

REFERENCE REPORT #37

CARBON DIOXIDE: A COMMODITY MARKET PERSPECTIVE

On July 18, 2007, The National Petroleum Council (NPC) in approving its report, *Facing the Hard Truths about Energy*, also approved the making available of certain materials used in the study process, including detailed, specific subject matter papers prepared or used by the Task Groups and their Subgroups. These Topic Papers were working documents that were part of the analyses that led to development of the summary results presented in the report's Executive Summary and Chapters.

These Topic Papers represent the views and conclusions of the authors. The National Petroleum Council has not endorsed or approved the statements and conclusions contained in these documents but approved the publication of these materials as part of the study process.

The NPC believes that these papers will be of interest to the readers of the report and will help them better understand the results. These materials are being made available in the interest of transparency.

The attached Topic Paper is one of 38 such working document used in the study analyses. Also included is a roster of the Subgroup that developed or submitted this paper. Appendix E of the final NPC report provides a complete list of the 38 Topic Papers and an abstract for each. The printed final report volume contains a CD that includes pdf files of all papers. These papers also can be viewed and downloaded from the report section of the NPC website (www.npc.org).

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New York, March 27, 2007

Carbon Dioxide: A Commodity Market Perspective

The emerging risks and opportunities of impending regulation of carbon dioxide (CO₂) emissions from US power generators and heavy industries has been discussed at length in JPMorgan's equity research¹, but it is in the commodity markets where the impact may be felt first.

Major players in energy markets in particular — where commercial interests in electricity, for example, overlap with exposure to CO₂ regulations in any form — are beginning to assess how to be positioned to limit exposure and gain first-mover advantage.

It is our contention that opportunities to express a view on CO₂ regulation in the US over the next 18 months to three years will be limited to existing and liquid energy markets most likely to be impacted by regulation, along with the purchase and sale of voluntary offsets. There is significant risk to advance positioning since the eventual look and feel of the regulation is unknown at this point, but there is little doubt that the regulation will have specific and meaningful impact on several domestic energy markets.

This note is the first of a series that intends to assess those risks and opportunities, and quantify potential impacts where possible. We will use the experience of the European Union (EU) CO₂ emissions cap-and-trade program and the US sulfur dioxide (SO₂) emissions cap-and-trade program as indicative of likely structures and impacts.

From an equity perspective, the impending CO₂ regulations are potentially a boon for nuclear power generators and renewable power developers while potential losers include coal-fired generators and heavy manufacturers. But the impact on commodities and the potential strategies for the likeliest natural longs and shorts transcend the analysis of basic winners and losers. Banks, hedge funds, pension funds, and energy trading shops are beginning to seek products with which to

Key Points on Impending CO₂ Markets, Regulation

- Current opportunities primarily lie in offset projects (especially those with the highest likelihood of being in compliance no matter the settled-upon regulatory scheme) and energy markets.
- Given the EU model and the sheer volume of US emissions, the CO₂ compliance market is certain to be large relative to other emissions markets and have a significant impact throughout the industrial and energy complex.
- While first-mover status may offer some future advantages, significant regulatory risk remains. This point has been exemplified by huge market design-driven price moves in the EU Emissions Trading Scheme.

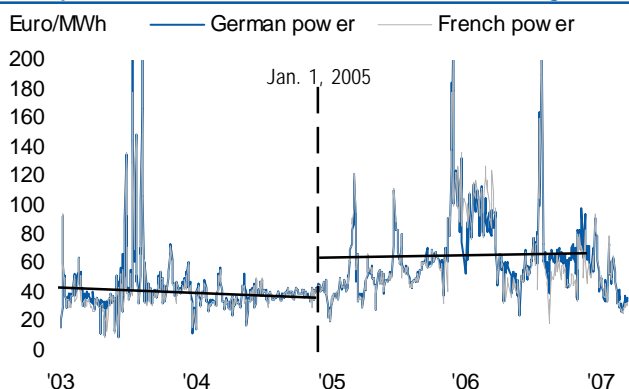
express fundamental emissions views, diversify portfolios, or simply gain experience within the potentially huge complex. Aside from outright exposure to emissions markets or exposure to equities with this risk in mind, the likeliest venue in which to express a 'CO₂ view' would be in electricity, natural gas, or coal markets. There is also potential indirect impact on the SO₂ market, though that market lacks the liquidity — especially deferred liquidity — that make the pure energy markets so attractive.

View in those markets need not necessarily be expressed as outright directional longs or shorts. There are timing and regulatory issues, relative value depending on the look-and-feel of impending regulations, relative value of fuel choice by region, and technology or infrastructure trades depending on how long the regulation adoption process takes. Even regulations that don't prove onerous in early stages will likely drive some psychological shift in electricity markets depending on the make up of the fuel stack. The increasing liquidity in forward electricity markets have made it increasingly possible to express a fuel preference view further out on the curve.

Eventual Size of US CO₂ Market

Aside from assessing potential impact on energy prices — which itself is an exercise in determining what value can be assessed to the elimination of a ton of CO₂ emissions — there is some value in trying to quantify the likeliest total value of a US CO₂ cap-and-trade system. But without the knowledge of what emissions baseline is to be used, what percentage of the baseline emissions permits are to be auctioned, whether carbon capture or sequestration is to be included, and whether offset projects are to play a role, there is little besides specula-

European Power Prices Pre- and Post-CO₂ Regulation



Source: JPMorgan Energy Strategy, Bloomberg

¹For more details regarding the EU system, rules and regional views see *Global Utilities, Trading Climate Change — Issue 1*, Rogers, et al. March 2007, on MorganMarkets.com or *All You Ever Wanted to Know About Carbon Trading — Volume 4, Part 1*, Rogers, et al, December 2006.

tion in those valuation estimates. Total US CO₂ emissions were around 6 billion tons in 1990 (versus something higher than 7 billion tons today), but there will likely be further emissions growth prior to enactment of any regulation. Under these circumstances, it is not unreasonable to expect an offset market in the 225 million tons-900 million tons range. This would lead to a potential compliance market of 1 billion tons-1.5 billion tons, depending on the baseline used.

The EU experience provided a preview of some of the pitfalls associated with ‘manufacturing’ a market, with two huge flushes in permit prices based primarily on overallocation of those permits — an example of the ongoing regulatory risk. While the framers of the subsequent US regional and eventually federal programs will likely learn from the mistakes made in earlier programs, even phase two of the EU system has inspired a fair amount of debate regarding what exactly a unit (in this case, 1 metric tonne of CO₂ emissions) will be worth.

Since the value of a permit is a direct function of the rules designed by policymakers, there is little practical benefit in attempting to quantify CO₂ market prices, percentage of allowances to be auctioned, or incremental reduction levels given the huge variances in baselines and market models. For example, while one would expect the price of one unit should generally be tied to the cost of removal of that one unit from the emissions of a power plant or industrial facility given today’s technology, but that’s not necessarily the case.

The EU model introduces certified emissions reductions (CERs), which are basically offsets in emerging markets that can be done far more cheaply than ‘cleaning’ the emissions of a modern plant. CERs are certificates that can be introduced into the EU emissions trading scheme and are governed by the United Nations Framework Convention on Climate Change (UNFCCC) under its Clean Development Mechanism (CDM). There is also a subset of the Kyoto Accord that allows Joint Implementation projects that will largely generated in industri-

alized countries such as Russia, Ukraine and others, but that scheme has yet to be made fully operational.

But the concept of joint implementation is an idea that has concrete merit — scientists and policymakers agree that it is more efficient to clean up the worst emitters (namely, inefficient applications in developing countries...the ‘low-hanging fruit’) first — but it certainly makes quantifying the value of emissions reduction more tricky.

Even under a ‘carbon tax’ regime, whereby emitters would be charged a flat per/ton of CO₂ emissions price, the technologies and industries covered would cause the total value of the market to vary wildly.

Knowns versus Unknowns

The knowns regarding CO₂ emissions reductions and regulations are all primarily related to price or cost consequences — we know that power prices and the prices charged for certain goods and services will rise. We can look at historical electricity prices in Europe and draw a straight line to the increases beginning on Jan. 1, 2005.

While the look and feel of the ultimate program will go a long way toward how much preference a specific fuel or technology will receive — or at least the magnitude of that preference — we can make certain assumptions about which power markets will likely see the greatest impact of the new regulatory regime.

The unknowns are certainly more readily identifiable than the knowns given the early stages of development of the regional initiatives, the number of renewable mandates and greenhouse gas emissions targets on the state level, and the number of legislative proposals already floating around Congress. The Congressional Budget Office (CBO) — in March 2005 — weighed in on whether a carbon price (i.e. tax) is preferable to a carbon cap, coming down on the side of setting a price.

This approach to limiting emissions, or incentivizing the limiting of those emissions, would likely have quite different results as it would likely provide less flexibility to comply with the regulations. The CBO points out that that cost of meeting a given cap on CO₂ emissions is difficult to estimate because the cost of meeting a future cap would vary significantly with the amount of growth in emissions in the interim; since policymakers have far less information about the cost of controlling emissions than do the firms that create them; and that the cost of meeting future caps will depend on the technologies that are developed to reduce CO₂ emissions and the economic consequences of adopting those technologies.

Historical Carbon Dioxide Allowance Prices



Source: JPMorgan Energy Strategy, Bloomberg.

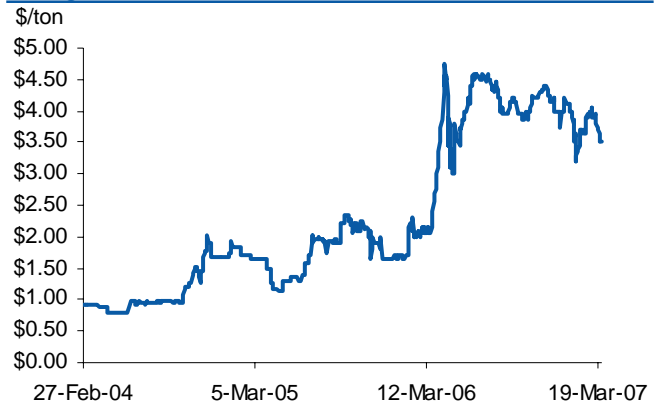
Prices on Current Allowances, Offsets

The CCX currently provides the lone US source of price transparency for the trading of voluntary emissions reductions of metric tons of CO₂ equivalent. There are eligible offset projects and legally-binding emissions reduction targets in two phases. Contract prices have gained steadily over the first several years of trading — commensurate with percentage emissions reductions — and are currently trading slightly below the \$4/ton CO₂ level.

The forward curve for the CCX CO₂ market is nearly flat through the vintage 2010 allowances. The different vintages have been moving in virtual lockstep, with relatively little volatility over the past three or four months. There has been a bit of slippage in pricing since November 2006, when the curve was trading at around the \$4.40 level.

Liquidity at CCX has increased substantially, but continues to pale in comparison to its European sister exchange — the European Climate Exchange. February CCX trading saw just more than 3.7 million tons of CO₂ change hands, while February ECX volume was 60.8 million tons.

Vintage 2006 CO₂ Allowance Prices at CCX



Source: CCX, JPMorgan Energy Strategy.

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Legislative, Policy Proposals

Sen. Jeff Bingaman (D-New Mexico)-Sen. Arlen Specter (R-Pennsylvania): Emissions would be reduced by 2.6% per unit of gross domestic product from 2012-2021, and by 3% beyond 2021. The most current variation on this proposal extends to 2050. Regulates all sources of emissions upstream, providing virtually economywide coverage.

Rep. Tom Udall (D-New Mexico)-Rep. Tom Petri (R-Wisconsin): Emissions would be capped at the average annual emissions of the three years immediately following enactment. Price cap emissions projections are from an EIA report on the bill's economic impact (<http://www.eia.doe.gov/oiaf/servicerpt/economicimpacts/index.html>)

Sen. John McCain (R-Arizona)-Sen. Joseph Lieberman (D-Connecticut): Emissions would be capped at 2004 levels from 2012-2019, 1990 levels from 2020-2029, approximately 22% below 1990 levels from 2030-2049, and 60% below 1990 levels in 2050. Regulates electric utilities and other large sources downstream as well, but regulates emissions from the transportation sector upstream at the point of petroleum importer and refiner.

Sen. John Kerry (D-Massachusetts)-Sen. Olympia Snowe (R-Maine): Emissions would be reduced to 1990 levels from 2010-2020. Beginning in 2021, emissions would be reduced 2.5% per year until 2030, and 3.5% per year until 2050. In 2050, the emissions cap would be equal to approximately 62% below 1990 levels. Leaves determination of regulated entities to the discretion of U.S. EPA.

Rep. John Olver (D-Massachusetts)-Rep. Wayne Gilchrest (R-Maryland): Emissions would be capped at 2004 levels from 2012-2019, 1990 levels from 2020-2029, approximately 33% below 1990 levels from 2030-2049, and approximately 75% below 1990 levels in 2050.

Sen. Bernie Sanders (I-Vermont)-Sen. Barbara Boxer (D-California): Emissions would be reduced to 1990 levels from 2010-2020, and to 80% below 1990 levels by 2050. Leaves the determination of regulated entities to the discretion of the EPA.

Sen. Dianne Feinstein (D-California)-Sen. Thomas Carper (D-Delaware): Emissions would be reduced by 6% below anticipated levels in 2011, with increasing reductions from 2015-2020, when emissions would be capped. Bill regulates electricity generators downstream.

Appendix

Regional Greenhouse Gas Initiative (RGGI)

www.rgi.org

Includes Maine, Vermont, New Hampshire, New York, Massachusetts, Connecticut, Rhode Island, New Jersey and Delaware.

Western Regional Climate Action Initiative

<http://governor.oregon.gov/Gov/pdf/letters/022607NGA.pdf>

Includes Arizona, California, New Mexico, Oregon and Washington.

Chicago Climate Exchange (CCX)

www.chicagoclimateexchange.com

United States Climate Partnership Association (USCPA)

www.usclimatepartnership.org

Intergovernmental Panel on Climate Change (IPCC)

www.ipcc.ch

World Resources Institute

www.wri.org

United Nations Environmental Programme (UNEP)

<http://climatechange.unep.net/>

Pew Center on Global Climate Change

<http://www.pewclimate.org/>