city of london

Delivering Copenhagen

The role of the City's financial services sector in supporting action on climate change.

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The Role of the City's Financial Services Sector

in Supporting Action on Climate Change

Contents

The City of London http://www.cityoflondon.gov.uk

The City of London believes that climate change is one of the greatest challenges facing mankind. This is why the City has been at the forefront of action on climate change for the last fifteen years- championing the uptake of renewable energy pioneering the development of carbon emissions markets and becoming the first public body to develop a climate adaptation strategy.

The City of London is the leading international centre for carbon finance. However it is not complacent and knows how critical it is to support and sustain the carbon finance sector at all levels. The City can only maintain its primacy by remaining a pre-eminent centre of business learning and skills: to this end the development of a comprehensive programme of carbon finance-related training is a natural reflection of the depth of the world-class professional skills base that exists here, and can only further enhance London's efforts to find financial solutions to drive the fight against climate change.

The London Accord http://www.london-accord.co.uk

The London Accord presents a compendium of reports, written by a range of financial services firms, providing insight into issues ranging from renewable energy to genetically modified organisms.

The financial services industry produces pertinent and valuable research which could, and should, be used by policy makers and NGOs who are shaping society's response to long-term issues such as climate change and global pandemics. However, much of this research only sees the desks of a select few and all too soon disappears into the filing systems and cupboards of the commercial sector. The London Accord allows access to this research free of charge - offering policy makers an insight which they may not otherwise access and giving the financial services industry a way of engaging with society on long-term issues.

The Consilience Energy Advisory Group Limited http://www.ceag.org/

The Consilience Energy Advisory Group Limited ('CEAG') is an energy consultancy firm specialising in markets. It provides consultancy services, expert witness support in litigation, trading training courses and publications in the field of oil, gas, power, freight, emissions and weather. It is staffed by career traders with first hand experience of each of the energy markets it covers.

Liz Bossley is the principal author of 'The Hole in the Barrel', 'Trading Natural Gas in the UK', 'Bossley's Guide to Energy Conversions', 'BFO: The Future Market', 'Project Finance Using the Forward Oil Curve', 'Emissions Trading and the City of London', 'UK Emissions Policy Options' and 'Climate Change and Emissions Trading: What Every Business Needs to Know', the third edition of which was published in summer 2009. She is on the advisory board of the Climate Alliance of Australia and was a founding director of the Carbon Markets and Investors Association. She is a member of the UK Treasury's carbon market experts group.

This paper has been compiled for the City of London and the London Accord by Liz Bossley of the Consilience Energy Advisory Group Limited.

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Executive Summary

Kyoto was an imperfect agreement, yet despite its many flaws, it has left one lasting legacy- positive proof that the concept of cap-and-trade can work.

If Copenhagen is to be a worthy successor to Kyoto, it is essential that there is a clear and strong signal from policy makers that they intend to follow through in a second commitment period with deeper cuts in greenhouse gas emissions targets that will be enforced robustly. This commitment is essential if the power of the markets is to be unleashed to hunt down investment in green technology and environmentally friendly projects.

A huge investment in clean technology is needed to prevent global warming from reaching dangerous levels of more than 2°C above the pre-industrial temperature. Given the scale of investment required and recent deterioration of public finances in many countries, it is only by leveraging private sector capital that this challenge can be met.

The City of London is the world's leading international financial and business centre capable of providing the necessary finance for that investment and of managing the new risks that go with it. However, whilst it is clear that business has a critical role to play in financing, developing and deploying low carbon solutions, it is important to understand that investors – whether pension funds, companies or venture capitalists – need to make returns on this investment.

To ensure maximum leverage from the limited available capital, innovative financing techniques are needed. However, in a post credit crunch world, policy makers view innovation with suspicion.

To ensure that scarce investment resources are deployed on the climate change mitigation effort, institutions and businesses need firm regulatory ground on which to base their investment decisions. However, recently businesses have been receiving mixed messages from politicians around the world.

In the run up to Copenhagen it is essential that the vital role markets have to play in tackling climate change is recognised by decision makers, and the financial services sector recognises that reflecting societal concerns is an essential part of its licence to operate.

This report looks at several innovative financing structures which could be harnessed in order to assist in the fight against climate change, and in doing so it hopes to de-mystify the role of the financial services sector in supporting Government and international policy making.

We look at the role of 'trade' in cap-and-trade and note the rapid growth of a complex market in the different asset classes of emissions permits or allowances. We note that, whilst mechanically the market tool is working as it should, the price signal delivered by these financial instruments is too low to galvanise the level of private investment called for by politicians. The solution is to give the market lower government enforced caps and the market will deliver a price high enough to change investment and consumer behaviour.

The mixed messages sent by governments about their ongoing commitment to reducing GHG emissions beyond 2012 are undermining investor confidence. To get around this fact, one of the financial innovations we examine is the index-linked carbon bond. As the yield of these government issued bonds varies depending on whether or not the issuer meets a pre-agreed environmental target, this instrument would underwrite political risk and encourage investment in low carbon technology.

We also consider forest-backed bonds which securitize a pool of forestry assets into marketable securities for sale to investors. This enables borrowers to raise capital by issuing bonds that yield short term cash flow without the need to harvest a long-term forestry asset. Payback time for forestry projects is typically variable and lengthy, but to encourage investors with varying risk appetites and payout needs, City of London institutions are bundling emissions credits into 'Environmental Baskets' of forestry credits at different stages along the project life cycle.

These ideas and financial products referred to above focus on mitigating climate change. By contrast, the market in weather derivatives has an increasing role to play in helping countries and companies adapt financially to the consequences of global warming. The Intergovernmental Panel on Climate Change ('IPCC') warns that, as average temperatures increase, we are likely to see an increasing incidence of extreme weather events. Insurance policies will either be unable to provide cover or will charge very high premia to do so. Weather derivatives, particularly weather options, are stepping into the breach. These pay out automatically, without the need to demonstrate an actual loss, if a reference weather index value – temperature, rainfall, wind speed, wave height – is exceeded within the time period of the option.

To support the goals of climate policymakers, the financial sector needs to be just as innovative as the scientists and engineers that are seeking a physical solution to global warming. Fortunately financial innovation is what the City of London does best.

Introduction

The climate negotiators heading to Copenhagen in December 2009 carry a heavy burden of responsibility on their shoulders to come up with a new deal to limit global warming.

The Kyoto Protocol, due to expire at the end of 2012, took the first faltering steps towards climate change mitigation and adaptation. The results of the discussions at Copenhagen will determine the future development path for the planet, and with it the fate of billions, yet unborn.

The Copenhagen Climate Change Conference in December 2009 provides an opportunity to draw a line under what has been a very difficult year for the worldwide economy. If the parties to the UN Framework Convention on Climate Change ('UNFCCC') can reach agreement on a successor to the Kyoto Protocol at this meeting, then the 'green shoots' of economic recovery can be truly green.

The enticing prospect is being held out of taking a new and more sustainable path of growth as we emerge from recession. If political decision makers agree the architecture of a new climate deal then the financial sector, led by the City of London, has the tools ready to make it happen.

This paper discusses some examples of how the financial services of the City of London can play a part in delivering against this vision: To this end, building the work of the London Accord, the City of London is pleased to present some examples of how the 'Square Mile' and the firms working within it are making a positive contribution to the climate change mitigation and adaptation effort.

The Role of Trade in 'Cap-and-Trade'

No one owns the atmosphere.

Because of this, there is nothing to stop people from dumping carbon dioxide into it. However, the Kyoto Protocol created a new commodity called the emissions allowance. Each allowance bestows upon its owner the right to emit 1 tonne of CO2 equivalent.

The protocol made no provision for how that new commodity should trade or what form its market should take. It challenged the private sector to devise its own market solutions for trading emissions allowances from which would emerge a transparent carbon price to inform investment decisions.

The financial services industry took up that gauntlet and developed a suite of contractual and financial instruments that allow companies to buy and sell allowances to comply with legislation, to manage their emissions price risk and to underwrite the economics of carbon-reducing investments. The result has been a new commodities market that has grown, over the space of a few short years into a $120 billion a year international trading programme which directly or indirectly affects the lives of millions of people.

The concept of cap-and-trade is elegantly simple: a Central Authority sets a limit on the permitted level of greenhouse gas ('GHG') emissions (' a cap'). The Central Authority sets this cap and allocates permits ('allowances') that bestow the right to emit GHGs *below* the current or expected level of emissions.

Allowances are either given for free to emitters or sold at auction to them. But the capped level ensures that there will be an overall shortage of allowances unless companies take steps to lower their business-as-usual emissions levels.

The emitter, faced with a shortage of allowances, can then:

- Cut its production;

- Invest in cleaner technology either at home or overseas[1]; or
- Buy in the market sufficient allowances to make up its shortfall compared with its actual emissions level.

The Kyoto Protocol relies on the ability of markets to function efficiently to allow countries and companies to trade allowances and establish the international price of carbon.

A clear carbon allowance price will allow emitters to choose which of the three options mentioned above– cut, invest or buy- is the most economically efficient for them. This allows for companies to draw up an Internal Carbon Abatement Curve ('ICAC') and find the point at which the different carbon reducing investments available are cheaper than simply buying allowances in the market to comply with legislation.

As national and regional cap-and-trade programmes are implemented around the world, ICAC is likely to become as familiar a term to board members as the company's Price/Earnings ratio, the IRR or the NPV.

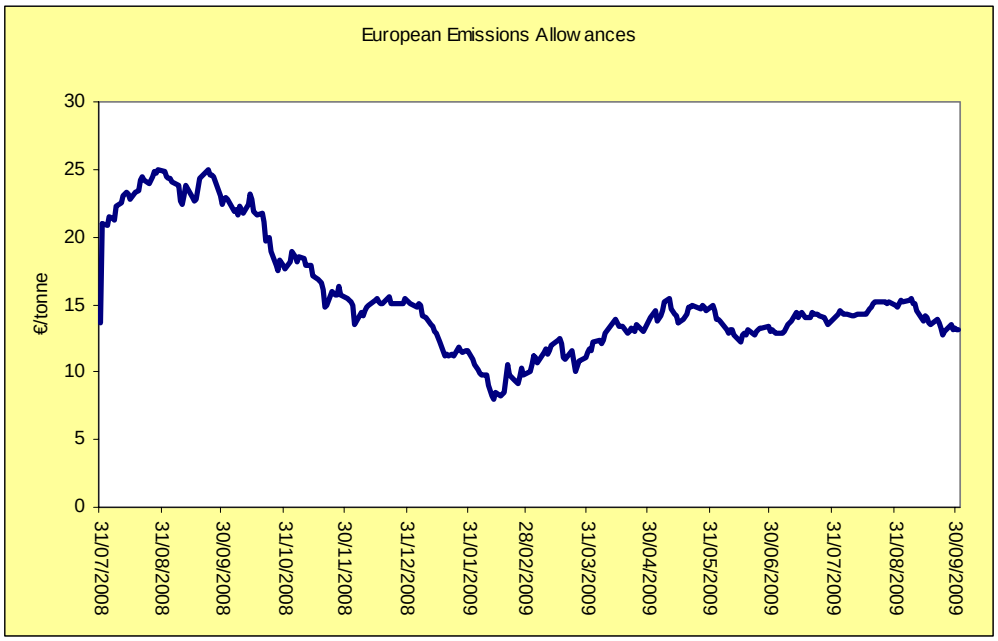
A high international allowance price is essential to the success of the Kyoto Protocol's objective of reducing GHGs by providing a stimulus to greater investment in clean technology.

Unfortunately the price signal that the market is currently transmitting is too low to incentivise investment in many new low carbon technologies, such as Carbon Capture and Storage ('CCS'). (See Chart One) This is a consequence of caps being set too high; it is not a flaw in the market mechanism:

[1] The overseas investment option refers to the Kyoto 'project' mechanisms: Joint Implementation ('JI') and the Clean Development Mechanism ('CDM')

To this end, if the Copenhagen conference in December 2009 produces lower emissions caps for a wider range of countries then there is a rapidly maturing market ready and able to deliver a price signal that will galvanise investment in carbon-reducing technologies.

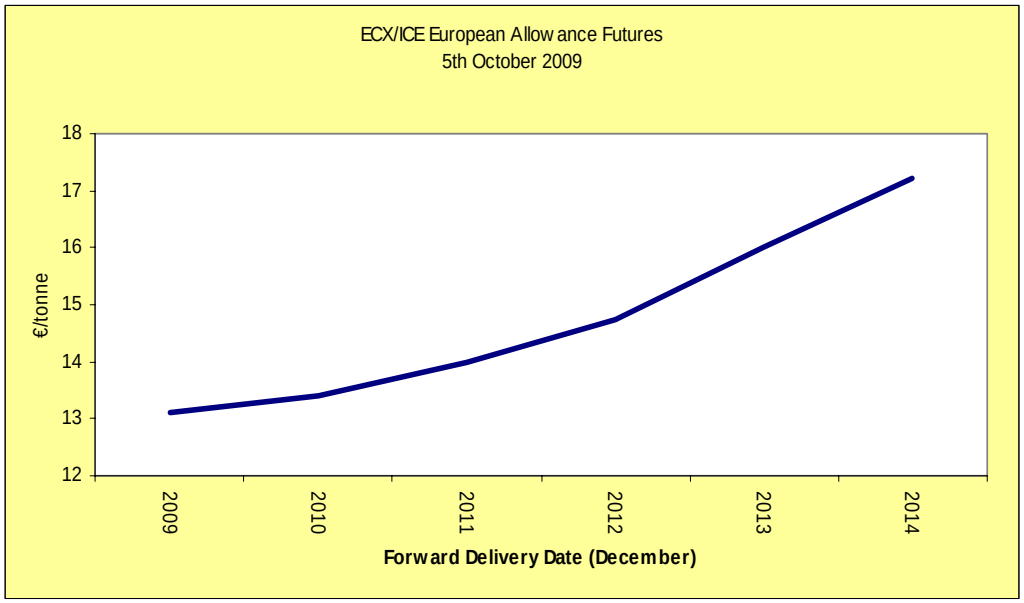
Chart 1: The Price of European Emissions Allowances



The price of emissions allowances can be traded or hedged several years in advance in the unregulated forward market or in a range of regulated futures contracts. (See Chart Two.) This allows companies to underwrite their investment decisions and achieve emissions price certainty. This is very important if the pay back period for a particular technology is tied to the price of carbon.

However, most projects have a payback period beyond the end of the first Kyoto commitment period where the market for allowances is very patchy. This is because market makers are understandably unwilling to make markets in a commodity which may not exist if the Kyoto Protocol expires in 2012 without a new climate deal to take its place.

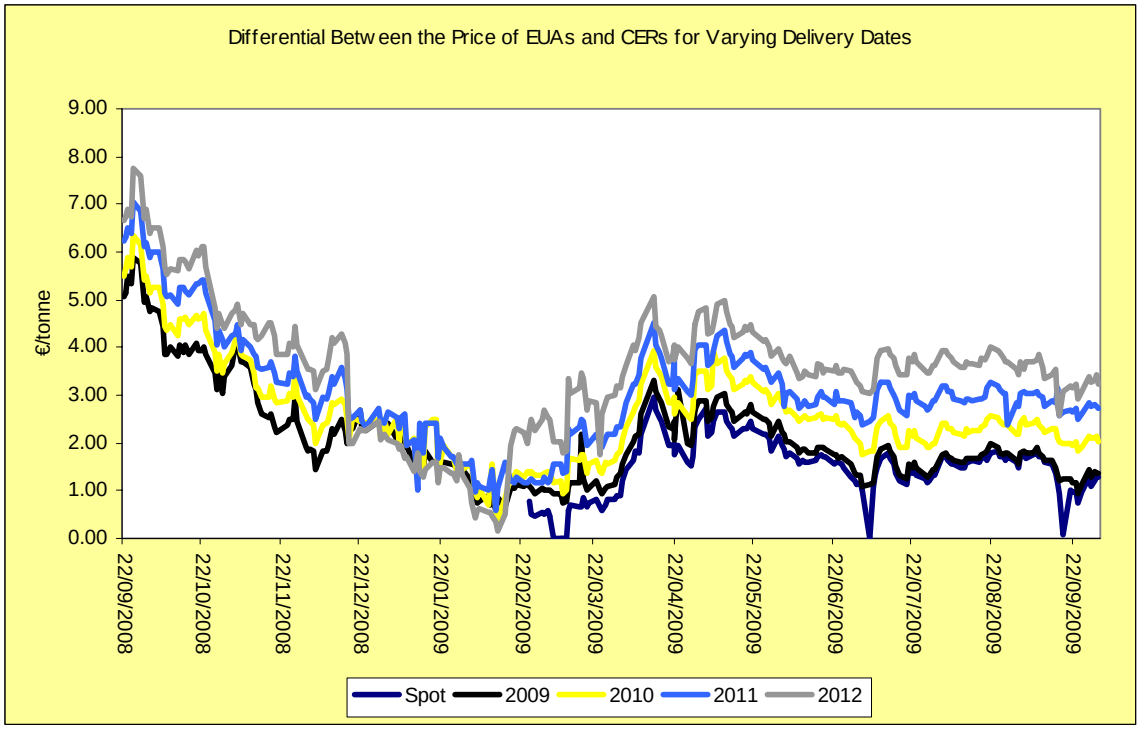
Chart 2: The European Allowance Futures Market



The most actively traded allowances are the European Emissions Allowances (the 'EUAs') issued by European member states under the terms of the European Emissions Directive. This is a regional scheme designed to help Europe comply with its Kyoto cap. These were the first allowances to start trading and they are considered by the market as an informal benchmark grade of allowance, against which the price of other asset classes of allowance is compared. (See Chart Three)

The allowances issued by the Kyoto Clean Development Mechanism ('CDM') executive board, Certified Emissions Reductions ('CERs'), also trade actively. These are allowances issued to investors from capped developed countries who invest in carbon reducing projects in developing countries that have ratified the Kyoto Protocol and can prove a consequential reduction in GHG emissions.

Chart 3: EUA Price minus CER Price



Markets in other asset classes of allowance already exist, but do not yet trade as actively as the EUA and the CER. Hence, investors who wish to under-write the economics of carbon-reducing projects that fall within the scope of the Kyoto Protocol or the European Emissions Directive can hedge the emissions allowance price easily up to the end of 2012. Beyond 2012 the daily volume traded is considerably lower reflecting the increased risk to market makers of trading into a period when the fundamentals of market supply and demand are shrouded in uncertainty.

The market for emissions allowances is a market in regulatory risk. Supply of and demand for allowances is determined by the outcome of negotiations in the worldwide political and economic arena. National and multi-national corporations will trade in the market to comply with the requirements of the countries in which they operate. They will do so to avoid a penalty or to gain a subsidy applied at the national level, but designed to implement international law as set down in the UNFCCC and the Kyoto Protocol.

The supply of allowances to the market reflects the caps, i.e. the quantity of GHGs that can be emitted without incurring a penalty. Demand is determined, ultimately, by how

consumers react to product prices that include the cost of carbon and by how companies react to emissions regulations, by investing in GHG reductions, by cutting output or by buying emissions allowances in the market.

Until the uncertainty over the post-2012 climate deal is resolved, the investment climate is not conducive to large scale or long term capital commitments. It is difficult to convince boards and shareholders of the economic case for investment in a project with a payback period beyond 2012 when the very existence of an emissions market, against which to compare an investor's ICAC, is open to question.

Even in the short term political shocks to the market, such as Poland and Estonia's victory in the European Court of First Instance on 23rd September 2009, have the effect of undermining confidence in just how serious even the apparently committed EU member states are about addressing global warming. The European Court over-turned decisions by the European Commission to reduce the number of allowance allocated to these two countries between 2008 and 2012 by a total of 90 million per year. This threatens the market price with an unexpected additional source of supply.

In short, the 'trade' aspect of the cap-and-trade concept is working well. But the failure to agree and observe meaningful caps effectively denies ammunition to what could be a powerful weapon in the fight to mitigate climate change, namely the market mechanism.

In the next section the London Accord, the world's largest cooperative environmental, social and governance ('ESG') investment research programme, has taken this seemingly intractable conundrum and turned it on its head with a new product that rewards investment even when the policy environment is uncertain - the index-linked carbon bond.

Index-Linked Carbon Bonds

The London Accord's model[2] for index-linked carbon bonds underwrites the risk associated with investment in an uncertain policy environment. As mentioned in the previous section, the emissions market is a market in regulatory risk, and as such is subject to political shocks. The index-linked carbon bond is a direct hedge of this regulatory risk.

Traditional bonds, also know as 'gilts' or 'treasuries', are negotiable interest-bearing or discounted certificates of debt that are issued by a government or corporation in order to raise cash. In exchange for investing a sum of money the investor receives from the issuer an annual return, or yield, usually in the form of an interest payment until maturity and then a fixed sum to repay the principal. Bonds, once issued, can be traded on in a secondary market and the price of a bond issue is typically quoted on stock markets.

An index-linked carbon bond is a government issued bond where the base interest rate is fixed, but actual interest payments vary depending on whether or not the issuer keeps an environmental promise. In effect the regulatory risk is unbundled from other project risks, including base rate risk, and managed separately. For example:

- the interest paid on the bond may escalate if the verified GHG emissions of issuer breach a promised maximum in a given year; or,
- annual payments may de-escalate if feed-in tariffs for renewable energy in the country concerned rise above pre-agreed level. (A feed-in tariff is an incentive payment structure to subsidise renewable power generation. Different models exist around the world, but the practical effect is that a buyer, such as a grid operator or utilities, is obliged to buy renewable power at above the market price for electricity); or,
- interest payments may go up or down with the market price of emissions allowances as quoted by a particular source of market data.

[2] http://www.zyen.com/Knowledge/Articles/index-linked_carbon_bonds_gilty_green_government.htm

An investor in an index-linked carbon bond receives a better yield if the issuing country's targets are not met, e.g. an extra percentage point of interest for each €1 that CO2 allowance prices are below a floor price.

Whilst there is currently political consensus on the danger that climate change poses[3], the decision maker who wishes to pursue a course of practical action faces a myriad of barriers and vested interests that must be negotiated in order to achieve that end. Often this involves compromise, which can influence the effectiveness of policy instruments. However, before investors part with cash for clean technologies such as renewable energy, a degree of certainty with respect to the regulatory environment is required.

Index-linked carbon bonds eliminate this risk; the one risk that differentiates clean technology projects from other energy projects.

If governments deliver effective policies that meet their aspirations for carbon reduction, they get cheap money by paying a lower interest rate on the bond. If governments fail to meet their green targets, they pay a higher interest rate on the bond. Investors in index-linked carbon bonds can proceed with projects or technologies that pay off in a low-carbon future because, if the low-carbon future fails to arrive, the issuing government will pay them higher interest rates on government debt.

The idea of index-linked carbon bonds was described in a London Accord team paper presented to the World Bank Government Borrowers' Forum at Ljubljana in May 2009 and it fits the current economic climate and the current questionable status of environmental commitment.

We have seen innovation in the bond markets before. For example, the introduction of claw-back provisions, i.e. options to redeem a specified fraction of the bond issue within a specified period at a predetermined price with funds that come from a subsequent equity offer. We saw inflation-linked bonds emerge when governments were facing high inflation and needed to issue debt. Examples of this phenomenon were seen in the UK in 1981, followed by Australia in 1985, then Canada in 1992 and Sweden in 1994.

[3] http://www.g20.org/Documents/pittsburgh_summit_leaders_statement_250909.pdf

However, whilst carbon bonds could be highly effective, they are not the appropriate tool for all circumstances. Investors whose risk profile is short term and depends on a transparent and actively traded index such as, say, the price of EUAs, may well prefer to hedge that risk directly in one of the markets for EUAs referred to above. But there are many instances when an investor's risk is directly linked to government indices that are not hedgable by traditional derivative instruments, or when the risk profile is too long term and extends beyond the point where a liquid traded market exists.

An example of this might be a project with a payback that relies on the future price of an emissions allowance that is not yet trading, such as the Australian AEU, which is expected to be issued under the Australian Carbon Pollution Reduction Scheme ('CPRS'). Or the project risk may relate to a CDM project where the payback period lies beyond 2012, where the investor may worry that a market may not exist if a new cap-and-trade climate deal is not agreed. In such cases a bond linked to the specific target or index may well reduce hedge basis risk.

For example, consider a complex, long-term investment in a tidal barrage scheme. Such schemes have characteristically huge capital costs, low costs of operation once installed and long lifetimes (around 200 years). This means they are difficult to value using conventional discounted cash flow methods.

Let us assume that a 4 km barrage costing €1.5bn ($2.2bn) producing 2.75 terawatt hours of electricity per year needs carbon prices of €40($59)/tonne CO2e to give a payback period of around 80 years and a price of €60($88.5)/tonne for a payback of 30 years. The effect of a high carbon price is to raise the wholesale costs of electricity produced by conventional means. These costs are passed on to the consumer thereby raising electricity prices, including the price that can be charged by the barrage scheme generator, which does not have to buy carbon allowances in order to generate. If the price of carbon is low, the barrage generator will lose this competitive advantage over fossil fuel generators.

The investor may buy a bond with the following characteristics:

- The base yield is 4% per annum;

- The base yield is indexed to a carbon price of €60/tonne and the bond is slightly leveraged:
    - above €60($88.5), the interest rate falls by 1% for every €20($29.5) increase in carbon;
    - below €60($88.5) the interest rate increases by 1% for every €5 ($7.4) decrease in the carbon price; and,
    - below €40($59) the rate increases by 1% for every €2.5 ($3.7) decrease.

The impact of such an instrument is to significantly reduce the investors' carbon price risk. When the carbon price is low the barrage generator receives additional interest from the bond to compensate it for the loss of competitive advantage.

The investor does not have to hedge the entire capital sum of €1.5 ($2.2) billion. Buying bonds of 10% of the project capital (€150million or $220million), i.e. a 'hedge ratio of 10%, is sufficient in this case to hedge against a fall in the carbon price to €30($44.2)/tonne. Without the bond the payback period for the project at this €30 price is 450 years (longer than its expected lifetime) while with the bond, its payback is 70 years.

The mechanics are simple: an investor typically finances a low-carbon project, by issuing equity or taking on debt. The investor's ability to pay dividends to equity shareholders or service the debt will vary with the profitability of the low-carbon project, which in turn correlates with government delivery on regulatory promises. The economic model of each project will identify the specific environmental index on which that project depends. This may be the feed-in tariff or the price of emissions allowances. When it raises equity or debt to finance the project, the investor can buy government carbon bonds, linked to the specific environmental index that best correlates with the project's risk.

The hedge ratio, i.e. the number of bonds the investor will buy per unit of investment, will depend primarily on the correlation between the IRR of the project and the carbon index in question. But it will also be influenced by the buyer's perception of regulatory risk. In the run-up to Copenhagen, when, we hope, we are seeing the darkest time for market confidence just before the dawn of a new climate deal, current faith in governments is at a very low ebb. In these circumstances the hedge ratio might be one to one, i.e. each

unit of investment in clean technology may require hedging with one equivalent unit investment in carbon bonds. This will vary from project to project, but, directionally, if Copenhagen delivers a new deal and confidence in governments rises, the hedge ratio would decrease.

The index-linked carbon bond is also likely to be of interest to funds, such as pension funds or mutual funds, with exposure to investments in renewable stocks. The value of the renewable portion of the portfolio will be influenced by government renewable policy, which is not easily hedged, other than by these types of bonds.

The choice of index allows the bond issuer to unbundle and eliminate quite specific risks that would otherwise act as a disincentive to invest. Index-linked carbon bonds would also enhance traditional bonds by showing that the national risk from climate change is being addressed. For example, a low-lying country's risk of flooding due to climate change could soon start being priced into its traditional long-term 20 to 30 year bonds. By adding index-linked carbon bonds to the mix of issuance the government would reduce perceived risk on its normal bonds.

The scale of the potential market in index linked carbon bonds is limited only by government deficits and borrowing needs. But as the International Monetary Fund ('IMF') estimates that G10 governments are likely to issue about $9(€6) trillion in bonds over the next three years, that limitation is not significant. Any government (supra-national, national, state, province) could issue index-linked carbon bonds without the need for a global initiative. Documentation would be simple. Most existing government treasury mandates already allow for these types of instruments.

Bond Supply

The Economist summarised a recent IMF report ('Fiscal Implications of the Global Economic and Financial Crisis', 9 June 2009)[4] 'by next year [2010] the gross public debt of the ten richest countries attending the summits of the G20 club of big economies will reach 106% of GDP, up from 78% in 2007. That translates into more than $9 trillion of extra debt in three years … The IMF economists' baseline is that the government debt of the rich ten will hit 114% of GDP by 2014. Under a darker scenario in which economies languish for longer while fears about governments' solvency push interest rates up, the debt

[4] http://www.imf.org/external/pubs/cat/longres.cfm?sk=22987.0

ratio could be 150%.' ['Government Debt: The Big Sweat', 11 June 2009] Against global GDP of some $55 trillion, that's a lot of new debt. The UK government estimates that it will be issuing £260 billion of gilts (UK government bonds) in 2010 alone on UK GDP of £1.2 trillion.

On the IMF's optimistic estimates, government debt will grow by 36% in three years; on its pessimistic estimates, by 50%, which may crowd out private sector debt. The ratio of global public sector debt to private sector debt is already about two to one. , so there's going to be a lot of crowding out. So much debt will increase governments' temptations to escape through inflation and default.

Government debt is about to rise sharply due to a perfect storm of financial crises: fiscal stimulus costs and falling tax receipts due to recession clashing head-on with demographic change leading to rising healthcare and pension costs. If that were not enough, there are also private finance initiatives that may be coming back to government balance sheets. With so much planned debt issuance, governments will need ways to distinguish themselves in a crowded bond market. Innovation is needed and City of London institutions are putting their heads together to supply that need.

Forestry Products

The Intergovernmental Panel on Climate Change ('IPCC') estimates that the cutting down of forests is now contributing close to 20% of the overall GHGs entering the atmosphere. Forest degradation also makes a significant contribution to emissions from forest ecosystems. A report to the UN Reduced Deforestation and Degradation ('REDD') programme on 23rd September 2009, estimated that a 25% reduction in deforestation could be achieved with a financial commitment of €15-20 billion ($22-29 billion) by 2015. This would represent a reduction of 7 gigatonnes of CO2 equivalent by 2015.

The treatment of forests under the Kyoto Protocol is one of the more complex aspects of the treaty. There are three areas of relevance:

- **Land Use, Land Use Change and Forestry ('LULUCF')**
  Article 3 of the Kyoto Protocol allows Annex B parties (i.e. developed countries that have agreed to cap their emissions during 2008-2012) to take into account GHG emissions associated with afforestation, reforestation and deforestation since 1990 in assessing compliance with their Kyoto targets. The countries concerned can issue additional allowances, called Removal Units ('RMUs') for each tonne of CO2 sequestered by LULUCF and surrender these to comply with their caps. RMUs have limitations and are regarded as 'second class' allowances because they cannot be banked for use to offset emissions post 2012. Furthermore the European Union Emissions Trading Scheme ('EU ETS'), currently the world's most active GHG cap-and-trade scheme, does not allow sequestration as an eligible activity nor does it allow the use of RMUs for compliance with its scheme;
- **Afforestation and Reforestation Projects under the Clean Development Mechanism**
  Under Annex 2 of the CDM, executive board decision number EB 48, projects involving afforestation and reforestation in developing countries were accepted as being within the scope of the CDM. Avoided deforestation and forest degradation however do not qualify as CDM projects. Hence there is a commercial incentive to cut down existing forests in developing countries and then to claim CDM credits for replanting the land. By October 2009 only 8 CDM

projects based on afforestation and reforestation had been registered with the CDM executive board. The EU ETS does not recognise CERs from afforestation and reforestation projects for compliance with its scheme;

- **Reduced Deforestation and Degradation ('REDD')** Under the Kyoto Protocol Article 3, forestry activity is measured and counts towards compliance with the caps of Annex B developed countries. Hence, afforestation, reforestation and deforestation by these countries is already rewarded or penalised. (A definition of forest degradation has not yet been agreed.) The REDD[5] initiative was introduced at the Bali conference in 2007. It aims to give value to carbon stored in forests in *developing* countries by offering incentives to halt deforestation and reduce emissions from forested lands.

The head of the REDD Programme Secretariat said at the G8 meeting: 'The significant flow of finance from developed to developing countries that REDD could stimulate could result not only in meaningful carbon emission reductions but could also help finance a new, low carbon path to development.' City of London institutions are already working on innovative ways to provide that finance.

Forum for the Future's Forest Investment Review[6] explores how best to stimulate private sector investment alongside public money to reduce deforestation in the developing world. Forum for the Future is a UK think tank working in partnership with businesses and public sector bodies, helping them devise more sustainable strategies and deliver these in the form of new products and services.

Its investment review states 'There is an emerging consensus that a new financing facility/mechanism is urgently needed to meet the substantial funding gap between existing funds for forests and a time when carbon markets may generate funds in the future. … A blend of funding sources will be needed to meet each country's individual requirements, given their unique economic profiles. Much of the funding in the early years will need to be through government grants, but there is scope for the private sector to play a greater part as time goes on'.

[5] UN Collaborative Programme on Reducing Emissions from Deforestation and forest Degradation
6 http://www.forumforthefuture.org/projects/forest-investment-review

Forest Facts

Over 30% of the world's land area – about 40 million km2 – is covered in forest.

96% of this is classified as natural forest.

Approximately 700million of the world's poorest people depend on forest land.

Around 86% of the world's forests are under government ownership, with 79% under the direct control of central governments.

Globally about 34% of forests are managed in some way.

Cutting down of forests is contributing about 20% of the overall GHGs emissions. Forest degradation also makes a significant contribution to emissions from forest ecosystems.

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Sources: Forum for the Future; FAO; IPCC

One financing innovation explored by Forum for the Future is forest-backed bonds[7] building on an idea suggested by London firm Henderson Global Investors.

The objective is to enhance the long term asset value of forests while addressing the need for short term income from, for example, timber yield and planting cash crops. The short term survival needs of indigenous populations are the driving force behind deforestation. To protect the natural forests, which may yield a crop only every 40-50 years, this short-term need has to be satisfied in another way. This has led to the replacement of natural forests with man made forests, or plantations, which can grow at up to 15 times the rate of natural forests. This delivers a homogenous and predictable supply of timber and related products, but imposes a heavy toll on biodiversity.

The forest backed bond mechanism provides an alternative. This involves first gathering up a pool of forestry assets into a package and securitising this package. A security is an investment instrument that represents ownership of a share of an asset or company. Securitisation is a familiar financial tool for packaging a designated pool of non-tradable assets with similar characteristics into marketable securities for sale to investors.

Having formed a neat package of diverse forestry assets the borrowers can then raise capital by issuing bonds, repayment of which is underwritten by the performance of the package of forestry assets. These bonds might mature, i.e. be repaid, in 40-50 years- the time horizon appropriate to harvesting a natural forest crop. This unlocks the

[7] Forum for the Future Forest-Backed Bonds Proof of Concept Study August 2007

necessary short term cash flow, removing the need to cut down the forest and, as a collateral benefit, protecting its long term asset value, financial and otherwise.

Securitisation of natural forestry assets scores over debt or equity financing in several ways:

- It spreads political, credit and operational risks, such as loss of forest to natural disasters or illegal logging, over a wider range of assets;
- A range of securitised assets provides a more easily tradable financial asset than single forest assets;
- It promotes the involvement of smaller and more mobile investors than the large-scale investors required by equity or debt financing of a single forest asset; and,
- By artificially reconstructing some of the advantages that plantations have over natural forestry, particularly regular cash flow, forest-backed bonds help maintain biodiversity and thus support eco-tourism.

Forest-backed bonds can be structured in a number of ways. Subject to credit guarantees they can be issued against a variety of cash flows, including:

- A portfolio of cash flows from tropical plantation, natural forest and conservation; or,
- Government income/licence fees from sustainable forest management ('SFM'); or,
- A portfolio of SFM related loans to small and medium forest enterprise; or,
- Plantation development linked to forest conservation.

Forum for the Future considers a portfolio of cash flows from tropical forest activity, structured as an export orientated future flow of deals, to be the most promising option in the short term.

The market for forest-backed bonds is likely to come from long term investors, such as pension funds and insurance companies. Such investors typically target inflation-linked bonds that guarantee a payback in line with their obligations to pensioners and annuity holders. To be attractive to this audience, says Forum for the Future, forest-backed bonds need to be issued through a supranational entity, and incorporate powerful guarantees. The bond issuers must provide sufficient transparency about the nature of

underlying asset and post-issue performance analysis to ensure that the bonds are effectively rated.

Forum for the Future warns that significant gaps still exist for biological and market data relating to tropical natural forestry, although data for plantations is more readily available. If the work of the IPCC and the REDD can plug some of these gaps by providing transparency and benchmarking data then a market in forest-backed bonds will be ready to fly.

But the financial sector is used to putting its own cash at risk now, dealing in the real world of imperfect data and opaque and incomplete legislation. Within the global carbon markets a significant effort has been invested to create credible and robust methodologies for forestry projects. The voluntary sector is a leading actor for forestry methodologies and standards. These exist outside the scope of the 'compliance sector', i.e. the Kyoto Protocol and the regional and national mandatory emissions trading schemes, and they fill the standardisation gap left behind by these schemes.

Projects in the voluntary sector generate so-called verified emissions reductions ('VERs'), although the term VER has come to mean voluntary sector carbon reduction credits that have been verified and audited in accordance with one specific environmental standard, the VER standard. Standards such as the Voluntary Carbon Standard ('VCS'), Climate, Community & Biodiversity Standard ('CCBS'), Plan Vivo and Carbon Fix have all introduced forestry project methodologies.

The EcoSecurities Group plc, a company listed on the UK's AIM market recently published its 'Forest Carbon Offsetting Survey, 2009'[8]. It reported that it found strong regional differences in general attitudes towards forest carbon. Carbon buyers in North America and the rest of the world outside of Europe have a more favourable opinion of forest carbon than buyers in Europe. It believes that this is the result of the exclusion of forestry from the EU ETS and of the forestry restrictions applying under the Kyoto Protocol.

As mentioned above, forestry project costs are front-loaded, whereas the actual carbon offsets, such as VERs, are generated very slowly over time as the trees grow and the

[8] http://www.ecosecurities.com/Registered/ECOForestrySurvey2009.pdf

carbon reductions are verified. EcoSecurities reports that 'in order to ensure that forest carbon projects come to fruition and deliver emission reductions, many offset buyers are willing to engage in innovatively structured transactions. Some organisations are prepared to make an up-front payment for future delivery of offsets or to invest in early stages of project development'.

To facilitate this investment innovation, a voluntary system to deliver, track and transfer credit was needed. Emissions credits or allowances are negotiable currency. Whereas trade in actual currencies is transacted through the international banking system, trade in emissions credits is transacted using an analogous system of transaction logs and registry infrastructure. In the compliance sector these transaction logs and registries were created and are managed by the UN secretariat and by national or regional regulatory authorities. Compliance sector infrastructure does not recognise credits generated in the voluntary sector. So the voluntary sector has created its own.

For example, the Markit Environmental Registry ('Markit') is one such registry that lists and manages environmental assets, including credits that are generated in the voluntary sector. It reports holdings of over 50 million credits from worldwide projects, with forestry credits accounting for just under10%. This essential infrastructure provides security and transparency to the voluntary sector and facilitates the development of innovative financing structures by simply managing the interface between project developers and credit buyers.

As mentioned in the first chapter of this report, there is an active forward market in emissions allowances. In the voluntary sector this forward market was hindered because credits were not visible and could not be traced easily to verify the environmental integrity of the allowances on offer and to ensure that credits were not being double-counted or over-sold.

Markit offers the service of tracking contractual rights to the future delivery of voluntary credits. Upon review of independent documentation validating GHG reductions in the voluntary sector, Markit lists credits not yet issued as so-called Pending Issuance Units ('PIUs'). It attaches a tracking number to credits providing visibility to the market for each unit throughout its lifecycle.

A PIU is a unit that represents a contractual right to an *anticipated* delivery of an emission reduction credit. When the potential emission reductions represented by the PIUs are subsequently verified, Markit issues the corresponding credits. However, to avoid double counting, the PIUs that previously reflected the contractual rights to the anticipated emission reductions are cancelled before the new verified credits are issued.

This to a certain extent mirrors procedures in the compliance sector, particularly the CDM registry, and is not exactly revolutionary. But whereas CERs may be sold in the forward market prior to issuance, they cannot actually be delivered until they are issued by the CDM executive board. The creation of PIUs takes the simple evolutionary step of allowing delivery of the asset prior to the issuance of the credit. This has removed one stumbling block to the development of a forward market and to the funding and risk management potential that goes with forward markets in all commodities.

This has allowed Markit to take a further step in the commoditisation of emissions credits by offering ‘Environmental Baskets’. This concept bundles VERs with PIUs. Bundling these two units together can help assure that the package will provide a minimum level of reductions in the event that the unissued or unverified portion does not complete the verification process.

Weather Derivatives

While the market in GHG emissions allowances focuses on reducing emissions and thus mitigating climate change, the market in weather derivatives has a role to play in helping countries and companies adapt to a changing climate.

Weather derivatives started trading in the late 1990s, long before the first carbon emissions allowances were allocated in the UK in 2002. But as concerns about the changing climate have spread an awareness of the ability to hedge against adverse weather has grown and the use of weather derivatives as a financial adaptation strategy is gaining ground.

Communities or businesses exposed to weather events have two basic choices of financial protection: weather insurance or weather derivatives. An insurable event is typically an extreme event that lies at the tail ends of the normal distribution, or bell, curve of weather events, i.e. greater than two standard deviations from the norm. Usually to claim against an insurance policy the claimant must demonstrate, first that the event could not be foreseen and, secondly, that damages and an actual loss have occurred. The insurance company reimburses only actual audited damages.

Businesses that rely on 'good' weather that fails to occur for non-catastrophic reasons, for example, a wind farm with too little wind or a sporting event that gets rained off, can claim against insurance. But such events are within one standard deviation of the norm and an insurance policy will charge an extremely high premium for such cover.

An alternative approach is to use a weather derivative. This pays out automatically, without the need to demonstrate loss if, say, the rainfall in a particular crop growing location is greater than a certain number of inches or centimetres over the harvest period, or if the snowfall is less than a certain trigger level in a specified place, like a ski resort, in a particular season.

In the early days of the weather market such deals were normally expressed as a swap, which meant that weather protection was not risk free, i.e. if the weather was better than expected, the buyer of the derivative had to pay out to the derivative provider. Today

most weather derivatives are expressed as options so that the buyer of the derivative never has to pay out more than the option premium.

The derivative provider uses historical weather data for the location to assess the risk and then quotes a price for the derivative taking into account factors such as weather trends and seasonal patterns.

How Weather Swaps and Options Work

A **swap** allows a party to change its exposure or risk from a floating future index to a fixed value agreed upfront. For example; a ski company's income will vary according to the amount of snowfall in a season. The resort may wish to hedge this uncertainty with a snowfall swap that locks in the financial value of the optimum number of inches of snow, X inches, during a particular time period. Actual measurement of snowfall during the season will reveal that actual snowfall is Y inches. If Y is less than X then the weather derivative pays out to the travel company. If Y is more than X then the weather derivative has to be paid out by the travel company. For most derivative buyers this is not acceptable and they prefer to structure their protection as an option.

An **option** gives the buyer of the option the right, not the obligation, to buy or sell the weather index at a specified price on a specified date. Two basic types of option exist:
Call: The owner of the call option has the right, but not the obligation, to *buy* the underlying weather index at a given value, by a certain date.
Put: The holder (buyer) of the put option has the right, but not the obligation, to *sell* the underlying weather index at a given value, by a certain date.

The index value which is fixed upfront is known as the strike value. The buyer of the call or put option pays the seller of the put or call an option premium. The size of premium is determined by a mix of factors related to risk.

For example, instead of buying a swap the travel company may buy a snowfall put option at a strike value of X inches and will pay a sum of money upfront for this option. Actual measurement of snowfall during the season will again reveal that actual snowfall is Y inches. If Y is greater than X then the travel company does not exercise the put option. If Y is less than X then the travel company exercises the put option and will be paid for the difference between X and Y by the derivative provider.

This allows the travel company to offer a snow guarantee in its brochure such that the tourist gets his/her money back if the snow does not appear.

While the weather derivatives market may have cut its teeth in the early days in what some may regard as the more frivolous tourist sector, it has grown up to provide an essential service to valuable areas such a the agricultural and utilities sectors. Derivatives are even available for the weather in space, where solar storms may affect communications and satellite navigation satellites.

According to Acclimatise, a UK based climate risk management company, in the hot European summer of 2003 electricity producer, EDF, was forced to shut down 14 nuclear power plants and lost €300 ($443) million in revenue. Acclimatise warns that the sustained period of high temperatures seen in 2003 was a 1-in-500 year event in the current climate. But by 2040 this could be a 1-in-2 year occurrence, i.e. a 'normal' event'.

Weather derivatives, for example, allow the nuclear power generator to hedge, not the price of the power it will be able to generate, which it can cover with traditional power price market, but to cover the risk of it not being able to generate at all. In other words it covers volume risk rather than price risk.

If climate scientists are correct, as global warming progresses, we are likely to see, amongst other negative impacts, an increased incidence of drought, increased flooding from the sea and rivers, declining production from agriculture and forestry, reduced snow cover and winter tourism, falling hydropower potential and summer tourism and an increased number of heat waves of greater intensity and duration[9].

This suggests a growing need for weather risk protection. It also makes it more difficult for weather risk providers to measure and value that risk because, by definition, weather history becomes a less reliable indicator of future weather if the climate is changing.

[9] The Fourth Assessment Report of the IPCC http://www.ipcc.ch/publications_and_data/publications_ipcc_fourth_assessment_report_synthesis_report.htm

Weather is a localised phenomenon and the providers of weather instruments are required to offer increasingly tailored products that address a wide range of different weather risks.

Climatologists and weather forecasters are a key part of the derivative providers' risk valuation teams, assessing very specific risks. For example, for a wind farm it is not sufficient to measure wind speed in a particular location. It also needs to be measured at the particular height relevant to the turbine, not at ground level. Weather experts are also needed to identify and eliminate data point 'outliers' i.e. anomalous weather readings taken from meters in accessible locations that are subject to interference and vandalism.

Weather trading "hubs"', such as London, Paris, Vancouver, Sydney etc, exist and are traded on regulated exchanges. But these sites provide inadequate cover for a large number of risk hedgers. For example, a Scottish famer who loses his lambs to late snow would receive no payment if he had hedged his weather risk at the London Heathrow weather hub where the sun was shining.

Exchange traded weather products based on these hubs are considered to be trivial in size relative to the risk placed in the OTC market.

The financial sector has risen to the challenge of diversified weather risk by providing 'bespoke' weather risk services in the over-the counter ('OTC') market. This makes the size of the weather market very difficult to assess as OTC deals tend not to be reported consistently by publications because of their private and confidential and one-off nature.

Most OTC business takes place in the form of contracts in highly tailored risks that cannot be readily laid off to another party with a natural equal and opposite risk. Speedwell Weather, a UK based provider of historical weather data and feeds, forecasts and weather derivative pricing tools, reports that hundreds of weather stations have traded worldwide. The OTC derivative providers take the same actuarial approach to a weather risk portfolio as the traditional weather insurance providers. This approach depends on a diversified portfolio where it is unlikely that all the provider's contracts will be hit at the same time.

The weather derivatives market is not just a ‘rich man’s hedge’, used to cover the inconvenience of a spoiled holiday. It allows businesses in both developed and developing countries to cover the non-catastrophic weather risk that can spell the difference between survival and ruin.

It would be ludicrous to suggest that a small farmer in sub-Saharan Africa should be expected to hedge his drought risk in the derivatives market to avoid famine. But some very innovative deals for micro farmers in India and Malawi have already been reported.

This points the way to a future where governments and aid agencies could now deploy the weather derivative tool in the worthwhile task of stretching limited relief resources to bolster the climate change adaptation effort. Developed economies have an ongoing responsibility to provide oversight by financial regulators to ensure performance by the pioneering derivatives providers.

Conclusion

The world is waiting with bated breath to see the shape of the climate deal that will emerge from COP 15 in Copenhagen. There is a wall of pent-up investment waiting to be released once we have some clarity about the legislative framework in which we will be operating after 2013. The current uncertainty about whether or not there will be a cap-and-trade scheme after 2012, how low the caps will be and whether or not at least the clean development mechanism will survive is arguably almost worse than certainty that climate negotiators are unable to reach agreement.

The outcome we need from Copenhagen is a new cap-and-trade scheme with deeper cuts in a wider range of sectors in a greater number of countries. But even if the meeting breaks up with no agreement, the financial sector, led by the City of London will deploy all its ingenuity to devise investment and risk management instruments and markets that will help national and regional governments implement whatever climate mitigation and adaptation policies they adopt.

Glossary

Term	Definition
Adaptation	The capacity of a society to respond to a change or perceived change in its external environment.
Afforestation	New forest planting on land that has not been forested for some pre-determined length of time. In the case of the Kyoto Protocol, afforestation refers to planting on land that has not been forested since 1990.
Allowance	A permit to emit one tonne of carbon dioxide equivalent ('CO_2e') into the atmosphere, issued to countries, installations, companies or individuals by a government or other regulatory authority.
Annex B Countries	The 39 countries specified in Annex B to the Kyoto Protocol, which include the European Union, OECD and Economies in Transition ('EIT') countries, that agreed to binding commitments on their greenhouse gas emissions of variable magnitude from 1990 to 2008-2012. The U.S.A. is an Annex B country, but it has not ratified the Kyoto Protocol so its status is meaningless.
Article 6 Projects	Projects developed under the auspices of Joint Implementation, as specified in Article 6 of the Kyoto Protocol.
Article 12 Projects	Projects developed under the auspices of the Clean Development Mechanism, as specified in Article 12 of the Kyoto Protocol.

Banking	The mechanism by which a party/facility within a cap-and-trade emissions trading scheme can carry forward carbon allowances or credits that it owns from one year or other specified period to the next. Each trading scheme has different rules for banking its allowances/credits.
Cap-and-Trade	An emissions trading regime in which a limit (cap) is placed on the total emissions allowable from the activities or sectors covered under the scheme. Emissions limits are set below the 'business as usual' scenario.
Carbon Bond (index-linked)	An index-linked carbon bond is a government issued bond where interest payments are linked to either levels of feed-in tariffs for renewable energy, emission certificates prices or actual greenhouse gas emissions of the issuing country. An investor in an index-linked carbon bond receives an excess return if the issuing country's targets are not met, e.g. an extra percentage point of interest for each €1 that CO2 emission prices are below a floor price.
Carbon Credits	A tradable credit, usually specified as the right to emit 1 tonne of carbon dioxide equivalent, created from an emission reduction project. Emission trading schemes have different eligibility and validation criteria for the creation of carbon credits.
Carbon Dioxide	A chemical formed by one carbon and two oxygen atoms. It is the most common greenhouse gas, a normal constituent of the global atmosphere and critical for biological life on Earth. Its increasing concentrations within the atmosphere have given rise to concerns about the long-term sustainability of human-induced carbon dioxide emitting activities, such as fossil fuel combustion.
Carbon Dioxide Equivalent	A measure for comparing the radiative effect of different greenhouse gases, in terms of the corresponding impact of

	emitting carbon dioxide. Carbon dioxide equivalents are calculated by multiplying the Global Warming Potential ('GWP') of a gas by its emitted weight.
Carbon Emissions Trading	A scheme for controlling greenhouse gas emissions at theoretical minimum cost, by allowing participants to respond to market signals and reach an economically optimum response through trading of carbon allowances/credits.
Carbon Finance	Resources provided to projects generating or expected to generate, greenhouse gas or carbon dioxide emission reductions in the form of the purchase of such emission reductions.
Carbon Offset	Offsetting implies avoiding a carbon emission in one location by implementing an emissions reduction project in another location. It is the net reduction in carbon emissions resulting from the avoidance of a tonne of CO_2, and is tradable.
Carbon Sequestration	The capture and storage of carbon dioxide within a carbon sink. Typically used to describe the absorption of atmospheric carbon dioxide by biomass, but can include the geological capture and storage of carbon dioxide, for example in oil/gas wells.
CDM Executive Board	The CDM Executive Board was set up at COP7 in 2001. It supervises the Clean Development Mechanism, under the authority and guidance of the COP/MOP. The COP named 10 members and 10 alternates to the CDM Executive board. The CDM Executive Board is authorised to approve methodologies for baselines, monitoring plans and project boundaries, accredit operational entities; and develop and maintain the CDM registry.

CER: Certified Emission Reduction	The tradable credit created by projects accredited under the Clean Development Mechanism of the Kyoto Protocol, representing a reduction of one tonne of carbon dioxide equivalent.
Clean Development Mechanism	The project-based mechanism articulated in Article 12 of the Kyoto Protocol that allows Annex B parties, i.e. developed countries with quantitative emission limits, to invest in carbon projects in non-Annex I countries, to assist their sustainable development. The investor receives tradable carbon credits ('Certified Emission Reductions') in return.
Commitment Period	The period over which participants within a trading scheme commit to capped emissions. The Kyoto Protocol first commitment period runs from 2008-2012.
Compliance Markets	Emissions markets regulated by laws and enforced by national governments.
Conference of the Parties ('COP')	The organising and decision making body of the United Nations Framework Convention on Climate Change ('UNFCC'), representing about 190 nations that have ratified the Convention.
Credits	Credits are the measure of the benefit to the global environment of undertaking emission reduction projects. Each credit represents the reduction of 1 tonne of carbon dioxide equivalent. Different jurisdictions recognise different types of credits. Kyoto-accredited credits are Certified Emission Reductions (from CDM projects), Emission Reduction Units (from JI projects) and Removal Units (from LULUCF activities).

Deforestation	Deforestation, as defined by the Marrakech Accords, is the direct human-induced conversion of forested land to non-forested land. A forest is defined as a minimum area of land of 0.05-1hectares with tree crown cover (or equivalent stocking level) of more than 10-30 percent with trees with the potential to reach a minimum height of 2-5 metres at maturity in situ. Actual definitions can vary from country to country as the Kyoto Protocol permits countries to specify the precise definition within these parameters to be used for national accounting of emissions. The FAO defines deforestation as 'the conversion of forest to another land use or the long-term reduction of the tree canopy cover below the minimum 10 percent threshold'.
Degradation	A definition for forest degradation has not yet been agreed. In principle, forest degradation is the depletion of forest to tree crown cover at a level above 10 percent, however beyond this general statement.
Emission Reduction Units ('ERUs')	A unit of emission reductions issued pursuant to a Joint Implementation project equal to one metric tonne of carbon dioxide equivalent.
Emission Standard	A legal limit of pollution from a source or site that may not be exceeded without penalty.
Emissions	The release of a substance into the ambient environment; commonly refers to gaseous pollutants emitted to the atmosphere.
Emissions Trading	A system for controlling greenhouse gas emissions at least cost to participants by using a market-based approach.

ERU: Emission Reduction Unit	Credits, each worth one tonne of carbon dioxide equivalent, allocated to projects under the Joint Implementation provisions (Article 6) of the Kyoto Protocol.
First Commitment Period	In the context of the Kyoto Protocol, this is the period 2008-2012, during which countries must meet their binding emissions targets.
Fungibility	Equivalence and interchangability. Usually used in relation to the different carbon allowances and credits accepted under the Kyoto Protocol or other trading scheme.
GHG	Greenhouse Gases. CO_2, CH_4, N_2O, HFCs, PFCs and SH_6.
Global Warming	A term commonly used to describe the increase in the surface temperatures of the Earth observed over the last 100 years or so, predicted for the future, and ascribed to human-induced climate change.
ICAC	Internal Carbon Abatement Curve
Intergovernmental Panel on Climate Change ('IPCC')	An organisation formed in 1988 by the World Meteorological Organisation and the UN Environment Programme to assess scientific and technical information relating to climate change, drawing on leading scientists and experts. It has become the de facto advisory body to world governments through its periodic assessments of the state of science of climate change and possible mitigation and adaptation options.
Internal Rate of Return ('IRR')	The annual rate of return that would make the present value of future cash flows from an investment equal the current market price of the investment.
International Emissions Trading ('IET')	One of three flexible mechanisms included in the Kyoto Protocol, IET allows countries with binding emissions targets to trade their

	Assigned Amount Units with other countries with binding targets.
Joint Implementation	One of three flexible mechanisms included in the Kyoto Protocol, specified in Article 6. JI allows Annex B countries with binding emissions targets to invest in projects - and obtain the resulting carbon credits ('ERUs') - from other Annex B developed countries with binding emissions targets.
Kyoto Mechanisms	The market-based 'flexible' mechanisms that allow participants to minimise the cost of meeting the binding emissions targets: Joint Implementation; Clean Development Mechanism; International Emissions Trading.
Kyoto Protocol	The agreement negotiated in 1997 at COP3, and subsequently refined. It commits developed countries to binding greenhouse gas emissions targets but provides three market-based 'flexible mechanisms' to minimise the cost to participants of meeting targets: JI, CDM and IET.
Land Use, Land Use Change and Forestry ('LULUCF')	The land-use, land-use change and forestry ('LULUCF') sector was included in the Kyoto Protocol to take account of human-induced activities that remove greenhouse gases from the atmosphere, also known as carbon 'sinks'. Article 3.3 of UNFCCC deals with afforestation, reforestation and deforestation. Article 3.4 provides that additional anthropogenic activities in the agricultural soils. LULUCF categories may be added by Annex I Parties to offset their emission targets.
Liquidity	A measure of the effectiveness of the market, determined by the numbers of buyers, sellers and trades undertaken. An illiquid market is unlikely to capture price information that truly reflects supply and demand fundamentals.
Marginal Abatement Costs	The relative financial cost of reducing emissions, in terms of €, £

	or $ invested per tonne of carbon dioxide equivalent abated.
Mitigation	The action of controlling and, ultimately, reducing GHGs.
National Allocation Plan (NAPs)	Each European member state establishes a plan listing its installations that are subject to the EU ETS, their absolute emission caps and the amount of CERs and ERUs that may be used by these installations to comply with their cap. The document must also declare the size of new entrants reserve and the treatment of existing installations or the process of allocation - free allocation or auctioning. The NAPs are subject to review by the European Commission.
NPV	Net Present Value
P/E ratio	Price: Earnings ratio
PIU	Pending Issuance Unit. A credit which bestows the contractual right to a verified emissions reduction allowance generated in the voluntary sector although the VER has not yet been issued.
Plan Vivo	Standard for verifying voluntary projects. Operated by the Plan Vivo Foundation, a UK-based NGO.
REDD	Reduced Emissions from Deforestation and Degradation.

REDD+	REDD+ addresses afforestation, reforestation and sustainable forest management in addition to reducing emissions from deforestation and forest degradation.
Reforestation	Reforestation is the direct human-induced conversion of non-forested land to forested land through planting, seeding and/or the human-induced promotion of natural seed sources, on land that was forested but that has been converted to non-forested land. For the first commitment period, reforestation activities will be limited to reforestation occurring on those lands that did not contain forest on 31 December 1989.
Registry	A database managing and tracking the allowances and credits of all participants within a trading scheme. National registries manage a government's Assigned Amount Units under the Kyoto Protocol.
Renewable Energy	Energy created from sources that are naturally renewed over short timescales: typically solar, wind, wave, tidal, hydro, and biomass.
RMUs: Removal Units	A type of carbon credit created under the Kyoto Protocol and allocated to carbon sink projects.
Securitisation	The packaging of designated pools of non-tradable assets with similar characteristics (such as loans) into marketable securities (such as bonds) and the selling thereof to investors. Securitisation converts illiquid assets into liquid assets

Sequestration	The process of uptake of a substance or chemical. This is typically used in the context of carbon dioxide being absorbed by the biosphere.
SFM	Sustainable Forest Management
Sustainable Development	Development that meets the economic, social and environmental needs of all stakeholders, including future generations.
UN Framework Convention on Climate Change ('UNFCCC')	The convention developed by the United Nations, following the Earth Summit in 1992, which commits signatories to stabilise greenhouse gas emissions at levels that would prevent dangerous human-induced interference with the climate system. It was adopted in 1994 and is now managed by the Conference to the Parties.
VCS	Voluntary Carbon Standard for verifying voluntary projects.
VCUs	These are VERs that have been verified to the VCS standard for verifying voluntary projects.
VER+ (See Verified Emissions Reductions +)	VER Plus Standard for verifying voluntary projects.
Verification	In the context of a CDM project it is the process of independently assessing whether projected emissions reductions have in fact taken place. In the EU ETS it is the independent 'audit' by licensed verifiers of annual emissions by installations which must take by 31st March in the following year.

VER +	The criteria for VER+ are in line with the project based, JI and CDM, mechanisms including the requirement on project additionality proving that the project is not a business as usual scenario. VER and VER+ differ as VER+ projects are not brought to registration with UNFCC and therefore not accounted on any ANNEX 1 country's Kyoto balance. For projects in developing countries more flexibility is provided on the choice of the applied methodologies, which may be composed according to the JI project guidelines.
Verified Emissions Reductions ('VERs')	VERs are generated by projects assessed and verified by third party organizations rather than the UNFCC channels. VERs are allowances from voluntary projects that have been independently verified to a specified international standard.
Voluntary Carbon Standard ('VCS')	VCS is a new standard intended to cover GHG emissions reduction projects developed for voluntary markets. VCS offsets must be real (have happened), additional (beyond business-as-usual activities), measurable, permanent, (not temporarily displace emissions), independently verified and unique (not used more than once to offset emissions).
Voluntary Markets	Voluntary markets for emissions reductions cover those buyers and sellers of VERs which seek to manage their emission exposure for non-regulatory purposes.

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