

United States

# Natural Gas

Commodities Research

## Prices collapse, now awaiting PRB coal-to-gas switching response

NYMEX natural gas prices have plummeted by close to 25% over the past two weeks to \$2.34/mmBtu, a level last seen in 2002, on continued realized and forecasted warmer-than-normal winter weather, which is leaving record gas volumes in storage and increasing the need for price-induced coal-to-gas switching in 2012, and in particular, the displacement of PRB coal.

### **NYMEX natural gas prices have collapsed in recent weeks, moving the market well into PRB coal switching territory**

We see potential for up to 3.5 Bcf/d of PRB coal-to-gas substitution, and we will be closely watching for signs of it starting in coming weeks. Ultimately, we expect this additional switching to provide support to prices, but expect the market to remain vulnerable to continued surprises to the downside in the near term until PRB switching actually materializes.

### **PRB coal prices and the cash costs of PRB coal and natural gas will determine the extent of the price-induced response in the supply-demand balance, and the sustainable price level for natural gas**

We expect that NYMEX natural gas prices below the following thresholds will induce considerable responses in the supply-demand balance:

At \$12.50/ton PRB coal, we estimate that 1.8 Bcf/d of incremental demand potential from combined cycle gas turbines (CCGTs) becomes competitive against PRB coal-fired power plants at NYMEX natural gas prices below \$2.75/mmBtu, with another 1.7 Bcf/d of incremental gas demand becoming competitive below \$2.55/mmBtu. While much of the coal sales for 2012 are already contracted at levels at or above our forecast, should prompt PRB coal prices remain near their current level of \$10.60/ton, these thresholds could drop to \$2.55/mmBtu and \$2.35/mmBtu, respectively.

If PRB coal-to-gas switching fails to materialize in sufficient scale, or quickly enough, natural gas prices are moving toward where we would expect to see some curtailment of natural gas production. More specifically, our GS Equity Research colleagues see average operating costs for natural gas producers running in the \$2.30-2.40/mmBtu range, including elements such as SG&A which may be viewed as fixed costs by some producers, with pure cash costs running closer to \$2.00/mmBtu.

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## Hedging and trading recommendations

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### Hedging recommendations

**Consumers:** We believe there are opportunities for consumer hedging in the long end of the NYMEX natural gas curve, particularly in calendar 2015 and 2016 contracts. Specifically, we believe that regulatory changes in the US power generation sector will lead to increased demand for natural gas, ultimately allowing prices to move higher. In addition, long-term US natural gas demand can be further supported by US LNG exports and industrial demand growth on the back of the current low prices.

**Producers:** We believe the hedging opportunities for US producers in calendar 2012 and 2013 contracts are limited, given current low prices.

### Trading recommendations

#### **Long UK NBP 4Q2012 ICE Natural Gas contracts (initial price 70.8 p/th, current loss 8.5 p/th)**

We continue to recommend a long position in UK NBP 4Q2012 contracts as we expect UK NBP prices to be well above the current forward curve in 2H2012. Our view is mainly driven by the expectation of a normalization of weather trends relative to the current very mild winter. This is likely to help narrow the price differential between spot and oil-indexed natural gas beyond what is currently priced into the forward curves.

## Current trading recommendations

Current trades	First recommended	Initial value	Current Value	Current profit/(loss) <sup>1</sup>
<b>Short March 2012 WTI - Brent spread, Long December 12 WTI - Brent spread</b>				
Buy March 2012 ICE Brent Crude Oil, Buy December 2012 NYMEX WTI Crude Oil, Sell March 2012 NYMEX WTI Crude Oil, Sell December 2012 ICE Brent Crude Oil				
	November 22, 2011 - <i>Energy Weekly</i>	\$1.79/bbl	\$3.64/bbl	<b>\$1.85/bbl</b>
<b>Long Gold</b>				
Buy December 2012 COMEX Gold				
	October 11, 2010 - <i>Precious Metals</i>	\$1,800.5/toz	\$1,676.9/toz	<b>\$300.3/toz</b>
Rolled from a long Dec-11 COMEX Gold future position on 13-Nov-11 with a potential gain of \$423.9/toz				
<b>Long Brent Crude Oil</b>				
Buy July 2012 ICE Brent Crude Oil				
	May 23, 2011 - <i>Energy Watch</i>	\$105.16/bbl	\$109.19/bbl	<b>\$2.08/bbl</b>
Rolled from a long Dec-12 ICE Brent Crude Oil future position on 1-Nov-11 with a potential loss of \$1.95/bbl				
<b>Long Copper</b>				
Buy June 2012 LME Copper				
	December 19, 2011 - <i>Metal Detector</i>	\$7,274/mt	\$8,226/mt	<b>\$952/mt</b>
<b>Long Zinc</b>				
Buy December 2012 LME Zinc				
	December 19, 2011 - <i>Metal Detector</i>	\$1,891/mt	\$2,061/mt	<b>\$170/mt</b>
<b>Long UK Natural Gas</b>				
Buy Q4 2012 ICE UK NBP Natural Gas				
	April 26, 2011 - <i>Natural Gas Weekly</i>	70.8 p/th	62.3 p/th	<b>(8.5 p/th)</b>

<sup>1</sup>As of close on January 20, 2012. Inclusive of all previous rolling profits/losses.

Source: Goldman Sachs Global ECS Research.

## Price actions, volatilities and forecasts

	Prices and monthly changes <sup>1</sup>			Volatilities (%) and monthly changes <sup>2</sup>				Historical Prices						Price Forecasts <sup>3</sup>		
	units	20 Jan	Change	Implied <sup>2</sup>	Change	Realized	Change	2Q 10	3Q 10	4Q 10	1Q 11	2Q 11	3Q 11	3m	6m	12m
<b>Energy</b>																
WTI Crude Oil	\$/bbl	98.46	↑ 1.24	34.9	-4.60	26.0	-3.6	78.05	76.21	85.24	94.60	102.34	89.54	113.00	115.00	123.50
Brent Crude Oil	\$/bbl	109.86	↑ 3.13	34.2	-4.50	22.6	-4.8	79.41	76.96	87.45	105.52	116.99	112.09	120.00	120.00	127.50
RBOB Gasoline	\$/gal	2.78	↑ 0.21	32.9	-5.52	21.0	-11.8	2.17	2.00	2.22	2.68	3.10	2.89	3.01	3.01	3.02
NYMEX Heating Oil	\$/gal	2.99	↑ 0.14	30.5	-2.40	21.3	-2.6	2.11	2.06	2.36	2.82	3.05	2.98	3.26	3.27	3.46
NYMEX Nat. Gas	\$/mmBtu	2.34	↓ -0.79	42.0	4.12	43.1	-4.3	4.35	4.23	3.98	4.20	4.38	4.06	2.90	2.75	4.25
UK NBP Nat. Gas	p/th	53.72	↓ -2.92	17.9	-10.76	27.1	2.8	37.48	42.68	51.74	56.77	58.04	57.03	66.20	72.30	87.70
<b>Industrial Metals<sup>4</sup></b>																
LME Aluminum	\$/mt	2217	↑ 214	25.9	-1.29	23.6	-6.9	2122	2110	2365	2531	2618	2430	2300	2400	2400
LME Copper	\$/mt	8220	↑ 810	36.1	-2.85	27.3	-8.5	7042	7278	8614	9629	9163	8993	8000	9000	9000
LME Nickel	\$/mt	20450	↑ 1585	39.8	-0.19	26.0	-17.7	22431	21271	23619	26926	24191	22037	18600	18600	18600
LME Zinc	\$/mt	2013	↑ 146	36.9	-1.08	21.8	-11.8	2052	2043	2333	2414	2271	2247	2050	2200	2200
<b>Precious Metals</b>																
COMEX Gold	\$/troy oz	1664	↑ 48	21.3	-3.43	16.7	-9.1	1197	1228	1370	1388	1508	1704	1785	1840	1940
COMEX Silver	\$/troy oz	30.4	↑ 1.1	40.8	-3.82	51.1	6.5	18	19	26	32	38	39	29.8	30.7	32.4
<b>Agriculture</b>																
CBOT Wheat	Cent/bu	611	↑ 3	32.8	0.22	33.6	6.7	467	653	707	786	745	690	620	620	575
CBOT Soybean	Cent/bu	1187	↑ 43	22.7	0.22	23.3	4.3	957	1035	1245	1379	1361	1356	1215	1215	1215
CBOT Corn	Cent/bu	612	↑ 5	30.8	0.59	32.4	12.0	355	422	562	670	731	696	630	630	525
NYBOT Cotton	Cent/bu	99	↑ 12	n/a	n/a	21.4	-4.9	81	87	128	179	156	106	90	85	85
NYBOT Coffee	Cent/bu	225	↑ 3	n/a	n/a	29.4	-0.6	140	174	205	257	271	256	235	200	175
NYBOT Cocoa	\$/mt	2259	↑ 74	n/a	n/a	48.2	2.9	2987	2863	2856	3307	3043	2962	2450	2450	2450
NYBOT Sugar	Cent/lb	24.9	↑ 1.4	29.6	-0.92	32.4	-0.9	16	20	29	31	24	29	22.0	22.0	22.0
CME Live Cattle	Cent/lb	124.6	↑ 4.0	n/a	n/a	14.9	-0.1	94	95	101	111	111	115	130.0	125.0	130.0
CME Lean Hog	Cent/lb	85.3	↑ 1.2	n/a	n/a	18.3	3.0	82	80	71	86	94	94	95.0	95.0	95.0

<sup>1</sup> Monthly change is difference of close on last business day and close a month ago.

<sup>2</sup> Monthly volatility change is difference of average volatility over the past month and that of the prior month (3-mo ATM implied volatility, 1-mo realized volatility).

<sup>3</sup> Price forecasts refer to prompt contract price forecasts in 3-, 6-, and 12-months time.

<sup>4</sup> Based on LME three month prices.

Source: Goldman Sachs Global ECS Research.

## Prices collapse, now awaiting PRB coal-to-gas switching response

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NYMEX natural gas prices have plunged \$0.72/mmBtu (or 23.5%) over the past two weeks to \$2.34/mmBtu, a level not seen since 2002, as both realized and forecasted temperatures remain substantially warmer than normal (see Exhibit 1). This unusually warm weather is leaving record natural gas volumes in storage and increasing the amount of price-induced coal-to-gas switching required to avoid breaching storage constraints in 2012. As discussed in our last report, we expected that to achieve this record amount of coal-to-gas switching would require natural gas prices to fall low enough to motivate coal-to-gas switching in the PRB-coal burning regions of the United States (see *Natural Gas: CSAPR delay and mild weather set the stage for PRB switching*, January 8, 2012 for details).

The sharp decline in natural gas prices has moved them well into the price range in which we expect PRB coal-to-gas switching to be economical. Consequently, we expect that PRB coal-to-gas switching should begin to tighten the underlying supply-demand balance and provide support to natural gas prices. However, it will likely take some time for the power generation sector to respond to the drop in natural gas prices, leaving natural gas prices vulnerable to continued downside risk from both realized and forecasted warm weather.

At this juncture, we think it most useful to focus on the price levels at which we expect to see significant price-induced changes in the US natural gas supply-demand balance. We believe that it is the size of the response in supply and demand at each of these price levels that will determine which price level will prove sustainable (see Exhibit 2).

- At \$12.50/ton PRB coal, we estimate that 1.8 Bcf/d of incremental demand potential from combined cycle gas turbines (CCGTs) becomes competitive against PRB coal-fired power plants at NYMEX natural gas prices below \$2.75/mmBtu, with another 1.7 Bcf/d of incremental gas demand becoming competitive below \$2.55/mmBtu.

Our GS Equity Research colleagues forecast PRB coal prices will average \$12.50/ton in 2012, and much of the PRB coal contracted for this year has been done at or above \$12.50/ton. Further, we expect that even should the warmer-than-normal temperatures forecasted for the next two weeks be realized, the first tranche of 1.8 Bcf/d of PRB coal-to-gas switching is sufficient to keep natural gas from breaching storage constraints. However, PRB coal prices have fallen sharply with natural gas prices in recent weeks; although the most recent weekly spot price as reported by the DOE is \$11.80/ton, the prompt ICE contract has declined to \$10.60/ton as of January 20 (see Exhibit 1). The decline in prompt PRB coal prices could be an early sign of movement toward PRB coal-to-gas switching, which would reduce demand for PRB coal. However, while much of the coal sales for 2012 are already contracted at levels at or above our forecast, the decline in front month PRB coal prices does indicate downside risk to our estimates of the PRB coal-to-gas switching thresholds. More specifically,

- At \$10.60/ton PRB coal, we estimate that the 1.8 Bcf/d of incremental demand potential from combined cycle gas turbines (CCGTs) becomes competitive against PRB coal-fired power plants at NYMEX natural gas prices below \$2.55/mmBtu, with the other 1.7 Bcf/d of incremental gas demand becoming competitive below \$2.35/mmBtu.

Consequently, should the recent weakness in PRB coal prices remain, NYMEX natural gas prices could become sustainable much closer to their current levels. However, we expect PRB coal prices will likely remain reasonably well supported by production costs at or above current near-dated market levels as our GS Equity Research colleagues estimate that cash costs plus royalties for PRB coal production are in the \$9.00-10.50/ton range (with the cash cost component running from \$5.50-\$6.50/ton), with price below that likely to lead to some curtailment in PRB coal supplies.

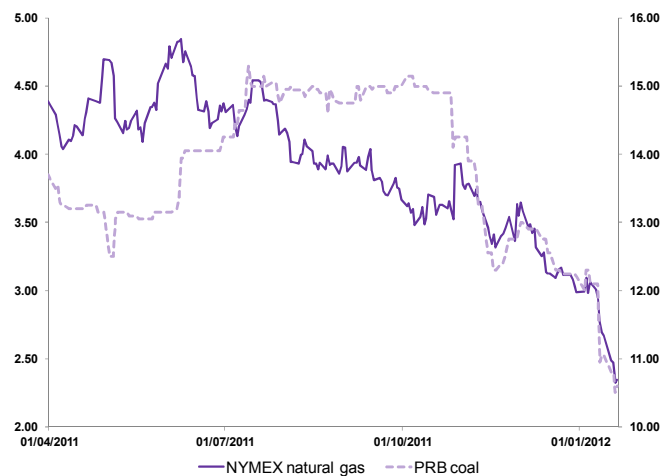
While we continue to expect that PRB coal-to-gas switching will prove sufficient to keep the gas market from breaching storage constraints this year, PRB coal-to-gas switching has not occurred in large scale before, and consequently, many of its features remain uncharted. If PRB coal-to-gas switching fails to materialize in sufficient scale, or quickly enough, natural gas prices are moving toward where we would expect to see some curtailment of natural gas production. More specifically,

- Our GS Equity Research colleagues see average operating costs for natural gas producers running in the \$2.30-2.40/mmBtu range, including elements such as SG&A which may be viewed as fixed costs by some producers, with pure cash costs running closer to \$2.00/mmBtu (see Americas: Energy: Oil & Gas - E&P: *Natural gas entering bottoming phase partly thanks to mild weather*, January 16, 2012 for details).

Consequently, if PRB coal-to-gas switching does not materialize quickly enough or natural gas prices drop further on continued realized and forecasted warmer than normal weather, we could see supply-side adjustments begin to rebalance the natural gas market. However, we continue to expect a substantial demand-side response from PRB coal-to-gas switching and in the remainder of this note we will focus on its expected features and scope.

**Exhibit 1: NYMEX natural gas prices have plunged in the past two weeks, and so have prompt PRB coal prices...**

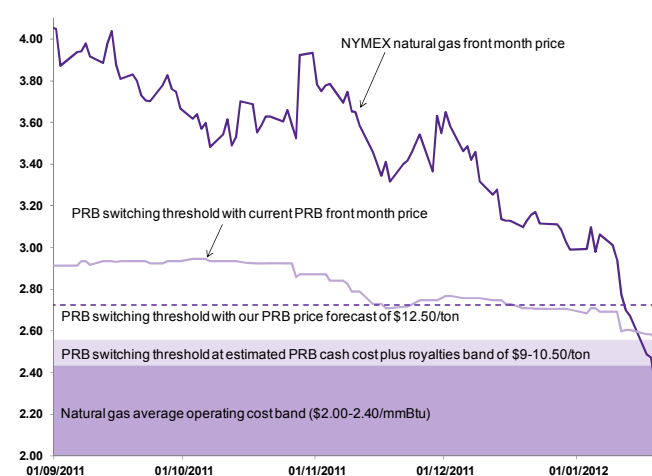
Left axis: NYMEX natural gas front month price in \$/mmBtu; right axis: PRB coal front month price in \$/ton



Source: NYMEX, Bloomberg.

**Exhibit 2: ... which should induce important shifts in the underlying supply-demand balance**

Key pricing thresholds, \$/mmBtu



Source: Goldman Sachs Global Investment Research.

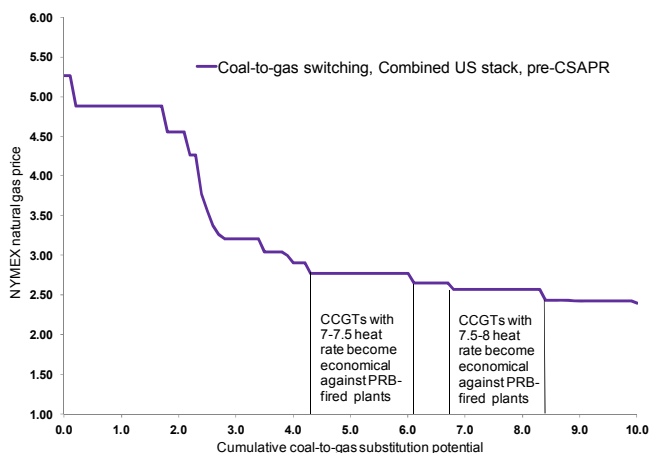
**The PRB coal consuming region of the United States**

Powder River Basin (PRB) coal is a relatively low-cost type of coal produced in Wyoming and to a lesser extent Montana. PRB coal is the most widely used type of coal in the United States, with buyers throughout the country. However, from the perspective of coal-to-gas switching in power generation, the consuming region of interest stretches from the Upper Midwest down to Texas and Louisiana (see Exhibits 3 and 4). Broadly, this area corresponds to the regional transmission networks of MISO, SPP and ERCOT. Some states to the east of the Mississippi river such as Alabama and Georgia also import meaningful amounts of PRB coal, but we expect that most natural gas plants in these states are already being used in switching against more expensive coal types, such as Central Appalachian



**Exhibit 5: We see potential for a large increase natural gas demand at current prices**

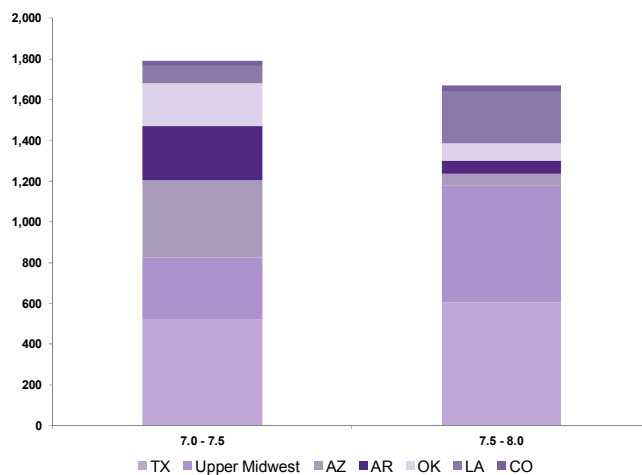
\$/mmBtu (vertical axis); Bcf/d (horizontal axis)



Source: Goldman Sachs Global ECS Research.

**Exhibit 6: CCGTs in Texas and the Midwest have the most potential to burn more natural gas**

Demand potential from CCGTs by heat rate, in mmcf/d



Source: Goldman Sachs Global ECS Research.

**PRB coal switching could fall short of potential due to infrastructure constraints, or further declines in PRB coal prices**

Our demand potential numbers assume CCGT generation capacity is effectively maxed out at around an 80% annual utilization rate, and that only two-thirds of the aggregate effective spare capacity can be considered available due to transmission and logistical constraints. However, there remains a risk that we overestimate the incremental demand potential by not fully accounting for transmission, contractual and logistical issues.

Underlying our estimate for incremental demand to enter the market if prices are sustained below certain levels are important assumptions for the PRB coal price, transport cost and the price incentive needed to get switching started in the first place. Specifically, we embed the PRB price forecast of GS Equity Research of \$12.50/ton in 2012, transportation costs of \$25/ton to ship PRB coal to the Midwest, and a discount of \$0.40/mmBtu of natural gas relative to PRB coal in gas-equivalent terms for power generators (see Exhibit 7).

However, as seen in Exhibit 1, prompt PRB coal prices have declined rapidly with natural gas prices in recent weeks, suggesting downside risk to our 2012 PRB price assumption of \$12.50/ton, as the gas price required to achieve a certain level of switching is *relative* to the PRB coal price. Specifically, although most PRB coal is bought on long-term contracts, which means that current market prices have a more limited impact on the switching decision, if prompt PRB coal prices are sustained near current levels of \$10.60/mmBtu, this would suggest a lower NYMEX natural gas price threshold for PRB coal-to-gas switching of \$2.55/mmBtu, instead of \$2.75/mmBtu (see Exhibit 8).

Further, weather clearly remains a key risk to prices going forward, especially as the current forecast points to markedly lower-than-normal temperatures and heating demand. Specifically, should the current two-week forecast for 16% less HDDs than normal be realized, we would expect the inventory overhang to increase by another 100 Bcf relative to what would have been the case under normal weather. As a result, the market would become even more dependent on displacement of PRB coal actually materializing on a meaningful scale. In such a weather scenario, we estimate 2012 prices would need to average below \$3.00/mmBtu to achieve this additional switching, compared to our current 2012 average NYMEX price forecast of \$3.10/mmBtu, and in particular see prices below the



PRB switching level of \$2.75/mmBtu through the end of the summer. However, relatively speaking, given the meaningful potential for increased natural gas demand should PRB coal switching start to occur, future weather deviations such as the current two-week forecast pose less of a downside risk than lower PRB coal prices to natural gas prices. While the weather deviation could be absorbed by PRB switching, should PRB prices remain weak the threshold level for switching in Q1-Q3 2012 could drop to \$2.55/mmBtu, as outlined above.

If PRB coal-to-gas switching does not materialize quickly enough or on the magnitude we expect, prices would likely need to move even lower towards production cash costs to curtail production, as inventory capacity otherwise is likely to be breached before the end of the summer. Consequently, we could see competition for market share in the generation sector between natural gas and coal resulting in lower prices for both fuels, until one of them ultimately finds support at cash costs. Our colleagues in GS Equity Research estimate average operating costs in natural gas production are \$2.30-\$2.40/mmBtu, but that within this there are arguably some fixed elements (for example portions of SG&A costs), meaning the true variable costs are lower, arguably at around \$2.00/mmBtu. Further, they estimate PRB coal cash costs plus royalties are in the \$9-10.50/ton range (corresponding to a \$2.45-2.55/mmBtu switching threshold), suggesting PRB coal could find cost support sooner than natural gas, allowing gas to sustainably establish the price spread needed to displace PRB coal before curtailing natural gas production.

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#### Exhibit 7: The economics are in place for PRB coal to be displaced by natural gas

Key assumptions behind our \$2.75/mmBtu threshold for PRB 8800 displacement

PRB price	12.5 \$/ton
PRB transport costs	25 \$/ton
PRB heat content	17.6 mmBtu/ton
Heat rate gas plant	7.5 mmBtu/MWh
Heat rate coal plant	11.0 mmBtu/MWh
Gas discount needed	0.40 \$/mmBtu
<b>Gas price needed</b>	<b>2.73 \$/mmBtu</b>

Source: Goldman Sachs Global ECS Research.

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#### Exhibit 8: Lower PRB prices lower the natural gas price threshold to make CCGTs economical

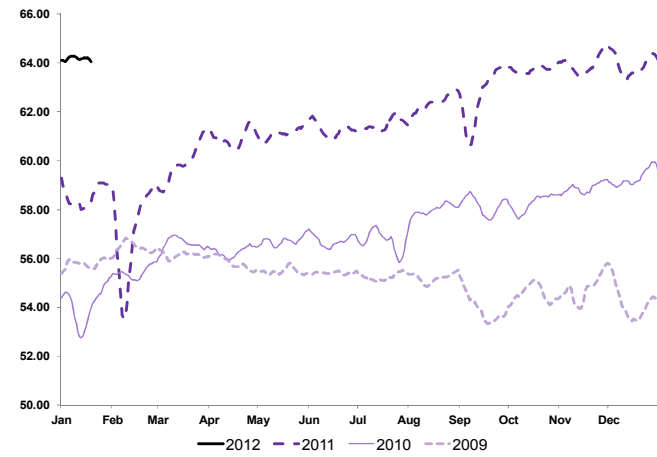
Gas price needed to make 7.5 HR CCGTs economical against PRB-fired power generation, at different PRB prices

PRB price (\$/ton)	Gas price needed (\$/mmBtu)
14.00	2.85
13.00	2.77
12.50	2.73
12.00	2.68
11.00	2.60
10.60	2.57
10.00	2.52
9.00	2.43

Source: Goldman Sachs Global ECS Research.

### US dry production

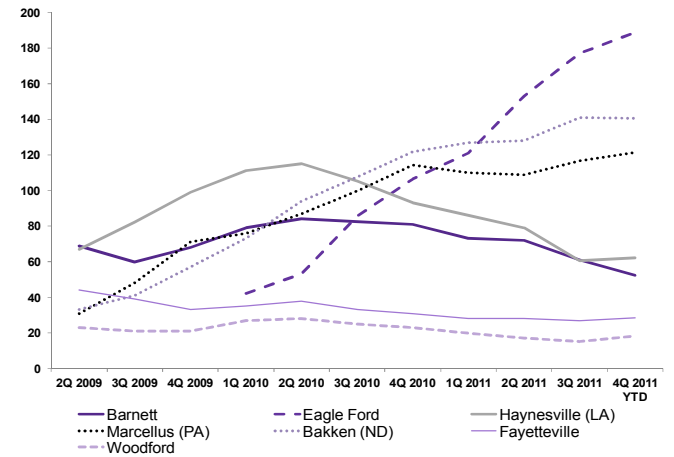
Bcf/day



Source: Bentek Energy.

### Natural gas and oil rig counts in major shale plays

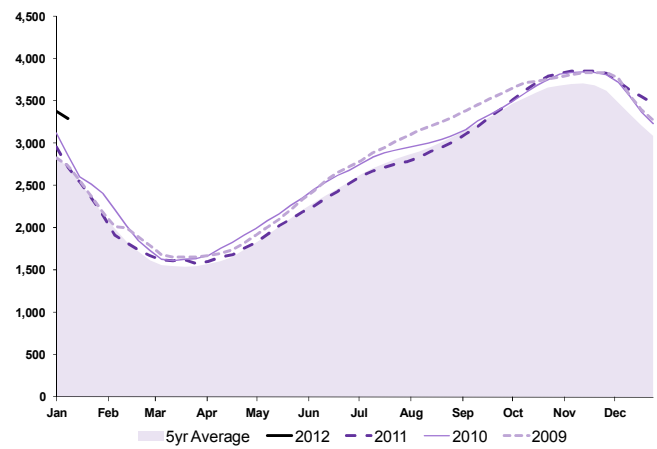
Number of rigs



Source: Land Rig Newsletter.

### US natural gas working inventories

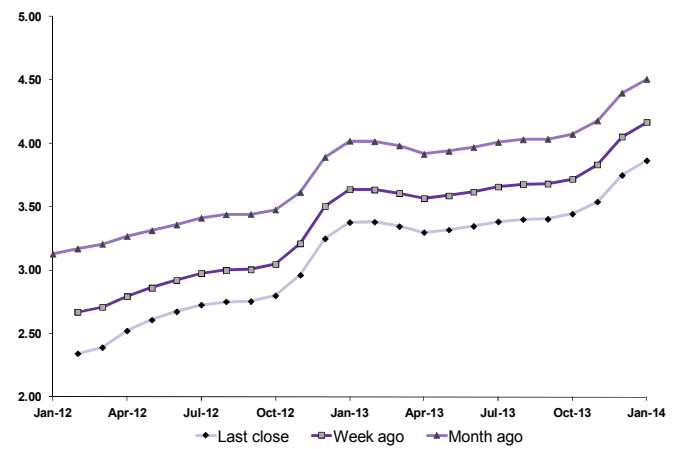
Bcf



Source: DOE.

### NYMEX natural gas forward curve

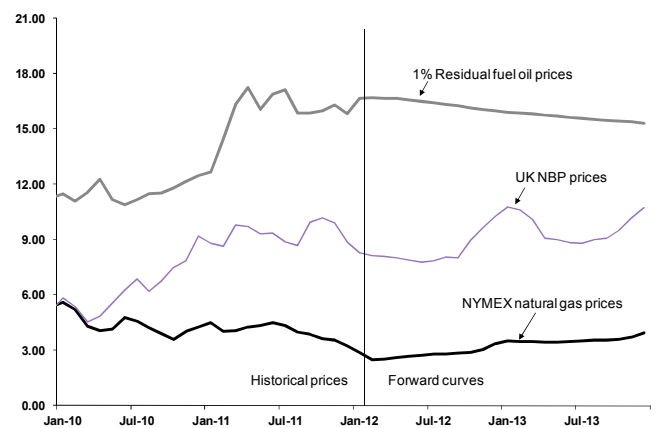
\$/mmBtu



Source: NYMEX.

### Global energy prices

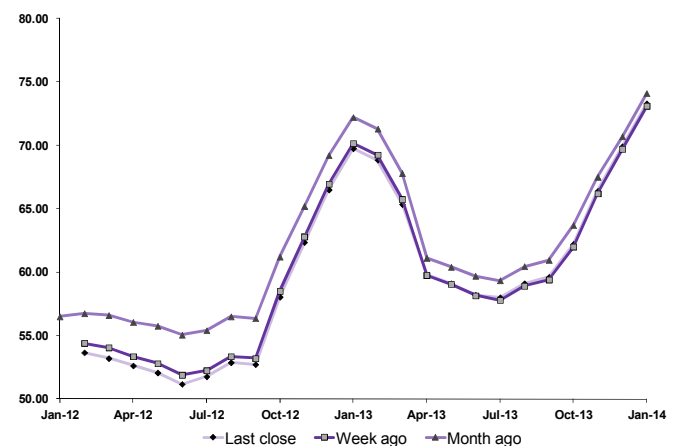
\$/mmBtu



Source: NYMEX, ICE, Goldman Sachs Global ECS Research.

### UK NBP natural gas forward curve

p/th



Source: ICE.

# Disclosure Appendix

## Reg AC

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We, David Greely and Johan Spetz, hereby certify that all of the views expressed in this report accurately reflect our personal views, which have not been influenced by considerations of the firm's business or client relationships.

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