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Carbon Reductions and Offsets

A GCP Report for the ESSP

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Executive Summary

Growing awareness of climate change has generated demand for CO_2 reductions by individuals, institutions and businesses for specific activities and for offsetting their full carbon footprints. These decisions are mainly driven by business profit, environmental commitment, civil responsibility, and leadership goals. The recently established voluntary carbon market is gaining momentum as growth in the demand for CO_2 reductions is outpacing the wider introduction of low-carbon technologies in transport, energy production and manufacturing.

While there are concerns related to the voluntary and unregulated nature of this market, new robust standards, reporting and verification, along with broad project implementation are raising confidence in the system. The impact of voluntary carbon offsets is increasing as the economic analysis of the carbon market gains wider acceptance and the support of more speculative investors.

Voluntary carbon offsets are most beneficial if the purchase of offsets is preceded by the implementation of measures to reduce or avoid emissions.

While there are currently a number of competing standards for voluntary offsets with somewhat different criteria, verification has proven to be a step in the offset process that cannot be missed. The early open-ended and innovative carbon offsets were developed independently and initiated the market. Many of these providers are contributing their experience to the new standards, which foster maturity and balance through agreed measures and milestones.

As with any investment, financial support for offsets has broader implications for communities, ecosystems and development than the initial purpose intended. Credible carbon offsets must yield the promised level of emission reduction as a primary requirement. There are real economic, social and environmental benefits to be considered when selecting among credible projects, based on additional sustainable outcomes reflecting the values of individuals and organisations.

Carbon offset projects also allow developed nations to direct funding to less developed countries, which have limited capacity to deal with the most immediate climate change effects, yet shoulder the cost of implementing new low-carbon technologies.

Conclusions:

1. Buying carbon offsets for particular activities (e.g., transport, manufacture, heating and cooling) is an important early step towards a cultural change reflecting responsibility for the carbon-climate consequences of our activities.

2. ’Carbon neutral’ is often used as a short form for the real intended effect, to become neutral in relation to the net radiative balance. This requires emissions calculations to include other greenhouse gases and consideration of the full radiative forcing that reflects other physical parameters, such as albedo from forest canopies and airplane contrails. Choosing comprehensive calculators leads to more realistic estimates of footprints from particular activities or institutions beyond a simple emissions tally.

3. Clearly defined organisational and operational boundaries set meaningful limits of responsibility in efforts to become carbon neutral in some or all activities. The simplest, most commonly accepted, and functional emission boundaries follow the lines of financial responsibility.

4. Reducing the carbon footprint of our activities begins with becoming more energy efficient in the workplace and then making processes more efficient. This can first include using more efficient lighting and cooling-heating systems and, secondly, substituting some face-to-face meetings with conference calls, webcams, video conferencing and web streaming and dematerialising communications away from paper based systems.

5. Purchasing 100 per cent truly new renewable electricity (which is not always the same as 'green energy') for research institutions, where available, is one of the easiest and most effective ways to move towards reduced carbon footprints for offices and institutions.

6. The best long-term carbon offset projects are the ones that avoid carbon emissions in the first place through investment in low carbon or clean energies to replace high carbon energy. Purchasing offsets used to finance, for example, a wind farm where a fossil fuel based plant would have been the most likely choice, yields the highest benefits for carbon offset investment.

7. Carbon offsets that rely on carbon sequestration in plants and soils are often less effective in the long term because they are susceptible to productivity crashes and the impacts of major disturbances such as fire. However, reforestation, afforestation and revegetation can have other additional environmental and social benefits that offset buyers may decide to favour.

8. Reforestation and avoided deforestation in the tropics are efficient and cost effective land-based options to reduce carbon emissions. The climate benefits of forest plantations in boreal and mid-latitudes are less certain as new evidence accumulates on the probably modest or nil net radiative forcing benefits.

9. Choosing offset projects with high standards ensures the projects meet the minimum requirements to achieve the intended outcome. The stringent standards are: The Gold Standard, (Greenhouse Gases) GHG Protocol, The International Organization for Standardization (ISO) ISO14064, The Voluntary Carbon Standard (VCS) and the Climate, Community and Biodiversity Standards (CCBS). These standards are designed to ensure additionality, no leakage and permanency and that the offset is verifiable and will minimise unintended negative consequences to the environment, society and culture.

10. Buying carbon credits sourced from internationally recognised carbon trading markets such as the European Union Emission Trading Scheme (EU ETS) theoretically prevents purchased carbon credits from being released to the atmosphere. Due to concerns about over allocation, the voluntary market has moved away from this practice and is investing in new intiatives to develop credible projects in addition to those from compliance processes.

11. The expense of CO_2 emission reduction and offset purchase needs to be integrated into the cost of each project from the planning phase in a similar manner to all other expenses. This incorporates carbon considerations into basic planning by streamlining the process and encourages making efficiencies first by apportioning carbon costs to specific activities.

12. As a case study for applying the various methodologies and parameters described in this report, it was estimated that in 2006 the GCP was responsible for a total of 361.9 tonnes of CO_2-equivalents; 40.8 tCO_2-e in building energy use and 321.1 tCO_2-e in travel. This amount has been partitioned into core activities (130.3 tCO2-e), hosted workshops (227.4 tCO2-e) and endorsed workshops (4.2 tCO_2-e). Travel accounted for 89 per cent of all GCP emissions.

13. The GCP has launched a “zero net carbon emissions” initiative by which all its core activities will be carbon neutral. It has set a goal to become CARBON NEUTRAL in ALL its activities by the end of 2008.

1. Introduction

This report explores the issues surrounding voluntary reductions in carbon emissions through efficiencies and emission avoidance and the selection of appropriate carbon offsets where needed. We develop a framework for decision making that focuses on the Earth System Science Partnership (ESSP) and its programs and projects, where travel, conferences and office support are the major emission causing activities. However, the findings apply to most international projects and research institutions conducting a variety of field, laboratory and administrative activities with significant carbon footprints.

The primary concerns are the scope and boundaries of the emissions accounted for in a footprint, both directly and indirectly, the efforts that will be needed to reduce these emissions and the quality of offsets applied to render the remainder carbon neutral. An effort has been made to identify the extent of efficiencies which can be implemented and clarify the essential characteristics of verifiable and effective offsets available for purchase.

Voluntary carbon offsets can be seen as a grassroots development adding to the portfolio of mitigations options regulated under legally binding mechanisms established by nations and international agreements such as the Kyoto Protocol. Consequently, their rules and standards vary, and harmonisation with accepted protocols may not be possible or perhaps even desirable in an effort to encourage higher levels of engagement. Although useful on a small scale, increases in voluntary emission offsets will be most effective if they facilitate the implementation of widespread policy initiatives.

While the aim of managing the carbon cycle is reducing net carbon emissions and ultimately stabilising and decreasing the atmospheric CO_2 concentration (Global Carbon Project 2003), the aim of voluntary offset mechanisms is to make specific project activities carbon neutral— that is, with no net effect on the atmospheric CO_2 concentration.

Voluntary offset mechanisms deal with this aim either by reducing carbon emissions elsewhere equivalent to those emitted by the carbon neutral project or by creating carbon sinks that will sequester carbon equal to that emitted by the project. It is the net balance of carbon sinks and sources that determines the growth in atmospheric CO_2 and it is that balance that is targeted by carbon offset mechanisms.

Being carbon neutral involves calculating the carbon emissions of all the individual activities that one wants to make carbon neutral, reducing them wherever possible through increased efficiencies and then balancing the remainder through carbon offset projects which reduce an equivalent quantity of emissions elsewhere.

2. Carbon management and cultural change

Concern for human interaction in global environmental change is a foundation of ESSP scientific research and capacity building programs. Integrating carbon management into daily operations strengthens our contribution by applying the knowledge and strategies the ESSP contributes to. The World Climate Research Programme (WCRP) has led the way with emission reductions and began offsetting CO_2 emissions in 2005 (WCRP 2006). With the help of an offset provider, they have invested in Gold Standard verified (see section 6.2) energy efficiency and renewable energy offset projects.

On any level, the new practice of offsetting carbon emissions is a step towards slowing the growth of atmospheric CO_2. As there has been little consideration of the atmospheric implications of our fossil fuel use in the past, tying specific offsetting costs to these activities reinforces a causal connection and establishes a direct fiscal responsibility. Along with the analysis of the impacts from other emission causing activities for individuals and organisations, being aware of the carbon footprint of our activities is the beginning of managing the carbon implications of daily decisions. In the long term, voluntary carbon offsets are expected to be a transient mechanism as low carbon strategies become business as usual in the future (Molitor 2005).

The first step in addressing organisational carbon management as it applies to the ESSP and its people, projects and institutions is to analyse options to become less carbon intense, thereby having the same activity output with reduced carbon emissions. Only then does engaging in carbon offset options make a more fundamental contribution.

Setting an absolute target against a baseline improves the likelihood of making real reductions. Targets that are a percentage of ongoing emissions will increase with organisational growth but will not necessarily result in an absolute CO_2 reduction. Instead, an annual reduction of, for instance, 3.5 per cent against a set baseline will yield an 80 per cent reduction by 2050 even if the organisation grows. This is because the reductions are cumulative and the baseline does not increase with growth.

It is essential to allocate time and resources to plan the greatest real reductions possible through increased efficiencies before considering the purchase of carbon offsets. While offsetting emissions is appealing due to the simple nature of essentially purchasing a solution, it cannot negate the need to reduce overall emissions by increased higher carbon efficiency to activity output. This requires a change in individual and organisational culture and awareness that is integrated into daily operations.

Carbon offsets can become a significant component of the cultural change required, but it is important to place their effectiveness in the larger goal of achieving CO_2 atmospheric stabilisation. Even if every individual and institution were to decide to offset their carbon emissions for a few activities (e.g., travelling) and the energy emissions from entire buildings (e.g., electricity, heating and cooling systems) this would only contribute to reducing carbon emissions but not to achieving stabilisation. A large portion of the carbon footprint of activities and institutions is embodied in consumer products, the transport energy for goods and services, the carbon releases incurred in the production of our food and emissions from waste disposal. They are often not attributed to any particular activity partly because of the intrinsic difficulty in calculating them.

Finally, it should be noted that while we refer to carbon offsets, a number of other greenhouse gases (GHGs) produced by our activities have a significant global warming potential (GWP), such as oxides from the combustion of fossil fuel and methane from the decomposition of organic matter. Therefore, when possible, calculations of carbon offsets are calculated in tonnes CO_2 equivalent (tCO2-e), which uses the warming potential of CO_2 over 100 years as the unit, and are inclusive of all greenhouse gases. Methane (CH4), for example, has a GWP of 21 (see section 8.2.1).

3. Carbon emission efficiencies

The first place for reductions will be different for every ESSP component (people, research projects, offices, institutions, meetings) but efficiencies in energy use will be common to all. Initially there are options for reduced consumption through turning off power when not in use, adding timers to lights and office equipment, adjusting thermostats and shutting down computers at the end of the day. Building efficiency can be improved by increasing the energy efficiency of walls, ceilings and windows.

Switching to a renewable power provider will produce a clear reduction in emissions where it is available. However, if power is supplied from a coal fired plant, for example, 'offset' green power may be the only alternative to neutralise these emissions (see section 4.1.2).

Because the economic implications of changing power generation and consumption are far-reaching, the production of low or zero carbon emission energy is essentially connected to marketplace forces. Increased consumer demand for 'green' electricity may support the growth of renewable energy power plants unless that demand is served through the supply of offsets. The differences in the way that power is marketed have a significant effect on emissions avoidance due to changes in how the products are perceived (Markard & Truffer 2006).

Currently, consumer demand in Europe exceeds the number of clean energy products available so market forces are pushing the development of new, clean power generation. When the capacity of clean energy exceeds demand, it will begin to replace more polluting forms of power generation (Markard & Truffer 2006). While the carbon offset market can help speed the widespread adoption of clean energies when they are not yet economically attractive, policy initiatives are also needed to meet ambitious targets for clean energies.

3.1 Travel

Aviation is the greatest source of emissions for the ESSP, so travel poses the best opportunity for gains as well as the greatest challenge in making reductions. There is no doubt about the value of face-to-face communication, where nuance of understanding can be critical. In attempts to foster the cross-disciplinary development of ideas, immediate question and answer sessions are of invaluable benefit in advancing understanding and pursuing new ideas and directions. The benefits of informal discussions and impromptu comments are difficult to achieve in a structured conference call or video meeting. These are the challenges that any organisation will address as it re-evaluates choices in light of placing a value on avoided carbon emissions.

Planning for reduced carbon emissions from travelling requires a variety of strategies. Improvements can be obtained from the better scheduling of events, back-to-back meetings in the same location, the increased use of conference calls and video conferencing, particularly when dealing with small groups, and broadcasting to the web to reach larger audiences. In addition, using ground transport, where practical, makes a smaller contribution to emissions for the distance travelled.

3.2 Offices and institutions

Efficiency options for offices and institutions include an evaluation of lighting systems incorporating the use of smart activity detectors and the use of compact fluorescent light bulbs, the choice of a fuel efficient car fleet and a careful look at the management of cooling and heating systems.

Selecting new equipment for energy efficiency and calibrating it for low energy profiles offers small improvements increase as they multiply throughout the workplace. The construction of new buildings or extensions provides excellent opportunities to implement efficiency options which reduce the carbon footprint of institutions, including the incorporation of power generation and solar passive design. The building industry does not currently make these efficiencies standard practice, so there will be increased transaction costs in both design and construction.

While emission reductions can come from efficiencies in building design, fit-out and use, a smaller footprint is simply the best outcome. Using office space that is the right size for the operation is highly efficient and generally has clear cost benefits. This may require a shift in organisational culture as operational needs are assessed.

EXAMPLES OF OFFICE EMISSIONS SOURCES THAT NEED TO BE TARGETED FOR EMISSION REDUCTIONS

Direct emissions from…

- Combustion of fuel in boilers or furnaces that are owned by your organisation
- Generation of electricity, steam, or heat in equipment that is owned by your organisation
- Business travel in vehicles that are owned by your company, such as company cars
- Employee commuting in company-owned vehicles, such as a van pool or company car

Indirect emissions from…

- Generation of purchased electricity, steam, or heat
- Business travel in non-company-owned vehicles, such as rental cars, employee cars, trains and commercial planes
- Combustion of fuel in boilers or furnaces not owned by your organisation
- Employee commuting in vehicles not owned by your organisation, such as light rail, train, buses and employee cars
- Production or manufacture of materials and resources used by an office organisation, such as furniture, paper, equipment, toner cartridges etc.
- Incineration of office waste or decomposition in a landfill when the facilities are not owned by your organisation
- Outsourced activities such as shipping, courier services and printing services

Based on Working 9-5 on Climate Change: An Office Guide, WRI. 2002*

*World Resources Institute (WRI) is an environmental think-tank established in 1982.

Certified 'green' office buildings often have direct access to public transport. A green building incorporates design, construction and operations which reduce the negative impact of development on the environment and its occupants. Among the key criteria are energy efficiency, greenhouse gas emission abatement, water conservation, waste avoidance, reuse and recycling and pollution prevention, including noise, water, air, soil and light pollution (GBCA 2006).

3.3 Activities and products

The ESSP initiates meetings, conferences and seminars as well as publishes articles, brochures and reports which are periodically sent internationally. Aside from these specific events, the bulk of communication is through the web, so the ESSP accounts for relatively low emissions aside from travel and office use. Consumption demand for paper and manufactured goods contributes to the atmospheric emission load from deforestation. Minimising the use of these products is a valid strategy to reduce emissions overall.

Communication over the Internet, including electronic newsletters, is reducing the use of postal mail as well as providing an avenue for some reductions in meetings. In order for discrete projects, meetings and mail-outs to be evaluated for carbon reduction strategies and eventual offsets, the associated emissions are tracked from the planning stages. As this becomes a matter of practice, the systems will be in place and become less labour and time intensive.

4. Voluntary carbon offsets

A carbon offset is a project implemented specifically to reduce the level of greenhouse gases in the atmosphere and is a legitimate means of financing carbon reductions through regional and global projects. These reductions are quantified as carbon credits which can be bought to counterbalance or offset the purchaser's greenhouse gas emissions, making them effectively carbon neutral. While they are not currently regulated by an internationally agreed body, voluntary carbon offsets that follow one of the robust developing standards will comply with a number of basic criteria addressed through the Kyoto Protocol (see section 5). Credits used to meet policy and legal requirements are already offsetting emissions and cannot be double-counted as voluntary carbon offsets.

The voluntary offset market has developed alongside the compliance carbon market, where Europe and Japan have been the largest buyers and China the largest seller (Karan Capoor, Philippe Ambrosi 2006). Estimates in 2006 placed the regulated markets at $US21.5 billion and voluntary markets at about $US100 million for the first three quarters of 2006 (Hamilton et al., 2006). The greatest increase in purchases in the voluntary markets is from corporations with substantial footprints that are looking to minimise their risks ahead of possible regulation.

A carbon offset is best applied after reducing carbon emissions wherever possible (i.e., increased efficiency). Along with other specific criteria discussed in section 5, an offset is an initiative that provides reductions elsewhere which could not have happened without the revenue from the offset credit sale. For instance, purchasing cleaner electricity for an office or institution from a nearby wind farm is a reduction in emissions, not a carbon offset. If the electricity for the area is only supplied from, for example, a coal fired generation plant, subscription to a 'green power' option might make a contribution to the establishment of a carbon offset such as a new wind farm. This would provide additional low carbon power for someone else which would not have been economically possible otherwise. In this latter case, the atmospheric offset of the emissions may take place a few years later when the new wind farm is operational.

When offsets are purchased, one unit represents one tonne of CO_2 emissions avoided. All units are considered identical. In choosing an offset product to support, a distinction is being made in how that unit is achieved. As there are no allowances to be traded for voluntary offsets, the reductions are created through projects.

Offset projects fall into two general categories—avoided emissions and sequestration. The first category involves finding ways to accomplish tasks by using less fossil fuel, making fossil fuel less carbon intensive and switching to renewable fuels. The second category, sequestration offsets, involves capturing an equivalent amount of CO_2 from the atmosphere and storing it for a specified period.

4.1 Carbon emissions avoidance offsets

> "The cleanest, most sustainable kilowatt hour is the one not used."
> -Marianne Osterkorn, executive director, REEEP

Emissions avoidance is the most effective carbon management strategy over a multi-decadal timescale to achieve stabilisation and, ultimately, reductions of atmospheric CO_2. This avoids stable carbon deposits stored underground from entering either the atmosphere or the more labile carbon pools on land and in the oceans, which can be readily destabilised and returned to the atmosphere as CO_2.

4.1.1 Energy efficiencies: reduced energy consumption

Carbon offsets based on energy efficiency rely on technical efficiencies to reduce energy consumption and therefore lower CO_2 emissions. Such efficiencies are often achieved by introducing and distributing more energy efficient lightening, cooking, heating and cooling systems to those who cannot afford them. These are real emission reduction strategies and have created valid offset projects. For instances, in the UK, Climate Care offers carbon credits sourced from a project in Honduras where fuel efficient stoves replace open fires, reducing CO_2 emissions by an estimated 1.5 tonnes per household stove annually. This offset has the additional benefit of decreasing indoor pollution and improving health, particularly for women and children (Climate Care 2007). Other examples are providing free (or low cost) compact fluorescent bulbs for entire suburbs or cities in less developed countries or making available high efficiency rated refrigerators in areas where only old second-hand ones are available.

This type of carbon offset provides perhaps the simplest options that will ease the adoption of low carbon practices in regions where economically it would not be possible. When these practices become generally accepted, they will no longer qualify as offsets and further efficiencies will need to be promoted. A basic premise here is the ongoing improvement in practice that will guarantee a limited lifespan for many initiatives.

4.1.2 Renewable energy: displaced energy production

Emission avoidance projects that displace the production of high carbon intensity energy (e.g., coal power fired electricity generation) to low or zero emission energies (e.g., wind, solar, biofuel, fossil fuel energies with capture and storage) require a greater change in infrastructure and larger capital investments. Opportunities for carbon offset projects exist where the initial costs for transition to low or zero carbon energy make it unprofitable as an investment (at current energy prices). For instance, the implementation of renewable power generation avoids the emissions that would have been created in a traditional coal or gas fired power plant (although the former will still cause some emissions).

Some voluntary offset providers, such as Australia's Climate Friendly, source all projects from renewable energy generation, including wind, solar electric (PV), solar thermal, small-scale hydro (low-impact), geothermal, ecologically sound biomass, biogas, biofuels and landfill gas to energy (Climate Friendly 2007). Increasing renewable capacity has lasting effects by shifting the energy infrastructure to clean sources. This increases the expectation that power will be supplied renewably, although regulation is still needed to bring the change into the necessary timeframe (Markard & Truffer 2006). Fossil fuel power generation with capture and storage (e.g., zero emission coal fired power generation) is not yet available.

Offset projects can introduce changes that produce synergies in processes which create multiple benefits. The European provider Atmosfair sources some offsets from a project under development in Thailand, where for the past 25 years waste from palm oil production had been fermented and emissions released into the atmosphere. Now methane from the fermentation is captured to provide biofuel for the factory that produces it. This project improves water and air quality as well as provides an additional 10 local jobs. An emissions saving of 20,000 tonnes CO_2 per year over 10 years is expected to commence by the end of 2008 (Atmosfair 2007).

Biofuels are sourced from biomass, including recently living organisms and their by-products. Plant matter from timber, palm oil, sugar cane and soybeans are used as fuels along with by-products such as charcoal and dried dung. Municipal waste containing cellulose is an increasing source for ethanol production because of developments in conversion technology, lower feedstock costs and high potential for fossil fuel displacement (Kalogo et al. 2007). The greatest benefits are achieved where the fuel is generated from a waste product in its own right, sometimes referred to as second generation biofuel. Some first generation biofuels, such as ethanol from corn, when produced in the highly energy intensive agriculture in some parts of the US, may require as much energy input as the output energy achieved.

4.1.3 Fuel emission reductions: cleaner energy production

Traditionally, fossil fuel energy production facilities have been developed on a large scale where infrastructure remains in operation for multiple decades. This longevity allows scope for reducing the CO_2 emissions from ageing power plants. Because business considerations alone will be the greatest driver for these improvements to increase profitability, they provide fundamental reductions rather than offsets.

One option for emission reduction offsets is the improved disposal of waste methane. The projects capture (or convert) gases which would have been vented to the atmosphere more cheaply. The flaring converts methane (CH4) to CO_2, the latter with a much smaller global warming potential (GWP), which translates into real carbon offsets.

For instance, the Australian government Greenhouse Friendly program uses this practice to generate some of the offsets they provide for institutional product programs included in petroleum from BP and flights from Virgin Blue (Dept of Environment and Water Resources 2007).

Possible future changes in energy prices due to the associated cost of emitting carbon may make methane capture for power generation economically viable. At this point, flaring will become business as usual and will no longer work as a carbon offset.

4.2 Carbon sequestration offsets

Biosequestration offset projects create a reduction in atmospheric CO_2 concentration by growing vegetation that will store carbon in plants and soils equivalent to the amount of carbon intended to be offset.

Biological sinks on land through forestry and agriculture are the most common forms of biosequestration for carbon emissions, collectively under the name of land use, land use change and forestry (LULUCF) projects. The most widely available carbon offsets are afforestation and reforestation projects, although there is an increasing interest on ‘avoidance deforestation’ carbon credits and in projects that promote agricultural best practices that conserve or increase soil carbon.

In the case of avoided emissions, the projects need to demonstrate a change in the business-as-usual trends by decreasing deforestation rates or soil carbon lost in agricultural projects.

Biosequestration carbon offsets have the potential to bring multiple ancillary environmental and social benefits, such the establishment of long-term sustainable forestry industries, reduced erosion, the preservation of or increased biological diversity and improved hydrological regulation et cetera. For the same reasons, it may have unintended negative consequences, such as the use of limited water resources and biodiversity degradation if exotic species are planted in a monoculture et cetera. Thus, biosequestration carbon offset projects need to demonstrate a well integrated plan with other environmental resource uses and a framework for sustainable development.

Biosequestration as carbon offsets have other major issues which as a whole make this option less attractive over lower emission or renewable energy projects. Among these are concerns about the stability of biological carbon stores and, therefore, their likelihood to remain locked in biomass for many decades.

More recently there has been a rising concern about the net effect of the radiative forcing of forest plantations in mid and high latitudes. The net carbon balance of a plantation is undoubtedly beneficial to the stabilisation of atmospheric CO_2, although the ultimate intended benefit of carbon offset projects is to prevent additional climate change from a particular activity. Studies looking into the net balance of the radiative forcing of plantations outside tropical latitudes show that there is little or no benefit for the climate in planting trees (Bala et al. 2006). As such, they seriously question the validity of encouraging tree plantations as carbon offsets in boreal and temperate regions.

A report issued by the Royal Society in 2001, *The role of land carbon sinks in mitigating global climate change*, recommends that projects designed to enhance land carbon sinks not be allowed to divert resources from long-term reductions in the emissions of fossil fuel. They cited the relatively small amount of carbon that can be sequestered in relation to the quantity of CO_2 being emitted, the finite size and duration of potential carbon sequestration and the technical barriers to reliable monitoring of sequestration achieved (The Royal Society 2001). These issues have compelled many voluntary offset providers to reduce or remove forest offset projects from their offerings. Climate Care has moved from 20 per cent biosequestration offsets to only five per cent for 2006-07 (Climate Care 2007).

Finally, experiments into the limiting factors of ocean productivity have shown the potential for ocean carbon sequestration by fertilising with iron, one of the most limiting nutrients. Although carbon offset projects using biological ocean carbon sequestration are not yet offered, the likely large and unintended negative changes it produces in marine biodiversity and trophic interactions (Le Quere et al. 2004) make this option quite socially unacceptable.

5. Carbon offset criteria

A high quality carbon offset project should have at least the following three qualities. It must (i) be counted only once; (ii) be additional, transparent and verifiable; and (iii) avoid leakage, have permanence and be efficient. A detailed explanation of these different features is given in the following sections.

The criteria for a valid offset project have been developed concurrently with international negotiations through the Clean Development Mechanisms (CDM) of the UNFCCC. The CDM regulatory requirements combine economic, social and environmental benefits enabling industrialised countries to invest in potentially less expensive carbon reduction projects in developing countries. The voluntary standards that are currently being developed for carbon offset projects to ensure trading credibility and real atmospheric carbon reductions use features of the CDM as a common benchmark. Many carbon offset projects, however, may only be required to demonstrate a reduction of GHG emissions.

5.1 Additionality

While any reduction in carbon emissions might be seen as additional to the current practice, the requirement of additionality goes one step further. For offset projects a genuine reduction can only be counted if it is in addition to what would have been done in the normal social paradigm, be it for business profit or ongoing improvements.

It is important to distinguish between real and measurable emission reductions that might have happened anyway and to account for additional reductions resulting in offset credits. The yield and costs of renewable energy infrastructure, for instance, is heavily dependent on the site where the plant is constructed. An unfavourable site can contribute to the acceptance of the offset project if the funding is needed to make the installation function, satisfying the financial additionality criteria (Sven Bode & Axel Michaelowa 2001). This can have a perverse effect when developers search for an inefficient site in order to qualify for offset status.

For instance, Renewable Energy Certificates (RECs) were created to address the transition from fossil fuels where 1 REC equals 1 megawatt hour (MWh) of electricity generated from a renewable source. Because they were not developed as carbon offsets, they do not have to be new or additional and so may not decrease atmospheric CO_2 (Clean Air- Cool Planet 2006).

The assumptions needed to quantify offset benefits include a statement of expected outcomes if the project was not implemented. It is the difference between whether the project exists or not that defines the additional improvements accomplished. While accounting practice methodology is always open to error and manipulation unless it is transparent and independently verifiable, the difficulties here are the counterfactual nature of the 'what if' scenario. A project fails the test of additionality if the reduction would have taken place even if the offset funding had been absent.

The UNFCCC demonstrates and assesses additionality in CDM projects through:

- The identification of alternatives to the project activity
- Investment analysis to determine that the proposed project activity is not the most economically or financially attractive
- Barriers analysis
- Common practice analysis and
- The impact of registration of the proposed project activity as a CDM project activity (UNFCCC/CCNUCC 2005).

5.2 Leakage

The basic criteria of leakage refers to the displacement of emissions where offset projects may create carbon reductions in one place while increasing emissions from another source elsewhere, thus reducing the benefits gained.

Internally to the project, gains are reduced through the basic transaction costs of operating a project, such as fossil fuels consumption for the transport of staff, products and services; through changes of land use by the displacement of pre-project on croplands, grazing and fuel-wood collection activities; and through the diversion of investments (UNFCCC 2006a). These reductions need to be accounted for in the real estimate of project benefits.

Discrepancies arise where the leakage occurs outside the project boundaries and is not accounted for. It is difficult to attribute increased carbon emissions to a particular project when influences include other projects and changes in the broader economy. A classic example of leakage is when large reforestation plantations displace subsistence agriculture for native communities and lead to new deforestation elsewhere to compensate for the lost cropping area.

The accounting of early offset projects may well have underestimated the extent of leakage. In some cases, their documentation demonstrated confusion with fugitive emissions or physical leakage as well as simply reporting leakage as 'insignificant', 'negligible' or 'no potential source' (F.Voehringer et al. 2006).

5.3 Permanence

An effective emission reduction must be a permanent one. This is a significant hurdle for land use and forestry offsets, which by their nature often cannot be permanently secured. There are failures where trees do not deliver on the promised sequestration due to drought, unfavourable weather events and poor soil conditions and as well as where the unintended release of sequestered carbon occurs through wild fires and die-off from drought. Even if the risk of reversibility is minimised before verification and certification and a mechanism offers replacement or compensation for any reversal, there is the possibility that the benefits will be lost. While there are efforts to attach economic discounting to the value of impermanent reductions from the agricultural and forestry sectors, the impact on the atmosphere cannot be discounted. These factors add weight to the awareness that increasing climate impacts and emission caps will reduce the advantage of biosequestration as a mitigation strategy relative to emission reduction through technical change (Bruce A. McCarl 2001).

5.4 Verification

In the short history of carbon offsets, the spectres of false claims and unfulfilled promises have haunted the system. In reaction to this, there are a growing number of project standards which insist on the independent and transparent verification of reductions. Key accounting requirements are accurate and ongoing data recording and analysis and ensuring that reductions are counted only once (see section 8).

5.5 Efficiency

The value of an offset is increased by efficient operation, yielding the greatest benefit for the investment. In the marketplace, successful projects will yield real emission reductions with competitive costs. Financially efficient offset schemes demonstrate clear cost benefit attributes and can be compared with other offset schemes. This is useful to organisations operating in more than one country, which must evaluate offsets sourced from various providers.

5.6 Offset plus

The ancillary benefits of both biosequestration and energy sector emission reductions are difficult to quantify and remain secondary to GHG emission abatement in offset considerations. Where the additional benefits carry increased costs, an organisation may want to choose offsets which further their other goals as well. In efforts to keep these factors discrete from the CO_2 mitigation services, some providers are advocating a premium or plus category for carbon offsets.

Many benefits are inherent in the emission reductions alone. Avoided GHG emissions result in reductions of such pollutants as sulphur dioxide (SO_2) and nitrogen oxides (NO_X) as well as carbon monoxide (CO), volatile organic compounds (VOCs), particulate matter (PM) and ground-level ozone (O_3). This leads to human health benefits, such as avoided respiratory complications. Substantial agricultural benefits include increased soil fertility, crop yield and nutritional quality. Forestry projects can also yield positive effects by increased water regulation and quality, and reduced erosion and biodiversity conservation.

In addition to environmental and health benefits, some projects can provide additional societal and cultural benefits in the form of new opportunities for the livelihood of poor communities, the recovery of cultural values via agricultural practices and improved sustainable development through the financial benefits of carbon offset projects.

In the same way that the implementation of carbon offset projects can and is encouraged to bring additional benefits to those of climate mitigation, carbon offsets can also bring unintended negative impacts which must be avoided.

6. Project standards

The developing voluntary market is trialling a number of project standards to create a higher level of buyer certainty and improve the long-term viability of the projects. The uncertainties of regulatory structure and market forces make planning difficult for these long-term investments (Molitor 2005). Any commonly accepted standard has to be credible, financially efficient to administer and effective in the goal of reducing atmospheric CO_2. Because many self-developed standards used in the beginning of the voluntary offset market have failed in one or all of these criteria, there is considerable pressure from both suppliers and buyers for a common standard.

6.1 The International Organization for Standardization (ISO)

The ISO 14064 standards for greenhouse gas accounting and verification were published on 1 March 2006 (ISO 2006). While these standards were created to support emission reduction targets in the Kyoto Protocol, they can also apply to projects offered as voluntary offsets and have informed the development of other standards. Although their detailed reporting requirements can place a large administrative cost on projects, ISO standards are being used as a solid foundation for the formulation of other offset criteria, such as the Voluntary Carbon Standard.

6.2 The Gold Standard

Launched in 2003, the Gold Standard, sponsored by the Word Wildlife Fund, now WWF, is based on the UNFCCC CDM criteria in the Kyoto Protocol. It excludes LULUC projects and includes a sustainable development component. As with other UN inspired processes, the reporting requirements can be complex and costly, making the Gold Standard generally suitable for medium and large-scale projects.

A Voluntary Gold Standard, developed with the Carbon Trust, a UK government funded independent company, was introduced in May 2006. It has less extensive reporting, making it applicable for smaller scale activities with sustainability outcomes while still excluding LULUC (Pablo Ceppi 2006).

The UK Government Carbon Offsetting Fund (GCOF) is developing countrywide standards for offsets based on the Gold Standard. They support a portfolio of selected project types from within the CDM that is focused on those involving renewable energy and energy efficiency with high sustainable development benefits (DEFRA 2007). Any offset providers using the Gold Standard are considered by most organisations to have met stringent requirements.

6.3 Greenhouse Gases Protocol

The World Business Council for Sustainable Development and the World Resources Institute (WRI) prepared the GHG Protocol, which is essentially a project accounting and reporting framework used to support cap and trade projects for compliance to targets as well as CO_2 reduction projects including LULUC. First published in 2001, these standards underpin practices for the International Organization for Standardization (ISO), the EU Emissions Trading Scheme and the California Climate Registry as well as many businesses and organisations (GHG Protocol Initiative 2004).

6.4 The Voluntary Carbon Standard (VCS)

The Voluntary Carbon Standards were offered for comment in March 2006 by The Climate Group (TCG), the International Emissions Trading Association (IETA) and the World Economic Forum Global Greenhouse Register (WEF) in response to the need for greater integrity in the voluntary carbon market. As part of the standards, the Bank of New York has initiated a central registry for verified credits and will account for their retirement as they are sold. The standard will require the independent verification of claims to produce Voluntary Carbon Units (VCUs) that represent “real, quantifiable, additional and permanent project-based emission reductions” (IETA 2006). Version 2 is currently under review, with the final standards, using the ISO14064/65 series as a backbone, to be published in mid-2007.

6.5 Climate, Community and Biodiversity Standards (CCBS)

Developed by the Climate, Community and Biodiversity Alliance and released in 2005, these standards for LULUC offset projects aim to be a Gold Standard equivalent and have attracted a number of developers. Two projects, in China and Panama, went through independent audit for certification in February 2007. Criteria are applied to the design and identification of land management projects that minimise climate change, support sustainable development and conserve biodiversity. The projects range from agroforestry and bioenergy to reforestation and conservation (Taiyab 2006).

6.6 The Green-e GHG Emission Reduction Product Certification Program

In response to the growing demand for renewable energy credits (RECs) as carbon offsets, the Centre for Resource Solutions (CRS), which administers the Green-e program, is reviewing its renewable energy standards and has created a separate verification standard to qualify projects as carbon offsets. The proposed new standards are distinct from the current Green-e offerings and address criteria for additionality, the avoidance of double-counting and quality assurance. Version 2.0 became available for stakeholder comment on 17 April, 2007 (Green-e 2007).

7. Carbon offset providers

Offset providers form a vital link in carbon reductions by selling large and small amounts of carbon offsets or credits to individuals and organisations. They act as brokers between the projects and cap and trade programs, which create emission reductions, and the end users, who pay to retire the emission credits issued. Provider credibility underpins market confidence and contributes to the stability and growth of the voluntary offset mechanism.

While it is important to understand the concepts behind becoming carbon neutral by reducing and then offsetting emissions, informed organisations and individuals will generally buy from reliable providers who source offsets from a number of certified projects. Effectively, the purchased carbon market investments express their profitability through authentic carbon emission reductions, contributing to slowing down CO_2 emission rates.

Offset providers are agents whose major concerns are selecting and supporting projects and selling certifiable offset credits. Their significant stake in reputation and profitability depends on projects that deliver as promised. This has led many providers to call for, and contribute to, the development of stringent common standards.

There are greatly differing cost and credibility levels on offer, making easy customer access to transparent reporting one simple test for selection. This has proved a problem with the Chicago Climate Exchange (CCX), which provided an important service in the US by starting an early voluntary market. Due to their reluctance to provide detailed project information and their use of RECs, some providers no longer source credits from the CCX.

Along with selling emissions offsets, many providers use a marketing approach to differentiate themselves by including environmental and social benefits. This allows individuals and institutions to make additional positive contributions and support outcomes aligned with their core beliefs. However, the certain positive net effect on atmospheric CO_2 should remain the primary consideration for selecting an offset provider.

Based on the criteria described in section 5, provided below is a sample of carbon offset providers who use some of the most stringent standards and therefore are most likely to deliver the intended results with the purchase of carbon offsets. The GCP has no association with any of these providers, which have been selected exclusively as examples.

Atmosfair http://www.atmosfair.de/index.php?id=9&L=3
Atmosfair was formed in 2003 by a consortium of tour operators and travel agencies along with the NGO Germanwatch. It focuses on offsetting air travel using a carbon calculator that takes into account more detail than most others, including what proportion of the trip occurs at low and high altitudes. All offsets involve energy reduction and fuel substitution sourced from CDM projects, therefore meeting the Gold Standard.

Climate Friendly http://www.climatefriendly.com
Climate Friendly was formed in 2004 in Australia as a for-profit business offering calculators for air and car travel as well as location specific calculators for electricity use in dozens of countries. Offset projects are sourced from CDM, Gold Standard wind farms and new Australian Accredited renewable energy,

Climate Care http://www.climatecare.org
Climate Care is a for-profit business formed in 1998 in the UK. It maintains a diverse portfolio of independently verified offsets, 80 per cent of which are energy efficiency or sustainable energy projects. It has contributed to the development of Voluntary Gold Standards, which it uses in its own projects.

My Climate (Swiss) http://www.myclimate.org/index.php?lang=en
My Climate started in 2002 as an initiative of the Climate Protection Partnership In Switzerland. Its offsets come from Gold Standard renewable energy and energy efficient technology projects.

My Climate (US) http://www.my-climate.com/
My Climate partnered with Sustainable Travel International in the US to provide offsets that are CDM Gold Standard or Green-e certified using only energy reduction and efficiency projects in developing countries.

Native Energy http://www.nativeenergy.com/
Native Energy was founded in 2000 as a private company with American Plains Indian tribes as majority shareholders. All projects are new renewable energy production certified by Green-e.

8. Calculating carbon emissions

To measure success in any carbon efficiency project or purchase carbon offsets, one needs to calculate the carbon emissions of the activities to be made carbon neutral. This allows the greatest gains to be identified and clear operational boundaries to be set (i.e., where an institution or individual should take responsibility for the associated carbon footprint from activities and services). Although this is voluntary, it is important that clear boundaries be set from the beginning so that targets can be achieved.

Energy use from fossil fuels for buildings and transportation is the greatest single source of anthropogenic CO_2 emissions. Calculation methods to determine the climate impact of activities focus on megawatt hours of electricity consumed for stationary energy production and distance travelled for transport. These simple inputs yield a variety of results, however, depending on the calculation parameters. One of the criteria in selecting an offset provider is that their calculators are reliable, accurate and relatively transparent.

The most common publicly available carbon calculators are online aviation impact tools. Because they apply to a particular flight which is a discreet event, they set their own boundaries and are relatively simple to use. For impacts other than transport, the amount of energy used becomes the input. Calculations of tonnes of carbon dioxide equivalent (tCO_2-e) for an event are estimated in kilowatt hours per day multiplied by an emissions factor for energy generation in that country.

In *Working 9-5 on Climate Change: An Office Guide*, the World Resources Institute (WRI) provides detailed and practical advice, starting with the appointment of a responsible person, the apportioning of resources, the explicit support of senior management to undertake an assessment of the carbon footprint and opportunities for reducing it. WRI determined that 50 per cent of its emissions in 2001 came from electricity use followed by 30 per cent from air travel and the rest from employee commuting and paper use (Pino 2002). (See section 9.3 for the carbon budget of the GCP for 2006.)

Basic guidelines for preparing a CO_2 inventory include deciding what is most relevant to core operations; undertaking a complete audit to justify why emissions are or are not included, being consistent so that there can be comparisons over time; making the process transparent by noting methodologies and important assumptions; and using the most precise calculations available.

8.1 Boundaries

Direct and *indirect* emissions have to be clarified to define the boundaries that mark any particular carbon footprint. It is simple to see the immediate result of our actions in air miles and electricity used, but where do we stop counting? If we account for the carbon costs of shipping 100 kilograms of brochures from Australia to the UK, should we also count the production costs in printing and paper or is that the responsibility of the publisher?

The operational boundary for *direct* emissions as recommended in ISO 14064 is defined by what we own or control which contributes to our direct responsibilities and benefits (e.g., company cars). We would have direct control over their selection, purchase, maintenance and usage patterns. *Indirect* emissions come from sources used for our benefit but controlled by others (Pino 2002), including purchased electricity, commercial air travel and taxi use.

As an organisation that does not own company vehicles or combustion heaters, the GCP, for example, accounts for no *direct* emissions. GCP hosted meetings and workshops have *indirect* emissions from travel, electricity and heating at venues, hotel accommodation, waste processing and local transportation while its offices account for staff travel, heating and cooling systems, waste processing and water usage and exclude staff commuting.

Boundaries are important to avoid the double-counting of emissions and reductions as well as to include otherwise unaccounted for parts of the total carbon footprint. This is another area where commonly agreed methodologies can provide some assurance of standard practices. As funding for reducing carbon footprints and buying offsets becomes integrated into project accounting, common practices are needed for international implementation.

8.2 Calculation parameters

In order to be a useful global framework, carbon calculators need to be reliable, transparent and consistent in their application. Fundamental principles incorporated in the models include global warming potential (GWP) and radiative forcing (RF). The IPCC *2006 Guidelines* provide worksheets to assist with the transparent application of the most basic, or Tier 1, estimation methodology (Rypdal; et al. 2006).

Many air travel calculators are available on the Internet and produce widely different results (see section 8.2.3). Online calculation tools from the Greenhouse Gases (GHG) Protocol (see section 6.3) have been set up to determine emissions per kilowatt hour for electricity consumption (http://www.ghgprotocol.org), and Climate Friendly is one of the offset providers who have developed a CO_2 emission calculation tool which can be used for meetings and events (http://www.climatefriendly.com). How closely any tool can model actual emissions depends on initial assumptions as much as the accuracy of the inputs. By basing calculation development on agreed standards such as the GHG Protocol and using a limited number of calculators, there can be consistency across organisations and over time, allowing for improvements to be applied uniformly as they develop.

8.2.1 Global warming potential

Global warming potentials (GWPs) are used to compare the heat trapping abilities of different atmospheric greenhouse gases. GWPs use carbon dioxide (CO_2) as a reference point (GWP value of 1) by comparing the radiative efficiency or heat-absorbing ability of each gas relative to CO_2, as well as the decay rate of each gas (the amount removed from the atmosphere over a given number of years) relative to that of CO_2. The GWP is the conversion factor for emissions of various gases into a common measure, which allows us to compile the radiative impacts of greenhouse gases into a single measure shown in tonnes of carbon dioxide tCO_2 or carbon dioxide equivalents (tCO_2-e).

In order to have a common method for comparison, the Kyoto Protocol requires that IPCC Second Assessment (IPCC 1995) values be used, although revised values have since been published (IPCC 2004).

8.2.2 Radiative forcing (RF)

The emissions of greenhouse gases alone do not account for the full impact of a particular activity on global warming. For air travel we have a host of gases emitted during taxying, takeoff, flight and landing as well as the emission of aerosols and stratospheric water vapour. These further affect the balance of heat remaining in the atmosphere through other mechanisms such as changes in albedo.

RF is a measure of the influence that a factor has in altering the balance of incoming and outgoing energy in the Earth-atmosphere system and is an index of the importance of the factor as a potential climate change mechanism. Positive forcing tends to warm the surface while negative forcing tends to cool it.

To estimate the impact of aircraft fleets on climate, the IPCC chose a single measure of climate change: radiative forcing (RF, or CO_2RF). This is calculated directly from changes in greenhouse gases, aerosols and clouds, allowing the comparison of climate impacts from different aviation scenarios (IPCC 1999).

The application of the Radiative Forcing Index (RFI) will vary with the intended purpose of the information. To examine aviation's relative contribution to radiative forcing in 2004, a UK study assigned a value of 3 for travel above 30,000 feet over and above the effect of CO_2 alone. In effect, this meant an RFI of 2.9 for the sample as a whole (Brand 2006). The IPCC recommends using an RFI of 2.7 with an allowable range from two to four times the actual emissions (IPCC 1999).

8.2.3 Calculation result variance

Focusing on calculations for air travel, the impact of flight activity is not calculated consistently between airlines and offset providers. With the implementation of a comprehensive government policy of emission reduction in the UK they are recommending set procedures that will fulfil their requirements. The proposed voluntary standards aim to include mechanisms for accurately calculating the emissions to be offset, using the database of government-agreed carbon emissions and factors (DEFRA 2007).

Calculating the offset needed for a return flight using several online carbon offset calculators yielded as much as three times the difference between the highest and lowest values (Table 1 and Figure 1). These variations are the result of differences in methodology. For example, incorporating flight length in the calculations and apportioning the take-off and landing load yields a higher value per kilometre for short flights and creates one variable. The value selected for the radiative forcing index can also be between two and four and comply with IPCC guidelines, although an RFI of 2.7 is recommended.

Table 1 Flight emission calculator results in tonnes CO2-e (as per January 2007)

Provider Calculator	Beijing (PEK) to Sydney (SYD) Return 17,900km*	Toronto (YYZ) to Los Angeles (LAX) Return 4,240 km*	London (LHR) to Paris (ORY) Return 730km*
Atmosfair	5.94	2.02	0.14
Climate Friendly	5.32	2.08	0.3
Ben & Jerry's My Climate	4.6	1.75	0.25
My Climate	3.42	1.35	0.16
Climate Care	2.58	0.76	0.11
TerraPass	1.97	0.77	0.13
*Distances calculated through www.webflyer.com			

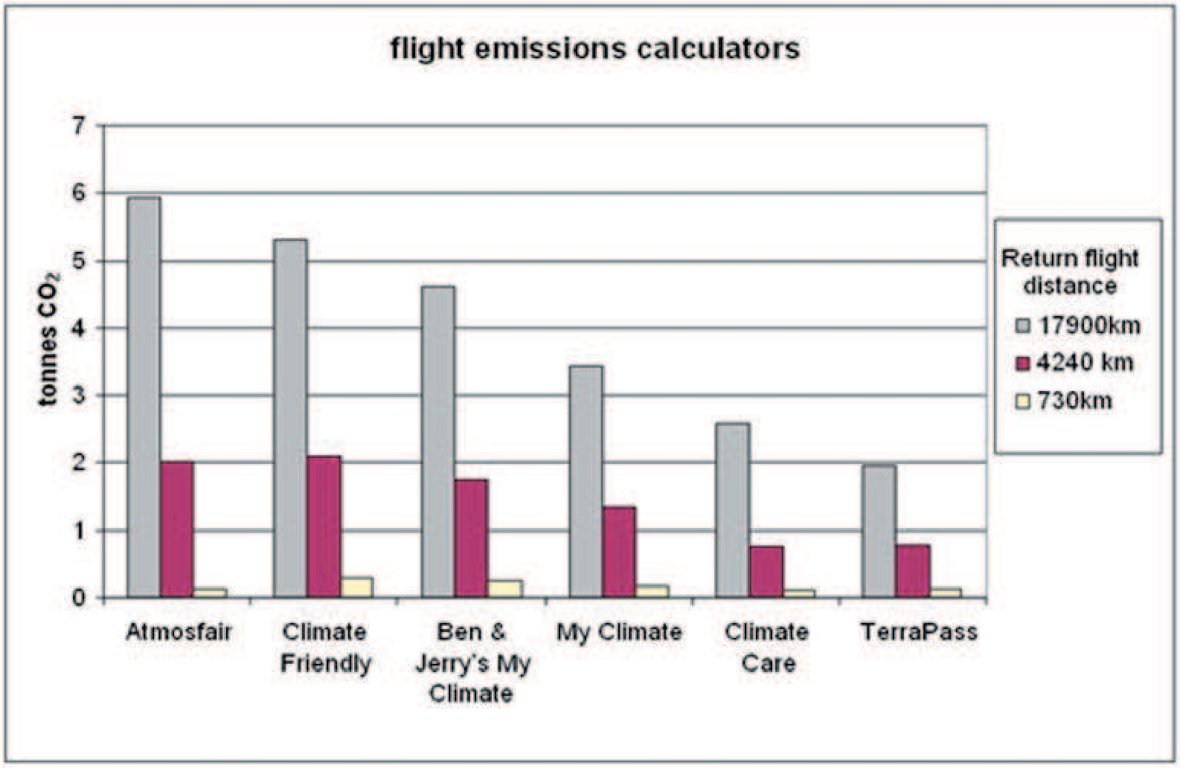

Figure 1 Flight emission calculator results in tonnes CO2e (as per January 2007).

9. The GCP carbon neutral program

In 2006, the Global Carbon Project undertook an emissions evaluation program in order to move towards a smaller carbon footprint and to become carbon neutral by 2008. The steps involved were (i) to identify the boundaries for emission responsibility (see figure 2) in order to set a baseline for reporting (section 9.1), (ii) to identify opportunities for reductions and implementing them (section 9.2), (iii) to choose a methodology to determine the resulting emissions (section 9.3) and (iv) to select verified offsets to neutralise an agreed amount of emissions (section 9.4).

An inventory of activities was completed after boundaries were set defining the extent of emissions responsibility and calculations were set up to approximate the tonnes of CO_2 equivalent impact. An offset provider was selected and their online calculators for air travel and electricity impact were applied throughout the audit both for emissions and offset costs. The activities, impacts and offset costs were analysed and offsets were purchased where funding could be allocated. The process was reviewed to inform GCP procedures to integrate carbon neutral practices into future proposals and budgets.

9.1 GCP boundaries

The GCP has no assets included in the operational boundary for *direct* emissions (what is owned or controlled which contributes to direct responsibilities and benefits, such as company cars). The GCP footprint is made up of *indirect* emissions that come from sources used for its benefit but controlled by others (see section 8.1).

The simplest, most commonly accepted and functional delineation of emission boundaries follows the lines of financial responsibility. The GCP identified four general categories of activities (Figure 2): (i) *core operations*, (ii) *hosted workshops* and *conferences*, (iii) *invitations to attend meetings* and (iv) *endorsed events*. The carbon footprint is counted wherever the GCP has control of funding for the activity

(i) *Core operations* include maintaining offices in Canberra, Australia and Tskuba, Japan; organising and attending SSC and executive committee meetings; creating funding partnerships; establishing new project activities and research networks; and participation in the publication process. The emissions for these activities are included when they are a GCP expense. For the purpose of this audit, the GCP affiliated and liaison offices in Beijing (China), Jena (Germany) and Washington D.C. (USA) were not included.

(ii) *Hosted workshops and conferences* are events for which the GCP is organisationally and financially responsible. Emissions include those resulting from the consumption of energy in the meeting venue and travel for participants covered by the GCP. Observers or guests who are funded by other organisations are not the responsibility of the GCP. The responsibility for co-organized events is proportional to the organisational and financial responsibilities of the various co-sponsors.

(iii) *Invitations to attend meetings* are defined as invitations to attend meetings organised and paid for by organisations other than the GCP. In responding to invitations, consistent with the aims of the GCP, the footprint of the event (including travel) is considered the responsibility of the host organisation and, therefore, has no impact on the GCP's carbon footprint. The GCP will, however, request that carbon offsets be arranged for such impacts.

(iv) *GCP endorsed events* which are hosted by other organisations and involve no funding from the GCP are not considered the GCP's responsibility. If the GCP supports the participation of a few individuals, the GCP is responsible for the travel emissions of those participants. However, it is the GCP's responsibility to inform the organisers that it expects all endorsed events to be carbon neutral through reductions and credible offsets.

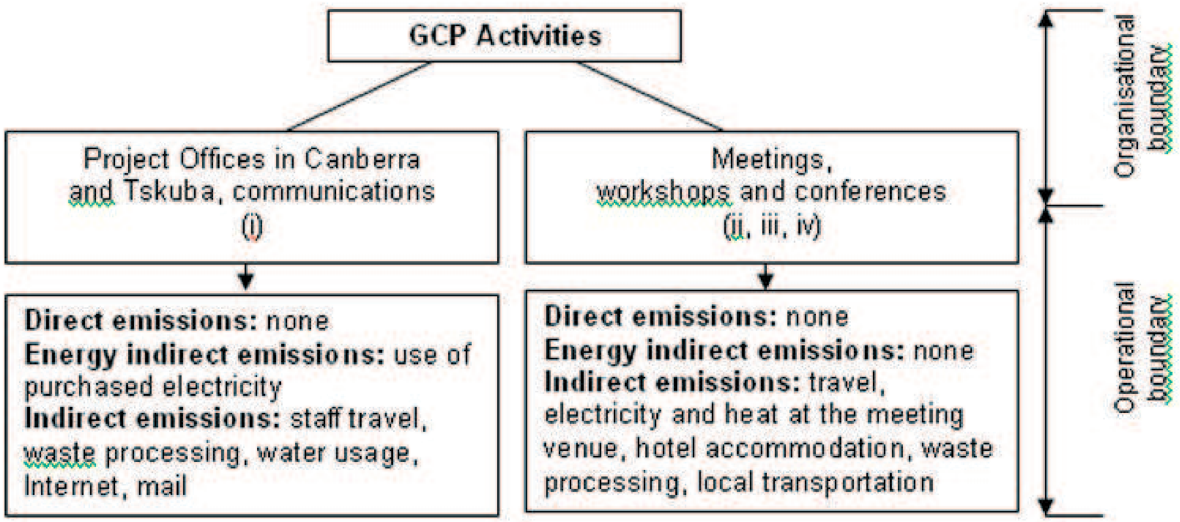

Figure 2. Emissions for which the GCP takes responsibility, modelled after UNFCCC (UNFCCC 2006b). The GCP footprint is made up of indirect emissions which come from sources used for the GCP's benefit but controlled by others. Excluded are office staff commuting, conference meals and incidental transportation.

9.2 Reductions

Although basic awareness was already high in office energy savings, the GCP took more office equipment off standby (e.g., computers are shut down or hibernated), used less lighting and purchased furniture with a low impact lifecycle. The GCP office in Japan is situated in the National Institute for Environmental Studies (NIES), which has made a co-ordinated effort to reduce energy usage through efficiencies and usage changes. In the most recent figures available, NIES energy use for 2005 showed a 15 per cent real reduction against the base year of 2001 even though there was an increase in floor space across the institution. This reduction applied directly to the offices occupied by the GCP.

CSIRO Marine and Atmospheric Research, where the GCP office is hosted in Canberra, has initiated a sustainability program that includes an energy audit to reduce the carbon footprint of the division and the leasing of more fuel efficient cars.

Reducing building energy use in GCP's Tsukuba International Project office

GCP's Tsukuba International Project office has a dedicated room inside the Climate Change Research Hall of the National Institute for Environmental Studies, Japan. This three-story building with 4,900 square metres of floor space and a ferroconcrete structure employs state-of-the-art measures for energy efficiency, heating and cooling systems. It aims to be a showcase and test site for various new building technologies. Some of the technologies that GCP Tsukuba International Office enjoys are:

- Building architecture: The building is oriented to make maximum use of façades, wind direction and natural lighting. It is also designed to make maximum use of natural and cross-ventilation and this is integrated to the heating and cooling (HVAC) system. The fenestration (arrangement of windows in the walls) is designed to reduce energy consumption. Roof planting and solar panels are integrated in the roof and high albedo paints are used in the building.
- Lighting system: The lighting system is controlled with sensors and provides real-time variations in the intensity of the 32-watt compact florescent lamps, reflecting the natural lighting condition outside. These sensors maintain 700 lux in the room all the times. Studies show that, in a no-control case, 30 per cent of energy was saved.
- Smart glass: The fenestration utilises a combination of autonomous response thermotropic glass (changing colour from clear to opaque), solar-shading low-e glass, a cavity between glass panels, or double glazing, and canopies. Together, the auto shading glass, building architecture, high albedo paints, balcony and solar orientation create a situation favourable for brighter day lighting with less heat transfer in the warmer months.
- An optimised and efficient HVAC system
- Maintaining a larger temperature range between 28ºC in summer and 19ºC in winter following the 'Warm-biz' and 'Cool-biz' campaign initiated by the Japanese Ministry of Environment.

Efficiencies in travel emissions were achieved through:

(i) The co-location and coordinated scheduling of meetings.

(ii) Stricter procedures to assess the benefits to the GCP and ESSP and to the larger goals of the carbon climate community to attend non-core or non-essential meetings. While a number of GCP staff remain committed to providing presentations at meetings, they continue to reduce the total number of trips taken every year.

(iii) The executive committee and directors of the offices in Canberra and Tsukuba are tightly coordinated to maximise the GCP's reach. At the same time they aim to minimise unnecessary overlap or redundancy in their work.

9.3 Calculations

Carbon impacts are calculated through both transport and energy use but are reported for attribution purposes in terms of activities accomplished and program responsibility. In the GCP case, these categories were core operations and hosted workshops and conferences. The calculations include aviation, car and rail transport and energy use in offices, meeting venues and accommodation.

To keep results consistent, only calculators from Climate Friendly (http://www.climatefriendly.com) were used. However, there are other appropriate and functional calculators available. The selection was based on full radiative forcing in air travel, online factors to convert megawatt hour (MWh) to tCO_2-e impact for many countries as well as simple hotel and venue formulas for events.

Air travel calculations were simple from major destinations but became more complex for more remote areas. For example, to compute travel in remote areas of Indonesia, Malaysia and Thailand, the 'see other cities near…' section of the time and date website (http://www.timeanddate.com/worldclock/city.html?n=583) was used to record flight distances.

For simplicity, if the individual details were not known, accommodation was counted for the event plus one day for departure, and flights were calculated from the participants' recorded place of residence. Based on an audit completed at a Gold Coast hotel, Climate Friendly recommend apportioning 25 kilowatt hours per person per day at a conference venue and 20 kilowatt hours per person per night for accommodation, allowing for all shared facilities. The CO_2 impact was then calculated online using the factors established for that country.

Both GCP offices consume 25 kilowatt hours per person per day, or the equivalent of a medium residential unit (Climate Friendly 2007). While this is high for the amount of space occupied, it includes an allowance for substantial common areas and facilities in a heated and air-conditioned building. According to the Climate Friendly online calculator for energy use, the substantial use of hydropower generation in Japan means that the office at NIES accounts for only 4 tCO_2-e while the same power usage yields approximately 9 tCO_2-e per annum in the Australian Capital Territory, where electricity is delivered from a coal fired power station.

In 2006, the energy consumption by GCP in offices and meeting venues was 59.2 megawatt hours. Staff travel amounted to 1,070,265 kilometres, which is equivalent to going around the world more than 26 times. Communication and energy embedded in other products added a relatively insignificant amount of energy use. The combined activity emitted 361.9 tCO_2-e. Core activity was responsible for 130.3 tCO_2-e, and workshops and meetings accounted for 231.6 tCO_2-e. Travel accounted for 89 per cent of all GCP emissions.

Table 2. Inventory of greenhouse gas emissions (tCO_2-e) for all GCP activities during 2006

GCP Core Operations	Use	Full warming impact (tCO_2-e) TRAVEL	Full warming impact (tCO_2-e) ENERGY	Offset cost Climate Friendly ($A)
Canberra Office - Mwh @ 25kwh/ day	9.1	0.0	9.0	327.15
Tskuba Office - Mwh @ 25kwh/ day	9.1	0.0	4.0	272.15
Incidentals from consumables, waste disposal, printing and posting -nominal value		0.0	0.5	20.73
Travel accommodation - Mwh	2.7		1.4	85.02
Transport aviation - km	247,496	64.7		1,694.22
Transport rail - km	400	0.1	0.0	3.46
Transport car - km	2,000	0.6	0.0	24.19
SSC annual meeting - supported aviation - km	153,420	48.6		1,067.79
SSC annual meeting - accommodation energy use - Mwh @ 20kwh/ day	0.9	0.0	0.5	27.58
SSC annual meeting - venue energy use -Mwh @ 25kwh/ day	1.5	0.0	0.9	47.01
Subtotal		**114.0**	**16.3**	**3,569.30**
[1]GCP Hosted Wks and Confer.				
Venue energy use - 25kwh/ day	29.1	0.0	20.4	949.58
Supported Accommodation energy use - 20kwh/ day	6.4		4.1	204.37
transport car - km	700	0.2	0.0	8.10
GCP aviation - km	194,356	57.9	0.0	1,356.32
Supported presenters aviation - km	471,893	144.8	0.0	3,196.53
Subtotal		**202.9**	**24.5**	**5,714.90**
Invitations to Attend Meetings (hosted by others)		0.0	0.0	0.0
[2]**GCP Endorsed Events** (supported participants)		**4.2**	**0.0**	**91.74**
Total		**321.1**	**40.8**	**9,284.20**

GCP 2006
FULL WARMING IMPACT (tCO_2-e) 361.9

[1]Nine workshops (Australia, Indonesia, Japan, Taiwan, USA) and one conference (Mexico)
[2]Five workshops: (Austria, Indonesia, Kenya, USA) and two conferences (China, Greece)

9.4 Offsets

Offsets were selected on the basis that they provided the best possibility of real reductions in atmospheric carbon dioxide through the displacement of fossil fuel CO_2 emissions. These were selected from Climate Friendly, an offset provider using a Gold Standard wind farm project in New Zealand and 100 per cent accredited new and renewable energy in Australia. After investigating several factors, this provider was chosen from a number of potential options.

The selection was based on clear online calculations, the incorporation of full radiative forcing of the emissions to be offset and a freely available independent audit of the provider's claims (Crawford-Smith 2006). The Climate Friendly website encouraged reduction before offsetting and offered background information on emissions and climate. Climate Friendly provides documentation on accountability and the use of funds as well as links to external sites verifying project claims. Their staffs were responsive to inquiries and provided additional information on request.

For 2006, the GCP purchased offsets equivalent to the footprint of its core operations, or 130.3 tCO_2-e (see table 2) where 87 per cent of emissions are attributed to aviation and 10 per cent to office energy. Sponsored events in 2006 did not include a budget for offsets so were not included. This highlights the importance of integrated financial planning in successfully becoming carbon neutral.

9.5 GCP case study discussion

Many steps that integrate the consideration of carbon emission reductions also produce cost reductions and so have already been incorporated in basic GCP systems. Because air travel was confirmed as the greatest single emissions source, new opportunities for significant reductions will have to be found in managing travel. For the Global Carbon Project this highlights complex issues of value for resources, geographic equity in a global community and overcoming barriers to encourage research synthesis.

Ascribing responsibility for emissions and so for funding offsets to those financially responsible for the source proved a workable principle, grounded in recommendations from the Greenhouse Gas Protocol (see section 6.3) and World Resources Institute. Current reporting is facilitated because the inputs are being recorded as they happen in travel, accommodation and workshop management.

10. Conclusions

The basic goal of the voluntary carbon market is to reduce atmospheric CO_2 and slow climate change. While there is some danger of losing sight of this fundamental aim, as the economic analysis of the carbon market gains a wider audience and more speculative investors support it, robust standards, reporting and verification coupled with broad project implementation offer a credible step forward.

Purchasing carbon offsets should only be seen as a second step after other measures to reduce or avoid emissions have been thoroughly explored and acted upon.

When purchasing carbon offsets, choosing less secure or temporary reductions for a lower price per tonne can have the double difficulty of under-funding projects that create real reductions as well as possibly sequestering carbon in sinks vulnerable to unintended release at a later date. Investment in initiatives with the highest direct outcomes for the atmosphere will yield the greatest returns.

While there are currently a number of competing standards for voluntary offsets, verification has proven to be a step in the offset process that cannot be missed. The creativity and flexibility fostered by the initial open-ended and innovative system is contributing to the growing maturity and balance the offset market is developing through agreed measures and milestones.

Municipal, regional and federal governments around the world are adopting carbon management practices for mitigation in front of the necessary climate change strategies to deal with impacts. This is evident in the UK, where initiatives, studies and pilot projects are widely available to use as starting points. The UK's current development of voluntary standards which will receive government approval for funding support the adoption of a similar strategy within organisations (DEFRA 2007) to nominate preferred offset criteria while allow freedom to choose within that structure.

As with any investment, financial support has broader implications for communities, ecosystems and development than the initial purpose intended. As long as carbon offsets actually yield the required level of emission reduction, there are real benefits to selecting projects based on additional sustainable economic, social and environmental outcomes reflecting the values of the individual and the organisation.

There are concerns about the possible effect of allowing more developed nations to continue with carbon-intensive activities while poorer countries experience the most immediate climate change effects. Financial resources are concentrated, however, in the most developed countries. Directing these funds through the carbon offset market to emission reduction research, development and implementation can contribute to a low-carbon global economy.

The following conclusions can be drawn from this case study:

1. Buying carbon offsets for particular activities (e.g., travel) is an important early step towards a cultural change reflecting responsibility for the carbon climate consequences of our activities.

2. Although becoming 'carbon neutral' is used as shorthand, the real intended effect is to become neutral in relation to the net radiative balance. This requires emissions calculations from our activities to include other greenhouse gases and, when possible, a consideration of the full radiative forcing that reflects other physical parameters, such as albedo from forest canopies and plane contrails. Choosing

particular activities or institutions.

3. Clearly defined organisational and operational boundaries set meaningful limits of responsibility in efforts to become carbon neutral or make individual activities carbon neutral. They also help track progress from a baseline.

4. Reducing the carbon footprint of our activities begins with becoming more energy efficient in the workplace and then making the processes used to achieve the required work outputs more efficient. This can include, firstly, using more efficient lighting, cooling-heating systems and, secondly, substituting some face-to-face meetings with conference calls, webcams, video conferencing and web streaming and dematerialising communications away from paper based systems.

5. Purchasing 100 per cent truly new renewable electricity (which is not always the same as 'green energy') for research institutions, where available, is one of the easiest and most effective ways to move towards reduced carbon footprints for offices and institutions.

6. The best long-term carbon offset projects are the ones that avoid carbon emissions in the first place through investment in low carbon or clean energies to replace high carbon energy. Purchasing offsets used to finance, for example, a wind farm where a fossil fuel based plant would have been the most likely choice yields the highest benefits for carbon offset investment.

7. Carbon offsets that rely on carbon sequestration in plants and soils are less effective in the long term because they are susceptible to productivity crashes and the impacts of major disturbances (e.g., fire). However, reforestation, afforestation and revegetation can have other additional environmental and social benefits that offset buyers may decide to favour.

8. Forest plantations in boreal and mid-latitudes are discouraged as a primary source of carbon offsets because of their likely limited effect on the net radiative balance. In contrast, reforestation and avoided deforestation in the tropics are efficient and cost effective ways to reduce carbon emissions.

9. Choosing offset projects with stringent standards will ensure the projects meet the minimum requirements to achieve the intended outcome: to make a specific project or institution carbon neutral. The stringent standards are: the Gold Standard, Greenhouse Gases Protocol, the International Organization for Standardization (ISO) ISO14064, the Voluntary Carbon Standard (VCS), and Climate, Community and Biodiversity Standards (CCBS). These standards are designed to ensure additionality, no leakage and permanency and that the offset is verifiable and will minimise unintended negative consequences to the environment, society and culture.

10. Buying carbon credits from internationally recognised carbon trading markets such as the European Union Emission Trading Scheme (EU ETS) ensures the most stringent standards through the UNFFCC and guarantees that purchased carbon credits will not be released to the atmosphere. Voluntary offset providers applying stringent standards also have the opportunity to develop credible projects in addition to those from compliance processes.

11. The cost for CO_2 emission reduction and the purchase of offsets need to be factored

into project costs from the planning phase through incorporation in a similar manner to all other expenses. This integrates carbon considerations into basic planning by streamlining the process and apportioning costs to activities which encourage efficiencies first.

12. As an illustration of the various methodologies and parameters described in this report, it was estimated that in 2006 the GCP was responsible for a total of 361.9 tonnes of CO_2-equivalents, 40.8 tCO_2-e in building energy use and 321.1 tCO_2-e in travel. This amount has been partitioned into core activities (130.3 tCO_2-e), hosted workshops (227.4 tCO2-e) and endorsed workshops (4.2 tCO_2-e). Travel accounted for 89 per cent of all GCP emissions. For 2006, the GCP retrospectively offset carbon emissions from core activities (130.3 tCO_2-e) at a cost of $US2,933.25.

14. The GCP has launched a zero net carbon emissions initiative by which all its core activities (retrospectively from January 2006) will be carbon neutral. It has set a goal to become CARBON NEUTRAL for ALL its activities by 2008.

11. Web links

These external web links, current at the time of this report's issue, are included for information purposes and do not reflect an endorsement by the Global Carbon Project.

Atmosfair	http://www.atmosfair.de
Business for Social responsibility	http://www.bsr.org
Carbon Balance and Management Journal	http://www.cbmjournal.com/home/
Carbon Finance	http://www.carbon-financeonline.com
Carbon Trust	http://www.carbontrust.co.uk
CDM Gold Standard	http://www.cdmgoldstandard.org/
Clean Air-Cool planet	http://www.cleanair-coolplanet.org
Climate Care	http://www.climatecare.org
Climate Friendly	http://www.climatefriendly.com
Climate Wedge	http://www.climatewedge.com/company.html
David Suzuki Foundation	http://www.davidsuzuki.org/Climate_Change/What_You_Can_Do/carbon_neutral.asp
DEFRA Offsetting	http://www.defra.gov.uk/environment/climate change/uk/carbonoffset/index.htm
Green-e greenhouse gas reduction	http://www.green-e.org/getcert_ghg.shtml
Greenhouse Gas Protocol initiative	http://www.ghgprotocol.org
Intergovernmental Panel on Climate Change	http://www.ipcc.ch
International Emissions Trading Assoc.	http://www.ieta.org
International Institute for Environment and Development	http://www.iied.org
International Organization for Standardisation	http://www.iso.org/iso/en/ISOOnline.frontpage
Katoomba Group Ecosystem Marketplace	http://ecosystemmarketplace.com
My Climate (Swiss)	http://www.myclimate.org
My Climate (US)	http://www.my-climate.com
Native Energy	http://www.nativeenergy.com
Renewable Energy & Energy Efficiency Partnership	http://www.reeep.org/
The Climate Group	http://www.theclimategroup.org
The Climate, Community and Biodiversity Alliance	http://www.climate-standards.org
The Climate Catalog	http://www.carboncatalog.org
Tufts Climate initiative	http://www.tufts.edu/tie/tci/carbonoffsets/Other-Offset-Reports.htm
UN Framework Convention on Climate Change	http://cdm.unfccc.int/index.html
World Green Building Council	http://www.worldgbc.org
World Resources Institute	http://www.wri.org

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