

CLIMATE CHANGE: EMISSIONS TRADING

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Emissions Trading is a market based mechanism that regulates emissions using a system of exchangeable allowances. This Briefing introduces the concept, explores how it has been used in the past, and considers how the mechanism is currently used to reduce the emissions of greenhouse gases. It further considers how the proposals in the Scottish Climate Change Bill fit in with existing emissions trading schemes.

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KEY POINTS

- United Nations scientists advise that recently observed changes in the earth's climate are *very likely* due to human-caused emissions of greenhouse gases (GHG) such as carbon dioxide
- To avoid further changes which could be dangerous and costly, scientists advise that the level of greenhouse gases in the atmosphere must be stabilised. This would require emissions to be reduced considerably
- Greenhouse gas emissions are a negative economic externality - the costs of climate change are not wholly borne by those who emit greenhouse gases, but by others across the world and in future generations
- The Stern review described climate change as one of the most significant market failures ever seen, and suggested the economic costs of tackling it could be marginal compared to a "business as usual" scenario of unmitigated climate change
- One of the main policies Governments around the world are implementing to reduce emissions is emissions trading - a market where allowances to emit are exchanged as a commodity with a price determined by supply and demand. Some economists consider this to be the best economic instrument to regulate and reduce emissions, as opposed to one of the main alternatives, a carbon tax
- The idea is that the market will decide where emissions can be reduced most cost effectively. Firms that can reduce emissions for less than the price of an allowance will do so, firms for whom emissions reductions are more costly will buy allowances in the market
- A 'Cap and Trade' scheme sets a limit on the total number of allowances, and so the overall level of emissions, in the market. The 'cap' can be reduced in line with emission targets to assist with international obligations such as the Kyoto Protocol
- The European Union operates the world's first mandatory international Emissions Trading Scheme. Large emissions sources, such as power stations and steel works, are included in the scheme, accounting for nearly half of total EU carbon dioxide emissions. A conclusion on the framework for Phase 3 of the EU Emissions Trading Scheme was given final agreement in the European Parliament on 17 December 2008
- The UK Climate Change Act 2008 gives UK ministers and the devolved administrations the ability to establish emissions trading schemes. The first of these, the Carbon Reduction Commitment, will commence in full in 2010 and cover emissions from large corporations and public sector bodies
- The Scottish Climate Change Bill would allow Scottish Ministers to engage in trading to help meet Scottish emissions reduction targets, and sets no limit on the amount of trading
- The global market for emissions trading is expected to grow to around €63 billion Euros in 2008

- A risk of emissions trading is that by imposing a cost on businesses which those in other countries are not subject to, they are placed at a competitive disadvantage. This could lead some businesses to relocate to other parts of the world which are not part of a scheme, especially in those industries which are emissions intensive and produce commodities that are traded globally. This phenomenon is called “carbon leakage”
- This means that international negotiations to progressively implement emissions trading or carbon taxes which create a more level global playing field are important. Until then Governments must consider ways to account for this within their emissions trading schemes. To date Governments have sought to guard against carbon leakage by issuing free allowances to some of the most polluting enterprises
- The eventual outcome of the international climate change negotiations on a successor to the Kyoto Protocol, which are due to be completed in Copenhagen in 2009, will have a great bearing on the cuts in emissions that trading schemes are expected to deliver in coming years

INTRODUCTION

CLIMATE CHANGE AND GREENHOUSE GASES

The Fourth Assessment Report of the [Intergovernmental Panel on Climate Change](#) (IPCC 2007) stated that “warming of the climate system is unequivocal”, and that this warming is “very likely” – with more than 90% certainty – due to human activities; specifically, that it is caused by the increasing levels of greenhouse gases.

After water vapour, the most significant greenhouse gas is carbon dioxide (CO₂), which is thought to be at its highest level in the atmosphere for at least 650,000 years. Carbon dioxide levels have increased by over a third since pre-industrial times to 379 ppm¹ in 2005 (IPCC 2007), and total greenhouse gas levels now exceed 430 ppm of carbon dioxide equivalent (CO₂e)² (Stern 2006) “due primarily to fossil fuel use, with land-use change providing another significant but smaller contribution” (IPCC 2007). Average global temperatures rose by 0.74° C between 1906 and 2005 (IPCC 2007), and the nine warmest years on record have occurred in the last decade ([Met Office](#) 2008). The science and policy outcomes of the IPCC report are presented in more detail in recent reports on [Climate Change Science](#) (Smith 2007a) and [Averting ‘Dangerous’ Climate Change?](#) (Cook 2007a).

Scientists believe climate change mitigation requires emissions of greenhouse gases to be stabilised and then reduced. They estimate that there is a less than 25% probability of avoiding “dangerous” climate change of 2°C if total greenhouse gas concentrations reach 550 ppm carbon dioxide equivalent (Stern 2006). [The Stern Review](#) on the Economics of Climate Change (2006) warns that:

weak action in the next 10-20 years would put stabilisation even at 550ppm CO₂e beyond reach – and this level is already associated with significant risks.

Whatever measures are taken in the short term, the IPCC ([2007](#)) project further warming of at least 0.2° C for each of the next two decades, with further unavoidable change for several centuries due to the slow response of the climate system. Therefore any action taken now is with a view to long term mitigation of climate change. (Stern 2006).

Some have warned that many of the international targets being proposed are not strong enough to avert “dangerous” climate change of 2°C or more, and that economic and political interests are overwhelming the scientific and environmental consensus. [WWF](#) recently stated that targets should be based around scientific guidance for emissions to peak by 2015, and that the EU should be aiming for a 30% reduction by 2020 “because we know that is what’s needed” ([Planet Ark](#) 2008a).

The Confederation of British Industry (CBI) has [said](#) (2008a) that:

The best question for the business community is whether we can be certain that climate change presents a substantial risk; a risk that will have a profound impact on society and

¹ parts per million

² Carbon dioxide equivalent is a term used to indicate the potency of the other five greenhouse gases considered under the Kyoto Protocol relative to carbon dioxide. For instance methane is 21 times more potent than carbon dioxide and so one tonne of methane can be described as being 21 tonnes of carbon dioxide equivalent (25 tCO₂e)

the economy? To this the answer is clearly 'yes'. And so, as with all substantial risks, it is vital to mitigate the danger.

On negotiations for a follow-up to the Kyoto Protocol, the CBI (2008b) has [said](#):

The conclusion of a comprehensive global climate change agreement to replace the Kyoto Protocol which expires in 2012 is essential. If well designed, it will ensure the long-term competitiveness of British business and unlock the potential of a low-carbon future. A robust agreement will create a market for low-carbon technologies that could be worth \$1 trillion in the first five years of its implementation.

INTERNATIONAL ACTION ON CLIMATE CHANGE

The lead international agreement on climate change is the United Nations Framework Convention on Climate Change (UNFCCC). The Convention was adopted in 1992, since when Parties to the Convention have negotiated to advance its implementation. Early negotiations resulted in the adoption of the [Kyoto Protocol](#) in 1997. This established mandatory targets for greenhouse gas emissions for 38 developed countries (known as Annex 1 Parties) relative to a 1990 base year. The targets were for industrialised nations to reduce their total greenhouse gas emissions by an aggregate of 5% from 1990 levels between 2008 and 2012. Some countries with high emissions per capita, such as Australia and the USA, did not ratify the Protocol (though President-elect Barack Obama has [pledged](#) an 80% reduction on 1990 emission levels by 2050, and to reduce emissions to 1990 levels by 2020 (Obama-Biden 2008).

Australia has now ratified the Kyoto Protocol, though its target of reducing emissions by 60% of 2000 levels by 2050 and to aim for 5–15 % below 2000 levels (which equates to 4–14% below 1990 levels) has come in for some initial criticism ([Adelaide Now](#) 2008). Australia has also committed to introducing an emissions trading scheme. The Australian Government, in a [factsheet](#) (Australian Government Department of Climate Change 2008a) accompanying its newly published [climate change white paper](#) states (Australian Government Department of Climate Change 2008b):

The Government has set a medium-term target range for emissions reductions of between 5 and 15% below 2000 levels by 2020. The top of this range (a 5% reduction on 2000 levels) represents an unconditional commitment by Australia to reduce emissions even if no international agreement to do so is reached. The bottom of the range (a 15% reduction on 2000 levels) represents the emissions reductions Australia is prepared to undertake in the context of global agreement under which all major economies commit to substantially restrain emissions, and advanced economies take on reductions comparable to Australia.

The [latest figures](#) produced by the UNFCCC (2008a) show that:

emissions of 40 industrialized countries that have greenhouse gas reporting obligations under the Convention remained in 2006 below the 1990 level by about 5%, but rose by 2.3 percent in the time-frame 2000 to 2006. For the smaller group of those industrialized countries that have ratified the Kyoto Protocol, emissions in 2006 were about 17% below the Kyoto baseline, but still growing after the year 2000. The initial decrease in Kyoto countries mainly came about through the economic decline of economies in transition (countries in eastern and central Europe) in the 1990s. Meanwhile, the biggest recent increase in emissions of industrialized countries has come from economies in transition, which have seen a rise of 7.4% in greenhouse gas emissions within the 2000 to 2006 time-frame.

In 2007 the [UN Climate Change Conference](#) agreed the [Bali Roadmap](#) for action beyond the Kyoto Protocol (UNFCCC 2007). This stated that future action should be agreed by the end of 2009. Some movement along the way to a global agreement to replace Kyoto was achieved at the United Nations Climate Change Conference in Poznań which concluded on 13 December. At the Conference it was agreed that the first draft of a concrete negotiating text would be available at a UNFCCC gathering in Bonn in June of 2009, with a view to a final agreement being made in Copenhagen in December 2009 ([UNFCCC 2008b](#)).

In January 2008, the European Commission [announced](#) its climate and energy proposals (European Commission 2008). On 12 December 2008 (Council of the European Union 2008) [agreed](#) to the final package on climate change and energy measures. The final agreement saw the EU 27 commit to three targets for 2020:

- reducing greenhouse gas emissions by 20 % (30% if a global deal is reached in Copenhagen in 2009)
- increasing the proportion of renewable energies to 20 %
- making energy savings of 20%

These three targets are supported by a package of four elements: an emissions trading scheme, a fair distribution of effort between countries, promotion of renewable energies and CO₂ capture and storage.

The G8 meeting in Japan in July 2008 said in its communique that ([G8 2008](#)):

We seek to share with all Parties to the UNFCCC the vision of, and together with them to consider and adopt in the UNFCCC negotiations, the goal of achieving at least 50% reduction of global emissions by 2050, recognizing that this global challenge can only be met by a global response, in particular, by the contributions from all major economies, consistent with the principle of common but differentiated responsibilities and respective capabilities.

EFFORT SHARING

The EU has agreed to meet its Kyoto obligations collectively. The specific targets assigned under Kyoto to each individual Member State have been redistributed using a concept called burden or effort sharing (European Commission 2008b).

Effort sharing allows targets for each member of a group to reflect their individual economic circumstances whilst ensuring that overall targets are met. For example, the EU has a higher than average Kyoto Protocol target of 8%, which is itself distributed between member states and sectors as shown in Figure 1. In this way, countries with lower relative GDPs are able to grow their economies (without the risk of compromising their growth by seeking to reduce emissions at the same time), while those that have emitted more in the past must make significant reductions. Effort sharing is viewed as a key concept in fair and equitable action on climate change, and relies on cooperation, rather than individual action, to achieve targets.

Using Australia as an example (even though they did not ratify it early on), Smith and Edwards (2008) stated:

[In the Kyoto negotiations] Australia successfully argued that targets should be allocated on the basis of equality of effort, which led to differentiated targets. Hence the target for Australia for its average annual emissions for 2008-12 is 108% of 1990 levels. The other

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developed countries with targets either at or above the 1990 base included: Iceland (110%); New Zealand (100%); Norway (101%); Russian Federation (100%); and the Ukraine (100%). Other countries' targets range from 92 percent to 95 percent, with the majority committed to a 92 percent target.³

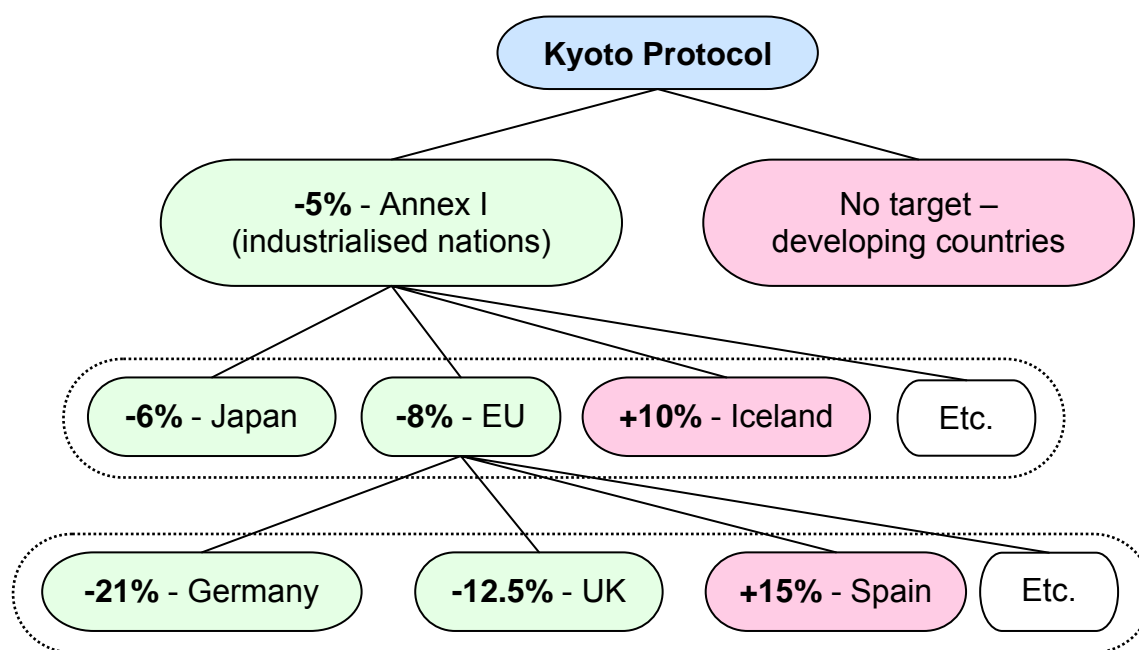


Figure 1. Hierarchy of effort sharing for emission reduction targets in the Kyoto Protocol

KYOTO PROTOCOL MECHANISMS

The Kyoto Protocol established three [flexible mechanisms](#) (United Nations Framework Convention on Climate Change [UNFCCC]) to encourage international activity on emissions abatement. These are:

- Clean Development Mechanism (CDM)
- Joint Implementation (JI)
- Emissions Trading

The CDM and JI are voluntary, international project-based schemes to reduce emissions using a baseline and credit system, while emissions trading describes the general framework enabling nations to exchange credits and allowances and use them to account for a portion of their domestic emissions and targets.

A key operating rule of these international market mechanisms is the “supplementarity principle”, which ensures that the majority of climate change mitigation occurs domestically. This is implicit in several parts of the Kyoto Protocol, such as Article 6.1 which states that:

“The acquisition of emission reduction units shall be supplemental to domestic actions for the purposes of meeting commitments”.

However, the level of supplementarity required by the Protocol is not well defined, and has been interpreted by different countries as anything up to 50% of emissions.

³ Kyoto Protocol to the United Nations Framework Convention on Climate Change, Annex B
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Clean Development Mechanism (CDM)

The [Clean Development Mechanism](#) allows organisations from Annex I countries (those with Kyoto Protocol targets) to organise emissions abatement projects in developing countries. In return for emissions reduced or avoided, Certified Emission Reduction (CER) credits, each representing 1 tCO₂e are earned, which can be counted towards Kyoto Protocol reduction targets, or sold to other Annex I countries through emissions trading systems. The CDM is designed to encourage international development and technology transfer, as well as emission reductions.

Emission reductions due to CDM projects must be additional to a “business as usual” scenario, meaning that the activities must not have been planned before the introduction of the CDM, and they must also contribute to the sustainable development goals of the host country. Projects can involve a range of activities including energy efficiency, renewable energy production, agricultural methods and transport.

The Clean Development Mechanism has been in operation since 2000, allowing Annex I countries to bank CER credits for use during the Kyoto Protocol compliance period of 2008-2012.

Joint Implementation (JI)

[Joint Implementation](#) projects are similar to the CDM, but are undertaken by organisations from one developed country in the territory of another.

Unlike the CDM, emission reductions are not independently verified, and generate credits called Emissions Reduction Units (ERU), also representing 1 tCO₂e. However, for the purposes of emissions abatement, ERU and CER credits are considered equivalent and can be traded interchangeably. Joint Implementation projects are able to operate from 2008 to enable their use in the Kyoto Protocol compliance period.

THE ECONOMICS OF CLIMATE CHANGE

THE POTENTIAL COSTS OF GLOBAL WARMING

The potential environmental effects of climate change have been widely reported, but recent work has also focussed on the economic impacts and costs. Commissioned by Gordon Brown for the UK Treasury, the 2006 Stern Review on the Economics of Climate Change examined this subject in the context of wider policies on climate change mitigation.

The Stern Review (2006) reiterates the point that greenhouse gas emissions are a negative economic externality. In other words the costs of climate change are not wholly borne by those who emit greenhouse gases, but by others across the world and in future generations. Stern describes climate change as presenting

“...a unique challenge for economics: it is the greatest and widest-ranging market failure ever seen”.

The [UN Human Development Report 2007/2008](#) (United Nations Development Programme 2008) recognised that:

While the world’s poor walk the Earth with a light carbon footprint they are bearing the brunt of unsustainable management of our ecological interdependence. In rich countries,

coping with climate change to date has largely been a matter of adjusting thermostats, dealing with longer, hotter summers, and observing seasonal shifts. Cities like London and Los Angeles may face flooding risks as sea levels rise, but their inhabitants are protected by elaborate flood defence systems. By contrast, when global warming changes weather patterns in the Horn of Africa, it means that crops fail and people go hungry, or that women and young girls spend more hours collecting water.

The Stern Review reported that, especially in the short term, it will be the world's poorest countries and people that will bear the majority of the costs of climate change through depleted resources, loss of land, and impacts to health. It estimated the costs of climate change to be 5-20% of average annual GDP by the middle of the century if no action is taken. Stabilising greenhouse gases between 500 and 550 ppm by 2050 is predicted to cost significantly less, at around 1% of annual GDP, and the Stern Review concludes that

“Emissions have been, and continue to be, driven by economic growth; yet stabilisation of greenhouse-gas concentrations in the atmosphere is feasible and consistent with continued growth”.

PUTTING A PRICE ON GREENHOUSE GAS EMISSIONS

One fundamental solution to the market failure of climate change is to apply the “polluter pays” principle and define greenhouse gases as a commodity. The first key recommendation of the Stern Review (2006) is that:

“Putting an appropriate price on carbon⁴ – explicitly through tax or trading, or implicitly through regulation – means that people are faced with the full social cost of their actions. This will lead individuals and businesses to switch away from high-carbon goods and services, and to invest in low-carbon alternatives. Economic efficiency points to the advantages of a common global carbon price: emissions reductions will then take place wherever they are cheapest”.

The Fourth Assessment Report of the IPCC (2007) includes detailed analysis of adaptation and mitigation options, and states that:

“An effective carbon-price signal could realise significant mitigation potential in all sectors. Modelling studies show global carbon prices rising to 20-80 US\$/tCO₂-eq⁵ by 2030 are consistent with stabilisation at around 550 ppm CO₂-eq by 2100. For the same stabilisation level, induced technological change may lower these price ranges to 5-65 US\$/tCO₂-eq in 2030”.

A choice exists between emission trading, which (for the most part) allows the market to decide the price of carbon within an overall emissions limit, and a carbon tax, which sets a price and allows the market to decide the level of emissions. Hybrid schemes are possible, where emission trading schemes include a price cap, acting as an upper ceiling on allowance prices, but if the price cap is reached, there is no effective limit on emissions.

The price of carbon, and the emission trading tool used heavily influences the resulting emission pathways. In 2007 the UK Department for Environment, Food and Rural Affairs ([2007a](#)) established a “shadow price of carbon” based on criteria it felt appropriate at the time, though

⁴ Sometimes ‘carbon’ and ‘carbon dioxide’ are used interchangeably, though this is not scientifically correct

⁵ This means US Dollars per tonne of carbon dioxide equivalent. Carbon dioxide equivalent is a term used to indicate the potency of the other five greenhouse gases considered under the Kyoto Protocol

this has been [critiqued](#) by the Stockholm Environment Institute (2008). Generally, the kind of emission pathways associated with avoiding the worst impacts of climate change involve steeper reductions than most current emissions trading schemes propose.

EMISSIONS TRADING SCHEMES

Emissions Trading is a market based mechanism that applies a limit on pollution, and regulates it with a system of allowances that can be exchanged between participants. Each allowance gives its holder the right to emit a specified level of the relevant pollutant, and the supply of these can be used to control the overall level of pollution. Trading of allowances between parties who are responsible for emissions can occur on an open market with a price determined by demand.

Where the cost of reducing emissions is cheaper than the price of allowances, participants in a trading scheme have a financial incentive to reduce their emissions. Conversely, when the costs are high it is preferable to purchase sufficient allowances to cover emissions. When allowances become scarce and the price of emissions rise, there is a corresponding increase in the available options for cost effective emissions reduction; and in this way emissions trading schemes produce the most economically efficient way for a group of participants to reduce their emissions, with the “lowest hanging fruit” always targeted first.

Emissions trading schemes can work in many different ways, and the following sections outline the basic principles and introduce some important concepts. A more thorough [Guide to Emissions Trading](#) is available from the UN Environment Programme (Haites 2002).

FUNDAMENTAL ISSUES

Emissions trading schemes can regulate a wide range of pollutants, from greenhouse gases to toxic metals (see Box 1). They may also include three fundamentally different kinds of activity:

- the **emission** of a pollutant (e.g. greenhouse gas) into the environment, for which allowances must be owned and surrendered to the regulator
- the active **reduction of emissions**, perhaps by the closure of an emission source or improvements in efficiency, for which allowances can be granted by the regulator
- the **removal** of a pollutant from the environment into a store or “sink” (e.g. Carbon Capture and Storage⁶ for which allowances are also earned.

Allowances are the currency of a trading scheme, and represent a fixed quantity of pollutant. For greenhouse gases, they usually equate to one tonne of carbon dioxide, and can either be allocated, or purchased on a market. To allow different greenhouse gases to be treated in the same way, their relative potencies, called global warming potential (GWP), are used to define them in tonnes of carbon dioxide equivalent (tCO₂e). For example, one tonne of methane, which has a GWP of 25 (IPCC 2007), can be represented by 25 tCO₂e.

Trading schemes are market based instruments, and therefore require liquidity – a volume of trade in allowances and the efficient transfer of price information to market participants - to operate effectively. Membership can be voluntary or compulsory, and determined by either geographical area, economic sector, or by a threshold on emissions. A scheme operates over specific trading periods during which emissions are monitored and allowances exchanged. At the end of a trading period each participant is usually required to surrender allowances equalling their emissions to the scheme regulator. Transactions and participant details are administered

⁶ See [SPICe Briefing on Carbon Capture & Storage](#) (Reid 2007)

by a central registry, and trading can take place privately, or through a broker or exchange in broadly the same way as stocks and shares.

The emerging carbon market

Emission permits can be traded between scheme participants and other parties in three ways: privately, through a broker, or on a spot market. The emerging market for emission commodities has seen new establishments such as the [Chicago Climate Exchange](#) (CCX) and the [European Climate Exchange](#) (ECX) opened. These operate in a similar manner to stock exchanges, and allow the market for allowances to be “played” in the same way as other more established financial instruments (such as futures and hedging). The ECX accounts for almost 80% of the spot market for EU Emissions Trading Scheme allowances, dealing with almost 1.3 billion tonnes of carbon dioxide since 2005, worth €24 billion. [Recent estimates](#) project the total value of the global carbon market to be €63 billion Euros in 2008 (Point Carbon 2008).

Box 1 – The History of Emissions Trading

Emissions trading was pioneered in the United States of America (USA) under the Clean Air Act amendments of 1970 as a method to reduce harmful pollution. The first major trading scheme operated to reduce the lead content of petrol.

The US Environmental Protection Agency (US EPA) enforced strict regulations from 1975 onwards to reduce the concentration of lead in gasoline (petrol) ([EPA 2008](#)). The limit was applied over quarterly cycles, and allowed some averaging between production batches. By 1982 this regulation was supplemented by a trading process where averaging could be used between different refineries and companies and over longer periods of time. A baseline concentration was enforced, and producers who stayed within this were awarded credits that they could then bank for future use (e.g. for a higher-lead batch) or sell to competitors who exceeded it. The EPA judged the lead trading programme to be successful, noting that:

“the use of lead in leaded gasoline was sharply reduced over a short period of time without spikes in the price of gasoline that otherwise might have occurred” (EPA 2008a).

Amendments to the USA’s Clean Air Act in 1990 introduced the Acid Rain Programme, which included a trading scheme for sulphur dioxide (SO₂) emissions from electrical power stations. This “cap and trade” scheme set a limit on the total amount of SO₂ that could be emitted, and required its participants to either reduce their own emissions or purchase allowances from competitors. The resulting demand for new technology saw the price of abatement fall, and between this and the use of low-sulphur coal, the targeted reductions have been successfully achieved, with emission reductions of 35% from 1990 levels projected for 2010. The success of the programme has been described as

The sulfur dioxide trading system in the US overshot its overall goals with time to spare, at costs lower than those predicted, with manageable transaction costs, and, so far, without extensive litigation ([Lohmann 2002](#)).

Consequently, the Acid Rain Programme is now viewed as one model example for greenhouse gas emissions trading schemes.

The UK Emissions Trading Scheme

Between 2002 and 2006, the UK operated the world’s first voluntary economy wide greenhouse gas emissions trading scheme (DEFRA 2007b). This consisted of thirty three large companies and organisations, with a targeted reduction of nearly 4 million tCO₂e (an average of 13% from 1998-2000 levels). By the end of the scheme the actual reductions by participants exceeded 7 million tCO₂e below their baseline level. The final [appraisal report](#) of the UK ETS (Enviros 2006) noted that:

The most common means of reducing emissions has been through reduced energy use, impacting on carbon dioxide emissions. Reductions have been made through the abatement of both indirect (electricity) and direct emissions [...] Reductions have been both achieved through the installation of emissions abatement equipment and also through modifications to the ways that existing pieces of kit are used

The experiences of abatement strategies and trading scheme administration have since been used to inform other European and UK policies.

TRADING SCHEME MODELS

There are two basic types of emissions trading schemes, widely known as “cap and trade” and “baseline and credit”. The concept of carbon offsetting can also be closely related to emissions trading. These trading scheme models are outlined below.

Cap and trade

In a cap and trade scheme the participants are bound by an absolute limit on the quantity of pollution they can emit. By enforcing this limit, a cap and trade scheme can be used to achieve targeted reductions in emissions such as those required by the Kyoto Protocol or the EU.

In such a scheme, the price of carbon is determined by three main factors:

1. the overall level of the cap – the lower the cap, the more scarce are allowances, and the higher the price of carbon
2. the tightness of the cap – the more offsetting that is allowed, the slacker the cap will be, and the carbon price will change accordingly
3. the allocation method – auctioning of credits will give a higher price than giving them away

There are three fundamental decisions involved in designing a cap and trade system ([Kruger, Oates & Pizer 2007](#)):

1. the participants are selected, defining the overall demand for allowances in the system
2. the cap is set based on an environmental target, defining the supply of allowances in the market
3. the market is set into motion by distributing allowances between the participants

If any participant exceeds their permitted emissions then they must purchase more allowances from others who have excess, and the market should function effectively as long as there are a sufficiently large number of participants and a scarcity of permits. In such a scheme, the price of carbon is influenced by several factors: the overall level of the cap, and the resulting scarcity of allowances; the tightness of the cap, and whether allowances from other schemes can be introduced to offset some emissions; and the method of allocating allowances, where auctioning them will result in higher prices than distributing them for free.

A key feature of cap and trade schemes is that the only environmental target is the overall cap: emissions by individual participants are not viewed as important as the aggregate total. Thus, while there may be a target to reduce overall emissions year-on-year, it is entirely possible for some members of a scheme to increase their emissions without further regulation, as shown in Figure 2.

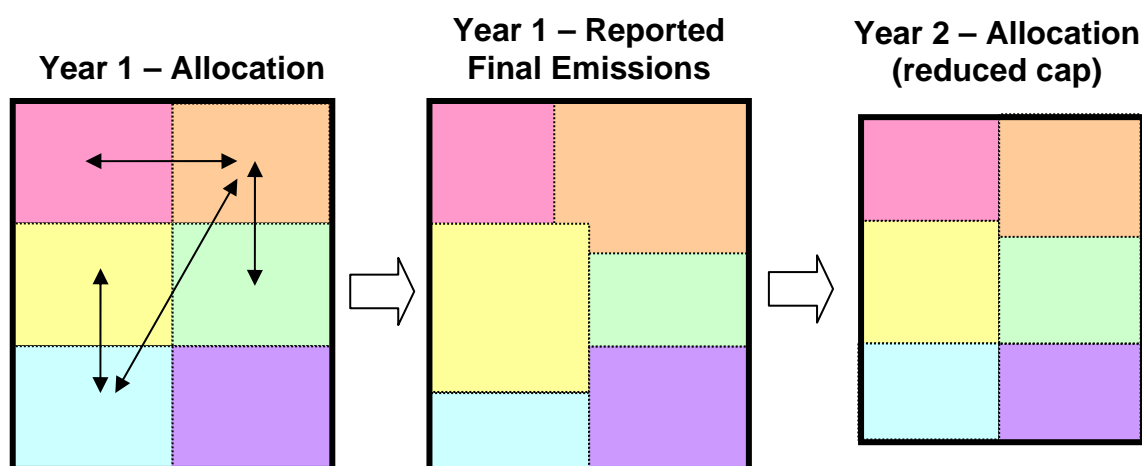


Figure 2 illustrates how members of a trading scheme can stay within the cap, while still allowing some participants' emissions to increase. By reducing the cap in subsequent years, real cuts in overall emissions can be made and reduction targets reached.

Baseline and credit

The “baseline and credit” concept is very different to “cap and trade”. It involves a process where each participant is given a target baseline for emissions, and is then awarded allowances for staying within it, for example in the leaded gasoline programme referred to in Box 1.

Because the allowances in a baseline and credit scheme relate to emissions around a theoretical baseline, they represent “reduced” or “avoided” emissions, as opposed to simply permitted emissions. Many of the economic concerns expressed about emissions trading relate to baseline and credit schemes, and a report on their potential problems ([Lohmann 2002](#)) states that:

“In such systems, attempts are made to equate numerically the transfer of underground mineral carbon to the atmosphere either with carbon dioxide absorption by the biosphere or lithosphere or with estimated ‘avoided emissions’.

In addition to the normal risks and uncertainties connected with any new market, [these] systems carry an overwhelming additional risk [of] market collapse due to the absence of a robust and deliverable commodity to trade.

Unlike [cap and trade] systems, [baseline and credit] systems need to construct a hybrid commodity quantitatively combining rights to emit on the one hand with, on the other, proof that carbon has been sequestered or a certain amount of hypothetical emissions ‘avoided’. The construction of this hybrid commodity is impossible...”

Although the total sum of credits issued in a baseline and credit scheme can be equivalent to an emissions cap, it is possible for them to rise in line with productivity and market activity. Thus, although the baseline and credit system can encourage better efficiency from participants, it is less efficient than cap and trade at facilitating absolute emission reductions ([Buckley, Mestelman & Muller 2005](#)).

Carbon offsetting

Alongside emissions trading there is a growing market in carbon offsetting, which enables individuals or organisations to pay for emission reduction or carbon removal projects as compensation for their own activities. Carbon offsetting is often used to attain “carbon neutral”

status, whereby sufficient offset credits are purchased to balance all emissions caused by a business, household, or individual.

Carbon offsetting is introduced in detail in a recent report on [Voluntary Carbon Offsets](#) (Smith 2007b). This explains the difficulties with quantifying offsets, and the concerns relating to permanence and timescales (e.g. the length of time it takes a tree to sequester offset carbon, and whether new plantations will remain in place for significant lengths of time), and whether they are additional to a “business as usual” scenario. The Department for Environment, Food and Rural Affairs (2008b) has [developed](#) an updated code of best practice for carbon offsetting which aims to ensure that the offsetting market is well regulated and these concerns addressed. However, even with strict regulation, many environmental groups do not view offsetting favourably, and [Friends of the Earth](#) (2008) responded to the Department for Environment, Food and Rural Affairs proposal by stating that:

“Carbon offsetting cannot substitute for cutting emissions here and now. This code will still allow offsets to be sold for our increasingly polluting lifestyles”.

EMISSIONS TRADING IN PRACTICE

THE EUROPEAN UNION EMISSIONS TRADING SCHEME

The [European Union Emissions Trading Scheme](#) (EU ETS) is the world's largest international emissions trading scheme, and is a cornerstone of EU climate change policy. It is a mandatory cap and trade scheme, covering more than 11,000 installations and emission sites in thirty countries from the EU and the European Economic Area. The EU ETS commenced in 2005, and is due to run in three phases until at least 2020. During the first two phases nearly all EU Allowances are distributed free by member states to individual installations, who then have the opportunity to trade them freely between themselves as demand arises. A conclusion on the framework for Phase 3 of the EU Emissions Trading Scheme was given final agreement in the European Parliament on 17 December 2008

The scheme covers carbon dioxide emissions from a range of high energy industries such as electricity generation, iron and steel plants, oil refineries and other large combustion units. Mineral industries, such as cement, and large paper and pulp processes are also covered due to their large carbon dioxide emissions. Nearly half of carbon dioxide emissions from member states are included in the EU ETS (around 40% of total greenhouse gas emissions), and the intention is to reduce by 7% between 2005 and 2012 ([European Commission 2008](#)).

Where fines or permits auctioned at the start of a phase are referred to (i.e. before they are bought and sold on the market), the money involved goes to the relevant Member State government.

Phase 1 (2005-2007) – trial and error

The EU ETS was launched in January 2005 and included all 25 then-members of the European Union. Phase 1 was intended to introduce emissions trading so the EU could benefit from “learning through doing” before the Kyoto Protocol compliance period began in 2008, and scheme details included:

- an overall European cap calculated as a total of individual National Allocation Plans (NAPs)
- annual, free allocation of all allowances according to a “grandfathering” approach based on historical emission baselines for each participant site
- the ability to bank allowances for use in future years, and a limited ability to borrow allowances from the following year's allocation
- a closed system in which only EU emission Allowances (EUA) could be traded
- a fine of €40/tonne charged for emitting in excess of allowances plus the requirement to add these to the next year's annual total emissions, a so called double hit, and ensuring that the overall cap is not breached.

The EU ETS received significant media attention when the market price crashed in May 2006 from around €30 to less than €10/tonne after the market became aware of oversupply of allowances because of overgenerous allocations in some NAPs.

The infrastructure and trading mechanisms functioned as planned, and there was a generally high compliance rate – although this may have been assisted by the low prices throughout the phase, which dipped to 10 cents per tonne towards the end of the trading period.

Phase 2 (2008-2012) – Kyoto Protocol compliance

The second phase of the EU ETS is the core instrument for Kyoto compliance in the European Union. It now includes all EU member states as well as Norway, Iceland, Switzerland, and Liechtenstein. There have been some changes to the trading scheme, including:

- The cap will be decreased to target an average reduction of 7% below 2005 levels by the end of 2012
- phase 1 allowances banked after the market crash cannot be used in phase 2
- credits from Kyoto Protocol flexible mechanisms (CDM and JI) can be used to account for some emissions, but offsets from forestry projects are not allowed
- the penalty has risen to €100/tonne, as well as the allowance “double hit”
- aviation (both inter-EU flights and flights arriving from or departing to international locations) will be introduced to the scheme in 2012, with an allocation of allowances corresponding to 97% of average 2004-2006 aviation emissions.

Smith and Edwards (2008) have [considered](#) the first two phases of the EU ETS thus:

For the first and second phases of the Scheme, at least 90% of the emission allowances were distributed free of charge. This attracted some criticism, as it gave rise to windfall profits to some industries, notably power generators. For the second trading period the Commission has capped national emissions from EU ETS sectors at an average of around 6.5% below 2005 levels.

The basis of a successful market-based instrument is that the carbon price signal flows through the economic chain gradually inducing moves to low carbon production and consumption choices at each stage. To date, the introduction of the European Trading Scheme has seen a mixed integration of the carbon price signal. In those sectors where companies compete against others not subject to climate change policies, there has been a limited increase in prices. This implies that the companies are absorbing the increasing carbon cost. In other sectors, particularly power generation, the pass through of the carbon price has been more easily achieved, and has contributed to an increase in electricity prices.⁷

Phase 3 (2013-2020) – towards a global carbon market?

In January 2008 the European Commission announced a series of amendments to the way the EU ETS will operate during its third phase with an overall aim of a target of Phase 3 to bring total greenhouse gas emissions from participants to at least 21% below 2005 levels by 2020.

The Commission proposals for the EU ETS included:

- the introduction of a single European cap on emissions instead of individual NAPs
- a year on year reduction in the cap to 2020 to reach 21% below 2005 levels (other European targets will need to be considered here too, for instance on renewables and energy efficiency)
- emissions from aviation will be capped at 95% of average 2004-2006 emissions throughout the phase
- allocation rules will be harmonised across the scheme and administered by the EU

⁷ Commission of the European Communities, Communication from the Commission to the Council, The European Parliament, the European Economic and Social Committee and the Committee of the Regions, *Building a global carbon market – Report pursuant to Article 30 of the Directive 2003/87/EC*. Brussels, 13.11.2006 COM (2006) 676 final.

- there will be full auctioning of allowances for some sectors, such as electricity generation, from 2013 with increased auctioning in all other sectors from 2013 leading to full auctioning by 2020 – it is expected that around 60% of all allowances will be auctioned in 2013
- some sectors subject to strong international competition, and therefore at risk from carbon leakage, will continue to receive some allowances free
- further industrial sectors, and other greenhouse gases will be included in the scheme
- the scheme will operate more closely with other emerging international trading schemes, including the CDM and JI, forming the basis of a global carbon market.

Following on from a vote in October 2008 where the European Parliament voted to keep the broad architecture of the Commission proposals unchanged ([Euractiv.com](#) 2008a), the debate moved onto the European Council, where Heads of State led (rather than Environment Ministers – this signifies the importance of the issue). Final [agreement](#) was reached in Council on 12 December 2008 (Council of the European Union 2008), with [endorsement](#) by the European Parliament on 17 December 2008 ([Euractiv.com](#) 2008c). The final agreement saw the EU 27 commit to three targets for 2020:

- reducing greenhouse gas emissions by 20 % (30% if a global deal is reached in Copenhagen in 2009)
- increasing the proportion of renewable energies to 20 %
- making energy savings of 20%

As stated earlier, these three targets are supported by a package of four elements: an emissions trading scheme, a fair distribution of effort between countries, promotion of renewable energies and CO₂ capture and storage.

As regards the emissions trading scheme, the agreed proposals are not quite as strong as those originally proposed by the European Commission, as the 27 “*decided to reserve for the new Member States 12 % of the emission allowances originally intended to be auctioned, to support the modernising of their industries and their energy production*” (Council of the European Union 2008). This was to address the issue of carbon leakage, described below.

Some commentators, such as Sandbag, an organisation which exists to try and remove permits from the EU ETS, have said that ([Sandbag](#) 2008):

It may take months before analysts are able to get a clear picture of what the package means for European industry and the whole thing is still contingent on a global deal being reached before the end of 2012.

Another recent development saw the House of Lords EU Committee (2008) [publish a report](#) calling for reform of the EU ETS to deliver substantial greenhouse gas reductions.

Competitiveness issues and “carbon leakage”

One of the concerns voiced about carbon pricing in general, and emissions trading in particular, is that it negatively affects competition in global markets. If operating costs are increased in a geographical area by the “full social cost” of emissions, a business may either lose out to unregulated competitors, or choose to relocate to an unregulated region themselves ([International Energy Agency 2005](#)). If a polluting activity is driven out of the European Union, and relocates somewhere else where it is not subject to emissions trading then, globally, the policy will have failed as the pollution has simply moved, not been reduced. This is known as “carbon leakage”. The associated emissions are still a consequence of activities within the

geographical area, but would not be included within the cap and trade system in operation there. Movement of high emitting business may not always result in emissions increases, it could be possible for example for the new location to use less polluting energy sources than were used originally.

A recent [report](#) found that the EU ETS would only have a marginal impact on the competitiveness of EU industry (Carbon Trust 2008), but that some sectors, including cement, steel and aluminium, would be more exposed than others. There are suggestions that up to 15% of European businesses are “considering” moving their production facilities to unregulated parts of the world (ENDS Europe Daily 2008a). To date the EU ETS has guarded against this risk with the free allocation of allowances, a practice which will continue to some extent for some sectors after the most recent negotiations on the matter.

The “Linking Directive” between EU ETS and Kyoto Protocol Mechanisms

Another measure dealing with competitiveness is a proposal to extend the scope for linking between the EU ETS and other trading schemes. The advantage of linking is that it would extend the size of the market, and the scope for making the most cost effective reductions in emissions – if businesses outside the EU can reduce emissions more cheaply than business in the EU, EU businesses can buy allowances from them. The European Commission (European Commission 2008) state that:

“The Commission sees the EU ETS as an important building block for the development of a global network of emission trading systems. [...]

While the current Directive allows for linking the EU ETS with other industrialised countries that have ratified the Kyoto Protocol, the Commission is proposing to extend this to include any country or administrative entity (such as a state or group of states under a federal system) which has established a cap-and-trade system whose design elements would not undermine the environmental integrity of the EU ETS. Where such systems cap absolute emissions, there would be mutual recognition of allowances issued by them and the EU ETS”.

Phase 2 of the EU ETS allows credits from the Kyoto Protocol mechanisms to offset some emissions by participants. The agreement known as the Linking Directive ([European Parliament and Council \(2004\)](#)) restricts use of credits generated by activities outwith the EU, with the exact level set by each member state in turn. Credits generated by forestry activities are excluded due to their uncertain long term carbon storage and other potential environmental impacts.

The Stern Review (2006) recognised that the linking directive and the use of the CDM “could improve liquidity⁸ while also establishing the nucleus of a global carbon market”. However, several environmental NGOs have raised issues regarding the agreement, and are concerned that offsetting emissions using baseline and credit schemes such as the CDM could result in some carbon leakage ([Climate Action Network Europe 2004](#)). This is based on the theory that EU businesses would be able to obtain allowances from such schemes where reductions would have happened anyway, and consequently the net position is no better off.

The restrictions on CDM and JI use in the Linking Directive have been questioned by some businesses who think that this may keep the allowance price low which means that things like CO₂ capture and storage are uneconomical with an allowance price at that level. A [statement](#) by

⁸ i.e. harmonise the global price of emissions, and reduce the risk of localised price volatility
providing research and information services to the Scottish Parliament

the European Federation of Energy Traders (EFET 2008) in response to European Commission proposals states:

“CER/ERU restrictions for the EU ETS would frustrate the development of a deep market for emission reduction projects and thereby significantly increase in the cost of reducing emissions for Europe, as low cost abatement potential in developing countries would not be fully tapped”.

The way in which these international credits, including EUA allowances, are counted in national greenhouse gas inventories is still unclear and inconsistent, as discussed in a review conducted by the National Audit Office (2008) for the UK Parliament Environmental Audit Committee on [UK Greenhouse Gas Emissions: Measurement and Reporting](#). As introduced previously, in cap and trade schemes the emissions from any individual installation or group of installations (including those from a single country) may fall below an overall target in any given year, whilst being compensated for by overachievement elsewhere. Due to this the average reduction of the scheme cap is more relevant than the actual emissions from participants, although it is these reported emissions that are listed in greenhouse gas inventories. This results in a requirement for carbon accounting above and beyond measured emissions when reporting progress towards targets.

IMPLEMENTATION OF EMISSIONS TRADING IN SCOTLAND

REGULATION OF THE EU ETS

Administration of the EU ETS in the United Kingdom is shared between the UK Government and the devolved administrations. In Scotland the regulatory body is the Scottish Environment Protection Agency (SEPA).

The EU ETS follows an annual cycle within the wider context of the multi-year trading period (or phase). Allowances are distributed to participants at the beginning of each year according to their emissions baseline in the National Allocation Plan, and can be traded from then on. Each site monitors and records its own emissions, and submits an annual report the following January (at which point the following year's allowances are issued). An accredited independent consultant must then inspect the site and verify the emissions before passing the report to SEPA. After this there is a two month grace period during which any necessary trading must be completed, before the allowances covering the previous year's emissions are surrendered to SEPA by April.

Any participants penalised for having insufficient allowances are “double hit” with a requirement to surrender the required allowances during the following year, as well as paying a fine of €100/tonne. This ensures that the cap is maintained over the course of the trading period, and that it is not possible to simply pay for over-emission. Phase 2 allowances can be banked for use in later years or in Phase 3.

There has been full compliance from sites in Scotland since the start of the EU ETS in 2005, with only a few cases of non-compliance occurring during the first year of the scheme in England and Wales (e.g. [BBC 2006](#)). As regards the purchase of credits under the scheme by installations based in Scotland, and under Phase 1 of the EU ETS, this information is deemed by the Registry Administrator⁹ in the UK to be:

⁹ In the UK, the [EU/UN Registry](#) is operated by the [Environment Agency](#) (EA) meaning they carry out the role of Registry Administrator.

“confidential and market sensitive. This is not information that is publicly available or required to be under the Registry Regulations”.

Information is available on the allocations given to individual installations in Scotland, and this can be compared with the actual emissions for any given year, though this is a complicated calculation, and for a Scotland-wide total, does not necessarily include installations which either entered or left the scheme halfway through, or were exempted for other reasons.

TARGETS IN THE SCOTTISH CLIMATE CHANGE BILL

The Scottish Government’s [Scottish Climate Change Bill](#), introduced in the Scottish Parliament on 4 December 2008, includes proposals for an 80% reduction of greenhouse gas emissions by 2050 and 50% by 2030, compared to 1990 levels.

The [consultation](#) on the Scottish Climate Change Bill released in January 2008 (Scottish Government, 2008) discussed the impact of the EU ETS and other trading schemes on Scottish climate change policy. At present nearly 50% of carbon dioxide emissions in Scotland have come from Scottish participants in the EU ETS, and the consultation document stated that:

“... it is important to understand certain features of the trading regime. [...] the caps for individual installations covered by the EU ETS in Scotland may be set on the basis of a different target to that proposed to be set in the Scottish Climate Change Bill. Imposing further statutory controls on those installations covered by the EUETS [...] would be unlikely to generate any additional reductions globally [...] and may result in industry moving out of Scotland. [Consequently] the EUETS imposes certain, important, limitations on what can be achieved through national emission reduction targets...

[...] The nature of the EUETS means that the Scottish Government cannot directly control what emissions are released by installations within the EUETS. Scottish emissions may rise because Scottish emitters choose to buy allowances, but nevertheless there would be an overall beneficial impact on global emissions because savings would have occurred elsewhere.

This would mean that one of the key policy levers regulating a large proportion of our CO₂ emissions to meet the Scottish target is not set directly by Scottish Ministers, nor is it necessarily set consistently with Scottish or UK targets.

In the future, the influence of the EUETS on national emissions is likely to become of greater significance. It is probable that over time, other sectors and gases not currently covered by the scheme will be included, such as aviation and possibly surface transport. This means that emissions from other areas of the economy will be removed from the direct control of Scottish Ministers”.

Although discussed in some detail in the Bill consultation, the Bill and accompanying documents say little on emission trading, except to acknowledge they could be used to help Scotland meet its emissions reduction targets (and to refer to the UK Climate Change Act, discussed below, which allows devolved administrations to take forward work on emissions trading). There is no reference to any limit which might be placed on the number of credits which could be purchased by organisations in Scotland to help meet the emissions targets contained in the Bill.

Once the UK Carbon Reduction Commitment (explained below) begins in 2010, the impact of emissions trading on the Scottish target will be enhanced, with perhaps significantly more than half of Scotland's greenhouse gas emissions under regulation by targets set at UK and EU level.

UK EMISSIONS TRADING POLICY

The [UK Climate Change Act 2008](#) received Royal Assent in November 2008. The Act establishes the legal framework under which future UK climate change policy will be set. The Act:

- sets targets for greenhouse gas emissions to be at least 26% lower than the 1990 baseline by 2020, and 80% lower than the 1990 baseline by 2050.
- establishes a new independent non-departmental public body, the Committee on Climate Change. The Committee has been operating in shadow form for a number of months, and the Committee's [first formal report](#) was published on 1 December 2008 (Committee on Climate Change 2008)
- Gives the UK Secretary of State and the devolved administrations powers to establish trading schemes relating to greenhouse gas emissions through secondary legislation.

The range of powers relating to trading schemes is broad, allowing a wide interpretation for future policy development. Although the Act enables Scottish Ministers to establish separate trading schemes, it has been indicated by the Minister for Transport, Infrastructure and Climate Change that it is unlikely that these powers will be used in the foreseeable future ([Scottish Parliament 2007](#)).

One objective of this framework is to establish a single UK trading scheme for large corporations and public sector organisations not already included in the EU ETS. This trading scheme is the [Carbon Reduction Commitment](#), more detail on which is given below.

A Legislative Consent Memorandum on the UK Climate Change Bill was considered by the Scottish Parliament, detailed in a SPICe Briefing ([Cook 2007c](#)).

THE CARBON REDUCTION COMMITMENT

The Carbon Reduction Commitment (CRC) is a mandatory cap and trade scheme allowed for under the UK Climate Change Act. It will regulate all large organisations and public bodies, not already included in the EU ETS or regulated by Climate Change Agreements, whose annual half-hourly metered electricity use is greater than 6,000 MWh ([Department for Environment, Food and Rural Affairs 2008c](#)).

Electricity use was chosen as the inclusion criterion because it is an accurate and simple measure of energy use; however all energy use, not just electricity, will be covered by the scheme. The stated policy objective of the CRC is to raise awareness and encourage emission reductions through better efficiency and management practice (Department for Environment, Food and Rural Affairs 2008c).

There are several fundamental differences between the design of the CRC and the EU ETS, for example:

- the CRC regulates the aggregate energy use of companies (as defined by the Companies Act), rather than emissions from individual sites

- it covers electricity as a downstream emission source – i.e. it double counts the indirect emissions from electricity that are already regulated by the EU ETS
- membership can be easily expanded or contracted by varying the electricity threshold
- all allowances will be auctioned, but
- The CRC will be roughly revenue neutral. Revenues from the sale or auction will not be kept by Government but will be returned to participants in proportion to their performance in reducing their emissions from their energy use, which will determine their position in a league table
- A purchase-only “safety valve” allowing participants to buy EUA allowances from the EU ETS to account for some emissions – this effectively sets a ceiling price on CRC allowances at the level of EU allowances.

The CRC will commence in 2010, and is expected to include around 5% of companies registered in the UK, totalling more than 5,000 participants. The first three years of the scheme will be uncapped, and involve a fixed price allowance of £12 (around €15) per tonne of carbon dioxide. From 2013 the scheme will be subject to an annually reducing cap similar to Phase 3 of the EU ETS. The [Partial Regulatory Impact Assessment on the Carbon Reduction Commitment](#) states “currently available energy efficiency measures could cost effectively save 0.5 MtC per year by 2015, rising to 1.2 MtC per year by 2020” (Department for Environment, Food and Rural Affairs 2007c).

Regulation of the CRC will be devolved, with SEPA covering companies registered in Scotland (not simply premises located in Scotland). However the management of the trading scheme, including reduction targets, caps, and participation criteria, will be maintained at UK level.

The decision to include indirect emissions from electricity in the CRC follows the precedent set by the earlier voluntary UK ETS ([Department for Environment, Food and Rural Affairs 2007e](#)). However, all combustion-based power stations in the UK already participate in the EU ETS and have their direct emissions covered by the EU-wide carbon price and cap.

OTHER UK MEASURES TO TACKLE CLIMATE CHANGE

Although there is scope in the UK Climate Change Act to increase the CRC to include smaller businesses and emitters, any system of personal carbon allowances, carbon rationing, or similar individual trading schemes may require further primary legislation, and the theory is that should emissions trading work properly, other schemes may not be required anyway.

The Climate Change Levy and Climate Change Agreements

The Climate Change Levy (CCL) was introduced in 2001 and is a tax on energy use by businesses and the public sector in the UK ([Department for Environment, Food and Rural Affairs 2007f](#)). The aim of the levy is to encourage improved energy efficiency and emissions reductions. Revenue from the Climate Change Levy funds initiatives such as the Carbon Trust who encourage energy savings and the development of low carbon technology.

Energy intensive industries are able to enter into Climate Change Agreements (CCA) that offer an 80% reduction in the CCL in return for specific energy efficiency and emission reduction targets ([Enviros 2008](#)). CCAs can include electricity, and as such overlaps with emissions in the EU ETS. The Department for Environment, Food and Rural Affairs have arranged a system to avoid this double counting and any resultant detrimental costs or impacts.

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