Annex: 'Stress testing' ETS price scenarios.[1]

Our study *Strengthening the EU ETS* has underlined that uncertainty is a fundamental issue in any response to the present situation. Indeed if there were no uncertainty, the choice between a Quantity and Price response – or indeed system – might matter little. However in the real world, uncertainty is endemic – and hugely important. This Annex illustrates with a very simple example as follows.

Some basic uncertainties could be simply summarised as follows.

Volume uncertainties

- A 1%/yr reduction of economic growth relative to expectations could reduce emissions by around 500MtCO_2, given a standard assumption about the relationship of GDP to emissions.[2] Energy efficiency policies can cut back emissions for a given GDP level, but there may be a comparable degree of uncertainty about their full impact on demand and emissions (including 'rebound' effects).[3] A combination of depressed economic growth rates with more successful energy efficiency policies delivering close to the EU target could cut 1000MtCO_2 from 'reference' projections. It is harder to construct a big 'upside' from higher economic growth rates, since higher economic growth rates tend to be associated with new and more efficient capital stock.

- Changes in relative gas and coal prices sufficient to move from 'coal' to 'gas' baseload operation would change the underlying demand for power sector emissions. Total power sector emissions in reference scenarios exceed 10,000 MtCO_2, most of this from coal power stations. Scenarios depend not only on relative coal-gas prices, but also the nature and rate of new plant construction. It is not hard to construct scenarios in which low gas prices for most of Phase III, combined with power sector liberalisation, lead to a new wave of gas plant construction; switching 10% of coal operation to gas over Phase III would reduce emissions over Phase III by 500MtCO_2. There is some potential for fuel switching (notably biomass) in industry emissions as well. On the upside, high gas prices combined with failure to deliver renewable energy targets could increase emissions by at least as much.

These reflect uncertainties respectively concerning energy demand, and the carbon intensity of energy supply, which is a useful way to conceptualise two distinct sources of uncertainty. It suggests that on *each* of these two dimensions, the uncertainty in cumulative Phase III emissions could be at least 1000MtCO_2.

[1] This Annex presents a deliberately highly simplified framework for thinking about potential scales of uncertainty and the implications of different kinds of intervention. The framework and results should not be used for any other purposes of price projection.

[2] Assuming that a 1% reduction in GDP changes emissions by 0.8%, see Bowen et al (2009)

[3] For example, EU efforts on energy efficiency have been invigorated partly by assessment that the EU is falling far short of its target to improve gross energy intensity by 20% on 1990 levels – and might only achieve 10%. The difference between 10 and 20% improvement by 2020 is substantially bigger than the impact of a 1%/yr change in economic growth rates from 2012 to 2020.

Translation to price impacts

Varied studies based on complex models of the EU energy system suggest that setting aside 1400 $MtCO_2$, as proposed by the EU Parliament Environment Committee, might increase prices from the present levels to around €20/tCO_2.[4] This is consistent with a crude order-of magnitude assumption that withdrawing 1000 $MtCO_2$ from the ETS market over the course of Phase III (c.6% of allowances) would double the average CO_2 price on central assumptions. These anchor points can be used to translate volume uncertainties into prices.

Examining the impact of a 1400$MtCO_2$ Set-Aside, and/or a reserve price consistent with our price scenario in Table 3 (average price €18.5/tCO_2), this simple combination can generate estimates of the price impact of 'stress testing' underlying assumptions. The tables below show the implications if the "stress test" range of volume assumptions, based on the above, is that demand-side and supply-side variations could each impact underlying volume demand within overall range of 1200$MtCO_2$ (+/- 600$MtCO_2$ around a central case), each being cumulative over Phase III.

The 'stress test' combination of low energy demand + low carbon intensity is then 1200$MtCO_2$ below the reference case, whilst the 'high energy demand + high carbon intensity' case is 1200$MtCO_2$ above it. Scenarios of low economic growth, successful energy efficiency, and low gas prices over Phase III do not seem too hard to construct. The higher case carries more uncertainty, in terms of both volume and price; however, even if volumes scenarios +1200$MtCO_2$ above reference are hard to construct, there is also uncertainty about the translation to prices which could be non-linear (particularly in high gas price scenarios). The numbers below assume a linear relationship of volume to price.

This framework also enables a simple approximate estimate of the gross revenues associated with auctioning, after taking account of the number of allowances held back; in the low base emission scenarios, of course, more needs to be held back to deliver a given reserve price. Of course, both prices and revenues are ultimately paid through consumer expenditure, primarily through impact on electricity prices. As with any market-based instrument, there are no "free lunches", just more or less efficient responses and resources potentially available for the most appropriate uses.

[4] A short Reuters survey in Feb 2012 found an average estimate of €17/tCO2. The base starting price may already contain some degree of uplift due to market expectations of intervention.

Table A-1: Average carbon price and Phase III Revenues under different scenarios with 1400 $MtCO_2$ set-aside

	Low economic growth / high energy efficiency		High economic growth / low energy efficiency	
	Carbon price, €/tCO_2*	Indicative revenues, €bn**	Carbon price, €/tCO_2*	Indicative revenues, €bn**
Low gas-coal differential / high renewables	8.0	68	20.0	169
High gas-coal differential / low renewables	20.0	169	32.0	271

Table A-2: Average carbon price and Phase III Revenues under different scenarios with Reserve Price Auctions

	Low economic growth / high energy efficiency		High economic growth / low energy efficiency	
	Carbon price, €/tCO_2*	Indicative revenues, €bn**	Carbon price, €/tCO_2*	Indicative revenues, €bn**
Low gas-coal differential / high renewables	18.5	137	18.5	159
High gas-coal differential / low renewables	18.5	159	20.0	197

Table A-3: Average carbon price and Phase III Revenues under different scenarios with 1400 $MtCO_2$ set-aside plus reserve price auction

	Low economic growth / high energy efficiency		High economic growth / low energy efficiency	
	Carbon price, €/tCO_2*	Indicative revenues, €bn**	Carbon price, €/tCO_2*	Indicative revenues, €bn**
Low gas-coal differential / high renewables	18.5	136	20.0	169
High gas-coal differential / low renewables	20.0	169	32.0	271

* Average carbon prices over Phase III (2013-2020), assuming allowances are used in period except for those held back under the different mechanisms, which are cancelled or banked forward.

** Gross public revenues from auctions over Phase III, taking account of free allocation and assuming that all allowances withdrawn come from auctions, but neglecting timing effects