

# Biofuels driving global oil supply growth

## Biofuels are making up a huge portion of oil supply growth

The expanding global economy continues to face oil supply constraints, prompting consumers to become more efficient in their oil use and substitute into other fuels. Helped by a favourable policy wave, biofuels have rapidly become a major source of incremental fuel supply. On a global scale, biofuels are now the single largest contributor to world oil supply growth. We estimate that retail gasoline prices would be \$21/bbl higher, on average, without the incremental biofuel supply.

## In the meantime, food prices are rising across the board...

While corn-based ethanol has surely helped increase the supply of transportation fuels, it is also taking away significant amounts of food from the market. Almost 25% of the US corn crop was used for fuel ethanol in 2007, and this share is likely to increase to almost 35% in 2008. But the number is lower at a global level. When we aggregate global corn, soybeans, rice, wheat and sugar production, we find that 7% of the calories contained in these crops was turned into fuel in 2007.

## ...partly due to the incremental grain demand from biofuels

The sharp increase in grain demand from the biofuels sector—together with soaring demand for richer diets from emerging markets—has started to affect food prices. We estimate that the increased ethanol production from corn in the US has pushed up corn prices by 21% since 2004. In turn, corn is adding pressure on other food product prices through crop substitution and spill-over effects. Our analysis shows that price changes in corn tend to lead soybean and wheat prices. On a more positive note, sugar has bucked the trend, and prices have fallen below historical averages despite surging ethanol output thanks to expanding crops in Brazil and India.

Table 1: EIA Weekly Storage Update

	Latest	Prev.	Last Year	Change
Crude Stocks	306.8	311.6	342.3	(4.8)
Mogas Stocks	209.1	206.2	201.5	2.9
Mid Dist Stocks	111.7	109.4	122.3	2.3
Fuel Oil Stocks	38.2	39.2	35.9	(1.0)
Crude Imports	9,786	8,959	10,240	827.0
Mogas Imports	1,310	1,023	1,506	287.0
Mid Dist Imports	211	250	229	(39.0)
Refinery Runs	15,480	15,297	15,380	183.0
Refinery Ut (%)	89.7	87.9	89.6	1.8
Nat gas stocks	1,806	1,701	2,163	105

Source: US Department of Energy

Note: Stocks in million bbl, Flows in 1000 b/d.



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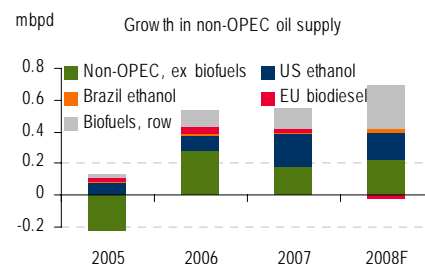
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Chart 1: Biofuels are driving global oil supply growth, adding two thirds of the incremental non-OPEC output this year



Source: FAPRI, IEA, Merrill Lynch Commodity Research

Table 2: ML Commodity Price Forecasts

(\$/bbl)	2Q2008	3Q2008	4Q2008
WTI Crude Oil	103.00	110.00	95.00
Brent Crude Oil	101.50	108.00	92.50
USGC No. 2 HO	11.79	11.03	13.65
USGC RBOB Gasoline	23.29	18.89	6.08
USGC 1% Residual	-21.67	-21.52	-21.61
NWE 0.2% Gasoil	12.45	12.16	13.97
NWE Prem. Gasoline	16.98	16.43	10.62
NWE 1% Residual	-17.39	-17.53	-16.03
US Natural Gas	11.00	11.30	12.80

Source: Merrill Lynch Commodity Research Estimates

Note: products quoted in crack spreads, US nat gas in \$/mmBTU

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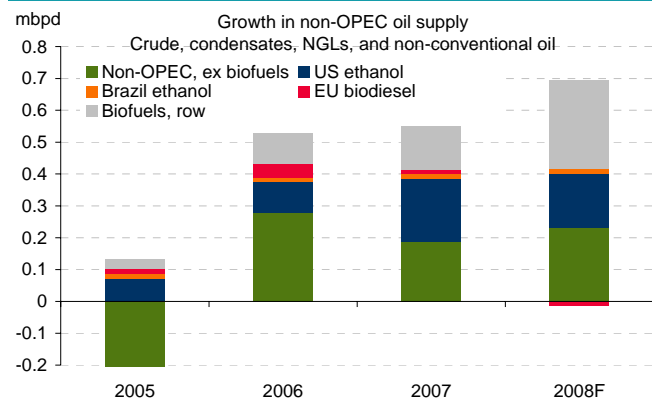
Refer to important disclosures on page 14.

## Biofuels driving global oil supply growth

### Biofuels are making up a huge portion of oil supply growth

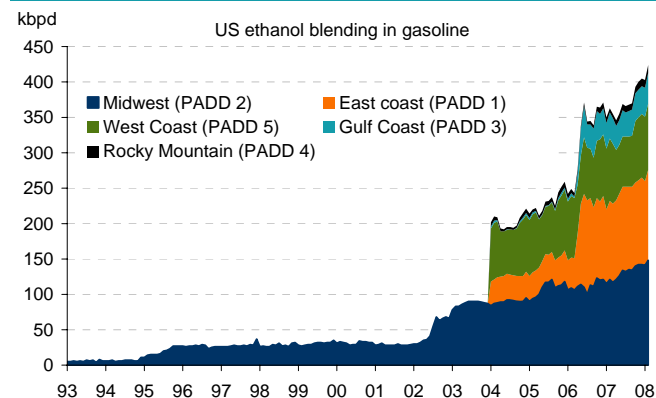
The expanding global economy continues to face oil supply constraints, prompting consumers to become more efficient in their oil use or substitute into other fuels. Substitution has many forms, and natural gas and coal have experienced fast demand growth in recent years. Similarly, helped by a favourable policy wave, biofuels have rapidly become a major source of incremental fuel supplies in an oil-constrained world economy. On a global scale, biofuels have become the single largest contributor to world oil supply growth in recent years (Chart 2), given the inability of non-OPEC crude oil supply to expand. As an example, corn-based ethanol is now adding more than 400 thousand b/d or 2% of supply to the domestic fuel mix in the US (Chart 3), up from 0.2% at the start of the decade. On our estimates, retail gasoline prices would be at least \$21/bbl higher on average without the incremental biofuel supplies. In particular, the surging ethanol output has contributed to temper prices in the Midwest (by \$32/bbl) and in the East Coast (by \$24/bbl) due to the greater availability of ethanol and the lower price elasticity of demand in these regions.

**Chart 2: Biofuels are driving global oil supply growth, adding two thirds of the incremental non-OPEC output this year**



Source: FAPRI, IEA, Merrill Lynch Commodity Research

**Chart 3: Fuel ethanol supplies are growing rapidly on the back of blenders credits, mandatory blending, and high energy prices**

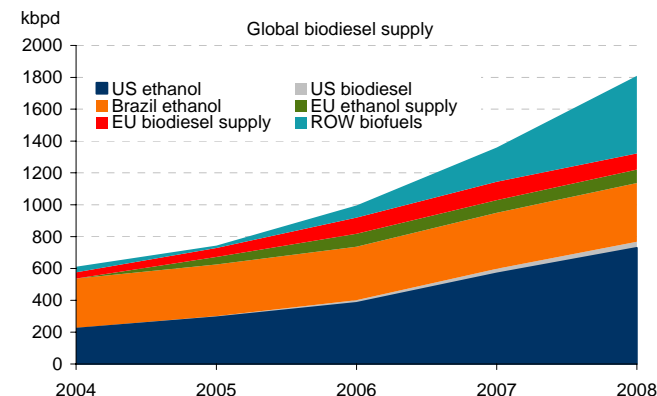


Source: RFA, IEA, USDA, Merrill Lynch Commodity Research

### European biodiesel output has suffered in recent months

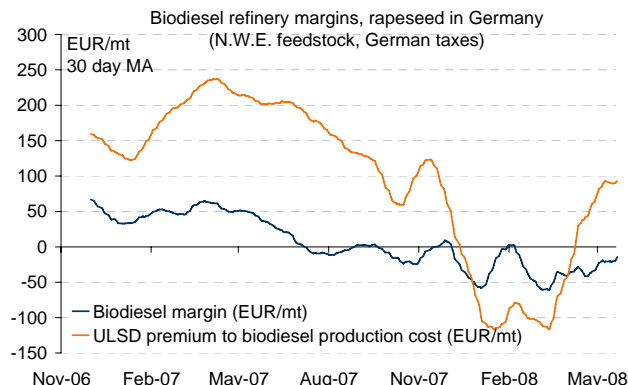
The growth in biofuels production has not been very even though, with the US and Brazilian ethanol production accounting for most of the growth while European production fell behind (Chart 4). In part, negative biodiesel margins have reduced the availability of oilseeds-based diesel fuels in Europe (Chart 5). Of course, with soybeans, crude palm oil and rapeseed oil prices hitting new records, biodiesel margins have turned negative in most regions in spite of the subsidies, reducing supply. As we pointed out in our March GEW (see ["Mind the refining gap in global distillates"](#)), the incremental amount of ethanol relative to biodiesel is lending support to a very wide diesel-gasoline spread.

**Chart 4: Biodiesel has only contributed modestly to the strong growth in global biofuel supplies in recent years**



Source: RFA, IEA, USDA, Merrill Lynch Commodity Research

**Chart 5: High vegetable oil prices and a decoupling of biodiesel from ULSD have squeezed European biodiesel refiners**

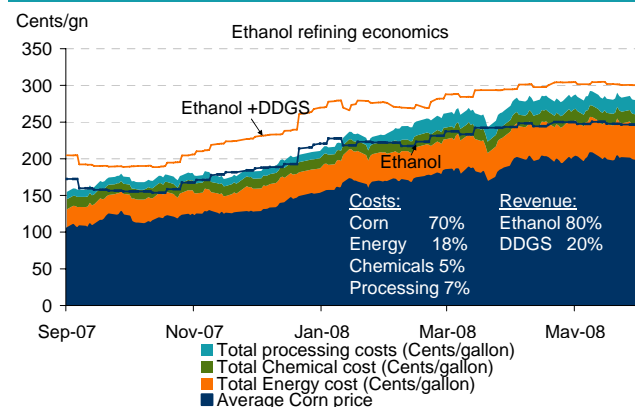


Source: Reuters, Merrill Lynch Commodity Research

## Subsidies and high oil prices supporting US corn ethanol

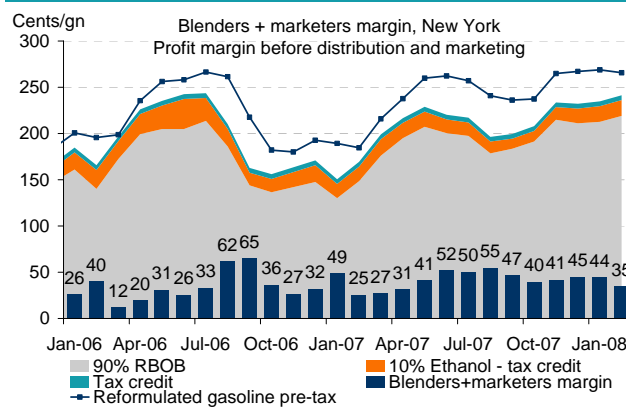
In effect, both corn and sugar-based ethanol are the key contributors to the growth in global biofuels supply. How is corn turned into ethanol? Corn contains starch, which can be transformed into sugar and then into ethanol through a high-temperature enzyme process. This is a highly energy-intensive process, which also requires water and chemicals. The output is ethanol, sold to gasoline marketers, and Dry Distillers Grains and Solubles (DDGS), sold to livestock producers as feed. Largely due to the USc 51/gallon blenders subsidy (USc 45/gallon when the new Farm Bill is enacted), gasoline marketers have been making a profit and were willing to pay a premium for ethanol, sharing these profits upstream (Chart 6 and 7).

**Chart 6: Refining of corn into ethanol has been a lucrative business, boosting supply for ethanol in the United States**



Source: Reuters, Bloomberg, Merrill Lynch Commodity Research

**Chart 7: Further downstream, ethanol marketers are also seeing handsome profits from the biofuels boom**



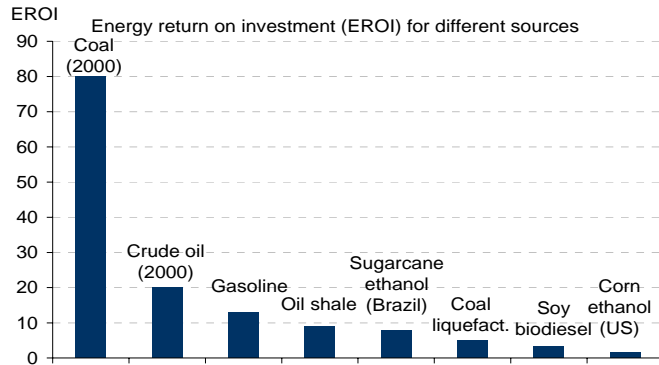
Source: EIA, Merrill Lynch Commodity Research

## Still, US corn ethanol will not save the oil markets

While a good part of the growth in global ethanol supply has come from corn, there are questions as to how sustainable this incremental production will be. In part, corn ethanol is a highly inefficient source of energy. A gallon of ethanol holds about 76 KBtu, but the production of a gallon of ethanol requires the energy equivalence of at least 40-50 KBtu to harvest the crop and transform it into fuel. Thus, the energy return on investment (EROI), defined as the ratio of energy delivered to the energy used as an input into the production process, is just about 1.5. In contrast, conventional fuel sources such as crude oil show an EROI of 20,

while coal can reach an EROI of 80 in some cases (Chart 8). With an EROI close to one, corn-based ethanol is essentially natural gas turned into a transportation fuel. Whenever natural gas has decoupled from oil in recent years, corn ethanol has been profitable. If US natural gas prices were to converge towards oil parity, corn-based ethanol would likely turn unprofitable very quickly (Chart 9).

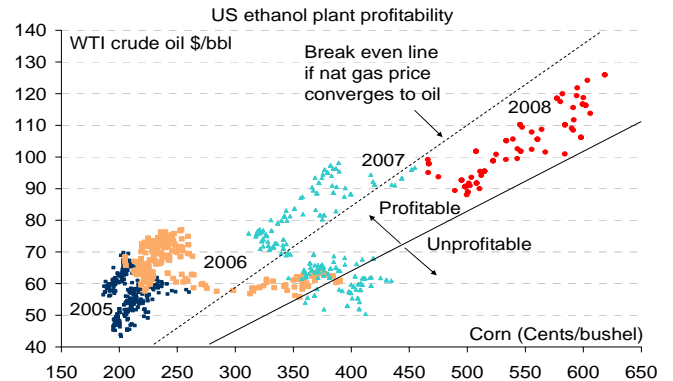
**Chart 8: When looked at from an Energy Return on Investment standpoint, corn ethanol is a highly inefficient source of energy**



Source: The encyclopedia of earth, Merrill Lynch Commodity Research

Note: Energy return on investment (EROI) is the ratio of the energy extracted or delivered to the energy used directly or indirectly in the process

**Chart 9: Margins at US corn-ethanol plants would suffer under nat gas price convergence to oil, decreasing utilization rates**

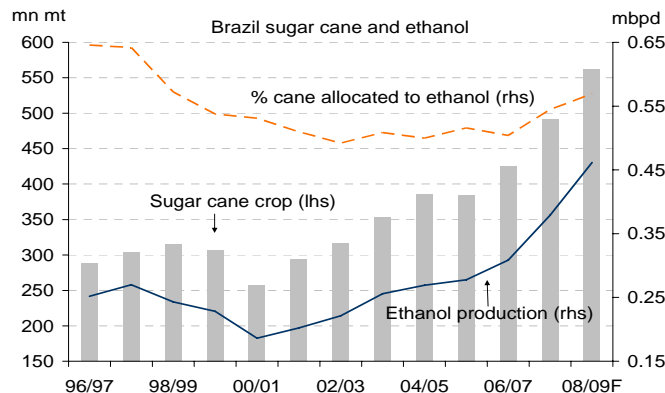


Source: Bloomberg, Merrill Lynch Commodity Research

## Brazilian sugar ethanol also helps, but it is no silver bullet

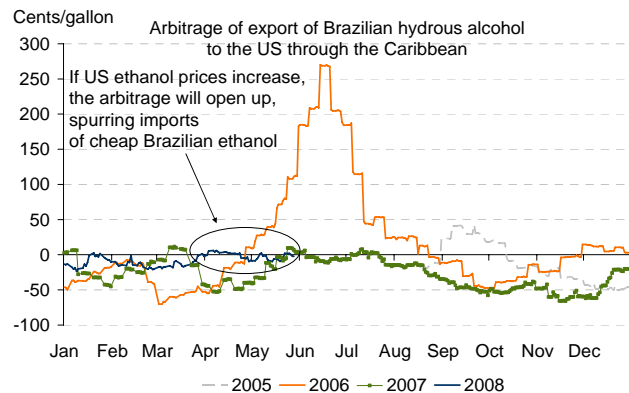
While corn-based ethanol is an inefficient source of energy, it has provided some relief to the extremely tight oil markets in the last few years. In the face of a global energy crunch and abundant corn supplies, corn ethanol seemed like a good option three years ago. However, as corn prices have now rallied to record levels, the market will likely start looking for a shift towards 2<sup>nd</sup> or 3<sup>rd</sup> generation biofuel technologies to produce incremental ethanol. Until these new technologies develop scalability, Brazilian sugar based ethanol will likely prosper. This year, Brazil is experiencing a bumper sugar crop, providing room for significant exports of ethanol (Chart 10). With a wider spread between US and Brazilian ethanol, an increasing share of Brazilian sugar-based ethanol could help fill American gas tanks this year (Chart 11).

**Chart 10: Brazil is experiencing a bumper crop in sugar cane and will increase ethanol allocation to almost 60%**



Source: USDA, UNICA, Merrill Lynch Commodity Research

**Chart 11: Exports of Brazilian ethanol to the US is becoming profitable, providing a hard ceiling on US ethanol prices**



Source: Bloomberg, Merrill Lynch Commodity Research

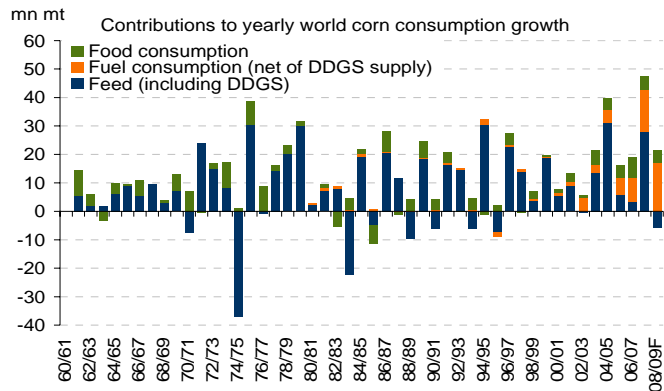
## In the meantime, world food prices are rising across the board...

While corn-based ethanol has surely helped increase the supply of transportation fuels, it is also taking away significant amounts of food from the market. Almost 25% of the US corn crop was used for fuel ethanol in 2007, amounting to a significant disappearance of food calories (Chart 12). On our estimates, this share is likely to rise to almost 35% at the end of 2008. A typical 15 gallon car tank of E-10 gasoline requires around half a bushel of corn. In turn, the food calories contained in the typical car tank can maintain the desirable weight of an adult man at low activity level for 11 days.

## ...partly due to the incremental grain demand from biofuels

In turn, the sharp increase in grain demand from the biofuels sector has started to affect food prices. We estimate that the increased ethanol production from corn in the US has pushed up corn prices by 21% since 2004. This figure is in line with the US Council of Economic Advisors' (CEA) estimate of 20%. Furthermore, corn ethanol demand has provided considerable pressure on other food product prices through crop substitution and spillover effects. Our statistical analysis shows that price changes in corn tend to lead soybean and wheat prices<sup>1</sup>. Thus, the world may have benefited from slightly lower gasoline prices but it is also suffering from higher food costs. These food price increases are in turn starting to affect global trade balances, and a number of poor countries particularly in Africa will be greatly affected (Chart 13).

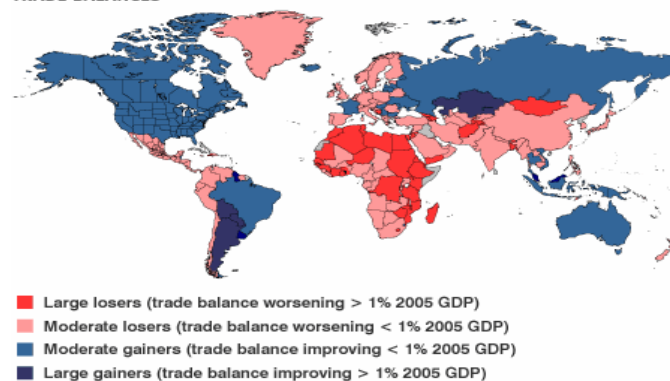
**Chart 12: Grains supplies are running thin, and the incremental growth in biofuels are particularly affecting corn demand**



Source: USDA, Merrill Lynch Commodity Research

**Chart 13: Food price increases are hurting developing markets particularly hard**

2007 - 2008 IMPACT OF PROJECTED FOOD PRICE INCREASES ON TRADE BALANCES



Source: The World Bank, Merrill Lynch Commodity Research

## In the short-run, corn and sugar are still relatively cheap...

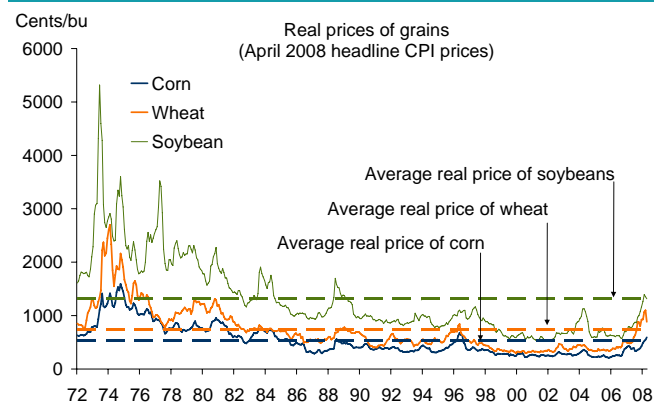
Historically, agricultural prices have seldom outperformed headline inflation, and even in spite of the recent run-up in prices, grains are still relatively cheap (Chart 14). As we expect supply to struggle in the face of soaring demand, we see particular upside for a number of agricultural commodity prices, including corn. The United States Department of Agriculture (USDA) expects a small world corn crop in 2008/9, suggesting that corn inventories could drop to a record low 23 days of demand coverage. Importantly, corn demand will remain robust and prices should continue to track oil fundamentals, even with a potential marginal switch in US ethanol demand towards Brazilian sugarcane.

<sup>1</sup> Corn prices Granger cause soybean and wheat prices on a monthly basis. The spillover peaks already after 3-5 months.

### ...and there is plenty of gasoline around

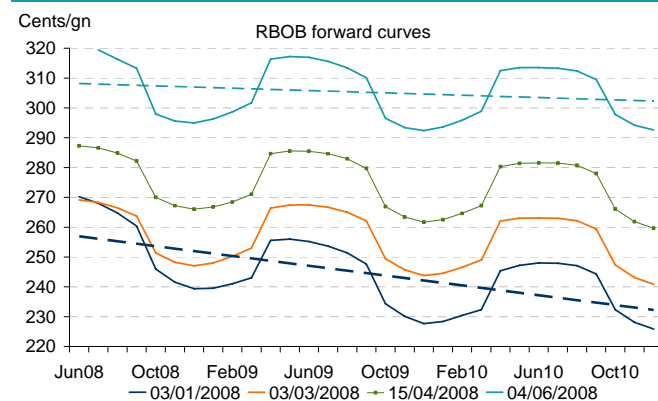
Still, the surge in ethanol supply could continue to exacerbate the ongoing gasoline glut partly because refiners around the world have hit flexibility constraints. As global jet and diesel demand has outstripped gasoline for a number of years now, refiners can no longer continue to alter yields to decrease gasoline production in favour of middle distillates. In addition, a warranted increase in energy efficiency in the US spells demand destruction in the horizon. Can gasoline prices hold firm in the face of slower demand and rising supplies? In recent months, the gasoline curve has flattened significantly led by developments in the WTI crude oil curve (Chart 15). This rotation could continue, should crude oil stocks build in the coming months.

**Chart 14: On a historical basis, taking headline inflation into account, grains prices are still not expensive**



Source: Bloomberg, Merrill Lynch Commodity Research

**Chart 15: The degree of backwardation has softened significantly in recent months, and the rotation could continue**

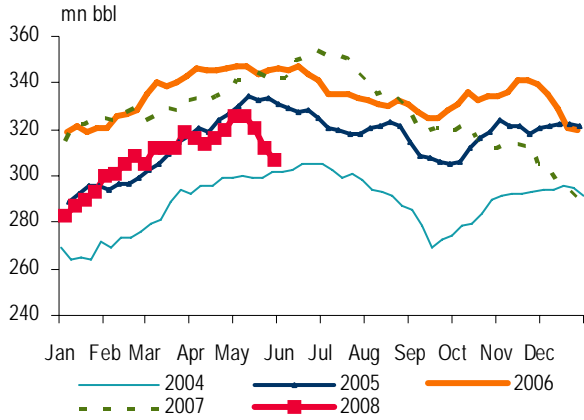


Source: Bloomberg, Merrill Lynch Commodity Research

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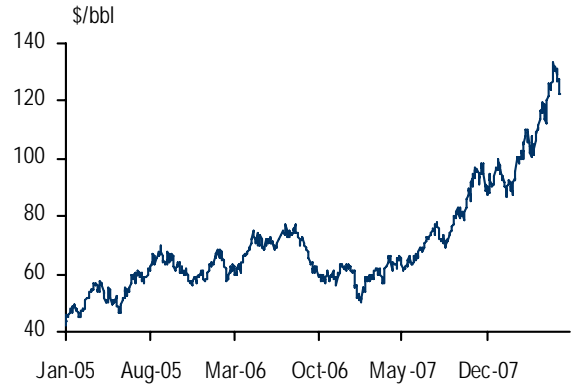
## Petroleum - US

Chart 16: US crude oil stocks



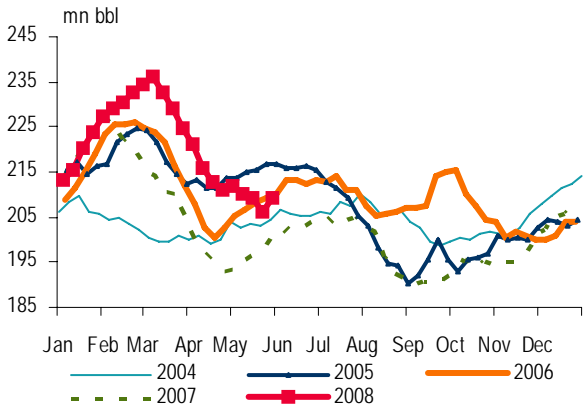
Source: US Department of Energy

Chart 17: WTI crude oil price



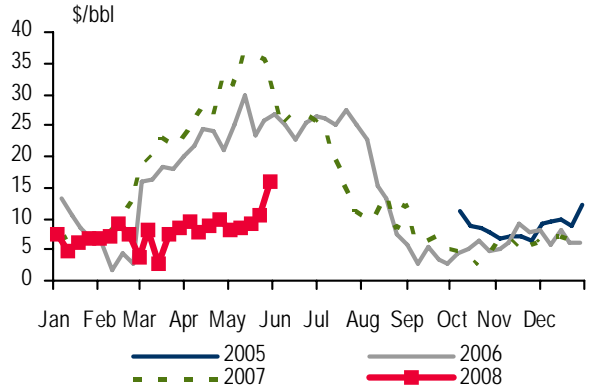
Source: NYMEX, Bloomberg

Chart 18: US gasoline stocks



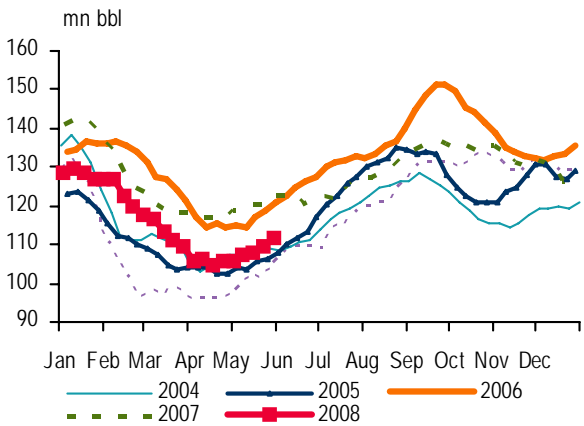
Source: US Department of Energy

Chart 19: US RBOB cracks



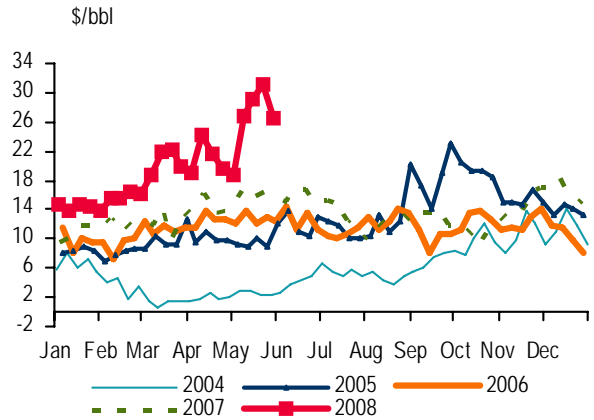
Source: NYMEX, Reuters

Chart 20: US distillate oil stocks



Source: US Department of Energy

Chart 21: US distillate oil cracks



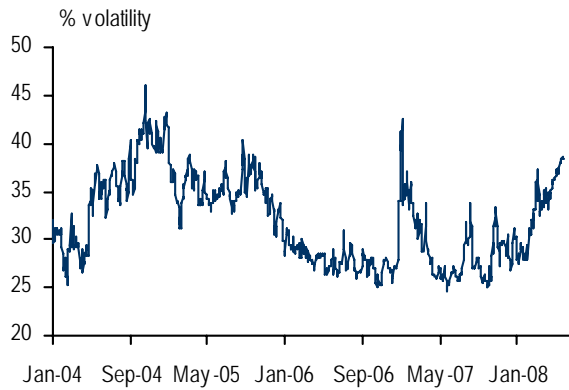
Source: NYMEX, Reuters



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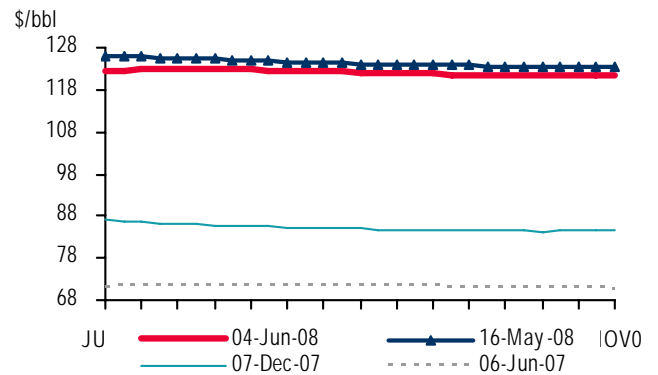
## Petroleum - US & Europe

Chart 22: WTI implied volatility



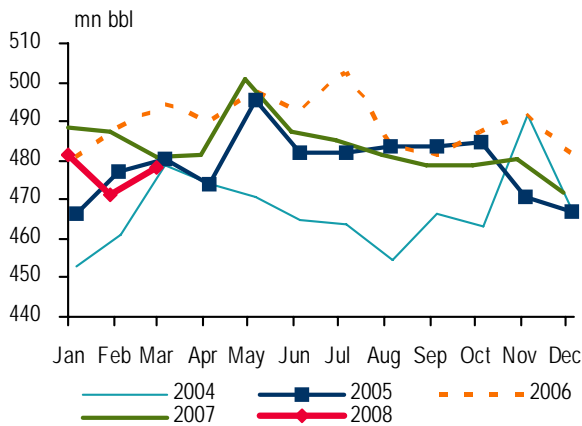
Source: NYMEX, Bloomberg

Chart 23: WTI Term Structure



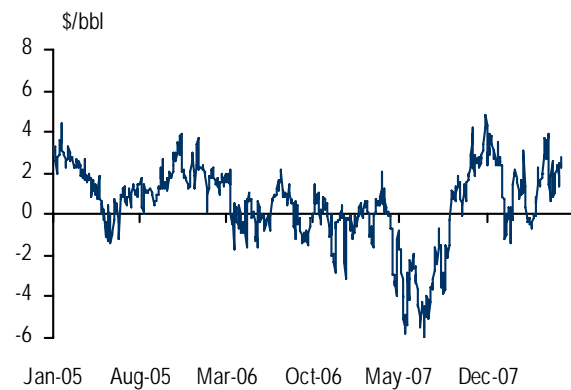
Source: NYMEX, Reuters

Chart 24: European crude oil stocks



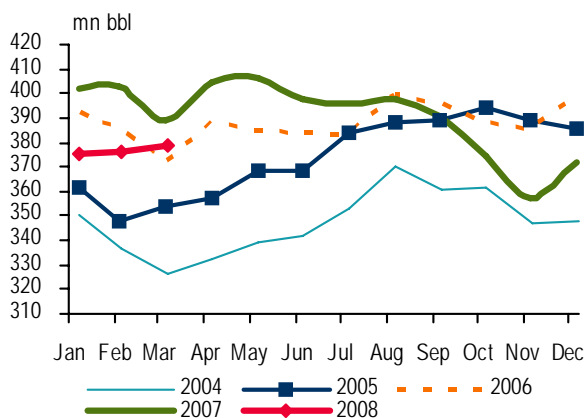
Source: Euroil

Chart 25: WTI - Brent crude spread



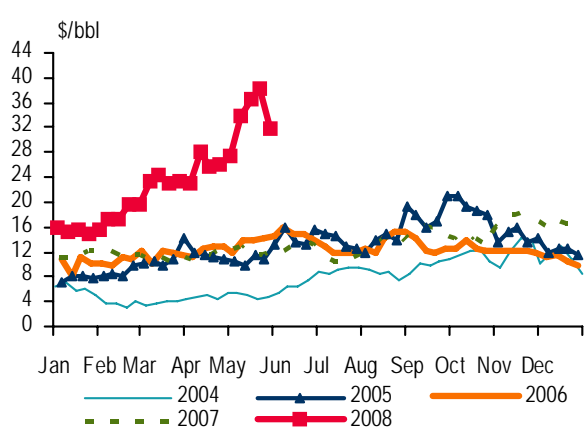
Source: IPE, Bloomberg

Chart 26: European distillate stocks



Source: Euroil

Chart 27: IPE gasoil cracks

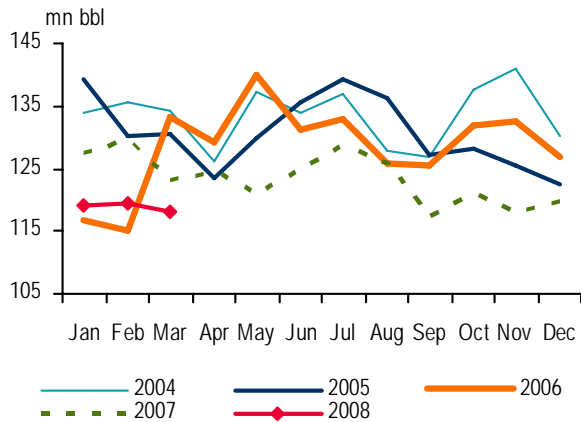


Source: Reuters



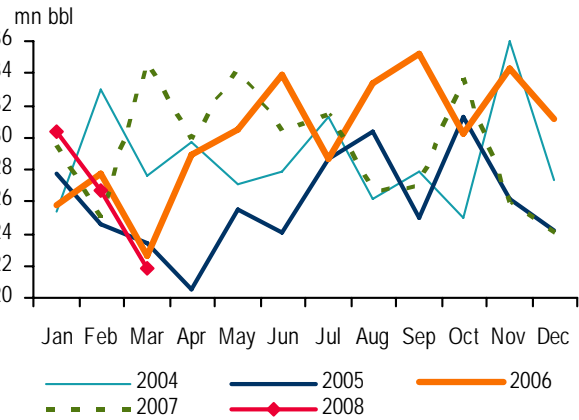
## Petroleum - Asia

Chart 28: Japanese crude oil stocks



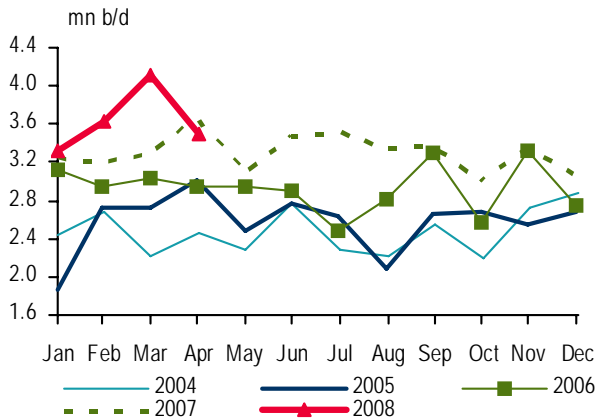
Source: International Energy Agency

Chart 29: South Korean crude oil stocks



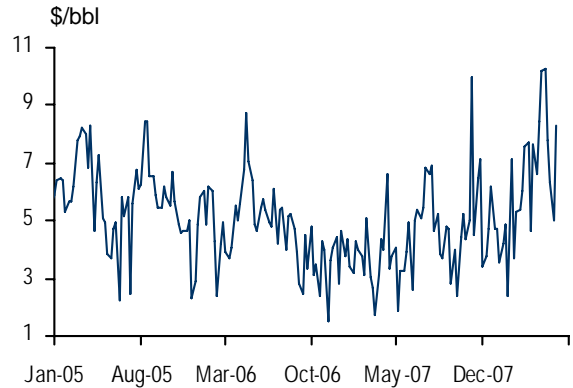
Source: International Energy Agency

Chart 30: China crude oil imports



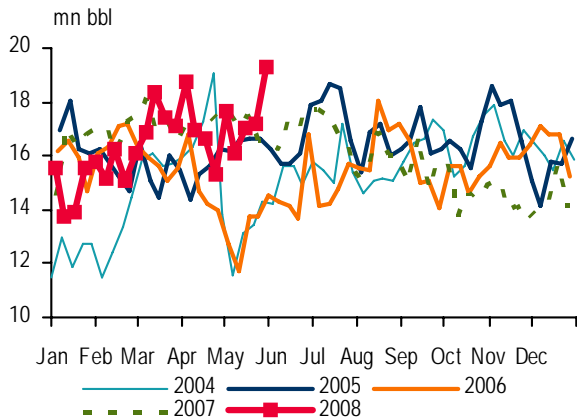
Source: Reuters

Chart 31: Brent - Dubai crude oil spread (1-month contract)



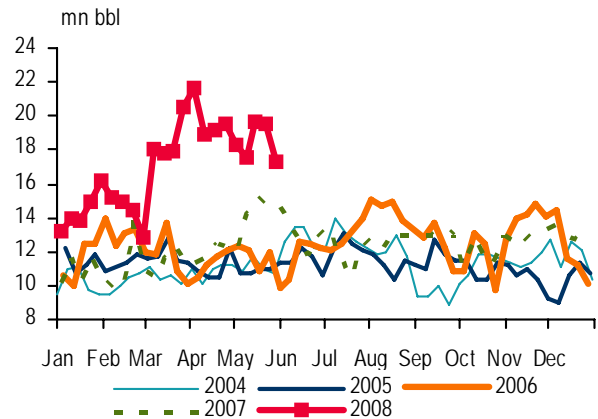
Source: Reuters

Chart 32: Singapore light & mid distillate stocks



Source: Reuters

Chart 33: Singapore residual stocks

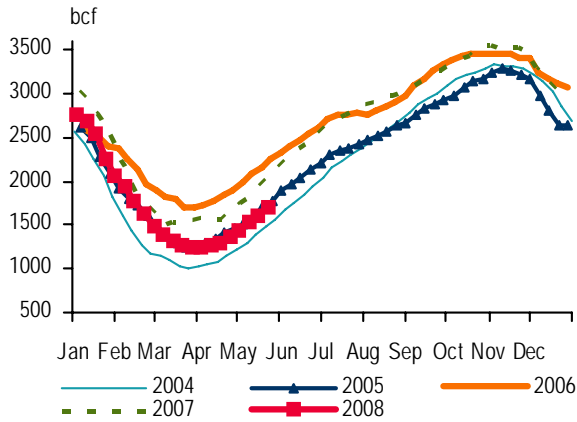


Source: Reuters

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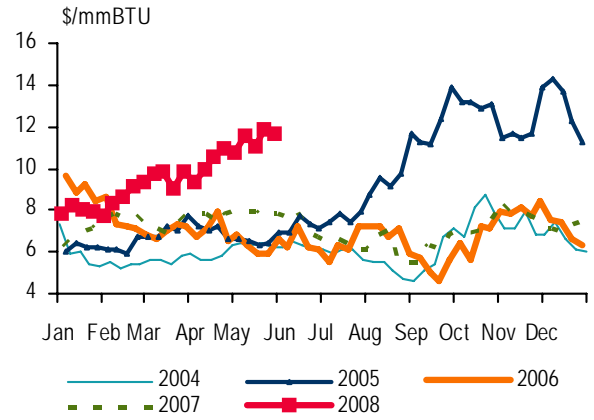
## Gas & Power - US

Chart 34: US natural gas stocks



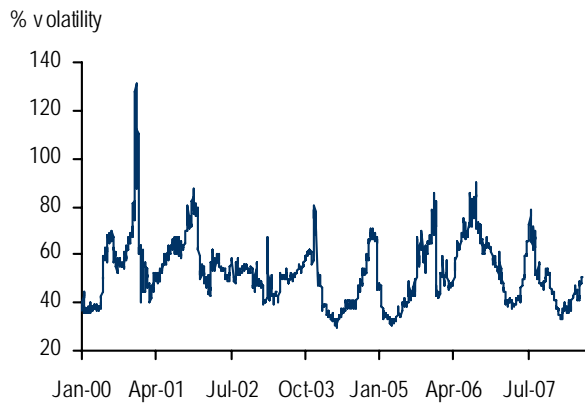
Source: US Department of Energy

Chart 35: US natural gas price



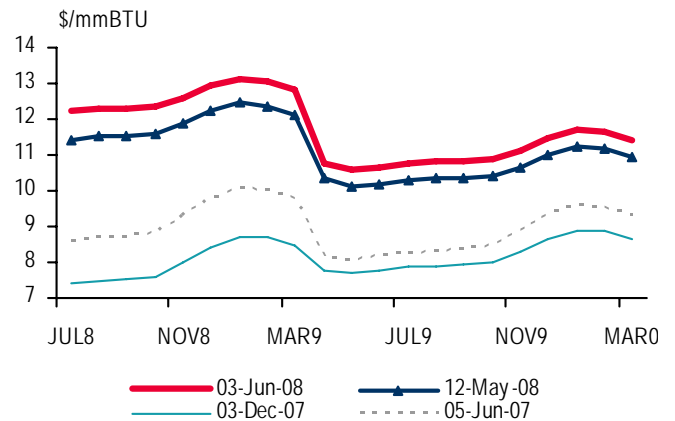
Source: NYMEX, Reuters

Chart 36: US natural gas implied volatility



Source: NYMEX, Bloomberg

Chart 37: US natural gas term structure



Source: NYMEX, Reuters

Chart 38: US NYMEX forward coal prices



Source: NYMEX, Reuters

Chart 39: US spot PJM power prices

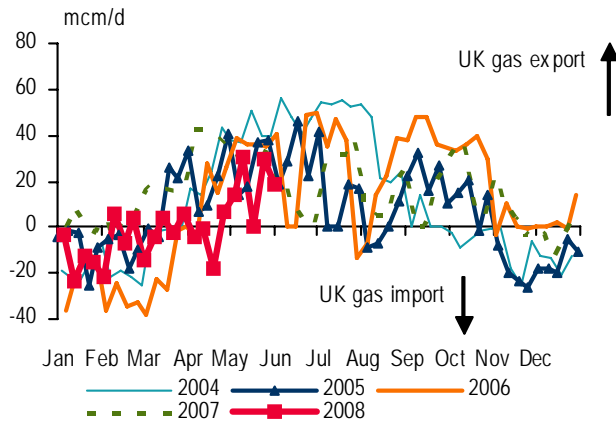


Source: NYMEX, Reuters

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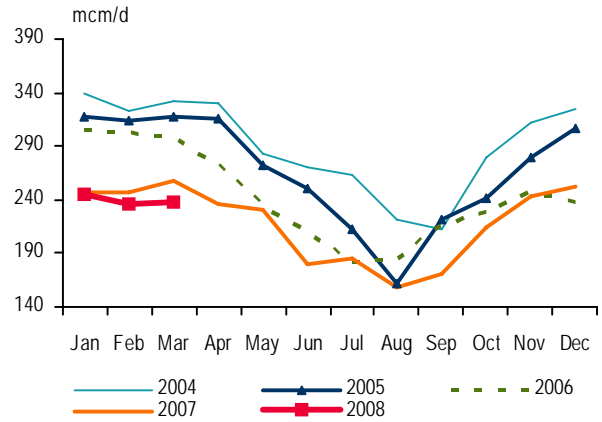
## Gas & Power - Europe

Chart 40: UK Interconnector gas flows



Source: UK Interconnector Flows

Chart 41: UK gross gas production



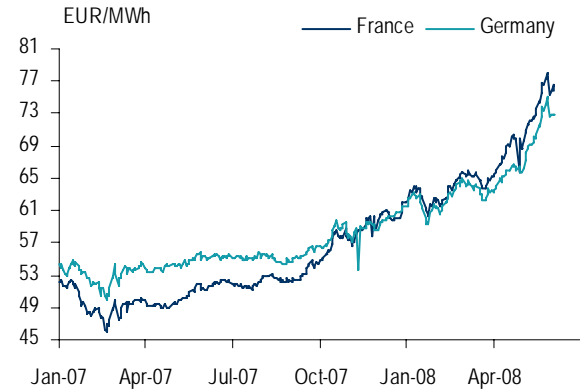
Source: UK Department of Trade and Industry

Chart 42: UK National Balancing Point (NBP) day ahead



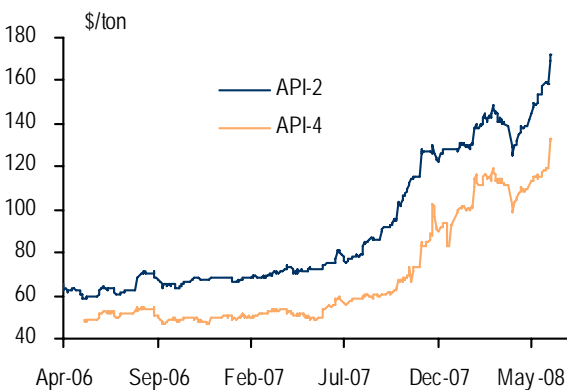
Source: Bloomberg

Chart 43: Germany and France CAL09 Baseload



Source: Reuters

Chart 44: TFS API2 coal in Rotterdam



Source: Reuters

Chart 45: European CO<sub>2</sub> Emissions Price 2008



Source: Reuters

**Table 3: Global Commodity Research Publications - Past Topics\***

Date	Publication	Title
02-Jun-08	Commodity Portfolio Monthly	Crude oil drives commodity returns in May
23-May-08	Global Energy Weekly	Despite the spike, we don't see a crude oil problem... Yet
19-May-08	Global Energy Weekly	US nat gas desperately chasing oil this summer
16-May-08	Commodity Derivatives Insights	Oil volatility surges across the curve on growing uncertainty
09-May-08	Global Energy Weekly	As oil rises, so will UK nat gas
02-May-08	Global Energy Weekly	Heavy crude can't keep up
01-May-08	Commodity Portfolio Monthly	Commodities again outperform other asset classes in April
01-May-08	Metals Update	Supply issues to galvanise zinc into action
25-Apr-08	Global Energy Weekly	US coal fires up
21-Apr-08	Commodity Derivatives Insights	Supply concerns translating into higher volatility
18-Apr-08	Global Energy Weekly	Russia's oil sector hits a wall
11-Apr-08	Global Energy Weekly	Can the US attract energy from abroad?
07-Apr-08	Physical Metal Exchange	Metals hit a sweet spot
04-Apr-08	Global Energy Weekly	Where did the winter premium in US nat gas go?
01-Apr-08	Commodity Portfolio Monthly	Commodities experience a modest pullback in March
28-Mar-08	Global Energy Weekly	Mind the refining gap in global distillates
17-Mar-08	Commodity Derivatives Insights	Volatility is contagious
18-Mar-08	Metals Update	Risks outweigh rewards in the copper market
17-Mar-08	Global Energy Weekly	Revising up our oil forecast
07-Mar-08	Global Energy Weekly	CO2: Like a box of chocolates
06-Mar-08	Global Commodity Paper #7	Commodity Volatility: a primer
04-Mar-08	Commodity Portfolio Monthly	Commodities outperformed equities and bonds in February
29-Feb-08	Global Energy Weekly	1997 in reverse
25-Feb-08	Global Energy Weekly	Global power, LNG bottlenecks to lift US nat gas prices
15-Feb-08	Global Energy Weekly	Oil remains the energy source of last resort
15-Feb-08	Physical Metal Exchange	Metals stuck between a rock and a hard place
13-Feb-08	Metals Update	China's power outage tightens metal markets
12-Feb-08	Commodity Strategist	Commodities face the good, the bad and the ugly
02-Feb-08	Commodity Portfolio Monthly	Commodities post mild returns in January after a stellar 2007
01-Feb-08	Global Energy Weekly	Harsh winter leaves China cold and hungry
01-Feb-08	Commodity Derivatives Insights	Options strategies for an uncertain macro outlook
25-Jan-08	Global Energy Weekly	A recession won't kill US oil demand
18-Jan-08	Global Energy Weekly	Asia's jet set to outpace Europe and US
11-Jan-08	Global Energy Weekly	Energy appetite in emerging markets to support coal prices
19-Dec-07	Global Energy Weekly	Our best 10 ideas for 1H2008
20-Dec-07	Commodity Derivatives Insights	Commodity index rebalancing suggests a stormy start to 2008
12-Dec-07	Energy Strategist	2008 Energy Market Outlook
27-Nov-07	Global Energy Weekly	Surging wet freight suggests oil could head lower near-term
16-Nov-07	Global Energy Weekly	European gas can't escape oil
09-Nov-07	Global Energy Weekly	China in a box: oil vs. USD
02-Nov-07	Global Energy Weekly	Surging oil & coal to support long-dated US nat gas
26-Oct-07	Global Energy Weekly	Oil volatility looks attractive relative to other asset classes
24-Oct-07	Commodity Derivatives Insights	Rolling up the oil volatility curve

**Table 3: Global Commodity Research Publications - Past Topics\***

Date	Publication	Title
19-Oct-07	Global Energy Weekly	Is anyone bothered by \$90 oil?
11-Oct-07	Global Energy Weekly	Don't lose sight of distillate this winter
04-Oct-07	The Physical Metals Exchange	Metal's golden age to continue
03-Oct-07	Global Energy Weekly	A crude reality check
01-Oct-07	Global Commodity Paper #6	The Merrill Lynch Biofuels Indices (MLCXB & MLCXBP)
28-Sep-07	Global Energy Weekly	Looking for relative value in biofuels
21-Sep-07	Global Energy Weekly	Too many dollars chasing too few commodities
13-Sep-07	Global Energy Weekly	WTI backwardation rings the alarm bell
13-Sep-07	Commodity Strategist	Backwardation is back
07-Sep-07	Global Energy Weekly	Electricity and aluminium are decoupling again
06-Sep-07	Metals Update - Aluminium	Energy costs underpin aluminium prices
31-Aug-07	Global Energy Weekly	Expect a roller-coaster ride for CO2 prices
24-Aug-07	Global Energy Weekly	Commodities will likely escape the credit crunch unharmed
09-Aug-07	Global Energy Weekly	More gloom than glory for US nat gas
06-Aug-07	Metals Update	Lead: Fundamentals take a back seat
03-Aug-07	Global Energy Weekly	The sweet conundrum in middle distillates
27-Jul-07	Global Energy Weekly	I know what you did last summer
24-Jul-07	Metals Update	Copper: Look beyond the strikes
20-Jul-07	Global Energy Weekly	Running on a tighter oil market
13-Jul-07	Global Energy Weekly	Residual fuel oil cracks could strengthen near-term
06-Jul-07	Global Energy Weekly	Using volatility to express a bearish winter gasoline view
29-Jun-07	Metals Strategist	New shorts emerge in metals
27-Jun-07	Global Energy Weekly	Long-dated oil prices at record highs
21-Jun-07	The Physical Metals Exchange	A different story for every metal
19-Jun-07	Global Energy Weekly	US nat gas volatility on the rise again
11-Jun-07	Energy Strategist	Energy Market Outlook for 2H2007 and Beyond
01-Jun-07	Global Commodity Paper #5	Capturing seasonality in commodity investments
30-May-07	Global Energy Weekly	German off-peak power to increase further
22-May-07	Global Energy Weekly	Near-term downside, medium term upside to US nat gas
15-May-07	Global Energy Weekly	Stars aligned for another leg up in oil prices
09-May-07	Global Energy Weekly	Can the US gasoline market find a balance?
01-May-07	Global Energy Weekly	Record dry freight suggests commodity supercycle lives on
24-Apr-07	Global Energy Weekly	Who cares about the WTI-Brent spread?
16-Apr-07	Global Energy Weekly	Don't write off landlocked WTI
03-Apr-07	Global Energy Weekly	Coal markets tighten as China becomes a net importer
27-Mar-07	Global Energy Weekly	Are petroleum products driving crude oil prices?
19-Mar-07	Global Energy Weekly	Global oil demand on the upswing
12-Mar-07	Global Energy Weekly	Phase II CO2 volatility could increase in the near-term
07-Mar-07	Global Energy Weekly	Commodities unscathed by vol surge in other asset classes

Source: ML Commodity Research

\*Please contact us if you would like to receive copies of any of the above

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