GF	Greenhouse Friendly if requested, at premium	$8.50 not certified	AGO	NA	NA
Greenfleet	nfp	BS	towards Greenhouse Friendly	$8.80	AGO, IPCC, ABS	NA	CWW, Telstra
Neco	profit	EE, RE	NSW GGAS, RECs under MRET	$20, $40	NA	NA	NA
TreeSmart	profit	BS	towards Greenhouse Friendly	$12	AGO, ABS	NA	Vic State Gov
Electricity Retailers							
Origin Energy	profit	RE, EE, BS	Origin CRS	$16	AGO, IPCC	NA	NAB, AIG, AFL
AGL	profit	GF	Greenhouse Friendly	$12/MWh	AGO	NA	NA
International Providers							
The Carbon Neutral Company (UK)	profit	RE, EE, BS, GF	The CarbonNeutral Company Protocol	£7 - 8	NA	NA	Honda, ITV, ABN-AMRO
Carbonfund. org (US)	nfp	RE, EE, BS	Green-e, ERT	US$6.06	EIA	NA	Calvert Group, Orbitz

* BS - Biosequestration, RE - Renewable Energy, EE - Energy Efficiency, GF - Gas Flaring.
**For a description please see page 10 # NA – Not Available ## nfp – not for profit

Source: Ribon and Scott (2007)[60]

- *Additionality:* Would the project have occurred anyway without funding from greenhouse gas offsets?
- *Baseline Determination:* Does the provider state commitments to a robust process to determine greenhouse gas emissions in the absence of the project?

[59] Ribón, L. and Scott, H. (2007) *Greenhouse gas Offset Service Providers in Australia 2007*, Global Sustainability at RMIT. Available at http://www.global.rmit.edu.au/Greenhouse gasOffsets2007.pdf. Accessed 25 October 2007.
[60] Ibid.

- *Benefit Quantification:* Does the provider have a track record of accurate quantification of emissions reductions or has that provider had failures in the past? Do the figures quoted reflect uncertainties?
- *Permanence:* Are there risks of loss of greenhouse gas from bushfires and drought? Is there a risk that customers will not install compact fluorescents? Is there a potential for future reversal of sequestration?
- *Ownership and Registration:* Is ownership of offsets clearly and formally registered? Is there any possibility of offsets being sold many times over?
- *Monitoring and Verification:* Does the provider commit to regularly monitor, verify and report greenhouse gas offsets over time?

Because the voluntary greenhouse gas offsets market is immature, no universally accepted standards for product quality have yet gained market dominance. However, as the RMIT report outlines, the following standards exist to provide quality guidance or certification for some areas of the greenhouse gas offsetting process. Ribón and Scott summarise these as follows:

1) *Measuring and Accounting for GHG Emissions: The main standards used here globally are the GHG Protocol for Project Accounting and the Corporate Accounting and Reporting Standards, released jointly by the World Business Council for Sustainable Development (WBCSD) and World Resources Institute (WRI). There is also the International Organisation for Standardisation's ISO 14064 standard for GHG accounting and verification.*
2) *Abatement Projects that Create Emission-Reduction Credits: These standards and protocols establish whether the GHG reduction project is credible. Examples include the Gold Standard for Voluntary Offsets, the Voluntary Carbon Standard (VCS), Australian Greenhouse Friendly initiative, and Origin Energy's Greenhouse gas Reduction Scheme (CRS).*
3) *Standards that Certify a Scheme for Selling Offsets: For example, the UK Government's Code of Best Practice.*
4) *Standards that can Certify whether an Organisation or Product has Credibly Offset its Emissions: This is important so that the organisation or product can market itself as 'greenhouse gas neutral'. Examples of this in Australia include the AGO's Greenhouse Friendly initiative.*[61]

Conclusion

As the David Suzuki Foundation states,[62]

> *Although some argue that purchasing carbon offsets amounts to 'buying one's way out', one can never reduce or eliminate 100% of one's emissions. Carbon neutrality offers the opportunity to take responsibility for one's entire climate impact. Also, simply creating an emissions inventory – which is necessary to determine how many offsets need to be purchased – is often an important first step for many organizations in realizing the magnitude of their emissions, and can lead to emission reductions down the road.*

[61] Ibid.
[62] See David Suzuki Foundation website - What you can do: Go Climate Neutral at http://www.davidsuzuki.org/Climate_Change/What_You_Can_Do/carbon_neutral.asp. Accessed 10 August 2007.

There is value in greenhouse gas offsetting approaches as long as organisations have first got their own ‘house in order’ by implementing all the possible energy efficiency opportunities available (refer to Modules A and B) and are purchasing their energy from low carbon renewable sources in the first instance (refer to Module C).

Optional Reading

1. David Suzuki Foundation website - *What you can do: Go Climate Neutral* at http://www.davidsuzuki.org/Climate_Change/What_You_Can_Do/carbon_neutral.asp. Accessed 10 August 2007.
2. Australian Greenhouse Office (2006) *Investing in Trees as Greenhouse Sinks: An Overview for Industry*, Department of Environment and Heritage, Australia. Available at http://www.greenhouse.gov.au/nrm/publications/pubs/sinks-industry.pdf. Accessed 25 January 2007.
3. Smith, M. and Hargroves, K. (2006) 'Wood – another low carbon footprint solution', *ECOS Magazine*, Feb-Mar 2006, pp 12-13. Available at http://www.publish.csiro.au/?act=view_file&file_id=EC129p12.pdf. Accessed 25 January 2007.
4. Lehmann, .J, Gaunt, J. and Rondon, M. (2006) 'Bio-char sequestration in terrestrial ecosystems – a review', *Mitigation and Adaptation Strategies for Global Change,* vol 11, pp 403-427. Available at http://www.css.cornell.edu/faculty/lehmann/biochar/Biochar_home.htm. Accessed 25 January 2007.
5. Trexler Climate and Energy Services (2006) *A Consumers' Guide to Retail Offset Providers,* prepared for Clean Air Cool Planet, USA. Available at http://www.cleanair-coolplanet.org/ConsumersGuidetoCarbonOffsets.pdf. Accessed 25 January 2007.
6. Department for Environment Food and Rural Affairs (2007a) *Climate Change: Carbon Offsetting,* DEFRA, United Kingdom. Available at http://www.defra.gov.uk/corporate/contacts/index.htm. Accessed 24 February 2007.
7. Department for Environment Food and Rural Affairs (2007b) *Consultation on Establishing a Voluntary Code of Best Practice for the Provision of Carbon Offsetting to UK Customers,* DEFRA, United Kingdom. Available at http://www.defra.gov.uk/corporate/consult/carbonoffsetting-cop/consultation.pdf. Accessed 15 February 2007.
8. Department for Environment Food and Rural Affairs (2007c) *Standard for Offsetting to Deliver Much Needed Clarity*, DEFRA, United Kingdom. Available at http://www.defra.gov.uk/news/2007/070118a.htm. Accessed 15 February 2007.

Key Words for Searching Online

Climate Neutral Carbon Offset, Soil Sequestration