US emissions allowance prices for sulphur dioxide (SO_2) rose nearly 200% in 2005 (end of November) and 300% during 2004. *Sandy Fielden* of Logical Information Machines examines the SO_2 emissions allowance market and discovers what market drivers are forcing prices ever higher.

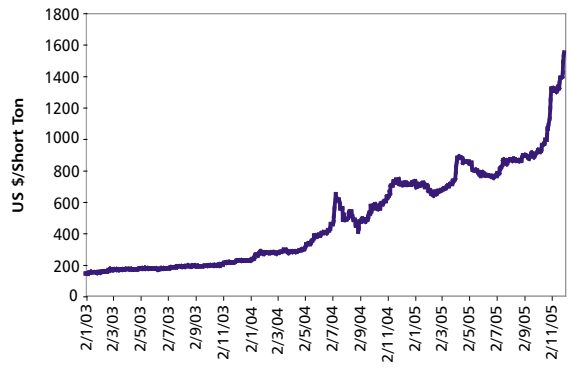
Sky-high cost of clean air

★ Acid rain occurs when emissions of SO_2 and nitrogen oxide (NOx) react with water, oxygen and oxidants in the atmosphere to form various acidic compounds. The discussion here focuses on SO_2 emissions. Title IV of the 1990 US Clean Air Act Amendments sought to reduce acid rain. The act established an acid rain programme run by the Unites States Environmental Protection Agency (EPA).

According to the EPA, electric power generation accounts for nearly 70% of acid rain. As a result, the law directed the EPA to implement a phased-in SO_2 reduction programme that initially targeted 110 high-emitting plants for the years 1995-1999. Starting in 2000, a second phase extended the limits to all fossil-fuelled power plants with more than 25 megawatts capacity. Today more than 3300 units are regulated. At the centre of the initiative, an SO_2 emission allowance trading programme was established. The goal of the programme was to get electric utilities to reduce their SO_2 emissions by about 50% from 1980 levels by the year 2010.

F1. SO_2 US daily assessment for year 1 since 2003

Source: *Petroleum Argus*



The daily price of SO_2 emission allowances rose by nearly 300% during 2004 and a further 200% between January and November 2005. The main drivers of the increase in price are more stringent SO_2 emissions legislation and the effect of rising natural gas prices on coal consumption.

The SO_2 emission allowance trading system was the first major pollution reduction initiative worldwide to employ a tradeable permits mechanism.

Under the system, power plants are allocated a 30-year stream of tradable allowances, each worth one tonne of SO_2 emissions. The allowances reflect pre-1980 emission levels. Each year since the programme started in 1995, plants can either use their allowances to "pay" for that year's sulphur emissions or they can reduce actual emissions and sell their excess allowances to others not in compliance. Alternatively they can bank allowances for use in future years. Allowances are designated by vintage year, which denotes the first year they can be used for compliance.

SO_2 allowances are tracked by the EPA using an online tracking system that records any exchanges of allowances (trading) and monitors plant emission compliance. Every March, the EPA performs a reconciliation of the scheme. If any power plant owner failed to achieve a balance of emissions and allowances through acquisition and surrender of allowances, they would be fined more than $2,000.

The EPA also conducts an annual auction of allowances in March. The auction is designed to help market liquidity and make allowances available for new generators who might need them.

The SO_2 emissions programme has proven an unqualified success. The EPA annual report on acid rain for 2004 stated that the programme had reduced emissions of SO_2 by over 5 million tonnes from 1990 levels and over 7 million tonnes from 1980 levels – more than a 40% reduction and well on the way to the goal of 50% reduction by 2010.

Emission allowances are widely traded bilaterally between plant owners, through brokers and by financial institutions. The EPA reported 2,332 trades between bilateral parties in November of 2005 compared with 339 trades in November 1995 (the first compliance year).

According to a report produced in 2004 by the Chicago Climate Exchange, there are five major market drivers that can affect the price of SO_2 emission allowances[1].

[1] *The Sulfur Dioxide Emission Allowance Trading Program : Market Architecture, Market Dynamics and Pricing*

The first market driver is the regulatory environment. If government changes the rules on emissions, this will have an over-riding impact. In March 2005, the EPA enacted a new Clean Air Interstate Rule (CAIR) that requires 28 states and the District of Columbia to reduce SO_2 emissions further in two phases, starting in 2010 and 2015, leading to an additional 70% reduction in SO_2 from current levels. The new rules stipulate that SO_2 emission allowances for 2010 through 2014 will only have half their previous value – i.e. two tonnes of allowance will be required to offset one tonne of SO_2 emissions. After 2015, the screws will tighten further when each allowance tonne will only have one third of its face value.

The second market driver is the cost of technology associated with reducing SO_2 emissions. Scrubber systems are used to remove SO_2 from the flue gases stream before it is vented to the atmosphere. Known as flue gas desulphurisation (FGD) these systems require expensive up-front install costs, often running into hundreds of millions of dollars and can take up to three years to install. Estimates made by various analysts put the cost of FGD technology at around $200 to $300 per tonne of SO_2 removed. Obviously if SO_2 emission allowances can be purchased for less than this price, then plant owners may prefer to shop for allowances in the market before investing in scrubbers. If SO_2 allowance prices stay above $400 per tonne, then further widespread installation of scrubbers can be expected. Conversely, scrubbers increase the supply of allowances, so if all plant owners install them, there will be an allowance glut.

In the early years of the SO_2 allowance trading system, many plant owners simply switched fuel from the relatively high-sulphur coal found in the eastern US (close to the generating plants) to lower sulphur coal that is available in abundance in the western US – particularly from Wyoming's Powder River Basin, which now supplies 35% of the coal used to generate electricity. This strategy avoids the need to install scrubber equipment and reduces emissions immediately, allowing for plant owners to bank or sell excess allowances.

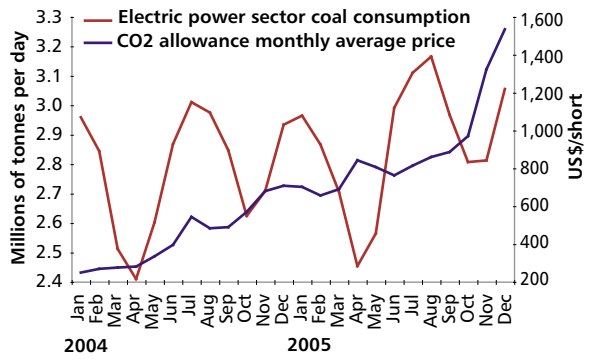
The third main driver of allowance prices is the level of electricity consumption in the marketplace. This factor is driven by the weather and by industrial activity levels. A particularly hot summer causes air conditioner use to increase and leads to more coal generation of power in the third quarter of the year (see figure 2). A similar increase can result from a cold winter. Changes in industrial production levels also affect electricity consumption.

The fourth driver of allowance prices is competing fuel costs. The share of electricity produced from natural gas increased from 1994 to 2004 from 12% to 18% because of a perceived low cost and plentiful supply. Generating electricity using natural gas does not produce any SO_2 emissions and natural gas plants are roughly half as expensive as coal plants to build. (See *Energy Risk*, June 2004 p.62 for a discussion of the pros and cons of coal and natural gas). In a low-priced natural gas market, generators will prefer gas over coal because the emissions tax on coal plants can be saved twice over if you do not need your emission allowance and are able to sell it to someone who does.

Since 2004 however, rising natural gas prices have made coal generation economically attractive, even factoring in the cost of emission allowances or scrubbers. Shortages of natural gas

Source: Petroleum Argus and Global Insight

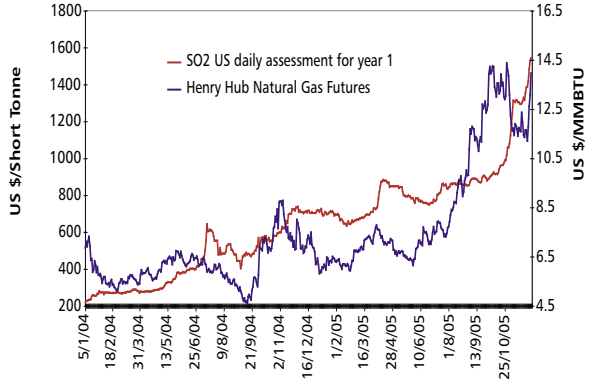
F2. Coal consumption and SO_2 allowance prices



As coal consumption for electricity generation increases, the price of SO_2 emission allowances goes up. This is because increases in coal consumption lead to higher emission levels while the amount of allowances are finite.

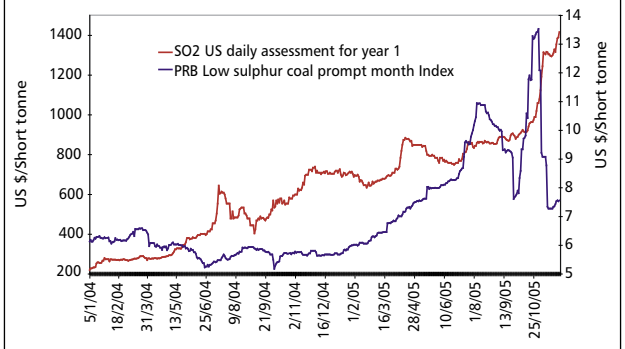
Source: Nymex and Petroleum Argus

F3. Natural gas and SO_2 allowance prices



There is direct correlation between higher natural gas prices and SO_2 emission allowances. As natural gas prices rose in 2004 and 2005, electricity generators found it increasingly economical to switch to coal. As more coal is used, SO_2 emissions increase and allowance prices rise.

F4. SO_2 allowances and Powder River Basin low sulphur coal



Source: Platts and Petroleum Argus

Prices for low sulphur coal from the Powder River Basin in Wyoming rose dramatically in 2005 partly as a result of higher natural gas prices and partly because of shortages created by supply disruptions just before the peak summer season. As the cost of SO_2 allowances rose during 2004 and 2005, lower sulphur coal becomes more attractive to plant operators looking to reduce emissions without investing in scrubbers or buying allowances.

caused by US Gulf production shut-ins after hurricanes Katrina and Rita in the autumn of 2005 have led to a near doubling of natural gas prices and a consequent reversal of the trend towards natural gas generation (see figure 3). In 2002, the EPA reported coal's share of electricity production at 50.1% but by 2005 they were estimating coal use would increase to 52%. A consequence of this is that coal prices have increased rapidly in 2004 and 2005. Coal plant generators were hit hard in May 2005 by a series of derailments on the train tracks leading out of the Powder River Basin (PRB) in Wyoming that cut shipments by up to 20% during the summer months. Front-month broker index prices for PRB coal rose by 44% from $7.60 per short tonne on the day of the derailment in May to $10.91 per short tonne on August 3, 2005 (see figure 4).

The final driver of SO_2 allowance prices is the size of the "bank" of vintage allowances available to the market. In the early years of the SO_2 allowance market, banked allowances grew as plant owners turned to low-sulphur coal to reduce emissions. Regulated utility companies preferred to bank allowances rather than jump through legal hoops to account for "profits" from trading. Between 1998 and 2000, the bank of allowances grew from 7 million tonnes to 11.6 million tonnes. Since 2000, the allowance bank has been depleted to 6.8 million tonnes (end of 2004, source EPA). This depletion reflects reductions in allowances available over time as the overall goals of reduced emissions are met.

Given these market drivers, it is easy to explain the dramatic increases in the prices of SO_2 allowances since the beginning of 2004. The new CAIR legislation tightens controls after 2009 and makes allowances for vintage years before 2010 much more valuable than before. Even before the legislation was enacted in March of 2005, the EPA reported that it had a dramatic impact on 2004 allowance prices. During the summer of 2005, reduced supply of low-sulphur coal from the PRB because of the train derailments put upward pressure on allowance prices because a switch to high-sulphur coal increased emissions. The 2005 hurricane season left large quantities of gulf production shut in by the end of September and forced generators to rely more heavily on coal, increasing emissions further. As the end-of-year reckoning approaches and plant owners tally their allowance requirements, prices continue to rise with demand.

Where will the SO_2 allowance market go from here? It seems hard to imagine lower prices in today's environment of higher natural gas prices. The tighter constraints imposed by CAIR can only continue to exert pressure on the finite reserves of banked allowances. However, at some point, the cost of compliance will force plant owners to bite the bullet and invest in technology to reduce emissions. Once the majority have installed scrubbers, the allowance crunch will ease and the cost of allowances will come down again. Until then, brokers and speculators in the emissions allowance market can expect a profitable ride.

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