

8 December 2008 (No. of pages: 28)

Utilities

Carbon forecasts – ETS supply / demand and price forecasts to 2020

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Summary

- Delegates from 190 countries will meet during December to discuss combating climate change at the UN COP14 meeting in Poznan (1-12 Dec), with EU members meeting separately at the Environment Council (4-5 Dec) and EU Summit in Brussels (11-12 Dec). Given the change in priorities since the economic slowdown we do not expect any material progress at these meetings with regard to firm commitments for CO2 reduction targets.
- The balance of evidence suggests a significant human influence on climate change. Over the medium term we expect an increasing emphasis on emission reduction, however in the short term budgetary control and corporate wellbeing are likely to take precedence.
- The Kyoto Protocol has been ratified by countries representing only about 30% of the world's greenhouse gas (GHG) emissions and does not include China and the US, the world's two largest emitters. Even for those that have ratified the treaty, currently around half of the countries are scheduled to miss their 2012 emission reduction targets.
- The EU Emission Trading Scheme (ETS) represents installations accounting for less than 10% of global GHG. Although scheme wide 2012 targets should be achieved, there is significant individual country divergence and a large proportion of the emission reduction will be achieved through international offset schemes and the decline of Eastern European output in the 1990s.
- The recessionary impact in Europe is likely to result in lower domestic emissions and a shift in emphasis to less costly international offsets. We see the Phase II EU ETS scheme as being oversupplied by over 800mt of allowances and the shortfall during 2008-2020 being only 73mt per annum – small enough to be met through fuel switching and other low cost abatement.
- We believe the international price of carbon will remain relatively low, restraining the price within the EU ETS. CER prices could decline as international competition for the supply of credits widens outside of China. Whilst we are likely to see emission targets and trading schemes from the US, Canada, Australia and New Zealand, all of these countries have less onerous reduction targets and suggested carbon price caps below current EUA trading levels.
- We forecast a 2012 EUA price of €16/tonne rising to €25/tonne in 2020, both below consensus.

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Carbon – not immune to recession

Summary

We have forecast EU ETS supply and demand to 2020 taking into account the likely impact on emissions as a result of economic sensitivity, the slowdown in renewable investment and the supply of international offset credits.

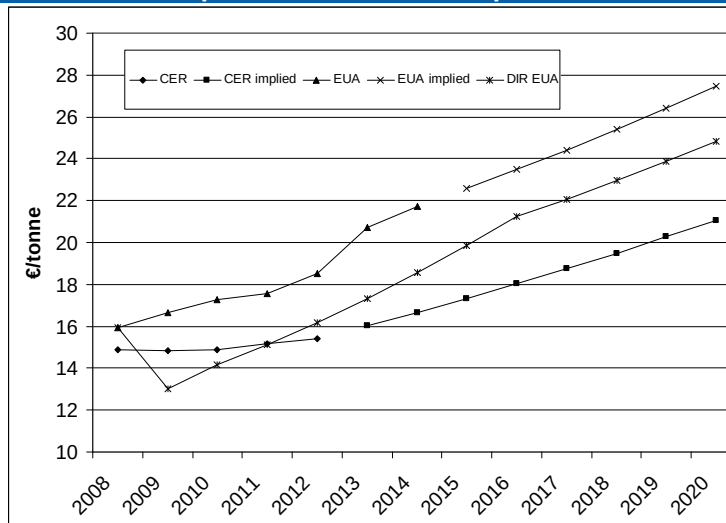
We estimate that during Phase II (2008-2012) of the EU ETS a surplus of over 800mt of allowances will be built up. With emission allowance shortfalls largely met by Certified Emission Reductions (CER) or Emission Reduction Units (ERU), we believe the EUA price will trade at a tight spread with the CER price, which itself may come under pressure. We forecast a 2012 EU Emission Allowance (EUA) price of €16/tonne.

During Phase III (2013-2020) forecast emissions exceed allowances and additional abatement will be required. However for the cumulative period 2008-2020 we estimate this shortfall amounts to just 73mt per annum, which we believe can be met through summer fuel switching or other low cost (<€25/tonne) abatement techniques. We forecast a 2020 EUA price of €25/tonne in 2020.

On balance we see downside risk to our demand forecasts given the potential for economic conditions to deteriorate further or nuclear lifetimes to be extended.

We plot below our carbon price forecasts to 2020 against current futures prices for EUAs and CERs and their future path based on a 4% cost of carry (given the scope to carry forward allowances into Phase III).

Forecast EUA price vs futures and implied EUA and CER prices Chart 1



Source: DIR, ECX ICE, Bloomberg.

Our forecasts are based on the following DIR commodity price assumptions:

DIR commodity price forecasts													Chart 2	
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Oil Price (\$/bbl)	73	99	67	87	102	100	100	100	100	100	100	100	100	100
API2 Coal price (\$/t)	89	140	105	105	105	96	96	96	96	96	96	96	96	96
UK Gas price (p/therm)	30	62	55	50	50	49	49	49	49	49	49	49	49	49
European Gas hhv price (€/MWh)	21	28	25	23	23	23	23	23	23	23	23	23	23	22
ETS CO2 certificates	19	22	13	14	15	16	17	19	20	21	22	23	24	25
UK Summer fuel switching level - coal to gas (€/t)	7	36	26	18	18	22	22	22	21	21	21	21	21	21
European summer fuel switching level - coal to gas (€/t)	36	41	36	26	27	31	31	30	30	31	31	31	31	29

Source: DIR

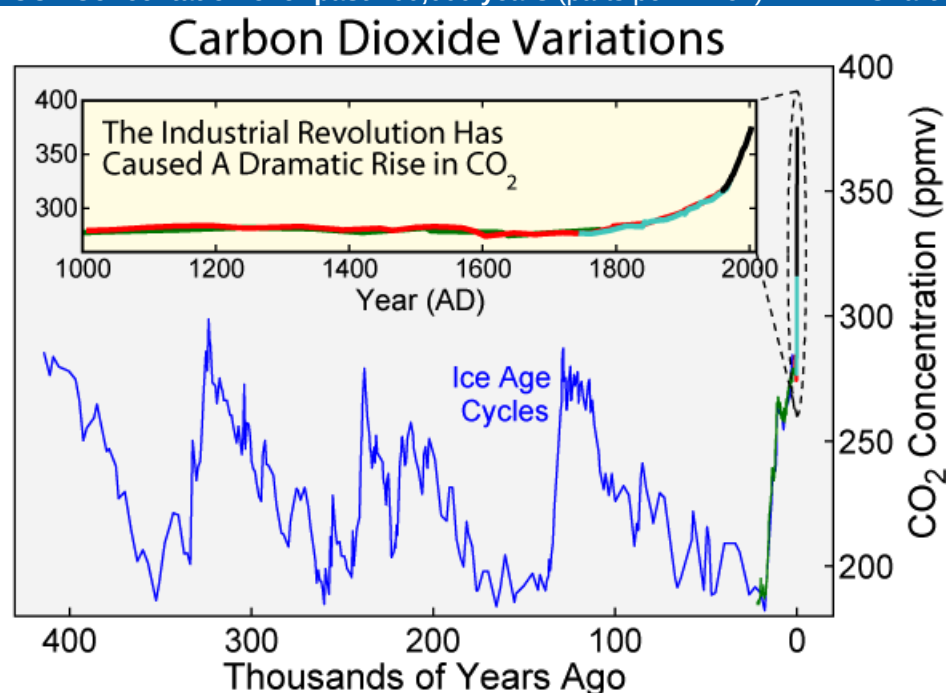
**CO₂ concentration
levels high and rising**

Greenhouse gases, global warming and sea levels

Atmospheric carbon is already at 385 parts per million (ppm), compared to 280 ppm in the eighteenth century, and is rising at around two ppm a year. Whilst historically CO₂ concentrations have varied, the maximum pre-industrial level found from an analysis of ice cores dating back over the past 8,000 years was 300 ppm and as can be seen from the chart below the trend has been sharply upwards since humanity started burning large amounts of coal and petroleum in the nineteenth century.

CO₂ Concentration over past 400,000 years (parts per million)

Chart 3



Source: Robert A. Rhode compiled from public sources.

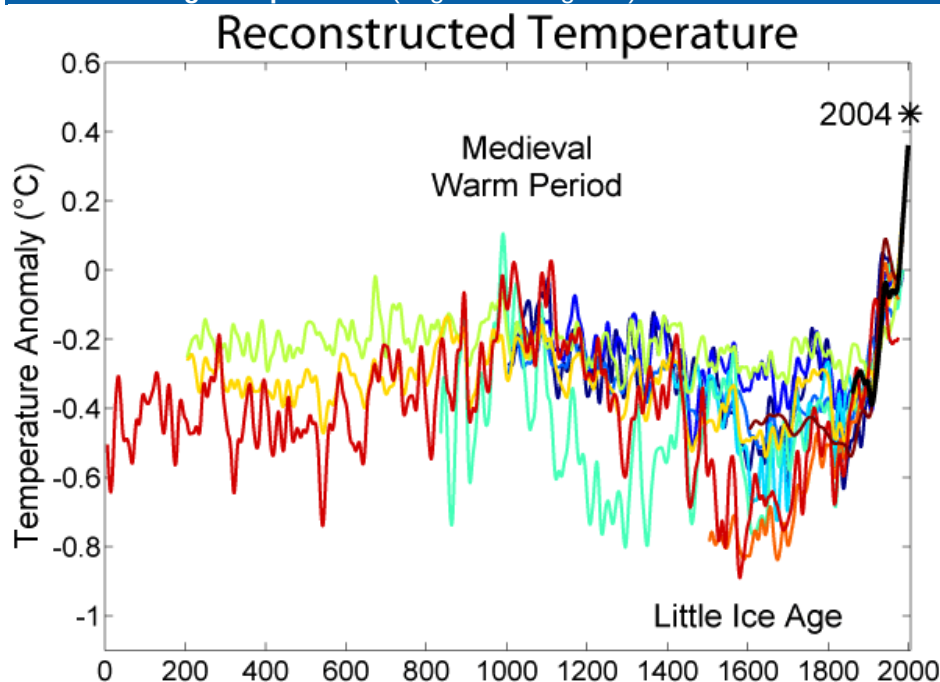
**An increase from
385ppm CO₂ to 450ppm
likely to accelerate
global warming**

Scientists estimate that a concentration of 450 ppm is equivalent to a rise of two degrees Celsius above pre-industrial levels in global average temperatures, a level where the UN predicts hundreds of millions of people would face reduced water supplies (above three degrees the UN estimates global food production would decline).

Current global temperatures are already above average as measured by a number of studies. The chart below plots a number of reconstructions of mean temperature changes experienced during the past two thousand years (with the most recent studies plotted towards the front) with the 2004 value plotted as an asterix. Recent studies suggest global warming is accelerating beyond the UN Intergovernmental Panel on Climate Change (IPCC) 2007 forecast and that even the less than one degree increase in global temperatures experienced to-date has already resulted in the disappearance of summer Arctic sea ice.

Global average temperature (degrees centigrade)

Chart 4



Source: Robert A. Rhode compiled from public sources.

Sea level rising

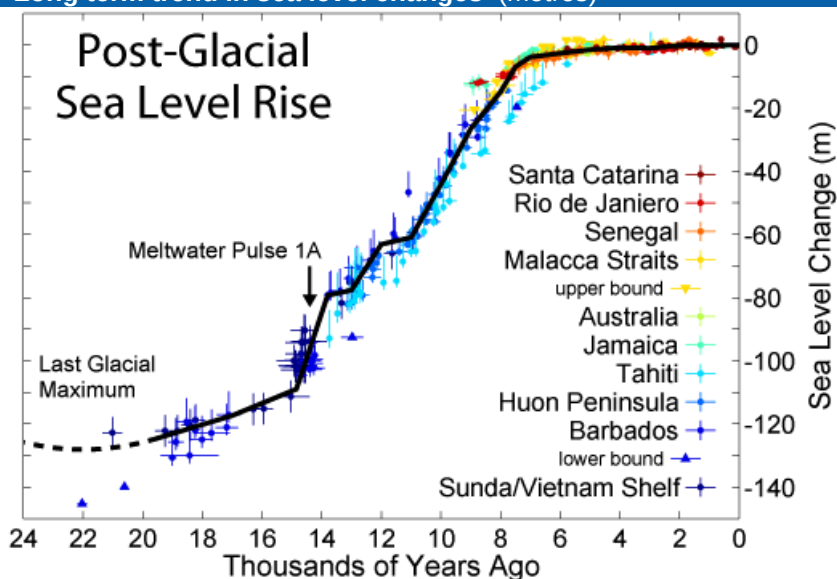
Global warming has been linked with a rising sea level and the chart below plots the sea level rise since the end of the last glacial episode.

The sheer weight of the ice sheets during the last Glacial Maximum depressed the global sea level by about 120 metres. Prior to this ice sheets were still increasing in size so that sea level was steadily reducing over a period of roughly 100,000 years.

Roughly ten thousand years post the Glacial Maximum the rapid deglaciation of the ice caps known as meltwater pulse 1A increased the sea level by about 30 metres. Whilst this data has been adjusted and it is not possible to know if the continued steady increase in sea levels is just a steady continuation of the deglaciation trend, it would appear that the sea level has never been higher than it is at present in the past twenty thousand years.

Long term trend in sea level changes (metres)

Chart 5

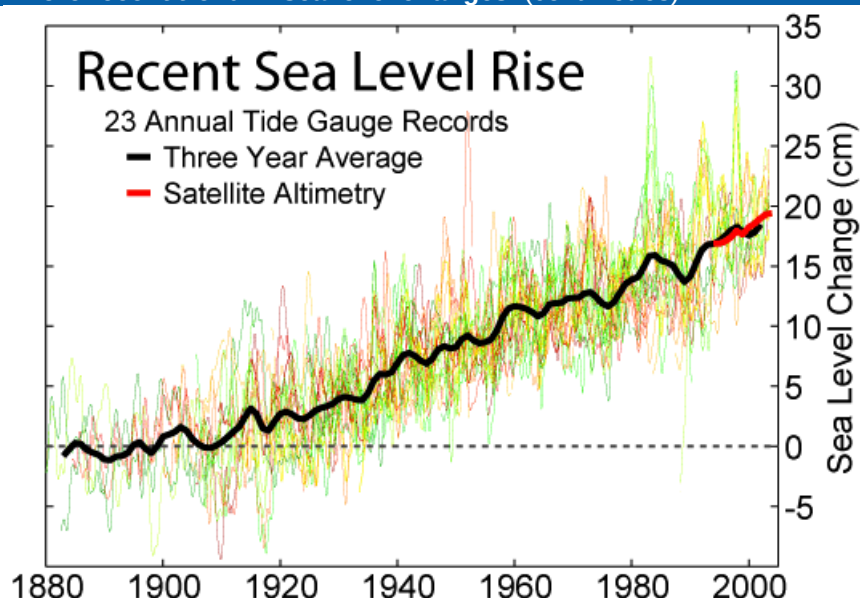


Source: Robert A. Rhode compiled from Fleming & Milne data.

An examination of the more recent trend in the sea level suggests a sea level rise of 18.5 cm from 1900 to 2000. The more recent satellite altimetry data (time taken by a radar pulse to travel from the satellite to the surface and back measures sea-surface heights) suggests a higher rate of increase. The IPCC estimates that the sea will rise 50cm by 2100 (roughly 20 inches or 1.7 feet). A one-foot sea level rise typically causes a shoreline retreat of 100 feet or more and roughly 630m people live within 30 feet of the sea.

More recent trend in sea level changes (centimetres)

Chart 6



Source: Robert A. Rhode compiled from Douglas and TOPEX / Poseidon data.

Kyoto Protocol emission targets and performance

Kyoto Protocol intended to reverse trend of increasing GHG emissions

Despite these worrying signals the International Energy Agency has forecast that assuming no change in government policies the concentration of GHG emissions will more than double to around 1,000 parts per million of CO₂ equivalent by the end of this century. This would result in an increase of up to six degrees Celsius in the global temperature.

To combat this threat governments have attempted to implement international climate change agreements, directed in a large part by the United Nations Framework Convention on Climate Change (UNFCCC). The most significant of these has been the Kyoto Protocol, adopted in 1997 by 40 Annex I countries (including the majority of the EU states, Japan, Canada, Russia and more recently Australia).

Target of 5% reduction in GHG 2008-2012 vs 1990 base year

The Kyoto Protocol sought on a voluntary basis to achieve a 5% reduction in GHG emission from Annex I countries for the period 2008-2012 compared to 1990 levels. The scale of the targeted emission change ranged from -8% for EU member countries to +10% for Iceland.

But only ratified by countries representing 30% of global emissions

The Kyoto Protocol was ratified in 2005 by 39 of these countries as the US did not ratify the treaty because developing countries had not made binding commitments – Kyoto has therefore been ratified by nations representing around 30% of the world's GHG emissions.

Kyoto Protocol GHG Emission Targets 2008-2012 vs 1990 (%) **Chart 7**

	Target (2008/2012 vs base year)
EU15, Bulgaria, Czech, Estonia, Latvia, Liechtenstein, Lithuania, Monaco, Romania, Slovakia, Slovenia, Switzerland US (not ratified)	-8%
Canada, Hungary, Japan, Poland Croatia	-7%
New Zealand, Russian Federation, Ukraine	-6%
Norway	-5%
Australia	0%
Iceland	1%
	8%
	10%

Source: UNFCCC; compiled by DIR.

The reductions are planned to be achieved through both domestic emission reductions and (from 2008) through the use of international offset mechanisms such as the purchase of Joint Initiative (JI) and Clean Development Mechanism (CDM) credits and the purchase of Annual Allowance Units (AAUs) by governments. Limits have been set as to the participation of JI/CDM credits on a national basis to ensure a focus on domestic emission reduction.

Total targeted reductions have been achieved but only as a result of cuts in Eastern Europe during 1990s

Overall, emissions in 2006 for the 41 Annex I countries (40 above including US plus Australia) decreased by 5% compared to 1990. This was driven by the 37% decline (-2,184mt CO₂) in emissions from the Economies in Transition (EIT) countries, largely former Soviet Union states, whose energy intensive industries declined post USSR dissolution in 1990. Emissions from the developed non-EIT countries rose by 10% (1,290mt CO₂) during the period.

Kyoto emissions during 2000-2006 rose by 2%, with Eastern European growth of 7%

Emissions in 2006 were roughly level with 2005 but benefited from a warm winter in Northern Europe which reduced gas and electricity demand. Emissions between 2000 and 2006 rose by 2.3%, driven by the former Soviet Union states where emissions increased by 7.4% over this period.

Kyoto Protocol Annex I countries GHG emissions vs 1990 base (mt CO₂ equivalent) **Chart 8**

Annex I (GT 000)	1990	2000	2005	2006	2006 vs 1990	2006 vs 2000
Economies in Transition (EIT)	5.9	3.5	3.6	3.7	-37%	7%
Non-EIT	13	14.2	14.4	14.3	10%	1%
Total Annex I	18.9	17.7	18	18	-5%	2%

Source: UNFCCC; compiled by DIR.

Half of the countries that ratified Kyoto likely to miss targets

As can be seen from the table below, roughly half of the countries that have ratified the treaty are exceeding their Kyoto targets in 2006, including Canada (162mt over), Japan (154mt over), Spain (100mt over) and Italy (84mt over). Most of these countries have already indicated they will not meet their Kyoto targets.

2006 emission levels compared to Kyoto targets (% vs 1990)**Chart 9**

	Change in 2006 emissions vs base year	Emission reduction target under Kyoto Protocol	Difference
Spain	50%	15%	35%
Luxembourg	1%	-28%	29%
Austria	15%	-13%	28%
Canada	21%	-6%	27%
Liechtenstein	19%	-8%	27%
New Zealand	26%	0%	26%
Denmark	2%	-21%	23%
Italy	10%	-7%	16%
Iceland	26%	10%	16%
Finland	13%	0%	13%
Ireland	26%	13%	13%
Japan	6%	-6%	12%
Portugal	38%	27%	11%
Slovenia	1%	-8%	9%
Switzerland	1%	-8%	9%
Norway	8%	1%	7%
EC	-3%	-8%	5%
Netherlands	-3%	-6%	3%
Germany	-19%	-21%	3%
Belgium	-6%	-8%	2%
Greece	24%	25%	-1%
United Kingdom	-16%	-13%	-3%
France	-4%	0%	-4%
Monaco	-13%	-8%	-5%
Sweden	-9%	4%	-13%
Czech Republic	-24%	-8%	-16%
Poland	-29%	-6%	-23%
Slovakia	-32%	-8%	-24%
Hungary	-32%	-6%	-26%
Russian Federation	-34%	0%	-34%
Romania	-44%	-8%	-36%
Bulgaria	-46%	-8%	-38%
Lithuania	-53%	-8%	-45%
Latvia	-55%	-8%	-47%
Estonia	-56%	-8%	-48%
Ukraine	-52%	0%	-52%
Australia	NA	8%	NA
Belarus	NA	-8%	NA
Croatia	NA	-5%	NA

Source: UNFCCC; compiled by DIR.

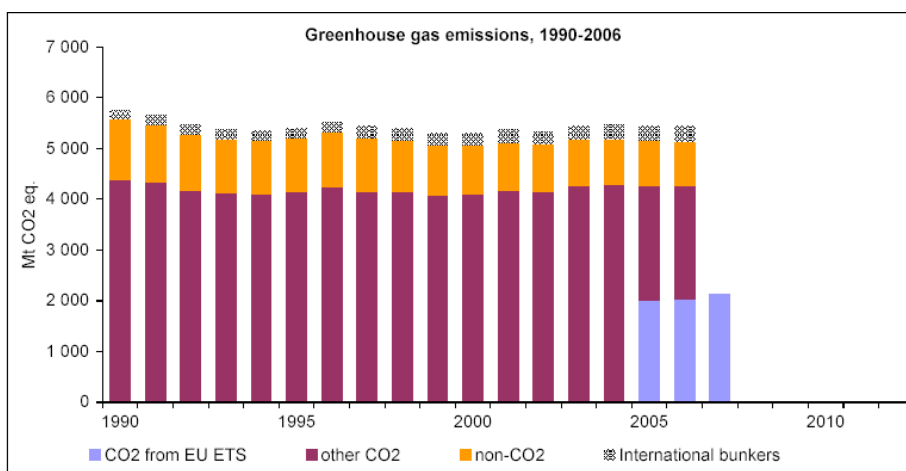
Eastern European states have significant excess allowances which they may sell to other governments

The countries that are significantly below their Kyoto limits are dominated by the former Soviet Union states and include Russia (1,100mt) and Ukraine (477mt). These countries are most likely to sell surplus Assigned Amount Units (AAUs) to other Annex B governments, although Russia may wait until post 2012 to make such disposals. To counter criticisms of “hot air” sales, the proceeds from AAU sales are ring-fenced into Green Investment Schemes (GISs) which are then used to fund energy efficiency projects.

EU emission targets to 2012 and performance to-date

EU15 emissions -3% in 2006 vs target of -8%

Against the target of an 8% reduction in GHG emissions compared to 1990, 2006 EU15 GHG emissions reduced by approximately 3% from the base-date, as can be seen from the chart below.

EU 15 GHG emissions 1990-2006 (mt CO2 equivalent)**Chart 10**

Source: European Environment Agency; compiled by DIR.

Germany / UK emissions down 18%/ 16% respectively. Other EU15 countries +11%

However there has been a significant divergence within the individual country performance and a significant component of the EU15 reduction has been achieved through the reduction in German (East Germany industry declined post reunification in 1990) and UK emissions (shift from coal to gas production and manufacturing closure). Whilst emissions in 2006 from Germany and UK have declined by 18% and 16% respectively compared to 1990, total emissions from the remaining EU15 members have increased by 11%.

Total EU27 GHG emissions in 2006 fell by 8% compared to 1990, largely as a result of the 24% decline in emissions from the 12 new member states (Eastern European decline as described earlier).

EU27 GHG emissions vs 1990 base (mt CO2 equivalent)						Chart 11
tCO2 m	1990	2005	% vs 1990	2006	% vs 1990	
EU15 (excluding Germany and UK)	2257	2558	13%	2494	11%	
Germany and UK	2009	1652	-18%	1657	-18%	
EU 15	4266	4210	-1%	4151	-3%	
EU 12	1307	1028	-21%	992	-24%	
EU 27	5572	5238	-6%	5143	-8%	

Source: European Environment Agency; compiled by DIR.

The following table details individual EU27 base year emissions, their Kyoto target (where applicable) and the European Environment Agency (EEA) forecasts for 2010 emissions (proxy for average of 2008-2012) based on: existing policies; governmental use of Kyoto Mechanisms (international offset schemes such as JI/CDM); the use of carbon sinks (e.g. additional forestation) and the use of additional carbon measures that have been announced but not yet implemented.

EU27 GHG emission forecasts (mt CO2 equivalent)								Chart 12
Country	Base Year Emissions MtCO2	Kyoto target %	2010 change vs base year with existing policies	2010 change vs base year with Kyoto Mechanisms	2010 change vs base year with Carbon Sinks	2010 change vs base year with Additional Measures	2010 change vs base year Total	
Austria	79	-13%	17%	-11%	-1%	-18%	-13%	
Belgium	146	-8%	-4%	-5%		0%	-9%	
Bulgaria	133	-8%	-30%			-5%	-35%	
Cyprus	6	NA	44%			-3%	41%	
Czech Republic	194	-8%	-25%		-1%	-3%	-29%	
Denmark	69	-21%	-2%	-6%	-3%	0%	-12%	
Estonia	43	-8%	-63%			-3%	-66%	
Finland	71	0%	20%	-2%	-1%	-17%	0%	
France	564	0%	1%		-1%	-4%	-4%	
Germany	1,232	-21%	-23%		0%	-3%	-26%	
Greece	107	25%	24%		-1%	-2%	21%	
Hungary	115	-6%	-25%			-1%	-25%	
Ireland	56	13%	23%	-7%	-4%	0%	12%	
Italy	517	-7%	8%	-4%	-5%	-3%	-5%	
Latvia	26	-8%	-46%			0%	-46%	
Lithuania	49	-8%	-30%			0%	-30%	
Luxembourg	13	-28%	3%	-30%		-1%	-28%	
Malta	2	NA	62%			0%	62%	
Netherlands	213	-6%	-2%	-6%	0%	0%	-8%	
Poland	563	-6%	-28%		-1%	0%	-29%	
Portugal	60	27%	44%	-10%	-8%	-4%	23%	
Romania	278	-8%	-31%			-4%	-35%	
Slovakia	72	-8%	-18%			-3%	-22%	
Slovenia	20	-8%	7%	-3%	-8%	-9%	-13%	
Spain	290	15%	52%	-20%	-2%	-10%	21%	
Sweden	72	4%	-3%		-3%	0%	-6%	
UK	776	-13%	-19%		-1%	0%	-20%	
EU-15	4,266	-8%	-4%	-3%	-1%	-3%	-11%	
EU-27	5,572	NA	-7%	NA	NA	-3%	-10%	

Source: European Environment Agency; compiled by DIR.

EU27 on track to achieve 2008-2012 targets

Whilst not every EU27 member has adopted the Kyoto Protocol, the expected 10% reduction in emissions by 2010 would be significantly better than a combined target (EU -8%, Poland -6%, Croatia -5%, Russia & Ukraine 0%).

EU15 to achieve targets through use of internal offsets

Overall the EU15 should be on target to achieve the 2008-2012 target of an 8% reduction, but only because roughly half of the emissions reduction is likely to be

derived from governmental and private sector use of international offset credits (JI/CDM), in line with the maximum JI/CDM cap set by the EU. In addition, the divergence of performance is likely to result in countries such as Finland, France, Germany, Sweden and the UK outperforming their targets whilst countries such as Denmark, Italy, Netherlands and Spain are likely to underperform.

EU emission targets to 2020 and beyond

20% reduction in EU emissions targeted for 2020 and targets on energy efficiency and renewables

In March 2007 the EU adopted more stringent targets for carbon reductions by 2020. The Integrated Energy and Climate Change package (dubbed “20/20/20 by 2020”) is targeting a 20% reduction in GHG emissions vs 1990 levels, an increase in energy efficiency of 20% and an increase in the share of renewable energy to at least 20% by the year 2020.

We expect EU ETS emissions target to be missed with 2,025mt CO₂ forecast for 2020 vs 1,720mt target

With regard to emissions, the 2020 target equates to a 14% reduction in emissions compared to 2005. This is split between a 19% reduction (to 1,720mt by 2020 or an average of 1,847mt 2012-2020) for EU ETS compared to 2005 and a 10% reduction for non-ETS sectors compared to 2005. We forecast that the EU ETS target will be missed with 2,052mt tonnes forecast for 2020 and average of 2,079mt forecast for 2012-2020.

We expect energy efficiency target to be missed

Member states are also behind schedule with regard to the energy efficiency target. The EU estimates that measures already adopted by the EU should achieve energy saving of only 13% by 2020.

We expect renewables target to be missed

The renewable target is also likely to be missed as we estimate renewable electricity will contribute around 25% of total electricity by 2020, lower than the 40% required to meet the 20% renewable energy target by 2020.

Targets would tighten in event of international accord but we view this as unlikely

In the event of a global agreement by other developed countries (e.g. the US) to make comparable emission reduction targets and for developing countries (e.g. China) to also contribute (extent unquantified) to this initiative, the EU will target a 30% reduction in GHG emissions by 2020 compared to the 1990 level. This would represent a 37% reduction vs 2005 levels for EU ETS sectors and a 16% reduction for non-ETS sectors. In this scenario the amount of international offset CERs/ERUs permissible in the EU ETS scheme would be increased.

However international 2020 reduction targets have so far been more conservative than EU targets – the US and Canada are only targeting a return to 1990 levels by 2020, rather than a reduction and Japan may target a 4% reduction vs 1990.

Given we believe the EU will miss its base case targets and that reaching an international accord on 2020 targets will be difficult (when even EU members are resisting the base case targets) we view the 30% reduction target as very unlikely to be adopted.

EU carbon trading mechanisms – EU ETS, CDM and JI

EU ETS scheme covers 45% of EU CO₂ emissions

The EU European Trading Scheme (EU ETS) was established in October 2003 and entered into force in January 2005. The scheme applied to five carbon intensive industries (electric utilities, oil, building materials, metals and paper) which account for 45% of total EU CO₂ emissions and covered over 12,000 individual installations.

Installations are allocated a certain amount of EU Allowance Units (EUAs) which are also organised under a National Allocation Plan (NAP) for each country (likely to develop into an EU-wide plan in the future). Each EUA permits the emission of

one tonne of CO₂ which can be retired against actual emissions or traded within a company, through a broker or on an exchange.

Cap-and-trade scheme allowing installations and countries to trade

The EUA is fungible with the equivalent Assigned Amount Unit (AAU) defined under Kyoto. This means that countries can trade AAUs between one another, with governmental sellers including Russia, Ukraine, Poland, Hungary and Czech Republic and governmental buyers including Japan, Spain, Denmark, Portugal and Austria.

Linkage with Kyoto mechanisms offers scope for international offsets in developed and developing nations

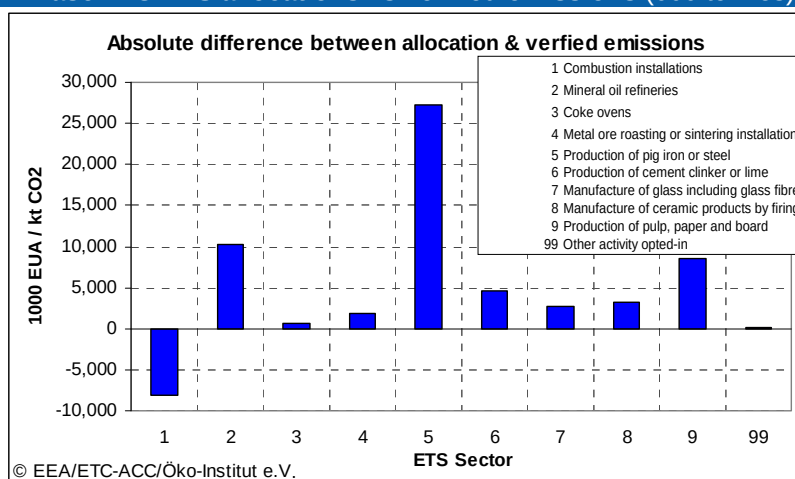
There is also a link with international Kyoto mechanisms such as the Clean Development Mechanism (CDM), which grants Certified Emission Reduction credits (CERs) for emission reduction projects in developing countries (largely China) and the Joint Implementation (JI) mechanism which grants Emission Reduction Units (ERUs) for carbon reduction projects in other developed (Annex I) countries such as Russia.

Because of this transferability there is a close relationship between the price of EUAs and the price of secondary CERs, although EUAs can trade at a premium because the maximum use of CERs/ERUs is fixed on a national basis and may not be sufficient to meet all demand (therefore marginal price set by cost of other abatement techniques).

Phase I period of scheme (2005-2007) failed due to over-allocation of allowances

Phase I of the EU ETS covered an introductory period of 2005-2007. The price of Phase I allowances initially rallied to €30/tonne, however the publication of verified 2005 emissions in early 2006 revealed that the level of free allowances given to installations would be more than enough to cover requirements. Verified emissions for the 2005/2006 period totalled 2,130mt against a Phase I period allocation of 2,299mt – a surplus of 169mt.

Phase I EU ETS allocations vs verified emissions (000 tonnes) Chart 13

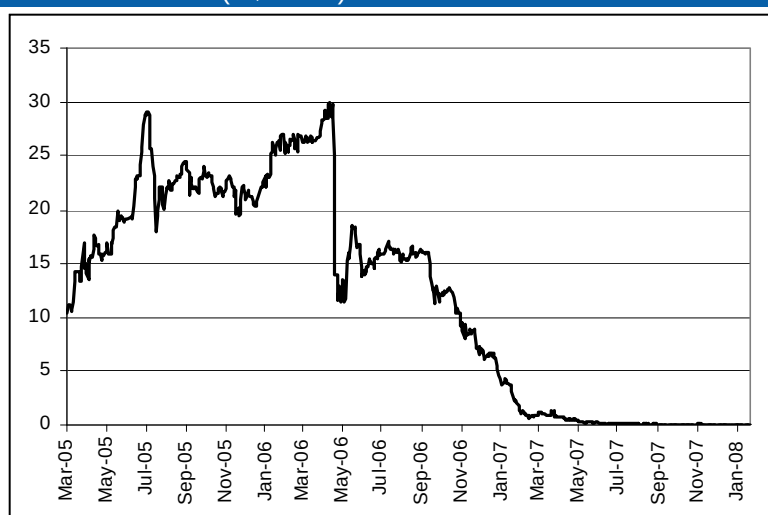


Source: EEA; compiled by DIR.

The allowances were given out for free and with more allowances than required there was no need for installation to purchase additional Phase I allowances and therefore the market price fell to zero.

Phase I EU ETS (€ /tonne)

Chart 14



Source: EEX / Datastream; compiled by DIR.

Phase II period (2008-2012) represents 7% cut in emissions vs 1990 but most allowances free

The Phase II ETS covers the period 2008 to 2012. ETS allowances total 2,083mt per annum during Phase II, a reduction of 2% compared to emissions in 2005 and 7% compared to 1990. Installations can borrow forward allowances from future years within Phase II (e.g. to mitigate the impact of a very cold winter) and allowances are bankable into Phase III. Allowances are given for free with the exception of the power sector where around 15% of the allowances are auctioned.

Phase III period (2012-2020) represents 19% cut in emissions and allowances auctioned

In Phase III of the scheme (2012-2020) allowances are initially cut in 2013 by 7% compared to 2005 deepening to 19% reduction vs 2005 in 2020. Full auctioning has been proposed for the power sector although concessions could be made for Poland and other Eastern European states (where significant proportion of electricity derived from coal).

Phase II EUA price historically tracks API2 coal price

So far during Phase II the EU ETS carbon price has generally tracked the Rotterdam API 2 coal price. In addition to the general commodity rout from which carbon has not been immune, as both coal and gas prices have reduced in absolute terms since July 2008, the absolute fuel switching level of coal to gas (i.e. theoretical price of carbon to induce switching power production) has reduced which has led the EU ETS price down. However should coal continue to fall at a faster rate than gas then the fuel switching level would increase.

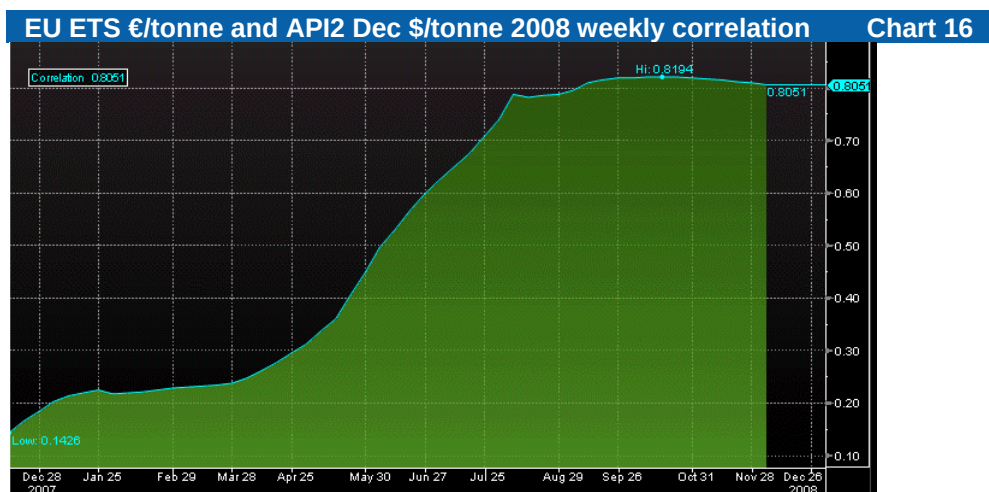
EU ETS €/tonne and API2 Dec \$/tonne 2008 contracts

Chart 15



Source: Bloomberg; compiled by DIR.

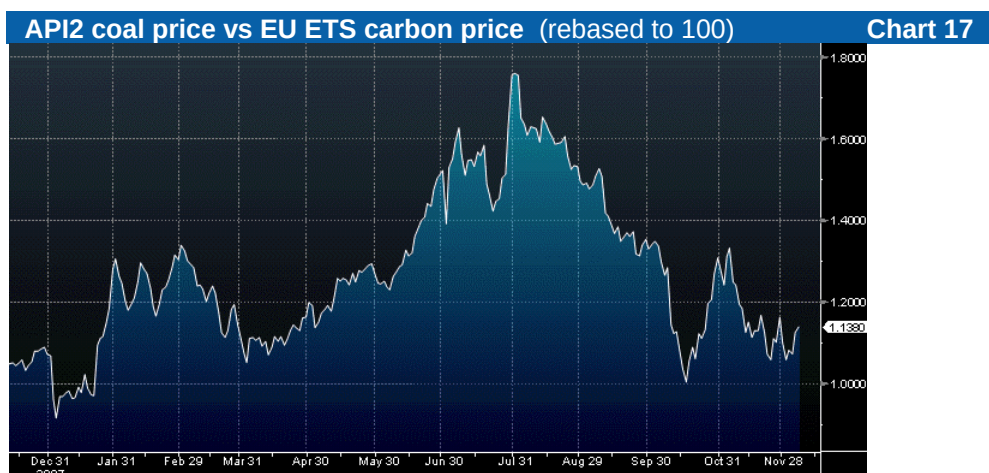
The weekly correlation between coal and carbon is 0.81 – similar to the 0.84 correlation between the ETS price and the oil price. This correlation has increased as commodity markets have fallen.



Source: Bloomberg; compiled by DIR.

Carbon price relatively stable compared to oil and coal price

Whilst the direction of the carbon move has been closely linked with the coal price the quantum of the move has not, with carbon volatility remaining **relatively** limited compared to other commodities. As the chart below shows during the summer of 2008 the price of coal increased at nearly double the rate of the price of carbon, but has subsequently fallen back by a similar amount.



Source: Bloomberg; compiled by DIR.

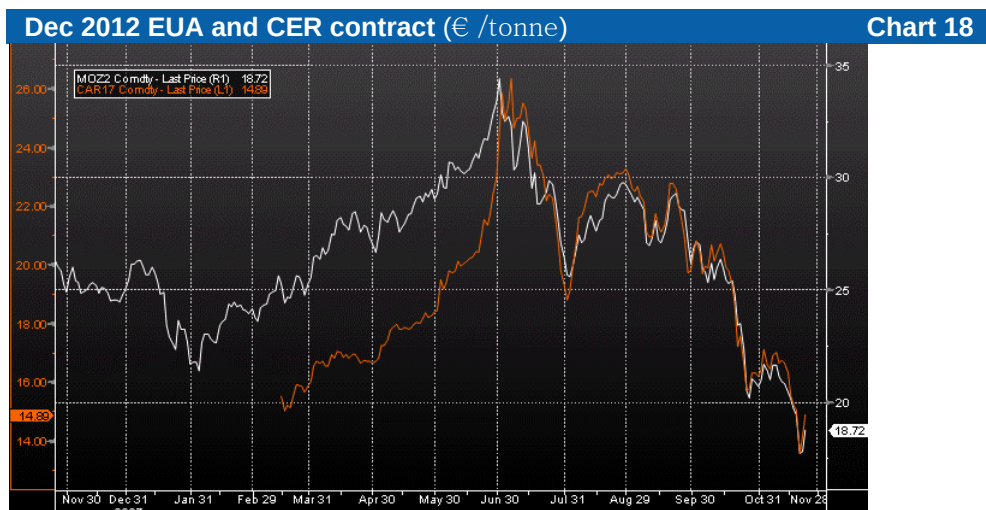
Carbon price not dictated by commodity prices alone and CER price has element of price regulation

However, as already noted with the fuel switching level, the carbon price is not dictated by the coal price alone and fuel switching levels depend upon the absolute difference between the cost of coal and the cost of gas, the average efficiency of the coal and gas plant production and the carbon intensity of the different power production. In addition, because of the links with international markets such as CERs where there is a degree of government price regulation, market forces alone do not dictate the price.

Whilst we believe fuel switching levels will support carbon prices over the medium term (deeper emission cuts will require a higher carbon price driven by long term abatement cost), in the short term the carbon price could be distorted by a politically driven supply/demand imbalance.

Phase II period to have excess allowances but carryover ability will halt repeat of Phase I

Less short term emphasis on emission reductions combined by recession-driven reduced output is likely to result in an excess of allowances in Phase II. Although the ability to carryover allowances into Phase III of the ETS should mean that Phase II allowances will always carry a value (unlike Phase I), we see the scope for EUA's to trade around the CER price which itself could trade as low as €10/tonne (RWE's average price per contracted CER certificate is <€10).



Source: ECX ICE / Bloomberg; compiled by DIR.

EU ETS Emission forecasts

We assume BAU emission growth of 1.5% per annum

In modelling our EU ETS carbon forecasts we have assumed a Business As Usual emission growth of 1.5% per annum – in line with the 1.3% per annum electricity growth to 2030 forecast for OECD Europe by Vattenfall in its BAU model.

Given the recent economic downturn we have then applied a reduction to these emission outputs based on the change in our DIR EU27 real GDP forecasts between our current forecasts and those issued in May 2008.

Economic sensitivity reduces BAU by 1.8% pa

We have assumed a carbon sensitivity to GDP for the ETS scheme of 0.2t per \$1,000 GDP (vs 0.4t per \$1000 real GDP for EIA Europe overall but we deem the change in the electricity demand component of the EU ETS to be less economically sensitive). These lower GDP forecasts have reduced our 2020 emissions from the BAU case by on average 1.8% per annum or 20% in total.

Estimated economic sensitivity of EU ETS emissions													Chart 19	
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Real GDP growth (May forecast)	2.70%	1.45%	1.61%	2.57%	2.65%	2.15%	2.09%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%
Real GDP growth (Nov forecast)	2.90%	1.20%	-0.70%	1.20%	2.40%	2.90%	2.40%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%	2.50%
Real €bn GDP (May)	10,630	10,784	10,958	11,240	11,538	11,786	12,033	12,334	12,642	12,958	13,282	13,614	13,955	14,303
Real €bn GDP (Nov)	10,648	10,776	10,701	10,829	11,089	11,411	11,684	11,976	12,276	12,583	12,897	13,220	13,550	13,889
Real €bn difference		-8	-257	-411	-449	-376	-349	-357	-366	-375	-385	-394	-404	-414
€/£ FX rate		1.47	1.25	1.24	1.24	1.24	1.24	1.24	1.24	1.24	1.24	1.24	1.24	1.24
Real \$bn difference			-321	-509	-557	-466	-432	-443	-454	-466	-477	-489	-501	-514
Economic sensitivity reduction in CO2 emissions (mt)			-64	-102	-111	-93	-86	-89	-91	-93	-95	-98	-100	-103
ETS economic sensitivity reduction in CO2 emissions (mt)			-29	-46	-50	-42	-39	-40	-41	-42	-43	-44	-45	-46

Source: DIR estimates.

There is already evidence of economic sensitivity in the EU ETS area.

Evidence of reduced electricity demand already apparent

In Italy the electricity grid operator Terna reported that weather adjusted demand fell by 2.5% yoy in October compared to growth of 0.5% for the first 10 months of the year. According to Terna, Italian industrial demand for electricity is estimated to have fallen by around 30% yoy in October and November.

In the UK the National Grid has estimated that peak demand will be 1% lower yoy over winter 2008 (500MW) whilst for 2009 peak demand could fall by 7% (we estimate this is equivalent to about 1.5% of total demand). Without much of a manufacturing base, UK electricity demand should be more resilient and countries such as Russia, Norway and Germany with an emphasis on energy intensive industries are likely to see a greater impact.

New renewable capacity to reduce emissions

We have also assumed that the increased participation of renewable power generation reduces emission output, although our forecast is below the EU targets for renewable generation (in part due to economic downturn and financing difficulties). We estimate renewable electricity will contribute around 25% of total electricity by 2020, an increase from 16% in 2007. This equates to an increase in renewable generation from 473 TWh in 2007 to 830 TWh in 2020. This is less than the 1,073 TWh forecast by the IEA and less than the estimated 40% of electricity generation required for the EU to meet its target of 20% energy to be derived from renewables by 2020.

Offset by nuclear closures (which could be delayed)

We have then factored in the estimated impact from the closure of CO2 free nuclear facilities (using IEA nuclear output forecasts) which are likely to be replaced by carbon emitting fossil fuel facilities (as renewable generation cannot provide baseload generation). Should European governments extend the lifetime of nuclear facilities (as we expect they will in Germany, France and Belgium) then this impact would be mitigated and emission levels would be lower (hence carbon price likely to be lower). Extension of nuclear lifetimes could offset roughly 880mt of CO2 cumulative 2008 to 2020, roughly a third of the cumulative shortfall (pre-CER) in CO2 we have modelled.

Combined factors results in emissions -0.8% pa from 2008

These four factors combined result in existing scheme ETS emissions reducing from an estimated 2,050mt in 2008 (ex-Romania and Bulgaria) to 1,880mt in 2020 – a reduction of 0.8% per annum from 2008.

With the scope of the EU ETS scheme widened we have also factored in to our forecasts the inclusion of Bulgaria and Romania within the EU and the inclusion of aviation from 2012.

For Bulgaria and Romania we have assumed emissions increased by 5% per annum to 2008 and increase by 2.5% per annum thereafter.

Aviation emissions included from 2012

For aviation we have assumed EU international and domestic emissions increased by 5% per annum 2005 to 2007 but will increase at only 2% per annum 2007 to 2020 (economic sensitivity and improved fuel efficiency from younger fleet). Our 2020 aviation emission forecast of 292mt is in line with the EEA forecast of 284mt.

EU ETS emission forecast 2005-2020 (mt CO2 equivalent)																Chart 20
EU-27	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Emissions (BAU @ 1.5%)	2012	2033	2050	2081	2112	2144	2176	2208	2242	2275	2309	2344	2379	2415	2451	2488
Economic sensitivity					-29	-75	-125	-167	-206	-246	-286	-328	-371	-415	-460	-507
Savings from renewables				-40	-65	-81	-96	-112	-127	-143	-159	-176	-192	-208	-225	-242
Increase from nuclear closure				9	18	26	35	44	53	62	71	85	99	113	126	140
Existing Scheme emissions	2012	2033	2050	2050	2035	2015	1990	1974	1961	1948	1934	1925	1914	1904	1892	1880
Growth		1.0%	0.8%	0.0%	-0.7%	-1.0%	-1.2%	-0.8%	-0.6%	-0.7%	-0.7%	-0.5%	-0.5%	-0.6%	-0.6%	-0.7%
Economic sensitivity effect					-1.4%	-2.1%	-2.3%	-1.9%	-1.7%	-1.8%	-1.8%	-1.8%	-1.8%	-1.8%	-1.8%	-1.9%
Renewable % of electricity					19%	20%	20%	21%	21%	22%	22%	23%	23%	24%	24%	25%
Romania & Bulgaria	111	117	122	128	132	135	138	142	145	149	153	157	160	164	169	173
Aviation emissions								250	255	260	265	270	276	281	287	292
Total ETS emissions	2123	2150	2172	2178	2167	2150	2129	2366	2361	2357	2352	2351	2350	2349	2347	2345

Source: DIR.

2020 emissions forecast at 2,345mt compared to 1,915mt target – balance to met by CER/ERU and abatement techniques

Total EU27 emissions are forecast at 2,345mt in 2020 (1,880mt EU25 plus 173mt Romania & Bulgaria plus 292mt aviation). However this forecasted emission level still represents an excess compared to the 1,915mt targeted by the EU under its emission allowances (1,720mt EU27 plus 195mt aviation). The balance therefore has to be met through CER/JI usage and/or additional abatement techniques (e.g. fuel switching). The pricing and availability of CER/JI credits and the cost of abatement will therefore dictate the EU ETs price.

EU ETS use of Kyoto mechanisms

We forecast CER/ERU demand of 1bn to 2012

We estimate the global demand for CERs/ERUs between 2008 and 2012 at around 1bn. The estimated EU government total of 350mt may reduce should Western European member states decide it is more economical to buy AAUs from Eastern European states (e.g. Russia and Ukraine together have more than 1,500mt AAUs that could be traded).

Estimated CER/ERU demand (mt CO₂ equivalent)

Chart 21

mt CO ₂ e	2008-2012
EU ETS required demand	17
EU Governments	350
Japan	550
New Zealand	30
Voluntary markets	50
Total	997

Source: DIR.

We estimate demand from Japan will be around 550mt, although the government forecast is around 350mt (of which public sector 100mt).

AAU/CER/ERU demand may be reduced if countries opt out of the Kyoto Protocol as Canada has done (we estimate this has removed around 100mt of demand for the period 2008 to 2012). Even post 2012 demand from Canada will be much reduced as the country will introduce a domestic cap-and-trade scheme in 2010. CERs will still be permitted but use will be limited (10% max) and greater focus will be placed on the generation of domestic credits (from agriculture, forestry, waste management projects) from projects commenced on January 2008 or later.

CER/ERU supply forecast to be sufficient to meet ETS demand and to be EUA price setter to 2012

Required demand for Phase II EU ETS is estimated to be minimal at only 17mt although we expect the private sector to purchase up to their full CER/ERU limit (1,554mt) to convert into EUAs to carry forward into Phase III. We forecast over 800mt of EUAs will be carried forward into the Phase III period. We therefore expect the principle driver of the EUA price in Phase II period to be the CER/ERU price as CER/ERUs will be sufficient to meet demand until 2016.

Phase II CER/ERU supply

Will there be enough CER/ERU supply, particularly now that credit market conditions may impact project financing?

Import limit on CER/ERU likely to be increased on an EU and national basis

Under the current scheme the EU ETS can import around 1,390mt CER/ERU over the five year Phase II period (roughly 280m per annum) and a proportion of these credits can be carried through to Phase III. However France has recently proposed an increase of 160mt to the CER/ERU limit to 1,544mt (marginally lower than the 168m increase voted for by the European Parliament's environment committee) over the 2008 to 2020 period and we expect this proposal to be adopted later this month. This CER/ERU total is based on the guideline that CER/ERU usage should

represent a maximum 50% of the reduction in emissions below 2005 levels (which could mean an increase to 1,893mt if targeted aviation reductions are included).

There is also likely to be a change to the national import limit of CER/JI credits, with a minimum import limit of 11% to be set. Countries such as Germany and Spain who have a higher (20%) limit set in Phase II of the scheme are likely to retain this upper limit but operators in countries such as the UK (8% limit) will benefit from higher CER/JI availability.

4,300 current CDM projects could generate 5.6 GT of CERs but 2.1 GT likely by 2012

The United Nations Framework Convention on Climate Change (UNFCCC) estimates that there are currently more than 4,300 CDM projects in the pipeline which could result in 5.6 GT of CERs. However issuance to-date has been just 528m since late 2005 (107m issued in 2008) and we would expect some impact from the economic slowdown and credit crisis. There have also been some issues with validation and verification, with DNV, who have validated around 50% of the CDM projects registered worldwide, experiencing a temporary (estimated one to two months at a rate of 3m CERs per month) suspension after internal audit failures.

Forecast CER supply 2008-2012 and 2013-2020 (m CER)

Chart 22

	Expected 2008-12	Available 2008-12	Available 2013-20
CER's	Million CERs		
2012 CER's expected from existing projects in validation stage	1223	271	603
2012 CER's expected from projects requesting registration	260	132	108
2012 CER's expected from registered projects	1382	754	372
Total amount of CERs expected from future projects until 2012	2053	185	1342
Total amount of CERs from existing projects produced after 2012			3168
Total amount of CERs issued	225	1568	5593
Share Of Proceeds (SOP) for the Adaptation Fund	4.5	31	112
Annual amount available		314	699

Source: UNEP RISOE.

Forecast of CER and ERU supply to 2012 from current projects likely to be sufficient to cover demand

UNEP RISOE estimates that roughly 2.1GT of CERs will be issued to 2012. Our estimate of around 1bn tonnes of CER/ERU underlying demand to 2012 would therefore represent less than half of this demand. Assuming the full 1,554mt EU ETS allocation is purchased in the Phase II period then this could still be met through CERs/ERUs as we forecast total demand of 2.5bn tonnes virtually matched by CER supply of 2,053mt and ERU supply of 313mt. The shortfall of 121mt would most likely be covered by EU Government purchase of cheaper AAUs rather than CER/ERUs or would require installations to phase their purchases through to the Phase III period.

Chinese dominance in CDM market likely to reduce

Currently 45% of expected CER volumes are estimated to be derived from Chinese CDM projects (vs 16% from India), with Brazil and Mexico dominating in Latin America. At this stage projects in Africa are hardly represented (2%). By project the dominant CDM technology is hydropower, followed by biomass and wind energy. Whilst there are only 22 HFC emission reduction projects scheduled to 2012, these projects account for around 17% of the expected CDM emissions reduction to this period (given GHG effect of HFC is 11,700 times that of CO₂).

CDM projects by hosting country (as per November 2008)

Chart 23

Total in the CDM Pipeline	Number	kCERs	2012 kCERs	Population	2012 CER per cap.
Latin America	814 19.1%	79,430	427,930 14.9%	449	0.95
Asia & Pacific	3,255 76.6%	476,382	2,281,589 79.6%	3,418	0.67
Europe and Central Asia	42 1.0%	4,064	18,953 0.7%	149	0.13
Africa	87 2.0%	18,642	98,577 3.4%	891	0.11
Middle-East	54 1.3%	8,376	38,093 1.3%	186	0.20
Less developed World	4,252 100%	586,894	2,865,143 100%	5,093	0.56

Source: UNEP RISOE.

JI market less developed but will scope to grow significantly

In contrast to the CDM market there are currently only around 166 JI projects in existence. However this is largely because the market is less mature (JI credits only permissible from 2008 compared to 2000 for CDM). It is estimated that JI schemes will produce around 312mt tonnes of ERUs between 2008 and 2012.

Longer term scope to include forestry would have dramatic impact on CDM/JI market

In addition, the supply of CER credits supply could also increase if the EU modified its qualitative restrictions on CERs. At the moment no forestry or nuclear CERs are permitted and large hydro projects (>20MW) require compliance with the World Commission on Dams report 2000 which has reduced hydro-related CER demand (which is why they trade at a discount).

Deforestation accounts for an estimated 20% of rising GHG emissions yet it is excluded from the EU CDM mechanism. However the EU has proposed a number of forestry initiatives to try to cut deforestation in half by 2020 and reduce net forest loss to zero by 2030, including the Global Forest Carbon Mechanism (which would use the proceeds from EU ETS auctions to pay for forest preservation in developing countries).

The EU Environment Council meeting on 4-5 December is likely to propose a pilot phase to “test the inclusion of deforestation credits in carbon markets”. Whilst full inclusion in the EU ETS is only likely post 2020, should forestry ever be linked to the EU ETS scheme we believe the volume of credits would increase markedly and the CER/ERU price would materially decline (the Forest Carbon Index estimates there are significant areas of the world where carbon reductions could be made for <\$6/tonne).

Phase II surplus of over 800mt EUAs to meet demand until 2017

Against a maximum limit of 1,554mt of CER/ERUs allowable in Phase II we forecast 875mt will be supplied in 2008 to 2012, with a further 679mt supplied by 2016. This suggests the EU ETS could actually have a surplus of 858mt of EUAs to carry forward into Phase III, which could meet demand until at least 2017.

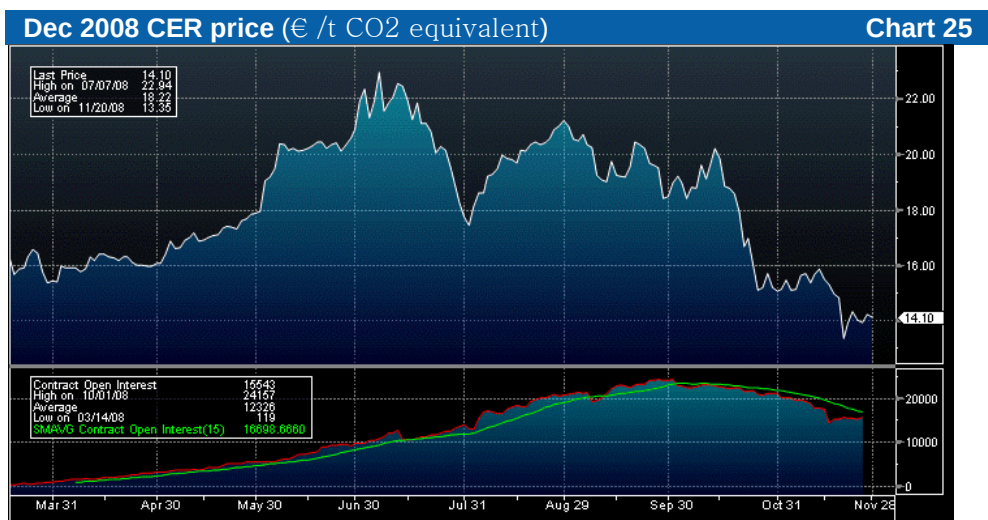
EU ETS allowance forecast 2005-2020 (mt CO2 equivalent)												Chart 24	
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Existing scheme allowances	2083	2083	2083	2083	2083	1974	1937	1901	1865	1829	1792	1756	1720
Change						-5.2%	-1.9%	-1.9%	-1.9%	-1.9%	-2.0%	-2.0%	-2.1%
Change vs 2005						-7.3%	-9.0%	-10.7%	-12.4%	-14.1%	-15.9%	-17.5%	-19.2%
Surplus new entrants reserve	72	72	72	72	72	0	0	0	0	0	0	0	0
Aviation allowances					199	195	195	195	195	195	195	195	195
CER/ERU required	24	12	-5	-26	12	193	225	256	292	327	362	396	430
CER/ERU allowed 2008-2020	120	120	120	120	120	120	120	120	120	120	120	120	120
CER/ERU allowed 2008-2012	311	311	311	311	311								
CER/ERU supplied	125	150	200	200	200	200	200	200	79				
ETS allowances + CER/ERU	2280	2305	2355	2355	2554	2369	2332	2296	2139	2024	1987	1951	1915
Excess/(Shortfall) actual	101	138	205	226	188	7	-25	-56	-213	-327	-362	-396	-430
Cumulative excess/(shortfall) actual	101	239	444	670	858	865	840	784	572	245	-117	-514	-944
Excess/(Shortfall) smoothed	96	107	124	146	108	-73	-105	-136	-172	-207	-243	-277	-311
Cumulative excess/(Shortfall) smoothed	96	203	327	473	580	507	402	265	93	-114	-357	-634	-944

Source: DIR.

EUA, CER and ERU pricing trends

Phase II CER price could decline given sufficient supply

Because we forecast sufficient supply of credits within 2008-2012 we believe CER prices could continue to come under pressure. The CER price has already fallen from over €22/tonne in July to around €15/tonne currently.



Source: ICE / Bloomberg; compiled by DIR.

Chinese price floor could be lowered (again)

However given the importance of China currently in the CDM mix we suspect this price is being supported by the effective price floor set for primary CERs by China's designated national authority (DNA). This price floor was reduced by €0.5/tonne in November 2008 but currently stands at around €12/tonne for wind-related projects and €8/tonne for hydro-related projects (hydro projects have greater compliance issues in EU ETS and therefore attract a lower price).

Ex-renewables, direct project costs <€10/tonne

Estimates of the costs of CDM/JI abatement projects suggest the CER price could fall below €10/tonne. Whilst wind-related projects are likely to remain relatively expensive (although will fall with turbine prices), methane, NoX and HFC23 projects remain relatively low cost as can be seen from the table below.

Estimated CDM/JI abatement costs (€ /t CO₂ equivalent) **Chart 26**

Green-house gas	Global warming potential (GWP)	Derivation	Mitigation	Mitigation Costs (Investment)
CO ₂	1	Burning of fossil fuels	Energy efficiency, renewable energy	> 10 €/t _{CO2e}
CH ₄ (methane)	21	Coal mines, landfills, animal waste	Installation of gas gathering and power generation systems	5-10 €/t _{CO2e}
N ₂ O (nitrous oxide)	310	By-product of fertilizer production	Installation of catalyst	< 5 €/t _{CO2e}
HFC23	11,700	By-product of cooling medium production	Installation of HFC23 incineration systems	< 1 €/t _{CO2e}

Source: RWE; compiled by DIR.

Price regulation has meant carbon cost significantly higher than investment cost – particularly with HFC

However, China's price regulation has meant that historically the price of CERs has not always reflected the project costs. According to the scientific journal Nature, it would have been nearly €5bn cheaper to directly fund the equipment to destroy HFC-23 emissions at refrigeration manufacturing plants rather than allocating CDM credits to these projects. Should China not reduce these prices we suspect other countries will and the geographic mix of CDM projects will shift.

ERU prices significantly below CER prices – unlikely to be sustained

JI/ERU prices are currently below those of CDM/CER (e.g. Slovakia recently sold around 10mt of JI credits for around €6/tonne), although we expect prices to converge (likely CER down) given the similar fungibility into EUAs.

Russia offers significant low cost JI project potential. The refurbishment of gas distribution pipelines to reduce the emission of methane through leakage is estimated to equate to a CO₂ saving of between €0.5-€2.5/tonne.

Non-Kyoto power sector abatement costs

We believe the EUA price is likely to track the CER/ERU price for as long as there are sufficient allowances to not require other abatement techniques such as fuel switching or domestic emission reduction investments.

Phase II EUA price likely to trade at small (premium) spread to CER

Whilst we expect the spread to narrow, the EUA price should always trade at a premium to the CER price as there are always likely to be some restriction as to the extent of CERs permissible in Phase III whereas there are no restrictions on exchanging EUAs into Phase III. In addition, whilst delivery can be guaranteed by the seller, CERs are also often sold by companies with a lower credit rating than EUA sellers so there is a greater counterparty risk.

Whilst we estimate sufficient CER/ERU allowances until 2017, given electricity companies sell forward their output (generally up to 4 years in advance) we estimate the EUA price will trade at a tight spread with the CER/ERU price until 2013, from which time we expect additional buying to be based against domestic abatement costs rather than the CER/ERU price.

Phase III pricing more focused on abatement cost

On the basis of a smoothed usage of CER/ERUs throughout the 2008-2020, we estimate additional emission reductions of 73mt per annum will be required to meet the EU ETS allowance ceiling (944mt cumulative shortfall over 13 years). How installations can achieve this 73mt additional abatement will determine the EU ETS price for much of the Phase III trading period.

Scope for 100mt to 150mt summer fuel switching at costs of between €21/tonne to €30/tonne

Probably the easiest abatement method available in the power sector is fuel switching, achieved by substituting higher carbon coal-fuelled generation with less carbon intense gas-fuelled generation. GDF Suez estimates there is scope for around 100mt to 150mt of CO₂ reduction from summer fuel switching and scope for 250mt to 300mt from all year switching (at a higher gas cost and therefore higher CO₂ price). GDF's estimate of the fuel switching potential is higher than that of Vattenfall who believe there is scope for roughly 170 TWh of additional gas production in Europe from existing assets using higher utilisation rates (would suggest roughly 80mt fuel switching potential).

Using the DIR full year 2020 forecasts of 49p/therm UK gas and €22.5/MWh for European gas, applying a 20% discount for summer gas prices and an API2 coal price of \$96/tonne, we estimate summer fuel switching costs of between €20.6/tonne (UK) and €29.5/tonne (Continental Europe).

Estimate €30/tonne ceiling price during Phase III – forecast 2020 EUA at €25/tonne

Given summer fuel switching should be sufficient to meet our forecast shortfall, at our forecast commodity price levels we believe the carbon price in Phase III should not exceed €30/tonne and forecast a 2020 EUA price of €24.8/tonne.

Forecast 2020 summer fuel switching levels	Chart 27
	2020
API2 coal (\$/t)	96
UK gas price p/therm	49.0
UK summer gas price p/therm	39.2
European gas - €/MWh hhv	22.5
European summer gas - €/MWh hhv	18.0
Hard coal power plant efficiency	38%
Hard coal carbon intensity (t CO ₂ /MWh)	0.89
Gas power plant efficiency	44.0%
Gas carbon intensity (t CO ₂ /MWh)	0.46
European coal to gas summer fuel switching level) - €/tonne	29.5
UK coal to gas summer fuel switching level - €/tonne	20.6

Source: DIR estimates.

However, in addition to fuel switching there are other (potentially lower cost) abatement techniques which the power sector could apply.

Other abatement techniques suggest ceiling of €25/tonne

Vattenfall estimates that the majority of abatement opportunities require a CO₂ price above €15/ton. The average abatement cost should fall to €25/ton in 2020 and €19/ton in 2030.

Lignite power production has a higher carbon intensity than hard coal (roughly 50% more) and therefore investments to improve fuel efficiency in lignite production can produce significant CO₂ reductions.

Estimate RWE's lignite WTA technology saves CO₂ at €15/tonne

We estimate RWE's WTA ((Wirbelschicht-Trocknung mit integrierter Abwärmenutzung - fluidized-bed drying with internal waste heat utilization) pre-drying technology offers carbon abatement for lignite power production facilities at around €15/tonne. In essence the steam used to dry the high moisture content lignite is used to heat the power plant boiler water rather than being discharged into the atmosphere in a traditional plant.

Estimated carbon abatement costs from WTA technology (€ /tonne) Chart 28

100 MW plant	Pre-WTA	Post-WTA
German lignite cost (€/metric ton)	12.0	12.0
Total fuel cost - €/MWhh	4.4	4.4
Through Life Efficiency (LHV) - old plant	31%	36%
German lignite fuel cost €/MWh	14.3	12.3
Lignite carbon intensity (tCO ₂ /MWhh)	0.4	0.4
Lignite carbon intensity (t CO ₂ /MWhe)	1.31	1.13
CO ₂ price €/t	16.0	16.0
Lignite CO ₂ price €/MWhe	33.0	18.1
Load hours (h)	7,500	7,500
Load factor	86%	86%
Annual CO ₂ mt	0.98	0.85
Annual saving mt		0.14
Annual saving €m		2.2
Capex per 100 MW (€m)		20
Carbon abatement cost (€/tonne)		14.6

Source: DIR estimates compiled from RWE data.

Post Kyoto and International targets

Focus on relatively high cost domestic CO₂ reduction not theoretically necessary

A molecule of CO₂ can travel from the US to China in less than a day so from an environmental point of view it shouldn't matter whether emission reductions are made domestically or abroad, although from a practical point of view the verification of the reduction is more rigorous domestically.

Majority of emission growth to come from Non-OECD countries

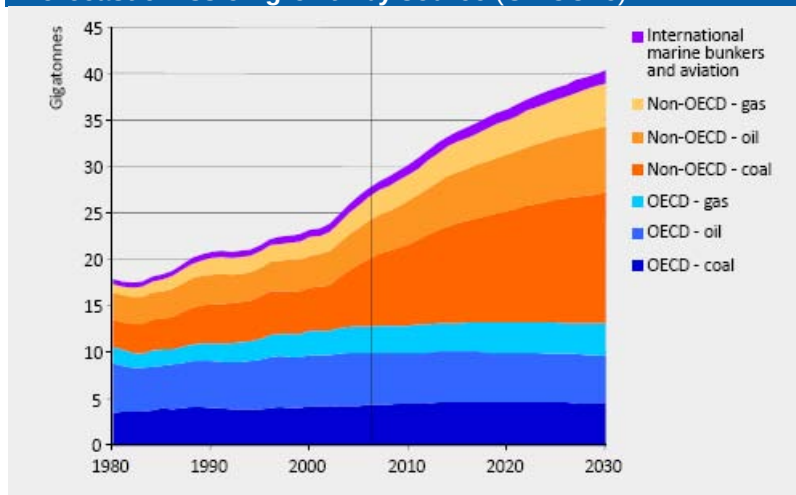
Given the EU ETS accounts for less than 10% of world's GHG emissions and that the IEA forecasts that the majority of emission growth will come from Non-OECD countries, what happens to climate change policies in the rest of the world is critical to the future of the environment, the EU ETS scheme and the Kyoto Protocol.

Two largest CO₂ emitters not party to Kyoto and won't commit to EU size reduction targets

This is because the two largest CO₂ emitters, China and the US, accounting for nearly half the world's GHG emissions, are not currently participating in the Kyoto targets. Highlighting the problem of achieving a multi-lateral agreement the US did not ratify Kyoto because of the absence of firm reductions by developing countries whilst China and India now argue against joining Kyoto without a firm commitment from the US.

Forecast emission growth by source (GT CO₂e)

Chart 29



Source: IEA; compiled by DIR.

December climate meetings unlikely to result in significant progress

During 1st to 12th December delegates from 190 countries will meet in Poznan, Poland at COP14 (Conference of the Parties to the UNFCCC) to discuss initiatives to tackle climate change.

This will be followed by the EU Summit on 11th to 12th December in Brussels. A vote on the basic principle and structure of any agreement is then likely to take place on 18th December, or January if a second reading is required.

We believe a satisfactory conclusion is unlikely at either of these meetings.

Too early for US cuts, far too early for China who have just entered their industrial revolution

Internationally, the US is unlikely to play an active role in short-term initiatives given the presidential handover process in the US. Developing countries continue to seek financial or technological assistance before adopting stringent emission reduction targets and highlight in their defense their low absolute emission levels per capita (China's emission levels per capita are one fifth of those of the US and one third of those of the EU).

EU progress has been slow and some members resisting tighter targets

Within the EU there is discontent with regard to the emission reduction targets, highlighted at the quarterly European Council meeting in October 2008 when Poland and Italy led a revolt against President Sarkozy's plan to include legally binding limits with the 2020 reduction targets. As a result the members only signed a conclusion that "confirms its determination to honour the ambitious commitments" and proposed "appropriate responses to the challenge...having regard to each member state's specific situation".

Whilst Poland (and Estonia) may be appeased by granting coal-dependent nations a phasing in of the power sector auctions, Italy is unlikely to be placated. This may make it difficult for the EU climate change policy package to be approved and voted on by April 2009, the target set by EU Parliament leaders (and also the date when verified emissions for the EU in 2008 are due to be published).

Lack of agreement in December 2008 may stall progress until H2 2009

The EU presidency is due to be passed from France to the Czech Republic for the first half of 2009 (to be replaced by Sweden in the second half). The Czech Republic derives nearly 60% of its electricity from coal fired plants and President Klaus was reported to have claimed global warming was a myth in an interview with a Czech newspaper in 2007¹.

¹ – "Global warming is a false myth and every serious person and scientist says so. It is not fair to refer to the U.N. panel. IPCC is not a scientific institution: it's a

This suggests much work may have to be done by the Swedish presidency during the second half of 2009, ahead of the COP15 meeting in Copenhagen in December 2009 when a new agreement to run to 2020 is supposed to replace the Kyoto Protocol.

Obama targets less ambitious than EU but will still be difficult to enact

It may also be difficult for the US to have passed legislation in both the House and Senate by December 2009. Whilst President-elect Obama has already declared emission reduction targets, passing legislation on the reduction target, extent of free auction and potential price caps could be a tall order given the restricted time frame.

Given US emission levels have risen by 14% since 1990, Obama's current targets include a return to 1990 emission levels by 2020 and a further 80% reduction by 2050. He has also called for a cap-and-trade system with 100% auctioning of allowances and has proposed a 10% contribution in the share of electricity from renewables by 2012 and 25% by 2025.

Whilst the Democrats are likely to be more in favour of environmental controls than the Republicans, the historic voting experience for environmental control has been poor with the renewal of the wind production tax credit only passing through Senate and Congress this year as an amendment to the TARP bail-out legislation.

In 1997 the Senate voted on whether the US should sign up to the international treaty on GHG emissions that would eventually become the Kyoto Protocol, with the result 95 to zero against unless it included targets for developing countries (41 Democrat votes including vice president elect Joe Biden and Barbara Boxer, chair of the Senate environment committee).

The legislative process may be accelerated as in January Senator Barbara Boxer (Democrat) is expected to introduce two pieces of carbon related legislation. The first should create a grant programme to fund \$15bn of clean energy technology (in line with Obama's target of spending \$150bn over 10 years on clean energy) whilst the second would direct the US Environmental Protection Agency (EPA) to develop a GHG cap-and-trade scheme by amending the existing Clean Air Act.

US and Canada likely to have carbon price caps around €9/tonne

However the cap-and-trade scheme is expected to be based upon the proposed Bingaman-Specter Low Carbon Economy Act of 2007, which proposed a price cap ("safety valve") which started a \$12/tonne (€9.2/tonne) increasing by 5% real per annum (about €19/tonne after 10 years).

This price cap would be in line with that proposed by Canada for its large final emitters (LFE) trading system (C\$15/tonne or €9.5/tonne) but is significantly below the current EUA or CER/ERU price, which would make linking the various international schemes difficult. After abandoning the Kyoto Protocol in 2006 Canada has proposed a 20% reduction in 2007 emissions by 2020, which would return emissions to around 1990 levels (compared to a Kyoto target of a 6% reduction from 1990 levels by 2012).

US voluntary carbon schemes trade at around €10/tonne

North America already operates a number of emission trading schemes, some of which are voluntary. Prices for Gold Standard Verified Emission Reduction credits

political body, a sort of non-government organization of green flavor. It's neither a forum of neutral scientists nor a balanced group of scientists. These people are politicized scientists who arrive there with a one-sided opinion and a one-sided assignment. "

(VERs), which are high quality CDM offsets which can be used in markets such as the US without an emissions cap, currently trade at around €11/tonne, whilst the California Climate Action Registry (CCAR) VERs trade at around €8/tonne.

Ten Northeastern and Mid-Atlantic states have also established a mandatory cap-and-trade emission system, the Regional Greenhouse Gas Initiative (RGGI). However, as with Phase I of the EU ETS, the cap for the period 2009-2014 of 188m short tons per annum looks to be in excess of existing emissions of some 160m short tons. Although RGGI allowances have been oversupplied they still trade (presently \$4/short ton) as their value reflects the optionality of conversion into a wider federal scheme. However it is unclear at this stage on what basis this potential fungibility will be allowed (e.g. one-for-one or two-for-one).

Japan trialling cap-and-trade schemes and reviewing €20/tonne carbon tax

Japan is trialling a voluntary emissions trading scheme and is targeting a 60% to 80% reduction in GHG emissions by 2050. Tokyo will introduce a cap-and-trade scheme in 2010 which will target a CO₂ reduction of 25% vs 2000 by 2020. In November 2008 the Environment Ministry proposed a carbon tax equivalent to around €20/tonne. GHG emissions in Japan in 2007 were 1,371mt an increase of 2.3% (31mt) vs 2006 and 8.7% higher than the Kyoto base of 1,261mt, although an estimated 63mt of the 2007 emissions resulted from lower nuclear availability (in large part due to the earthquake).

Australia and New Zealand may introduce carbon trading in 2010 but targets less ambitious than EU

Australia has delayed the announcement of its 2020 emission targets until after the Poznan meeting, but is expected to announce a cut of between 5% and 15% compared to 2000 levels by 2020, a lower reduction and a later base year than the EU reductions. Australia is also targeting a reduction of 60% in its emissions by 2050. Australia is due to introduce a carbon cap-and-trade scheme in 2010.

New Zealand's proposed carbon cap-and-trade scheme is also being reviewed by the new government and its implementation may be delayed until 2010 (or could be replaced with a carbon tax). Under the Kyoto Protocol New Zealand emissions were targeted to be level compared to 1990 but have instead increased by 26%. A unique problem for New Zealand is that half of the country's GHG emissions originate from agriculture where abatement techniques are currently less widely available. Animal methane accounts for around 18% of global GHG emissions and scientists are attempting to come up with a solution (GM, vaccine, feedstuff) to reduce the output.

Glossary

Additionality: A key eligibility test designed to generate carbon credits under the CDM and JI programmes. This test dictates that projects are only eligible for carbon credits if the resulting emission reductions were going to happen anyway (i.e. are additional to what would have occurred without the carbon credit incentive).

Assigned Amount Units (AAU): Scheme which allows the trading of assigned amount units between countries. AAUs can be used for compliance with the Kyoto treaty. Not valid for use in the EU ETS or to meet EU targets in the non-traded sector.

Certified Emission Reduction unit (CER): Certified emission reduction unit represents one tonne of CO₂ equivalent reduced under Joint Implementation.

Clean Development Mechanism (CDM): Scheme which allows credits to be issued from projects reducing GHG gases in Kyoto non-Annex 1 countries (developing countries). Credits are valid in the EU ETS and to meet EU targets in the non-traded sector, up to certain limits

Emission Reduction Unit (ERU): Emission Reduction Unit represents one tonne of CO₂ equivalent reduced under Joint Implementation.

Green Investment Schemes (GIS): Some countries are attaching Green Investment Schemes to AAUs in order to overcome buyers' concerns about additionality. Examples of GIS include direct investment in projects or policies to encourage non-fossil energy use, improvement in energy efficiency or projects to slow the rate of deforestation.

Joint Implementation (JI): Scheme which allows credits to be issued from projects that reduce emissions of GHGs in Kyoto Annex I countries. Credits are valid in the EU ETS up to certain limits.

Voluntary Credits: Credits generated by a wide variety of projects and sold to companies or individuals wishing to offset their emissions. No mandatory regulation. Currently no credits from these schemes can be used in the EU ETS or to meet EU targets.

Source: Climate Change Committee, carbonpositive

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