Power Generator Carbon Portfolio Management

(November 8, 2016)

Executive summary

This document characterizes the critical elements of power generator's carbon portfolio management. It primarily draws upon practices that are employed by utilities in the European Union's Emissions Trading System (EU ETS) – though methods employed in the United States and South Korea are also considered. A driving factor that influences carbon portfolio management is the nature of the ETS and, in particular, how it is administered. Surprisingly, a utility's power generation fleet, fuels portfolio, business model, and corporate culture are secondary factors. To that end, recommendations are provided, both for carbon portfolio management as well as for certain ETS design elements. The contents of this document are as noted below:

An important disclaimer: Though guidance provided herein reflects the experience of the authors in their engagement in ETS markets around the world, a power generator should tailor its carbon portfolio management strategy to fit its particular circumstances.

Description of different models that are used to manage carbon portfolios

This section explores the variety of carbon portfolio management strategies employed by power generators and electricity utilities (together generically referred to as "utilities") across the globe. This summary draws heavily from the experience gained from power generator participation in the EU ETS. As part of the largest, most sophisticated, most liquid and longest lived carbon emissions trading system globally, EU ETS participants have had the most opportunity to test out the different portfolio management practices. Other jurisdictions are brought into the discussion as appropriate to highlight behaviour that differs, or reinforces, that experienced in Europe.

For a number of reasons -- cultural, economic, appetite for risk,

Carbon Portfolio Definition

For the purposes of this discussion we define a 'carbon portfolio' as a company's balance sheet of carbon assets and obligations. It includes:

- Allowances assigned/allocated to the company
- Shortfalls/debits/compliance obligations that are owed by the company
- Carbon offsets and offset generating projects and/or their products that are owed or owned by the company
- Spot, forward, futures, options, and derivative products that are owned, controlled by, or owed to the company
- Carbon obligations associated with fuels consumed by, operations of, and, in the case of utilities, the power generated by the company.

generation portfolio, and regulatory restrictions – utilities employ a wide variety of carbon management strategies. Consequently, there are opportunities to learn lessons from European, and others', experience of emissions trading despite the apparent differences between the structure and regulatory oversight of Emissions Trading Systems in different regions.

An introduction to liquidity

Liquidity is a function of:

- Price transparency (good liquidity means that market participants can readily obtain market price information)
- Market depth (good liquidity means that abundant volume is available on the bid and offer)
- Bid/offer spreads (good liquidity requires offers to buy and sell to be close together)
- Transaction costs (good liquidity means there is a low cost of market access relative to the market price)
- Barriers to market entry (good liquidity occurs when the market is easily accessed and regulatory hurdles are not prohibitive).

In effect a carbon portfolio exists when there is an expectation of use of the physical asset. For example a power station has a typical life expectancy of 25 years but this doesn't necessarily mean that the power station has a carbon portfolio to actively manage for 25 years. To demonstrate this point, a power station operator knows it needs fuel to run the asset but rarely has a 25 year contract for fuel and therefore doesn't have a 'fuel portfolio' for the expected life of the plant. That's because such long-term markets don't exist and because circumstances change. For example the power station may become uneconomic and thus get decommissioned after 15 years, in which case its free allocation will cease (and may even have to be handed back if cessation happens mid-compliance year) along with its carbon obligations. So, for the purposes of this discussion, a carbon portfolio (i.e. a power generator's *balance sheet of assets and obligations*) exists over the same duration as any fuel contracts entered into, not the lifetime of the plant.

The exceptions to this rule are macro-strategic hedges and allowance and/or offset contracts entered into that outlast either fuels contracts or the expected life of the power station (more on these subjects below).

Electricity prices, whether set by regulation or free market economics, are a function of fuel cost, other variable power station costs and carbon costs. Effectively carbon allowances are treated, on a carbon intensity adjusted basis, like fuel – i.e., as an input cost. Therefore, electricity utilities should hedge their carbon portfolios in the same (or similar) way that they hedge fuels. Thus, much of the observed differences between how utilities manage carbon risk is more a function of how they manage commodity risks in general.

Exploring different strategies to manage carbon portfolios

When examining how electricity utilities manage their carbon portfolios and risk there exists a wide variety of approaches. The different carbon management strategies used can be split into five broad categories:

1. **Spot** – contemporaneous (hand-to-mouth) transactions (buying or selling) at or close to the time of production.
2. **Delayed spot** – buying or selling sometime after production but in time for annual compliance.

3. **Forward** – buying or selling a quantity of carbon (spot or futures) based on short to medium term forward sales (or expected sales) of power (6-12 months)
4. **Super forward** – buying or selling carbon (and fuels) based on long term forward sales of power (up to 3 years and beyond)
5. **Strategic** – transacting carbon as a macro-hedge (i.e. not simultaneous with power and fuel hedges), on the expectation that carbon prices will rise and more polluting generation portfolios (e.g. low efficiency coal and lignite) will become stranded assets due to carbon costs.

The motivation to employ the different strategies varies but typically the most sophisticated hedging behaviour (strategies 4 & 5 above) is exhibited by companies that have material carbon risk exposure, that are in '*liberalized*' power generation markets (where the price of electricity is set by competition between power generators and consumers of power) and that must answer to demanding shareholders. Hedging strategies 1 to 3 are typically used by companies with less pressure to demonstrate good carbon risk management, for example, those with a small carbon exposure relative to total input costs and those with private or government shareholders.

Why do power generators choose different hedging strategies? Some strategies are easier to categorize than others but typical features associated with different risk management approaches are summarised in the following table.

Utility Carbon Hedging Strategies							
#	**Carbon hedging strategy**	**Associated fuels market structure**	**Associated power market structure**	**A true hedge?**	**Typical company type**	**Motivation**	**Typical region?**
1	**Spot**	Spot	Spot market or input cost pass-through	Yes, spot power sales are matched with spot carbon (and fuel) purchases.	Company operating peaking capacity or with regulated margins or privately held	Comfortable with exposure to spot power prices or in regions where credit markets are less developed or where tariffs dictate hedging strategy.	Western Europe (most liberalized power markets), US, Eastern Europe, Ireland, South Korea
2	**Delayed spot**	Spot	Not applicable	No, caused by bad governance. Separation in time between selling a product and locking in the input costs creates risk.	Smaller company with poorly developed risk management	Insufficient time or management focus or market illiquid for smaller volumes.	Not applicable
3	**Forward**	Negotiated fixed price contract or market	Regulated electricity tariffs	Yes, power production margins locked in	State owned or regulated power generator	Keep risks low and nose clean	South Korea, US (retail market)

Utility Carbon Hedging Strategies							
#	Carbon hedging strategy	Associated fuels market structure	Associated power market structure	A true hedge?	Typical company type	Motivation	Typical region?
4	**Super-forward**	Free market pricing (with liquid forward market)	Free-market pricing changing every 15 or 30 minutes	Yes, power production margins locked in.	Listed company	Reduce cost of borrowing, shareholder pressure.	Western Europe, US
5	**Strategic**	Not applicable	Free-market pricing	No, like any investment in an asset, the unexpected can happen that reduces its value.	Listed company	Demonstrate to shareholders that the company is making the optimal investment in its own future.	All regions

Spot

Perhaps ironically, proper use of the spot market goes hand in hand with the most liberalized and advanced power markets when the opposite might be expected to be true. The reason for this is that only in liberalized power markets are there private companies taking the risk on being called upon to fill-in power generation when demand spikes or when power production outages strike. Being able to dip in and out of a market and hedge production with minimum slippage is indeed a feature of advanced liberalized markets. To reinforce the point, this model wouldn't work if a company sold power and had to wait a week for a carbon offer that is 20% away from the price it was expecting when it generated the power.

That said, the more traditional users of spot markets and indeed their main customers, by volume, are those companies with less access to credit who thus have a tougher time buying futures. The credit availability can also apply to the product they are selling and thus the *need* for hedging forward is lower. Consequently spot markets are typically prevalent in regions where financial markets are generally less developed or indeed where regulation *precludes* the use of futures markets. In the case of South Korea there is a triple-challenge -- companies not involved in the ETS (e.g. banks) are not allowed to participate in the market for carbon credits at all, futures trading is non-existent and power market prices are tightly controlled so there is less need for forward trading.

Delayed spot

Fuel used by companies has to be paid for at the time of delivery and/or consumption. However, companies can buy carbon credits *after* they have emitted carbon because the annual - or sometimes longer - compliance true-up periods mean they don't need the carbon credits for some time. A time separation between selling the product and pricing the input costs is poor risk management, plain and simple. A lot of industrials across Europe exhibit this behaviour but some, smaller, electricity generators also do this. Illiquidity (either because the volume to be purchased is small or due to the size and depth of the ETS concerned) is the only legitimate reason to be in this category of hedging. The behaviour can be reinforced by free allocation (see below) because it reduces the volume that a company must buy and thus it can be uneconomic to frequently enter the carbon market for small amounts, even in the most advanced and liquid carbon markets. Nonetheless, delayed spot trading is to be avoided where possible.

Forward hedging

Typically forward market participants need to lock in prices for a fixed period of time. An example is a power generator selling power on a one year fixed price regulated tariff. To hedge they will need to use de-regulated markets to lock in prices of each input cost. A less market-friendly approach is to give all the price risk to the consumer by recovering the cost (or giving back the benefit) of spot market prices being different to that envisaged by the regulated tariff by adjustment in the following period's tariff. Other forward market participants are power generators selling power on one year fixed price contracts to end-users, such as industrials.

Carbon Market Contango

A market in '*contango*' is one where the future price is always higher than the spot market. The opposite is a market in '*backwardation*'. Any market where the sole source of supply is the spot market will likely trade in contango. This is because anyone wanting to lock in the price of a product now but pay for it later (it is common to find someone who is capital constrained wanting to do this) must pay someone to buy the product for them and store it until they need it. Oil markets are typically in contango for this reason, in oil's case the contango is steepened by the cost of money to buy the oil AND the cost of physical storage of a hazardous substance. In carbon's case the contango is shallower: the cost of money is the same but the cost of storage is typically zero because maintaining an electronic registry has a very low or zero cost. The level of contango between spot and the various future delivery dates are termed '*spreads*' (i.e. the difference in price between each contract). Companies compete to finance the spreads market and thus drive down the cost implied by the spreads *and* add to liquidity. In liquid and competitive markets liquidity is further boosted by companies speculatively trading the spreads themselves, not just the underlying carbon allowances.

Locking in a year's carbon risk can be very capital intensive – buying a lot of spot now that won't be needed physically for up to one and half years in the future requires a lot of cash to be tied up. This is resolved through the Futures markets where prices are agreed long in advance of delivery and payment of the commodity.

Futures markets need a certain amount of financial liberalism to exist at all. Futures markets also subdivide the available liquidity (i.e., the numbers of companies that want to regularly participate in the market) between the spot contract and the future dates that participants prefer to be transacting. So, to be efficient, futures markets need large numbers of market participants to help give sufficient liquidity to each future settlement date '*contract*'. Even the world's largest and most active carbon market, the EU ETS, can only support a handful of liquid contracts. Typically the prompt December futures contract sees most of the action. Companies willing to trade the spread to other years allow the carbon market to generate liquidity in other contracts. Also see the box on 'contango'.

Super-forward

The distinction between Forward and Super Forward is only how far out companies hedge, regulated power tariffs don't typically go beyond one year so companies with this exposure belong in the

'*Forward*' category. Locking in long-term risk requires a highly mature market where companies take each other's credit risk for periods of several years and have stable production cycles to allow them to lock in prices for large chunks of their energy exposure.

Typically, only fully liberalized markets trade on this basis and only the largest companies have sufficient assets to enable such long-term hedges. The US, UK, Germany, Netherlands and Scandinavia are good examples, the Mediterranean countries fall somewhere in between (i.e., they might typically hedge up to two years out) and the rest of the world falls into the spot or one year regulated tariff '*forward*' bracket.

Strategic

There are few examples of companies that have actually taken this route. The best and most public example is provided by RWE, the German power generator that is the largest emitter in the EU ETS. They feared losing generation market share to cleaner generation fleets that they assumed would be dispatched ahead of them because of the expectation that carbon price would largely dictate how much electricity they would generate. To reduce the impact RWE made a strategic investment in carbon such that the average emissions of their fleet was reduced virtually to match their next nearest competitor. This meant that RWE could either use the carbon allowances to offset actual emissions or they could cash in the carbon allowances for a profit relative to the original purchase price and thereby be compensated for the lost electricity generation opportunity.

When is spot a forward?

In the table Ireland is highlighted as a country where the main power generation utilities will buy spot because the nature of power price regulation means that they will get compensated for the cost of buying spot carbon through regulated electricity prices. However, in reality, some Irish utilities buy carbon on a 'forward' settled basis. This raises the question, what is the difference between 'spot' and 'forward'? For this article we use the term forward to describe locking in carbon risk beyond the immediate physical need. In reality Forward trading, and it's exchange based equivalent, Futures trading, are the most basic forms of derivatives - prices are locked-in (or 'hedged') with a small deposit paid today and only paid for in full at some pre-determined point in the future when the Forward contract settles (i.e. delivers). This makes Forward & Futures trades more efficient from a cashflow perspective and they are thus favoured by those companies that need to manage cashflow and that have the balance-sheet (i.e. creditworthiness) required. In practice, such companies are still locking in carbon prices as the carbon liability is incurred, as a traditional spot market user would do, they just pay for it later.

This kind of 'macro' hedging strategy requires a well-developed carbon market and a stable or declining fossil fuel powered electricity generation market (participants in markets that are growing do not typically have concerns about generating less power). It also requires a forward-thinking management team with an appetite for taking a strategic view, typically this would only apply to companies faced with the pressures of demanding shareholders whose only motive is profitability (i.e., this won't apply to companies with government shareholders that typically prefer a wait and see risk management approach and that have agendas other than just profit).

Interdependency of carbon and power markets

The EU ETS is considered by some to be an example of good market design. After all, it is one of the world's most liquid commodity markets and is easily the world's most liquid carbon market. However, beyond not putting artificial constraints on the EU ETS (for example dis-allowing non-ETS participation – like in South Korea, banning futures – like in some of the Chinese pilot systems), this is not a consequence of clever market design. The impressive level of liquidity in the EU ETS markets is largely a consequence of the liberalized markets that the EU ETS is part of, in particular the EU power markets. The features of a liquid market are detailed in the 'info' box on liquidity, however the pre-requisites to *achieve* good liquidity are:

- A healthy supply and demand (the reason there is a need for a market in the first place)
- A large number of market participants (to provide the competition required to drive the bids and offers closer together and thus costs down and to foster innovation) including financial participants
- A 'standard' product (to give market participants something to focus their trading on)
- Regulatory certainty (to provide market participants with certainty of the rules by which the market and the ETS in general will be regulated)
- Market transparency (to allow all participants to be confident that the prices they observe and trade on are competitive because they are observable and accessible by all market participants).

By far the largest participants in all ETS markets are the power generation utilities, without them the markets would grind to a relative halt and the bid-offer spreads would make trading much more expensive. In the EU ETS the power sector is around 65% of all emissions and they are also the only participants that regularly re-optimise their portfolios (in response to changes in fuel and power markets) and thus enter the market as a buyer in one moment and a seller in the next. Industry, on the other hand, tends to be long or if short, hedges once per year or at most a few times per year.

Power generators, in the liberalized electricity markets in Western Europe, are transacting carbon in the EU ETS on a near constant basis. They hedge their power sales. They re-hedge them when power moves or when, for example, gas becomes cheaper than coal and it makes economic sense to re-optimise their portfolio of power generation units. They are the source of demand along the forward curve, from the most liquid prompt December contract all the way out to December 2020.

Banks and others respond to the power generator demand for longer term hedges by financing the carry trades that take their liquidity from the spot auctions and give it back to the utility buyers in longer dated contracts all the way along the trading curve. Spread traders, arbitraging their cost of capital against the cost of capital implied by the contango in the carbon market, or just plain speculating on spread levels, help fill in the various trading points along the curve.

Without these actors all working in harmony, the only trades each day in the EU ETS would be in the prompt December contract with interest moving to the next December contract as the prompt contract gets close to expiry. Without the power generation utilities that have the largest *need* to buy and sell along the various parts of the trading curve, there would be very little going on in the market, liquidity would suffer and all participants would face higher trading costs.

Different 'company culture' models

How a given power generator chooses to hedge carbon can be further sub-divided by the structure and even the culture of the company concerned. For example, companies with devolved hedging responsibilities act in a disaggregated way with individual sub-units belonging to the same company hedging independently of each other. The different styles of implementing the hedging strategies identified above are:

1. Centralized hedging – The at-risk corporation manages the risk centrally.
2. Disaggregated hedging – Each at risk facility manages its carbon risk.
3. Outsourced hedging – A third party company is tasked to manage carbon risk.
4. 'Optimised' hedging – The corporation re-optimises its portfolio as different fuels with their associated carbon requirements price in and out for a given power price.
5. Reactionary 'hedging' – The corporation actively seeks risk with a view to making a speculative profit but works within a hedging 'corridor' such that over time pre-agreed hedging levels are achieved.

It is more difficult to categorize the variations in hedging behaviour that may be caused by company culture. This is because there are examples of major companies, in each category in every country. And several different behaviours can be adopted by the same company. For example, in the United Kingdom alone, *all* of the different carbon management behaviours that are exhibited by different utilities, as characterised by the table below.

Hedging Behaviour in the United Kingdom				
#	**Behaviour type**	**Who does it?**	**Why?**	**Example(s)**
1	Centralized hedging	Most major power generators centralise their carbon hedging activity.	Economies of scale plus traders of larger portfolios gather outstanding expertise.	RWE, E.On, SSE, Scottish Power etc.
2	Disaggregated hedging	Rarer, some IPPs' individual facilities access the market independently. However, many major utilities make hedging decisions at power station level and use the central trading desk to execute so it is surprisingly common.	It can be more efficient for local companies to help local IPPs with all aspects of fuel hedging but sometimes they are unable to help in all jurisdictions. For major utilities local conditions can make self-despatch optimal.	AES corporation, RWE, E.On
3	Outsourced hedging	IPPs often outsource hedging of all fuels and power to third	When private equity owns power plant they won't always have	MPF Operations Ltd: Severn Power, Baglan Bay, Sutton

Hedging Behaviour in the United Kingdom				
#	Behaviour type	Who does it?	Why?	Example(s)
		parties who work on performance based contracts. These can be other major utilities or specialist firms.	the expertise to do this themselves so choose to outsource it.	Bridge, Uskmouth Power Company
4	'Optimised' hedging	Major generators with a variety of power generation technologies and customers.	As the economics of power generation move around due to gas, power, coal and carbon prices swings, at different times of the day, week, month, season or year, portfolios exercise their 'real options' and re-optimise existing hedges to improve returns.	RWE, E.On, SSE, Scottish Power etc.
5	Reactionary 'hedging'	Major power generators.	With so much risk to manage the majors employ the very best experts. The experience gained allows these experts to 'play' the markets and earn higher returns.	RWE, E.On, SSE, Scottish Power etc.

Centralized hedging *seems* like the most sensible approach to a given company's carbon risk and it is perhaps surprising that de-centralized hedging exists at all in more developed markets that have experience of commodity risk-management. Company politics or inertia are probably the most significant factors at play that determine how a company will react to an ETS. That all said, while the de-centralized model can be very inefficient, if individual facilities are sufficiently large the negative impact of that inefficiency is much reduced.

How carbon portfolio management has/could be affected by ETS design and administration

The design of an ETS and how it is administered are the most important determinants of how a power generator should manage its carbon portfolio. Managers should pay particular attention to; how allowances are allocated, whether or not the market is over-allocated, the permitted use of offsets, the availability of futures trading, the participation of financial intermediaries and regulatory uncertainty.

Free versus auctioned allowances

In liberalized power markets a carbon portfolio should not be managed any differently whether carbon allowances are given away free or paid for. This is because in liberalized power markets the price of electricity is set by the last power facility to be called on to meet demand. By definition this will always be the most expensive of the '*stack*' of power facilities called on to generate power. Therefore, the cost of carbon is always passed on to the consumer via the power price, even if it is given away in a free allocation because if it isn't, the power generator can simply sell the carbon allowance to the market instead and not generate power. This would necessitate replacement by a facility with no spare free allocation, that would have to buy carbon in the market to operate, and thus carbon is always passed through to power generation costs. So the only difference between free and auctioned carbon allowances is whether or not a power generator gets to make a windfall profit.

In '*regulated*' power markets there is typically very little leeway given to utilities to optimize free or auctioned allowances because the regulator will know what the power generator has for free and what it must pay for and will take that into account when setting tariffs or negotiating pass-through costs. Where carbon needs to be bought, the regulator typically relies on the spot market or auction clearing prices to make their assessments and it is up to the power generator to match the spot market price when it sources carbon to avoid basis risk between the price the regulator uses and their achieved cost of carbon. There is, however, sometimes the chance for speculation or arbitrage between the two.

Over allocation

In *liberalized* power markets, power utilities should probably want some free allocation but under-allocation overall. This is because any allocation makes a windfall profit as described above and a carbon market with restricted supply will have a higher price than one with excess supply. So the windfall profit is potentially greater even when the lower the level of free allocation is taken into account. This is amplified by the fact that power prices, in liberalized markets, are higher (in part) because such prices include the cost of carbon allowances and these carbon-elevated prices are also paid to the power generator's carbon-neutral MWhs (i.e., power generated by renewables and nuclear).

In *regulated* power markets the only optimization decision required when there is an over-allocation (apart from whether or not emissions can be reduced at a cost lower than current market prices and what offsets can be bought) is when to sell the excess carbon allowances? Most industrials in Europe had generous over-allocations and many have clung onto these volumes, fearful that one day in the future they will become short allowances and need them. The same may also apply to over-allocated utilities in regulated markets, in particular because they may not want to be seen to be profiting from the ETS for fear of incurring the wrath of their regulator.

Use of offsets

Offsets are usually less expensive than allowances. And the number of offsets that a power generator can use is not often a part of a power price regulator's calculation when determining fixed-price electricity tariffs or what costs can be passed through. So any use of offsets presents an opportunity for the power generator to make some windfall gains.

In contrast to hedging decisions related to allowances (that are in practice often devolved to the facilities), a particular company's offset use (and the profit that comes from it), is often centralized in the head-office. The logic here is that sourcing offsets has an economy of scale and their use is not a hedging decision, it is a question of timing (when the spread between allowances and offsets is at its highest or when a head-office sourced project can physically deliver its contracted carbon).

Offsets sourced direct from projects and that include delivery risk make carbon portfolios much more complex. Basic carbon allowances are like generic fuel going into power stations, there's no risk in the portfolio. When there are a number of non-firm offset projects (by which we mean projects that do not guarantee to deliver the contracted volume of offsets) delivering different types of carbon credits at different times and at different costs, or not delivering them at all, there needs to be intelligent optimization at a central level to achieve the best outcome for the company.

By way of an example, because offset project development can be a complex process, at it's peak, one of Europe's largest power generators had up to 80 people working on the offset part of its carbon business, finding projects, contracting with projects, writing and getting methodologies approved, obtaining letters of authority from Designated National Authorities, modelling the probability of each project's production, and performing related tasks. In contrast, they generally had five or fewer people trading (and otherwise managing) regular carbon allowances.

Prohibition of futures trading and exclusion of the financial sector

One lesson that can't be learned from the EU ETS, RGGI and the WCI is what happens to liquidity if it is artificially constrained. There are no artificial constraints to participation in these ETSs. In Europe, *any* private individual can open an EU registry account. And the trading of EUAs (and CERs) is not restricted in any way save for when such trades are defined as financial derivatives, in which case they are subject to the same regulatory constraints as any other commodity derivative.

Contrast this with South Korea where the only companies allowed to trade carbon allowances are those that are direct participants in the Korean Emissions Trading Scheme ("KETS"). As can be expected, given the EU ETS experience detailed earlier in this report, without the lower cost of capital and risk appetite of the finance and securities institutions, liquidity is a tiny fraction of what could otherwise be expected. To compound this issue, the Korean power industry is heavily regulated such that there is little or no need to lock in longer term prices because input costs are compensated for by electricity tariff setting. Finally, limited auctioning and the knowledge that there are a variety of price control mechanisms in place to moderate prices, provides little incentive to trade carbon allowances. The consequence is a market with very low liquidity. Trading volume in the first year of KETS was around 13Mt of carbon allowances, roughly the same volume that the EU ETS trades in a single day, despite the EU ETS being only around 3.5 times larger. It is also reasonable to conclude that, due to the low liquidity, the cost of carbon transactions will be much higher in South Korea than it would otherwise be.

Some of the Chinese pilot systems have mandated that all carbon allowance transactions pass through regulated exchanges. This is not ideal as it adds an artificial and arbitrary cost to trades and thus impacts the realized bid/offer spread. This is not a massive inhibitor to liquidity so long as exchange fees are small enough to be considered an irrelevance. However, regional monopolies and the lack of competition between exchanges could add up to a material risk to the development of liquidity. The banning of futures trading or of companies accessing the futures market is a material regulatory problem that will have a huge impact on trading volumes, as explained by the examples given earlier in this report.

Regulatory uncertainty

Regulatory uncertainty -- by which we mean uncertainty about the very rules governing the ETS that companies are subject to, allocation amounts, both now and in the future, the prospects for government intervention to adjust market prices, rules, offset eligibility and participation -- is *the* biggest issue facing power generators, indeed any company that is subject to an ETS. It is the aspect that companies have the least control over and yet a small change to the regulations can be a share price changing event.

The only way to attempt to manage the risk is to engage, where possible, directly with regulators and trade associations to elicit transparent dialogue with those directly impacted by an ETS and seek to minimize the negative impacts of any potential changes. The effect of regulatory uncertainty on portfolio management will vary according to the specifics of the ETS and the efficacy of the power generator's efforts to influence proposed ETS changes. On the plus-side, understanding the minutiae of the rules and potential changes to the rules is one of *the* major opportunities to make money in carbon markets. But of course it can also be very expensive if a company gets it wrong.

Lessons learned that may be applicable to China

Liquidity is a good thing, it lowers the cost of transactions and makes risk management and hedging of carbon portfolios efficient. To stand the best chance of generating good liquidity the Chinese National Emissions Trading System ("CNETS") should:

- Allow participation by financial institutions and individuals.
- Allow futures trading.
- Not mandate that exchanges be a participant in transactions. If this is unavoidable, provisions should be put in place that allow <u>any</u> exchange to clear a transaction, regardless of where the trade is executed. This will ensure that there is competition between the exchanges and will have the consequential effects of driving costs as low as possible and encouraging innovation.
- Minimize government intervention in allowance pricing. If this is unavoidable, such intervention should only occur under rare circumstances, following procedures that are defined well in advance of the intervention, in ways and means that are transparent to all market participants.
- Promote liberalization of the power generation markets. While liquidity generation alone will probably not be sufficient justification to implement such a large change, as we have explained, one of the benefits of a liberalized power market is an efficient carbon market.

A failure to address these constraints will contribute to a negative feedback loop that hampers liquidity, discourage participants from engaging in the market, dampen innovation, encourage regulated entities to seek on-site compliance solutions, raise the aggregate cost of compliance, and minimize the potential societal gains that would have otherwise resulted from the ETS. Efficient pricing of carbon and thus the products that are created by the combustion of fossil fuels will only occur when the carbon markets are set free to do the job that they are there to do.

Adopting and adapting strategies

To draw parallels between Chinese power generators' prospective carbon portfolio management and that of power generators in existing ETSs requires a comparison of the ETS rules. It is possible that the CNETS may be structured as follows:

- Annually issued allocations.
- *Ex poste* allocation adjustments (at the end of the year when the ETS administrator adjusts allocations based the company's performance against benchmarks).
- Regulations that are unclear and not specific and which, therefore allow a great deal of interpretation.
- Limited to no use of futures and/or derivatives.

This sets up large differences between the design and operation of the CNETS and most other major ETSs. In addition company structures, ownership, regulation and cultures are, on the whole, also different, for example, state ownership of power generators is very much a thing of the past in the West. However, based on what we have observed in those other ETSs there is a sufficient variety of approaches for some overlap to exist. Given the regulated nature of the Chinese power generation markets, and of some major industrial sectors, hedging strategy and carbon portfolio management by Chinese firms will most likely be similar to:

- Spot – contemporaneous (hand-to-mouth) transactions (buying or selling) at or close to the time of production.
- Delayed Spot – buying or selling sometime after production but in time for annual compliance.
- Forward – buying or selling a quantity of carbon (spot or futures) based on short to medium term forward sales (or expected sales) of power (6-12 months).

While Spot and Forward strategies are perfectly good carbon portfolio management approaches they do not generate liquidity in longer term carbon contracts and this shortcoming will affect the ability of companies to efficiently hedge or express a longer term view. The practice of the Delayed Spot strategy should be avoided.

Good practice carbon portfolio management.

At present, we do not yet know the details of the rules. It is reasonable to expect that these rules will evolve and become more detailed as China 'learns by doing'. Yet, there are some basic guidelines that a power generator (or any liable enterprise) should follow that will aide in risk management:

- Perform a detailed internal abatement analysis so that a company can understand how its internal abatement costs measure up against the market price for carbon.
- Establish a mechanism by which carbon liabilities can be measured, reported and acted upon. Leaving carbon risk to chance should not be an option. To do this properly requires a price forecast. Given all the moving parts of the CNETS, finding one that you can trust is not necessarily a straightforward process.
- Determine whether it is more appropriate to operate a centralized or decentralized carbon portfolio management strategy.

- Put in place a system that quantifies, measures and mitigates carbon risk. This may be dealt with by internal organization changes, additional recruitment, employment of external expertise or a combination.
- Determine a medium-term strategy whereby a company's ability to mitigate carbon emissions is compared to its incentives to do so. The current carbon emissions price is half of the story, what should a company do if electricity tariffs are tied to carbon intensity or future free allocation is based on historic emissions?
- Determine which assets are most likely to become stranded assets in a carbon constrained future and plan for them accordingly. For example, it will make less sense to prolong the life of a company's least carbon efficient facilities.
- Decide how the company will take advantage of the ability to use offsets. One consideration is should the power generator buy direct from projects or from the secondary market? The largest emitters in the CNETS will take a different view to the smallest due to the economies of scale and power generators, with the real options that their facilities represent, are better positioned to take project delivery risk.
- Review the strategy and carbon portfolio as the CNETS settles down and may appropriate adjustments.

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