OPINION

Weather derivatives for **environmental risk management**

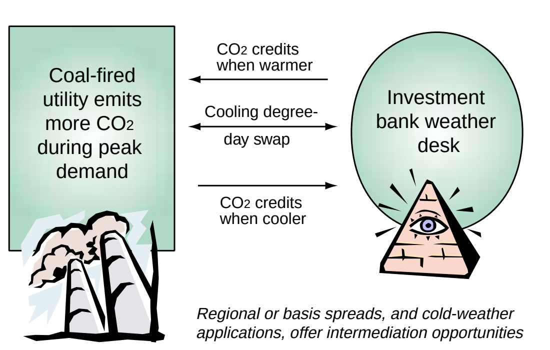
Here we look at a weather derivative with payouts denominated in carbon dioxide emission credits, which may allow generators to overcome their reluctance to pay cash for emission credits that are not yet recognised under a trading regime **By Jeremy Weinstein**

While the weather derivatives market has yet to really catch fire, the perceived audacity of these contracts has attracted much attention. But although the infinite variety of meteorological events can inhibit the development of standardised, liquid markets, it also offers many opportunities for creativity.

And while the weather derivatives market has been developing, there has been a drive towards legislation and treaties seeking to limit or further restrict power plant emissions – such as carbon dioxide (CO_2) – which increases the environmental risk energy companies may face from emissions regulation.

Weather derivatives, if financially structured in terms of environmental commodities themselves, could be used as tools to manage these risks. Examples include CO_2 credits, emissions allowances, or so called 'green tags' (see below).

Figure 1: Weather swap with carbon credit payment



CARBON-DENOMINATED WEATHER SWAPS

Greenhouse gases, such as CO_2, have been mainstream news lately, as much of the world – apart from the US – seemed to reach agreement on key parts of the Kyoto Protocol in late July. The Protocol is a United Nations treaty setting national limits on greenhouse gas emissions.

Power plants contribute about a third of the US' greenhouse gas emissions annually, and would be the first target of legislation in countries setting CO_2 emission limits.

The Protocol suggests international emissions trading as a way of lessening the overall costs of meeting limits. In emissions trading, aggregate and specific limits are set on emissions, and those who reduce emissions below the set level earn emissions credits that can be sold to others to use to meet their reduction requirements. Yet many specific issues have yet to be addressed, especially in the US.

There are questions over the treatment of reductions achieved before the Protocol's first commitment period of 2008–2012, and over ideologically based limits on the use of emissions trading to supplement targets. Intranational emissions trading presupposes international trading, and credits that qualify in one country might not qualify in another. And even within countries, companies trading credits before the establishment of a national emissions trading regime risk buying credits that may end up not qualifying.

Therefore, many generators are reluctant to hedge their exposure to CO_2 emissions risk through trading, because they do not want to pay cash, which is real, for CO_2 credits, which will only become real with the enactment of CO_2 caps and an emissions trading regime that recognises the credits purchased.

One way to address this problem would be a transaction that did not trade real-for-unreal, but rather like-for-like, such as a temperature-based weather swap in which the payouts are denominated in CO_2 credits. An example of such a deal is shown in figure 1.

If the local weather is particularly hot or cold, the increased power demand for cooling or heating would lead to increased generation to serve the local load and hence to greater emissions, and therefore to a need for more CO_2 credits to offset those emissions.

In such a transaction, each party takes the same risk as to the eventual 'reality' of the CO_2 credits, and both parties gain experience in managing greenhouse gas emissions risk without having to part with cash.

This method could be particularly useful for US utilities, as it allows them to avoid making a political statement about the Kyoto Protocol, which is opposed by the Bush administration.

TEMPERATURE/EMISSION PRICE CORRELATION

Weather risks often do not correlate with traditional market risks. For instance, rainfall in Chicago might correlate with corn futures prices, but not with the Dow Jones Industrial Average. Such non-correlation offers some value to investors seeking risk diversification.

Yet equally, correlation can add value with more precise or leveraged hedging opportunities – for example, the correlation between heat and generation load might further correlate with power prices. Hence, structuring a weather derivative with payouts in environmental commodities requires consideration of the effects of weather on the price of that environmental commodity.

Seeking to learn how emissions markets might correlate with weather, we analysed how sulphur dioxide (SO_2) emission allowance prices responded to temperatures and changes in temperature.

Under the US acid rain programme – administered by the US Environmental Protection Agency (EPA) – coal-fired power plants receive yearly SO_2 allowances. Continuous emissions monitors installed in plants' smokestacks report actual emissions, and at the end of each year each plant must hand over allowances equal to its emissions. A plant can either run as usual and use its allowances to comply, or it can reduce its emissions, leaving it with excess SO_2 credits that it can sell to emitters that are short of allowances.

Therefore, it seemed reasonable to posit that SO_2 allowances would increase in price during temperature extremes. Heatwaves increase the need for generation to power air conditioners; cold spells the need for heating. Plants working harder emit more, and will therefore need more allowances from a supply that is fixed – which should increase prices.

Figure 2 shows a comparison of emissions prices against temperatures in Cincinnati, Ohio, a city in the heart of an area of mid- to high-sulphur coal-fired electricity generation.

Surprisingly, the correlation of SO_2 allowance prices with temperatures and temperature changes in Cincinnati turns out to be 0.0. There are several possible explanations for this. Perhaps local temperature pressures were insufficient to move the market in emissions, even as these same temperature pressures led to brutal, successive meltdowns in the electricity markets.

However, the more likely answers are overall constrained generating capacity nationwide and market distortions through regulation.

Since the deregulation of US wholesale markets in the late 1990s, in many regions of the US coal generation has been running flat out, all the time, regardless of heat, cold, rain or shine, as power prices have often been at levels far above the marginal cost per megawatt hour (MWh) of coal generation.

Federal environmental regulations, known as the New Source Review (NSR), under the Clean Air Act may treat a plant undergoing routine repairs as a new plant, subject to significantly more burdensome environmental regulations. This has impeded maintenance of existing coal plants, and thus further constrained generation.

The US' new National Energy Policy has urged a multi-level review of NSR and its enforcement, and the EPA has hinted that it may scrap NSR in favour of stricter, specific emissions limits.

US state regulations also distort the market. Because of how retail rates are set in the US, a utility trading SO_2 allowances effectively writes a lookback-option to its ratepayers. A lookback option grants the rights to buy or sell the underlying commodity at the lowest or highest price reached during the life of the option.

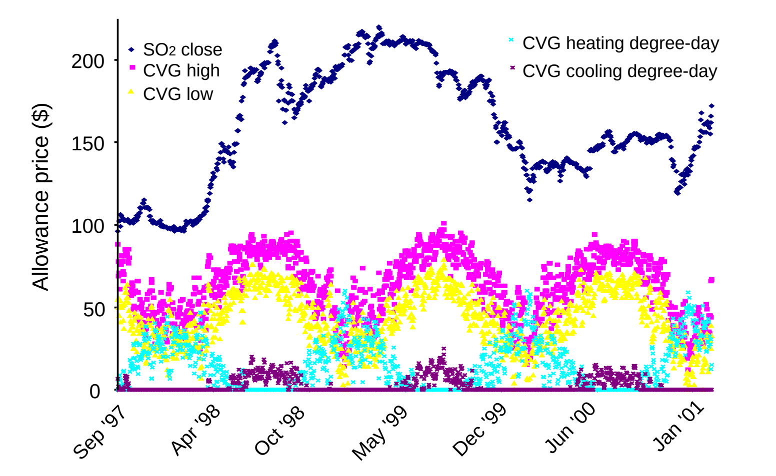
All money from sales of allowances generally goes to customers through lower rates. A utility trying to sell high in the market thinking it will buy back later to comply may well find that if its market prediction was right, the money made will go to the ratepayers, and if wrong, the trade deemed 'imprudent' and the loss borne by the shareholders. This discourages speculative trading by utilities.

Moreover, many flue-gas desulpherising scrubbers have been installed because of regulatory, rather than market, incentives, which also distorts the market.

The lack of correlation between temperatures and SO_2 allowance prices may also occur with CO_2 credit prices, were an international CO_2 trading market to develop, especially as CO_2-constrained emission sources would be spread over a much wider area – resulting in greater meteorological diversity – than SO_2-constrained emitters.

Nevertheless, assuming the current extreme tightness in generating capacity eventually slackens, a utility may well determine that a plant, especially a peaking plant, works harder and consumes more emissions credits during periods of high demand caused by temperature extremes in the area it serves. The utility may as a result wish to derive value from a hedge that pays emission credits at such times.

Figure 2: SO_2 allowance prices and Cincinatti weather



Source: Natsource and Evolution markets; Chicago Mercantile Exchange

GREEN-TAG WIND HEDGES

One regulatory approach to reducing air pollution is to encourage the use of renewable resource generation, such as wind power. Some jurisdictions have passed or are considering renewable portfolio standards (RPS) requiring electricity utilities to deliver a mandatory minimum of renewable resource generation, or require retail customers be given a choice of buying 'green power' from a renewable resource mix.

The UK's RPS starts next January under the Utilities Act, and similar schemes are in operation in Australia and Poland.

The RPS concept is also gathering momentum in the US, as more states and the US Congress consider the concept. In June, the US Department of Energy's Energy Information Administration revised its report on strategies for multi-pollutant reductions from power plants to include consideration of RPS.

Utilities subject to RPS or green power programmes are often permitted to meet the renewables requirement by generating from 'brown' power sources, such as coal, and buying the 'greenness' of power generated elsewhere with renewable resources. These green attributes of renewable resource power are generally known as green tags and denominated in units of generation – the greenness from 1 MWh of wind generation is a 1 MWh green tag.

Developers planning renewable resource generation or utilities planning to meet green power or RPS requirements from their existing renewable resources – and wishing to hedge their 'green' generation risk from adverse weather conditions – might be interested in hedging RPS risk by adding-in a partial payout in green tags. For example, a wind farm might seek a hedge that pays green tags in proportion to the amount of lost generation in the event of persistent low-wind-speed conditions.

At the moment, US green tags are non-standard, there being no guarantee that a green tag from a California windmill will satisfy an Arizona RPS. There have, however, been calls for regional, if not national, standardised green tags markets, and the development of these would help with the mitigation of RPS risk.

An interesting issue that has arisen in the nascent green tags markets in the US is whether a green tag can retain its green character if the potential CO_2 credit has been stripped out of it and sold elsewhere. The developing practice seems to require that the CO_2 credit stay with the green tag, but it really is still too early to tell.

TESTING THE BOUNDARIES

Weather risk markets are new, and their boundaries untested. There are many exciting ideas being spawned in this field. Other than life itself, nothing is more unpredictable and chaotic than the weather. But from these risks comes new opportunity.

The trend is towards custom solutions, but as such solutions become more commonly used, touchstones of fungibility and standardisation – and hence liquidity – will become apparent, and the market will develop accordingly. ■

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