Research

16 December 2010 | 36 pages

Global Gas Market

Blueprint for 2011

In this note we attempt to quantify the outlook for global natural gas and the companies most exposed to the natural gas market. Our analysis concludes that international gas markets are tightening in the short term and flexibility is reducing, increasing producer pricing power over the next three years.

- **Short term outlook improving ex-USA** — Demand recovery is dealing with surplus piped gas and LNG. LNG flexibility should be severely reduced by 2015 unless new LNG projects begin building soon.
- **Market pricing structures unlikely to change** — We believe the US market will remain a fungible, spot market while Asian and the majority of European markets will remain dependent on oil price indexation. Regional demand dynamics remain stronger than global linkage and the price premium of Europe and Asia looks sustainable in our view.
- **Supply is coming from increasingly distant sources** — Gas is therefore travelling further, increasing costs and reinforcing the strength of the contract segment.
- **Chinese demand growth could push gas prices further and faster** — China's gas demand is planned to increase c11% cagr to 2020. Moving gas penetration in China's energy mix could drive that even faster.
- **All of the IOC's benefit from improving gas background** — We identify Gazprom (1M; US$8.3 TP) and BG (1M; £15.00 TP) as key beneficiaries.

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See Appendix A-1 for Analyst Certification, Important Disclosures and non-US research analyst disclosures.

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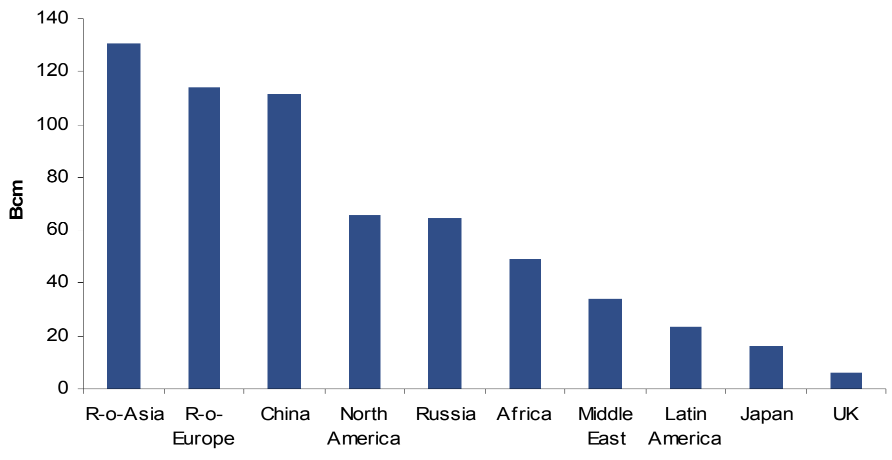
Short term supply surplus eroding

While the US gas market is used by many as the reference price for gas, the US represents only 20% of the global gas market. While there is some connectivity across markets, the US does not set price in the rest of the world. Recovery in demand in the larger LNG demand centers of the world (Japan, Korea, Spain) has driven LNG demand up by 16.2% in 2010. We estimate that the combination of demand improvement, and deceleration in new uncontracted supply hitting the market means that the LNG capacity cushion is reducing and short term European and Asian gas markets are tightening.

The economic crisis of 2008 drove 2009 global gas demand lower by c2.1% year on year, and in some key LNG markets like Japan and Spain, drove demand down below 2007 levels by c3.1% and c1.6% respectively. This demand failure was coupled with an increase in LNG supply from Qatar and a resurgent domestic output in the US leaving less room for imports and pushing more spot supply towards Europe. This almost perfect storm meant that European consumers deferred contractual volume under take or pay, using gas from inventory or newly available spot LNG in its place.

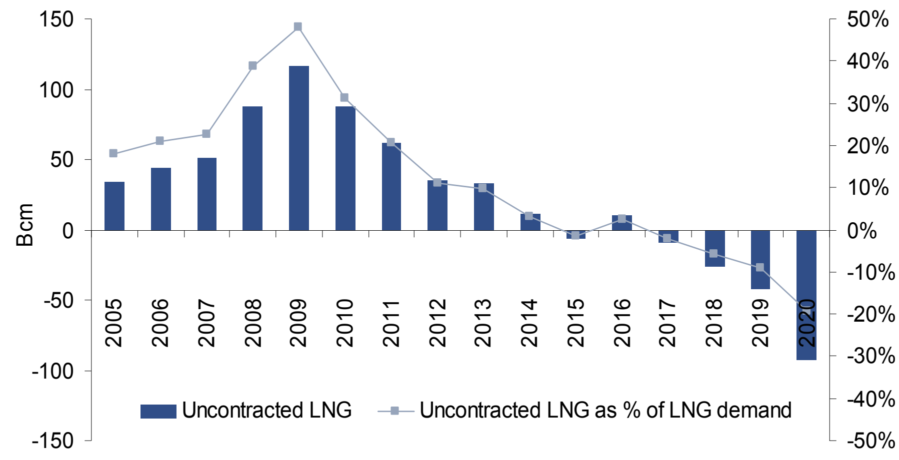
As 2010 has developed gas demand has recovered (global gas demand has increased 3.7%) and LNG demand in key market like Japan and Spain has improved (5.9% and 6.4% respectively). US gas supply remains replete with supply growth outstripping estimates and at lower cost than anticipated.

Figure 1. Natural gas demand is forecast to increase in key markets 2009-2015E



Source: Citi Investment Research and Analysis, BP stats review

Figure 2. Uncontracted LNG 'cushion' reducing



Source: Citi Investment Research and Analysis, BP stats review

Natural gas demand is forecast to outstrip supply by 2015

Figure 3. Natural gas demand (BCM)

	2000	2005	2009	2015E	2020E
North America	**796**	**769**	**790**	**856**	**898**
USA	664	622	640	681	710
Canada	93	98	95	104	112
Mexico	40	48	55	71	75
Asia Pacific	**291**	**396**	**497**	**756**	**948**
Japan	72	79	88	104	112
China	25	47	89	200	300
Others	194	271	321	451	535
Europe and Eurasia	**992**	**1123**	**1067**	**1251**	**1301**
Russia	353	400	390	454	460
UK	106	103	94	100	107
Spain	17	32	35	44	51
Others	516	587	548	652	683
Middle East	**186**	**279**	**346**	**380**	**446**
Africa	**57**	**79**	**94**	**143**	**163**
Latin America	**96**	**123**	**135**	**158**	**174**
World	**2418**	**2770**	**2928**	**3543**	**3930**

Source: Citi Investment Research and Analysis, BP stats review, IEA

Figure 4. Natural gas supply (BCM)

Supply (BCM)	**2000**	**2005**	**2009**	**2015E**	**2020E**
North America	**760**	**749**	**798**	**831**	**846**
USA	540	518	585	608	609
Canada	182	187	161	167	176
Mexico	38	44	51	56	61
Asia Pacific	**274**	**367**	**441**	**513**	**612**
Japan	3	3	3	4	4
China	27	50	85	109	159
Others	245	314	353	400	450
Europe and Eurasia	**949**	**1046**	**978**	**1181**	**1218**
Russia	529	580	528	654	688
UK	118	96	65	41	28
Spain	0	0	0	0	0
Others	302	370	386	486	502
Middle East	**208**	**320**	**407**	**493**	**569**
Africa	**130**	**176**	**204**	**258**	**303**
Latin America	**100**	**139**	**152**	**161**	**184**
World	**2421**	**2796**	**2980**	**3437**	**3733**

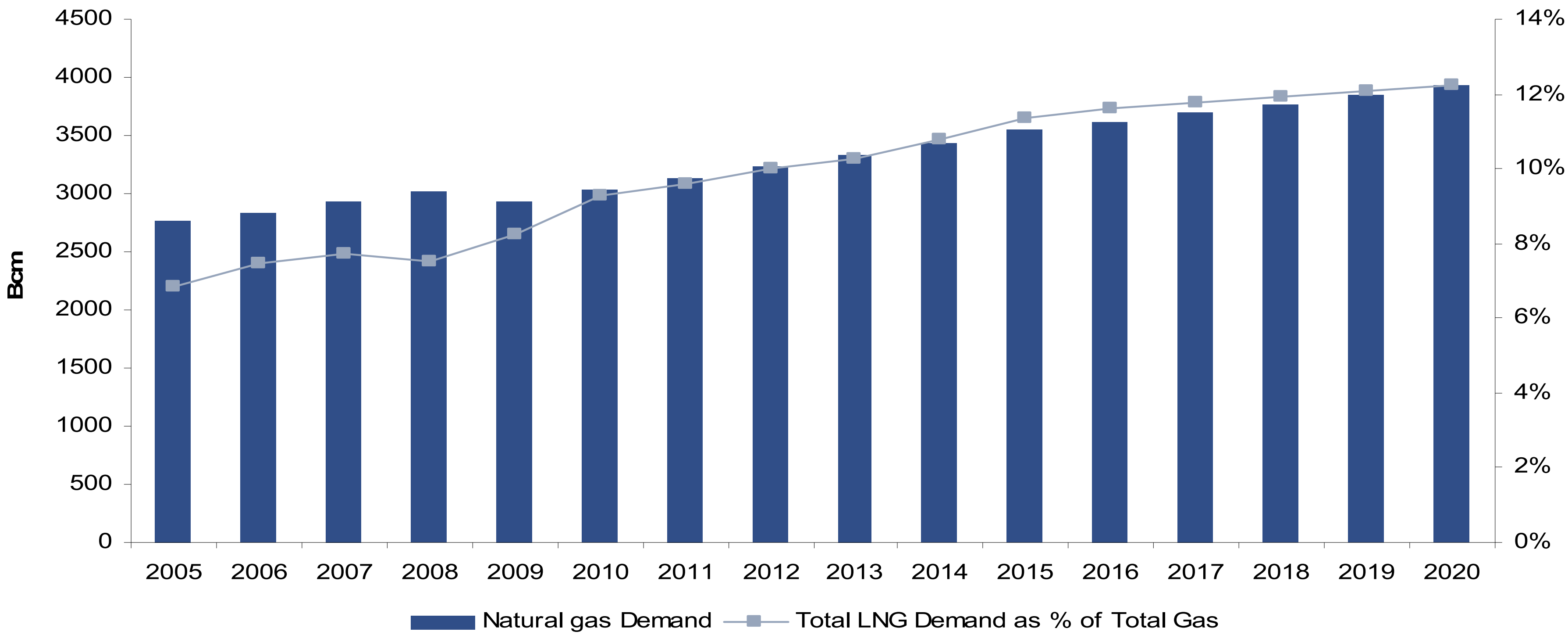
Source: Citi Investment Research and Analysis, BP stats review, IEA

Figure 5. Gas price forecasts

		2008	2009	2010	2011e	2012e	2013e	2104e	2015e
Brent Oil Price	($/bbl)	97.4	61.6	79.3	85.0	90.0	90.0	80.0	80.0
JCC	($/boe)	101.5	60.2	78.3	84.0	89.0	89.0	79.0	79.0
US gas price	$/mcf	8.9	4.0	4.6	4.3	5.5	5.5	5.5	5.5
Russian Export price to Europe	($/mcm)	411	271	300	340	350	360	350	340
UK NBP	($/mmbtu)	11.4	5.0	6.2	7.3	8.2	8.2	8.2	8.2
European LNG import price	($/mmbtu)	16.9	10.1	10.2	9.5	10.0	10.0	9.0	9.0
Japanese LNG import price	($/mmbtu)	12.5	8.9	10.8	13.8	14.5	14.5	13.0	13.0

Source: Citi Investment Research and Analysis

Figure 6. Global gas demand -BCM



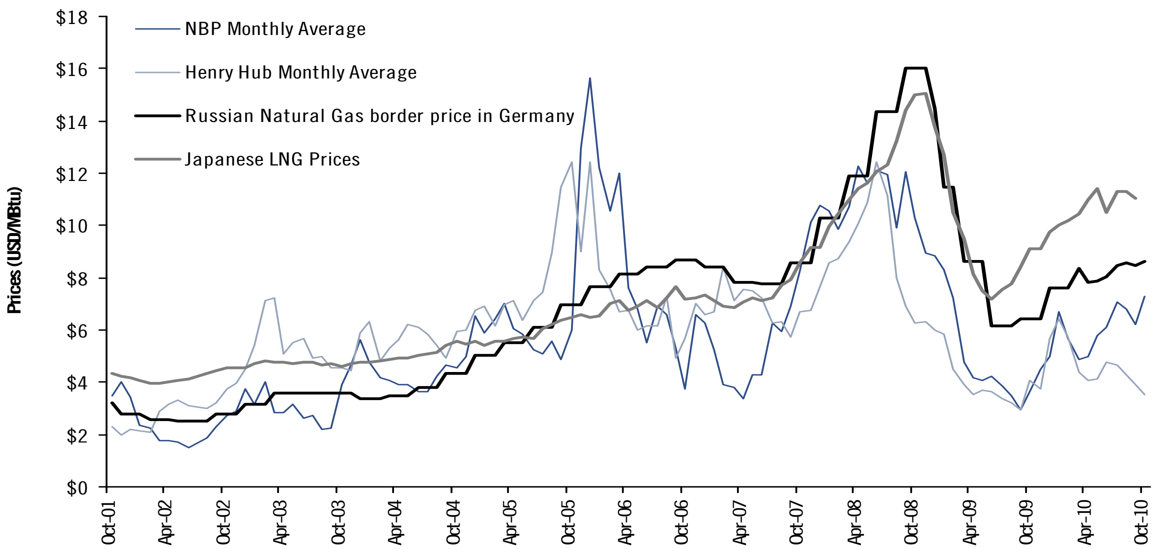
Source: Citi Investment Research and Analysis, BP stats review, IEA

Global gas – interconnected but separate markets

2010 continues to support the thesis that the global natural gas market is at best three regional but connected markets. Figure 7 below shows the price differentials across the global gas market. The chart shows the indicator prices for the US (Henry Hub), European contract price (approximated by Russian contract border price with Germany), European spot price (approximated by UK NBP) and Japanese LNG price. Globally prices were on an upward trend between 2001 and 2007, driven by increasing energy demand. The precipitous price fall in 2008 in response to a retreat in energy demand hides subtle different factors at work in each market. Spot prices in the US and Europe fell early in 2008, contract prices linked to lagged oil price, responded later in 2008. The US gas price was impacted by increased indigenous gas supply (non-conventional) as much as demand destruction. European spot gas prices were led by the US through 2008 and 2009, since the clearing price for 'flexible' LNG was the deep and fungible US spot market. Displaced in the US by relatively cheap non-conventional gas, that LNG found its way into the European markets. As surplus LNG has been soaked up by recovering demand, European spot prices have risen as can be seen by the closing of the differential between spot and contract gas in Europe.

The pressure of the 2008/9 market surplus had led to fears that contract pricing would be abandoned in favour of spot pricing. However, while spot markets are ideal for clearing surplus market they are not the mechanism for solving deficits. Figure 8 below illustrates that spot markets effectively account for only 30% of gas market transactions globally. Long term contracts are required to support import projects, particularly when gas has to be shipped over long distances. Contract pricing remains robust and the preferred mechanism in Asia and while there has been some near term renegotiation of contracts in Europe contract pricing remains the basis for around 85% of Gazprom's European export volumes, with that proportion likely to rise over time if gas is to be encouraged from the Yamal peninsular to industrialized Europe.

Figure 7. International gas prices have moved in different directions in 2010



Source: Citi Investment Research and Analysis, ICE, Bloomberg, IMF

The current market structure of higher prices as we move further east across the globe is determined by local energy market characteristics, and is unlikely to change in our view. US prices are set by the cost of indigenous supply (c$4-6/mcf) while Asian consumers bear prices of c$13/mcf, relying on imported gas on term contracts (for security of supply reasons), indexed to oil price (as the most immediate energy substitute). European spot prices are in the middle of that range, with contact prices set by the economics of Russian pipeline imports and spot prices buffeted between competition for LNG molecules with Far eastern consumers and a floor set for flexible cargoes by the US market. The global market is reliant on relatively few suppliers for international trade. Figure 9 below illustrates that the international gas trade is extremely concentrated, with 5 countries exporting 70% of the world's pipeline gas and the Top 5 LNG exporters representing 60% of that trade.

Figure 8. Spot pricing is NOT the dominant mechanism for gas pricing globally - (wholesale gas transactions by region, 2007 (%))

	Gas- to -gas competition	Oil-price indexation	Bilateral monopoly	Netback from final product	Regulation-cost of service	Regulation-social/ political	Regulation-below cost
North America	99%	0%	0%	0%	0%	0%	0%
Europe	22%	72%	2%	0%	0%	3%	0%
Pacific	16%	52%	8%	0%	3%	19%	0%
FSU	1%	0%	24%	0%	0%	2%	73%
Asia	8%	20%	5%	11%	8%	48%	0%
Middle East	0%	0%	3%	0%	0%	14%	80%
Africa	0%	5%	0%	1%	30%	9%	54%
Latin America	3%	12%	11%	0%	19%	5%	3%
World	33%	20%	8%	1%	3%	9%	26%

Source: Citi Investment Research and Analysis, IEA

Figure 9. Gas Production and Export are extremely concentrated (2009 TCM)

2009 (Tcm)	Production		Pipeline Export		LNG Export	
1	United States	593	Russia	176	Qatar	49
2	Russia	528	Norway	96	Malaysia	30
3	Canada	161	Canada	92	Indonesia	26
4	Iran	131	Netherlands	50	Australia	24
5	Norway	104	Algeria	32	Algeria	21
6	Qatar	89	US	29	Trinidad & Tobago	20
7	China	85	Qatar	19	Nigeria	16
8	Algeria	81	Turkmenistan	17	Egypt	13
9	Indonesia	72	Uzbekistan	16	Oman	12
10	Uzbekistan	64	Germany	13	Brunei	9
Total		**1909**		**539**		**219**
Top 5		52%		70%		62%

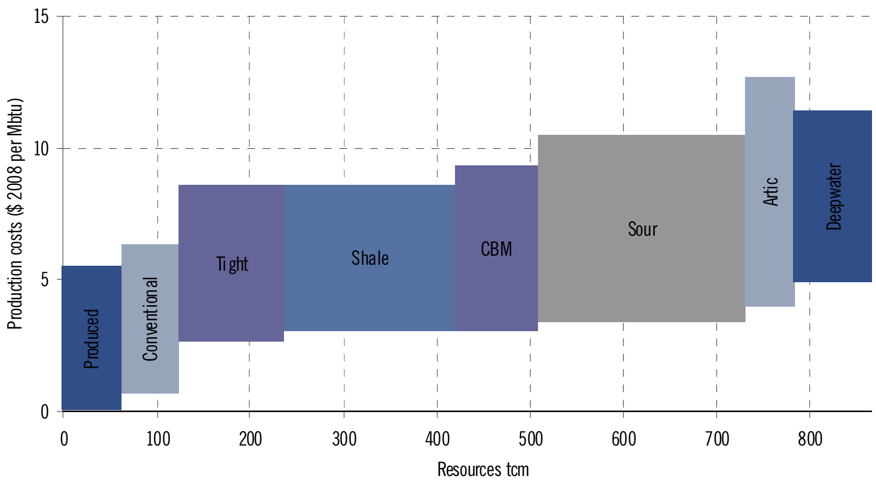
Source: Citi Investment Research and Analysis, BP stats review

Global Gas Supply

The global supply curve for natural gas depends not only on the cost of resource but also on distance of resource from market. As gas has to travel increasingly further, supply costs inevitably increase. Ex the USA, gas is increasingly required from more remote locations.

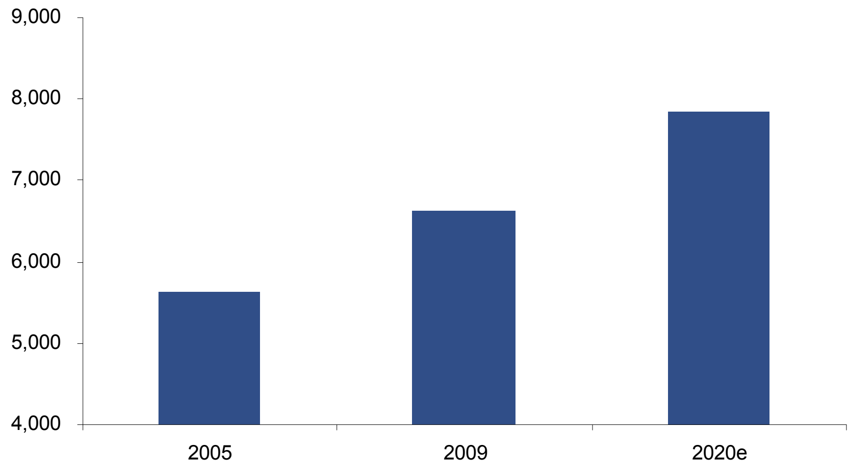
Figure 10 below shows the IEA's estimation of the long term gas supply curve for different types of gas, implying 3-400 years of supply from gas with a supply cost below $9/mcf. However, the other important overlay is distance from market. The proximity of gas to market and the cost of infrastructure to get gas to market are an important and expensive component in gas economics. As more gas has to be moved over longer distances to reach consumption centers, whether that is gas from Yamal to Europe or Qatari gas to China, the cost of transportation becomes an increasing burden. The average mileage travelled by a unit of LNG increased by 18% between 2009 and 2005. We estimate that those miles travelled will increase by another 18% to an average 7,800 miles per Bcm moved by 2020.

Figure 10. IEA estimate of long term gas supply cost curve



Source: Citi Investment Research and Analysis, IEA

Figure 11. Average miles travelled per Bcm of LNG increased 18% 2005-09



Source: Citi Investment Research and Analysis, BP stats review

The most contentious marginal sources of gas are LNG and non-conventional. LNG because of its flexibility and the ability it theoretically gives abundant stranded gas to address otherwise non-accessible markets and non-conventional because of its ability to reinvigorate local supply (alla the US). In the following sections we discuss the characteristics of LNG and the supply outlook and the impact non-conventional gas on the US market and potentially beyond

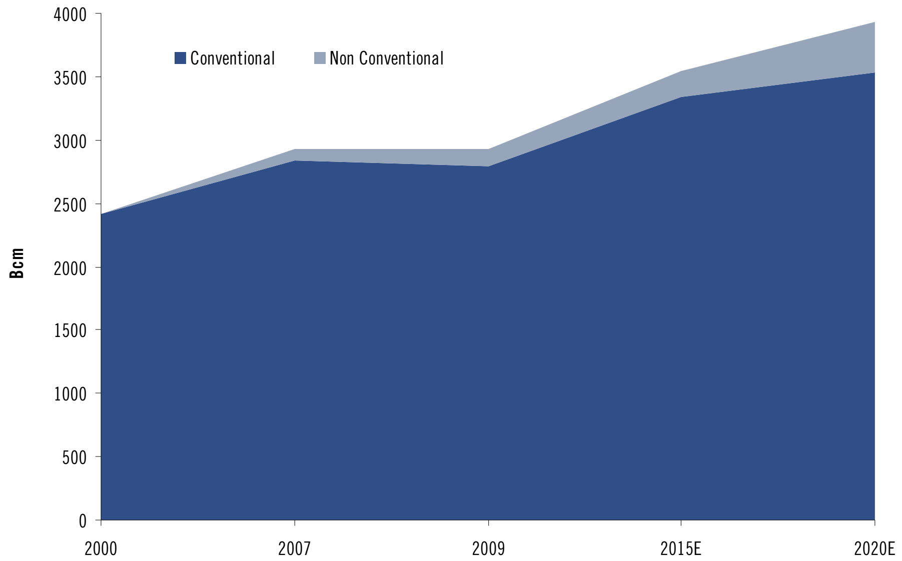
Non-conventional Gas – will Europe and Asia catch the US bug?

Non-Conventional gas has revolutionized the US gas market but is likely to have a negligible impact on European and Asian supply until beyond 2020 in our view. Figure 12 shows that Non conventional gas is estimated to be c10% of global supply by 2020 from almost zero in 2000. However, this production is almost exclusively US and reinforces North America's status increasingly as a gas Island.

Figure 13 shows that shale gas resources are abundant in many parts of the world. Investigation of the potential of European non-conventional geology remains at an early stage, however even if sub-surface feasibility is established, infrastructure issues and permitting present a much bigger obstacle than in the US.

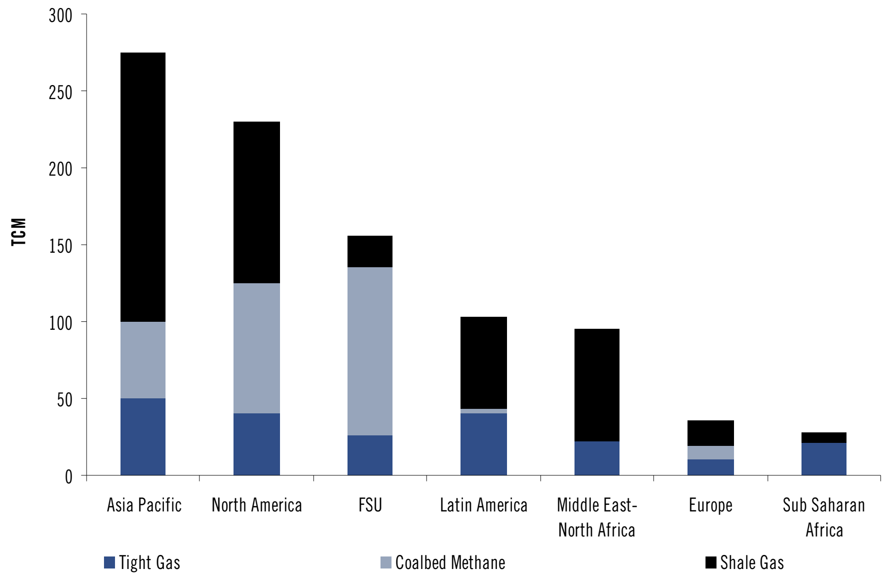
In the Far East, resource is concentrated in China and given the appetite for energy in that market, indigenous shale deposits and CBM are likely to be required alongside conventional piped gas and LNG to satisfy increasing demand (see page 24).

Figure 12. Non Conventional share will be c10%of world natural gas supply by 2020



Source: Citi Investment Research and Analysis, BP stats review

Figure 13. Only US has meaningful production of shale gas though resources are abundant



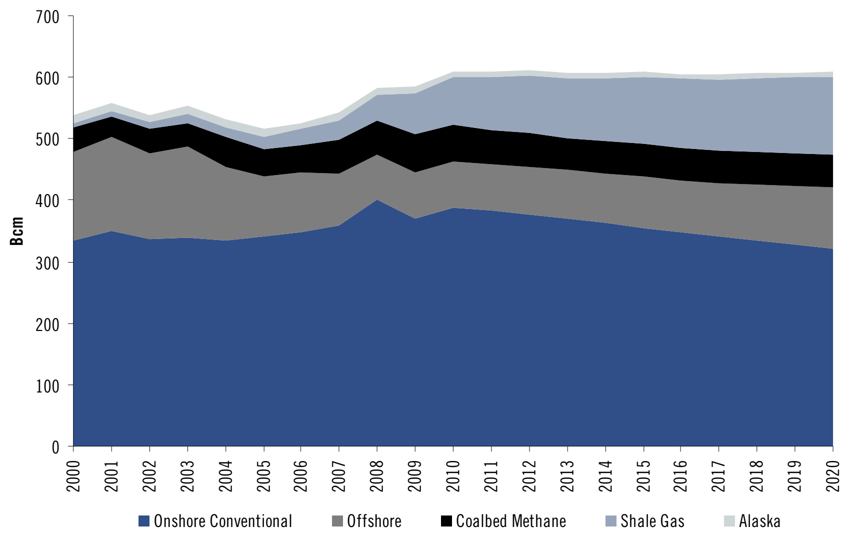
Source: Citi Investment Research and Analysis, IEA

The growth in non-conventional gas in the US has been phenomenal. Figure 14 shows that non conventional gas now account for around one third of supply versus zero in 1990 and that estimated contribution grows as shale gas production marches towards 128bcm in 2020E (Figure 15). Key to the rise in Shale Gas output has been the reduction of costs as producers have gone further down the experience curve. Increased drilling activity has seen US non conventional reserves more than treble between 2006 and 2008. The cost of Shale varies widely dependent upon water management, fiscal conditions and environmental regulations but more critically the quality and productivity of the play (Figure 16 &17). To achieve a 10% IRR threshold, we estimate that the marginal producer requires less than $6/mmbtu gas realisations, keeping a cap on gas prices in the US. That threshold drops significantly for wet-gas streams where 50% of revenue comes from liquids.

The impact of shale gas has been to make the US once again a virtual gas island. The expectation that a replete US market will set the market price for gas elsewhere in the world is still premature in our view since the infrastructure required to liquefy gas does not exist in the US. Though a number of companies are examining the feasibility of such projects, material gas export via LNG requires resolution of a couple of key issues.

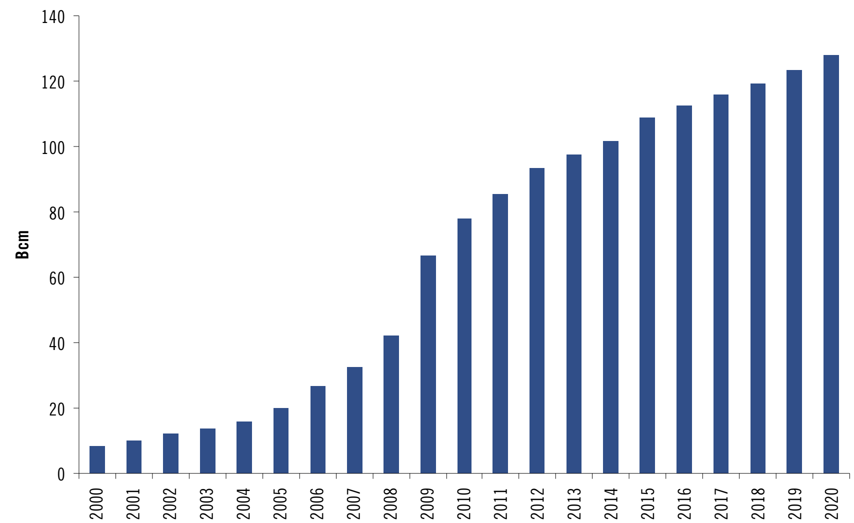
- Cost of transportation and liquefaction for onsale to high demand markets (i.e. the Far East) could add c$2-3/mcf or above for meaningful exports, making US supply competitive for export but not the most competitive.
- Even with an abundance of Shale gas, the US still imports LNG to help manage regional demand stress. Therefore wholesale conversion of re-gasification capacity to liquefaction as a quick and cheap export solution is unrealistic in our view.
- US gas demand could potentially grow more quickly than we forecast, displacing more coal generation or being consumed by Oil Sands projects (which take advantage of the arbitrage in energy cost between gas and oil).

Figure 14. US natgas production forecast



Source: Citi Investment Research and Analysis, EIA

Figure 15. Shale Gas Production



Source: Citi Investment Research and Analysis, EIA

Figure 16. Cost of USA Shale Gas Projects

	Shale Play/State	Supply Cost* ($/Mmbtu)	F&D cost ($/Mcfe)	Royalty (2009)
Jonah	Wyoming	2.90 - 4.00	1.5 - 2.00	21%
Piceance		1.00 - 5.25**	1.0 - 1.90	8%
Fort Worth	Barnett Shale	3.10 - 4.30	1.5	25%
East Texas	Deep Bossier	3.70 - 4.20	1.3	27%
Haynesville	Haynesville	3.75 - 4.45	2.12	21%

Source: Citi Investment Research and Analysis, EnCana company data , * Does not include G&A charges, ** Metrics include funding leveraged through joint ventures

Figure 17. Estimated recoverable natural gas from US shale basins (BCM)

BCM	2006	2008
Barnett	62	97
Wordford	12	17
Fytteville	26	42
Antrim	13	20
Marcellus/Haynesville/Bossier/Southwest Wyoming	102	566
Total	215	742

Source: Citi Investment Research and Analysis, The Federal Energy Regulatory Commission website, derived from the American Clean Skies Foundation, EIA, Baker Hughes

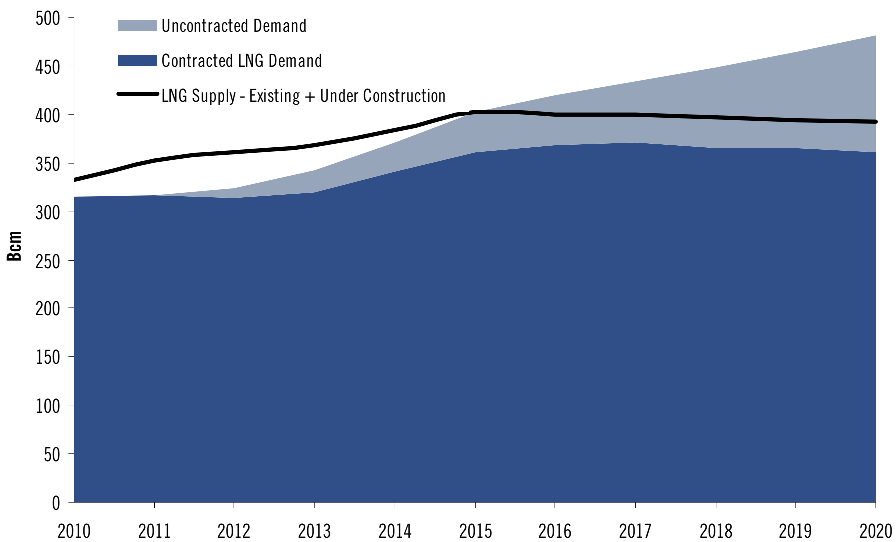
LNG – Surplus or Cushion?

Figure 18 summarises what we believe to be the supply and demand balance for LNG out to 2020, showing contracted demand and likely uncontracted demand based on our estimates of consumption growth and other available gas sources.

Our supply estimate (Figure 19) is based on currently installed capacity and includes only the addition of gas plants with contracts for offtake, peaking at c400bcm in 2015/16. The schedule therefore excludes capacity which is uncontracted and deemed not yet commercial. The balance shows that the uncontracted balance running into 2011 is around 36bcm or 10% of the total LNG market. In the context of the total global gas market, that flexible cushion represents <2% of world demand. In the absence of new capacity that cushion is eroded by 2014. While new capacity is likely to be sanctioned before 2015 with the backstop of customer contracts, no speculative capacity is being built. The important distinction is that any new output will be backed by commensurate demand added to the balance.

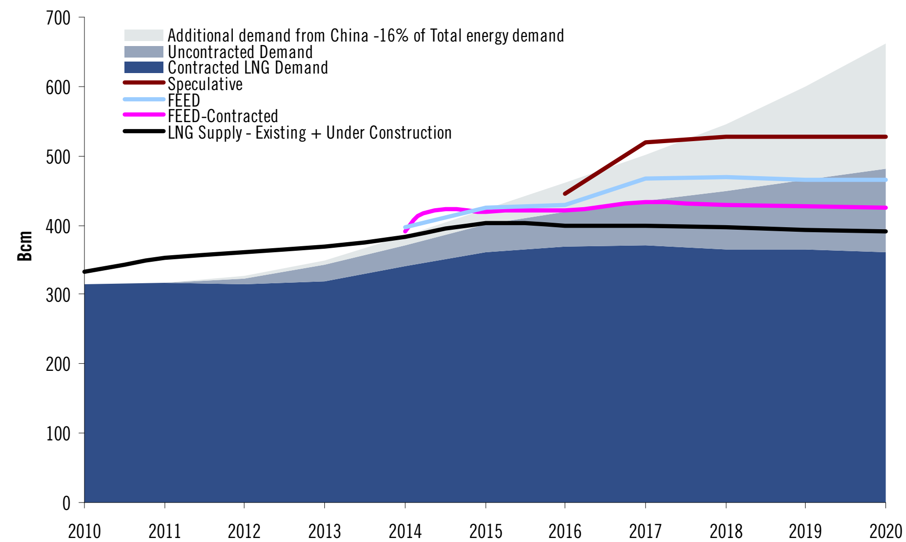
Figure 18 shows the supply schedule if the potential LNG capacity currently mooted in the world (from Nigeria to Australia) were built. To put this in perspective, we also superimpose the possible (though highly fanciful) lift to global demand were China to shift from its current 4% gas in the energy mix to a more globally normal 16%. The effect would be to push LNG demand above 600bcm in which case even the most speculative high cost projects the industry is discussing would be required to cover that demand.

Figure 18. Global LNG Demand compared to contracted Supply



Source: Citi Investment Research and Analysis, Bloomberg, IEA, EIA

Figure 19. The global LNG market by 2020 if known projects are matured and China gas demand shifts up



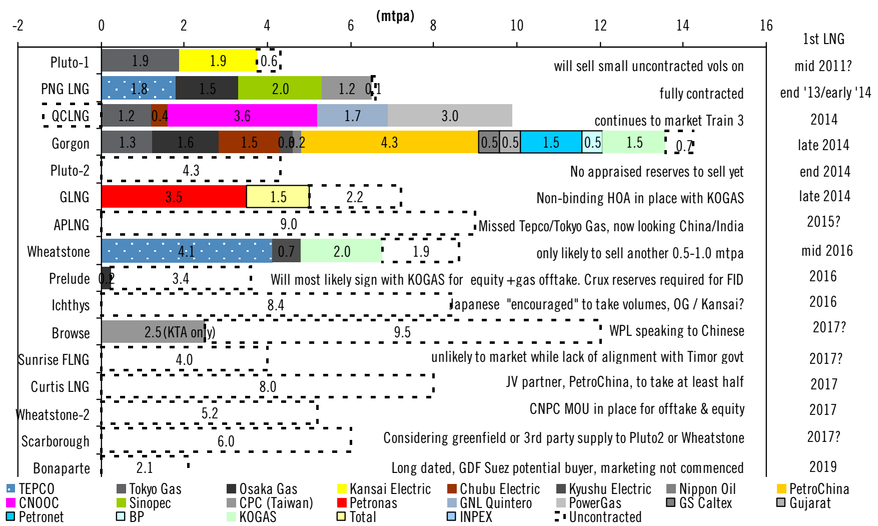
Source: Citi Investment Research and Analysis, Bloomberg, IEA, EIA

LNG – what do we expect to get built in the short term?

While total LNG supply is potentially 520BCM/376mtpa by 2017, many projects have neither contract customers nor FID (Final Investment Decision) and should be therefore treated as contingent. We estimate that of 376mtpa by 2017 only 314mtpa/433BCM have customer contract and therefore should be treated as ‘firm’.

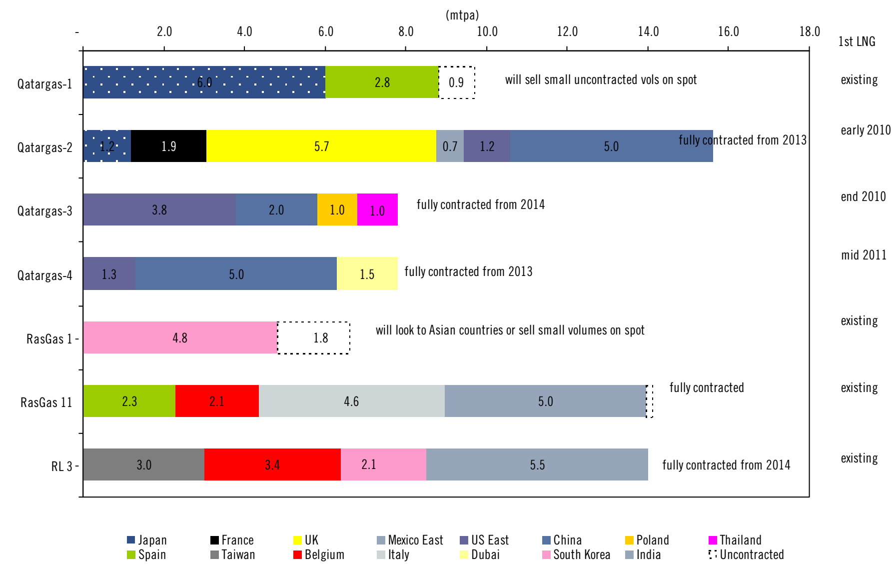
Figures 20 & 21 show our understanding of the contract position for LNG projects in Qatar and Australia. Australia is the region running fastest at the moment to sanction new supply and adding to fears that a surplus of flexible gas will be created. Qatar is essentially the Saudi Arabia of LNG given its abundant resource and advantaged resource cost. Figure 20 shows that while there is a proliferation of projects in Australia only a handful (Pluto, PNG, QCLNG, Wheatstone and Gorgon) have enough contract coverage to justify moving ahead in our view. Projects like Icthys, APLNG, Browse, Curtis LNG and the second stages of Pluto and Wheatstone look speculative and, for this analysis at least, we have not considered them as part of supply until new demand contracts are signed.

Figure 20. Australia LNG projects (mtpa)



Source: Citi Investment Research and Analysis, Company fillings

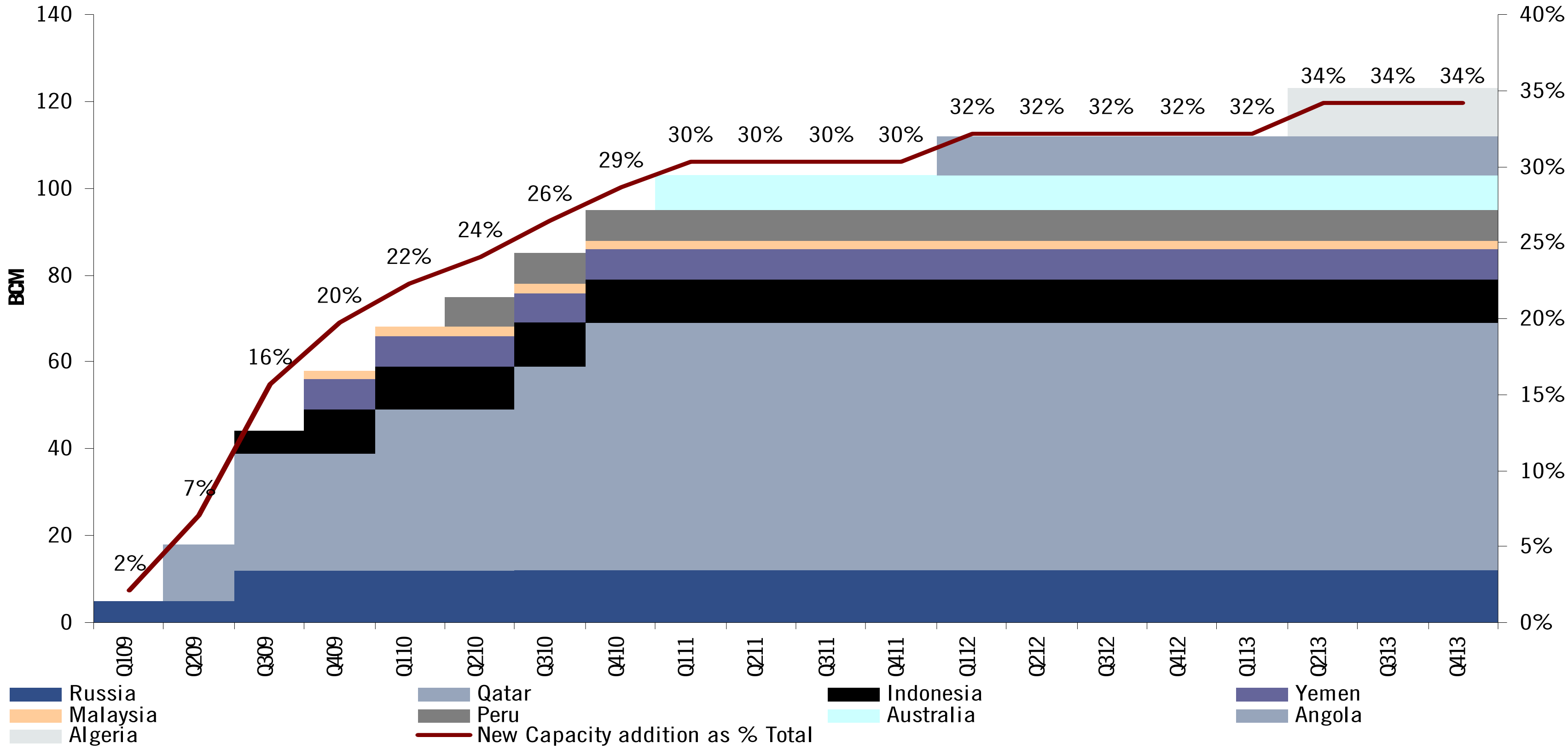
Figure 21. Qatar LNG projects (mtpa)



Source: Citi Investment Research and Analysis, company filings

Figure 21 shows the contract cover for Qatar, illustrating that while Qatargas-1 and Rasgas-1 retain around 1.5mtpa of flexibility, the vast majority of Qatari gas is contracted by 2017. The approach of Qatar has been to construct LNG capacity against contracted volume, but to leave a window between first output and contract inauguration. Figure 22 shows our understanding of new LNG capacity coming onstream to 2015, with the expectation that capacity will have increased by around one-third between 2009 and 2015. The majority of that new capacity (representing one quarter of world supply) comes from Qatar alone. The policy of that country has been to bring new capacity onstream before contract date to avoid the risk of non-delivery, but the ramp up in supply combined with demand dislocation has been one of the root causes of market uncertainty.

Figure 22. New LNG projects coming onstream



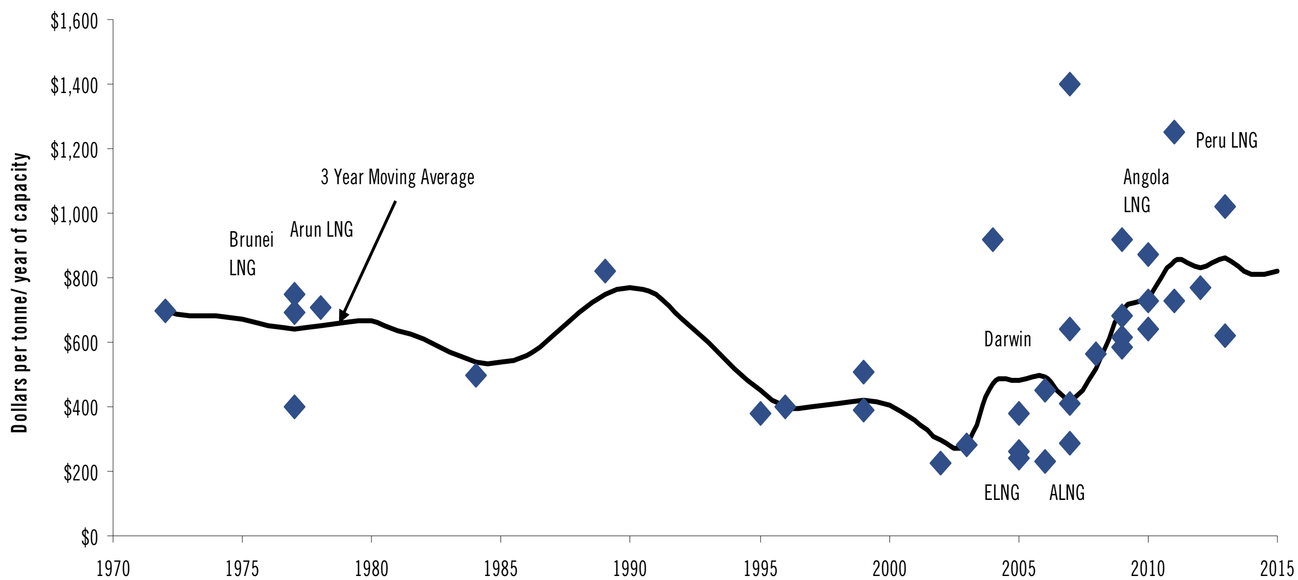
Source: Citi Investment Research and Analysis, IEA

Independent of the resource cost, the cost of new LNG capacity is increasing making the commercial outlook more uncertain. Figure 23 shows the progression of liquefaction costs over time.

In the 1970's liquefaction costs were c$700mn per ton of annual capacity. Moving along the experience curve coupled with technology developments meant that costs bottomed in the mid-2000s when costs reached $200m per ton of annual throughput. Development in more challenging locations and inflation in material and labour costs mean that current projects should be based on a rough assessment of $1bn per annual ton of capacity, 5x trough.

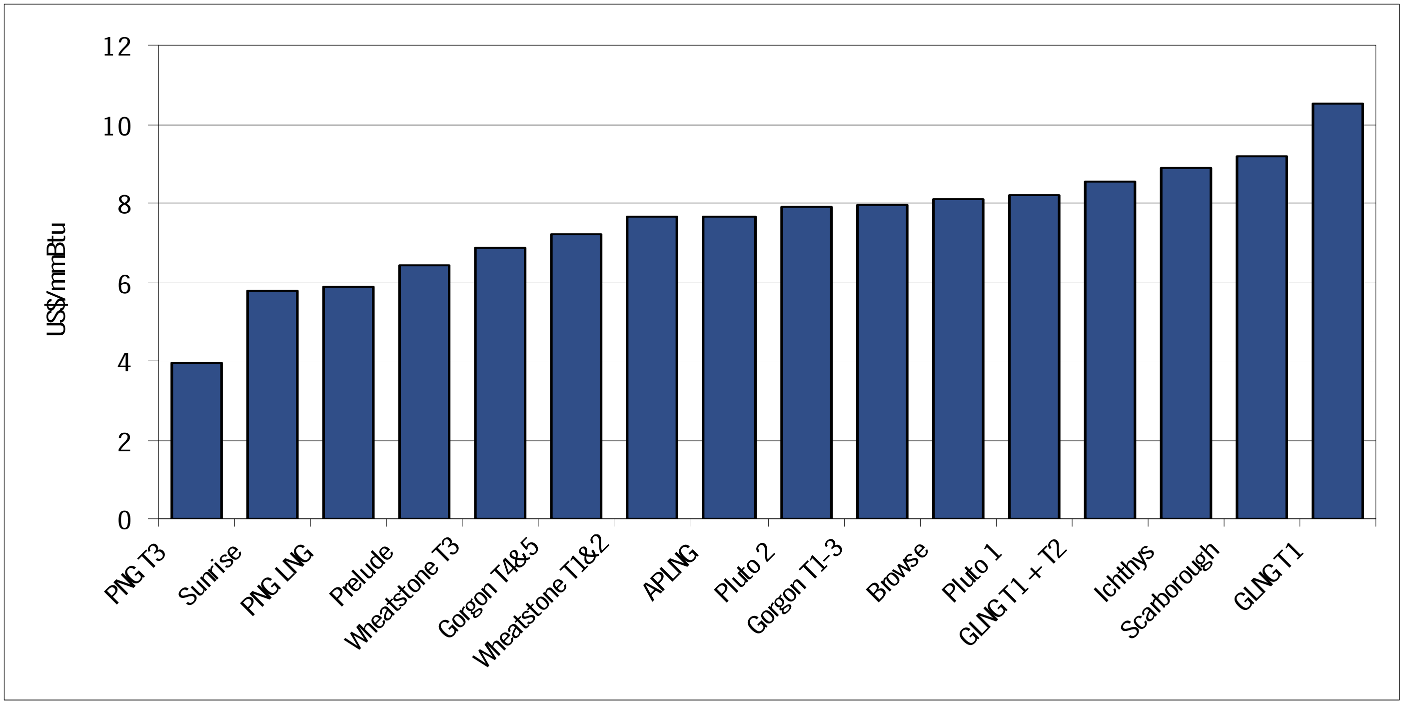
Figure 24 shows our estimate of break even costs for a selection of the most high profile LNG developments in the industry. The chart shows that most projects need less than $10/mcf net back to the plant to return 10% on investment. These project economics include the benefits of any associated liquids stream and therefore, for example, Qatari projects theoretically break-even even with a gas contribution of zero. Political risk considerations may mean that the required return in countries like Nigeria is likely to be higher than 10%, but nevertheless demonstrated that these projects are not viable at US Henry Hub pricing by our estimates.

Figure 23. LNG cost over time



Source: Citi Investment Research and Analysis, IEA

Figure 24. LNG Projects breakeven price- $/mmbtu



Source: Citi Investment Research and Analysis

Despite what appears to be attractive economics, these projects still need contracts indexed to oil price to make them work. Producers will not expose themselves to projects with total costs of >$10bn and a 30 year revenue stream without price certainty. Customers, particularly in the Far East, relying on LNG supply for base load gas need volume certainty and therefore a long term contract for volume and price is required. The status quo continues to be price indexation to oil and oil products. For customers, oil price indexation is attractive since it gives some hedging against substitute fuels – in the case of Japan, Korea etc oil product imports. For producer's oil or oil product price indexation has the attraction that LNG projects compete for scarce capital with oil projects and therefore reduces disadvantage.

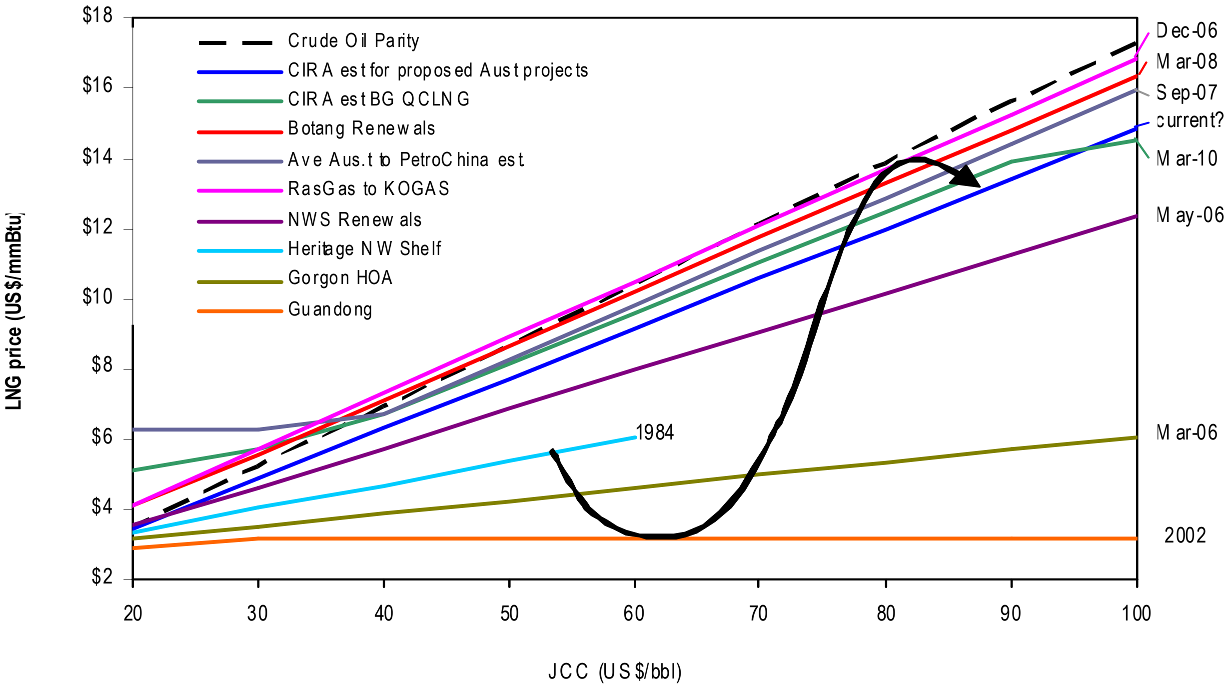
In the absence of a workable alternative, oil price indexation remains the dominant pricing mechanism for LNG in Asia, and therefore the rest of the world. Figure 25 shows recent Far Eastern LNG pricing agreements, as estimated by CIRA. More recent contracts are more likely to have an 'S' rather than a straight line relationship, with the gradient becoming more modest below $40/bbl oil and above $90/bbl.

It is also clear that more recent pricing has been at a larger discount to oil price than was negotiated in the middle of the last decade. Asian gas customers are aware that they face an array of sellers and are understandably bidding more aggressively on price. In 2007 and 2008 contracts were signed with a contract slope of 0.16-0.165 to Japanese Crude Cocktail (JCC) close to oil price parity. Most of the conventional LNG sold in 2009 and early 2010 (PNGLNG, Gorgon, Wheatstone) has been contracted at 0.1485 (c10% discount to oil price equivalence) and none have been signed at less than 0.14 (c15% discount to oil price equivalence). However, linkage remains to oil or oil product pricing because it is the least risk approach for both buyers and sellers.

Qatar dominate LNG supply and their behaviour is key to market stability. With capacity of c80mtpa growing to over 100mtpa by 2012, Qatar supplies around 30% of the global LNG market. From a cost perspective the fact that the gas stream is rich in liquids means that projects are commercial at almost zero gas price making Qatar difficult to compete with on resource cost. Nevertheless, for long term contract purposes Qatar has been resolute with Asian customers, indicating that they will not drop below 90% oil price gearing.

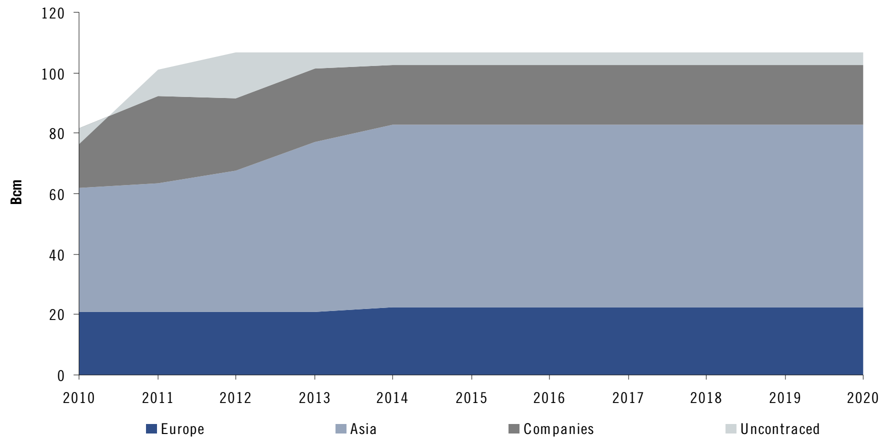
Following a frenetic build out in capacity over the past decade, Qatar has a moratorium on new projects beyond QatarGas-4, and therefore is not scheduled to deliver incremental gas to market after 2014. A change in that policy presents a fundamental risk to higher cost LNG producers.

Figure 25. Rumors of the death of Oil related contract pricing are premature in our view…Asia still relies on Oil price indexation



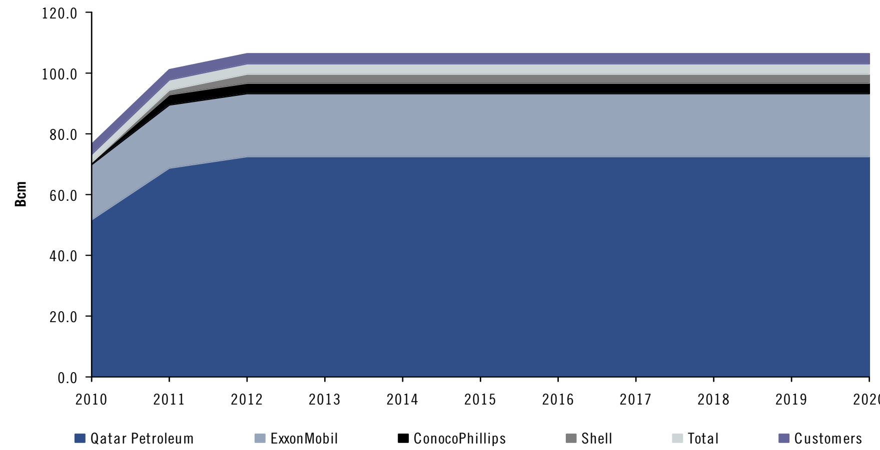
Source: Citi Investment Research and Analysis , company filings

Figure 26. Qatar LNG supply estimates



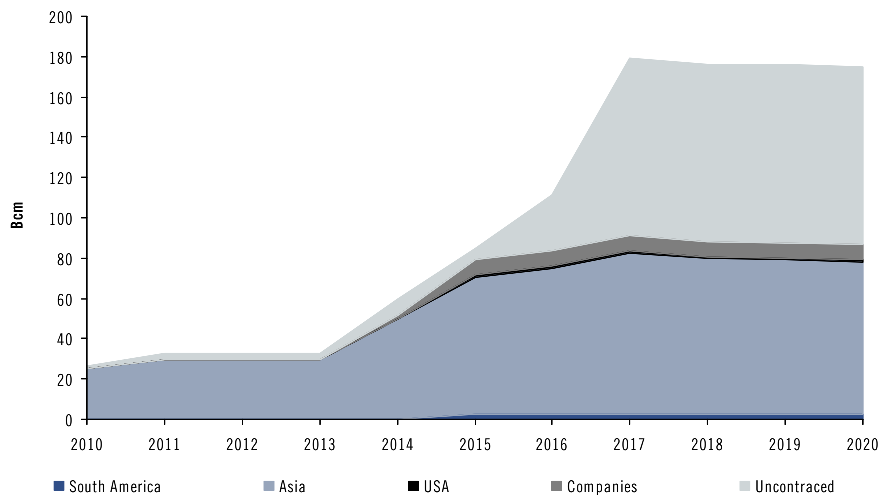
Source: Citi Investment Research and Analysis

Figure 27. Qatar supply by company



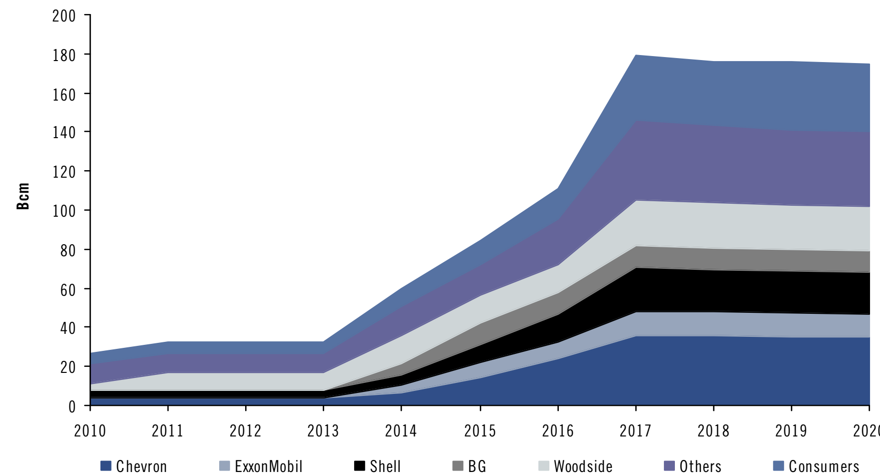
Source: Citi Investment Research and Analysis

Figure 28. Australian LNG supply estimates



Source: Citi Investment Research and Analysis

Figure 29. Australia supply by company

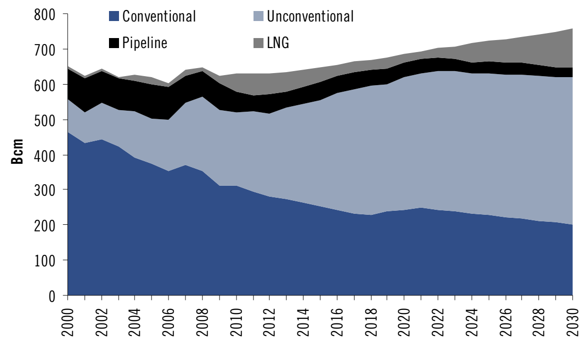


Source: Citi Investment Research and Analysis

Demand – growth to continue but is region specific

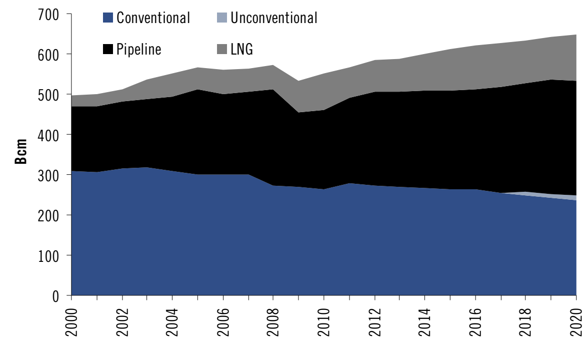
The demand outlook for gas remains extremely strong compared to other hydrocarbon fuels. The CIRA expectation is that global gas demand increases from 2.9TCM pa in 2009 at a cagr of 3% to 3.9TCM to 2020. Figures 30 to 32 shows the long term expectation for natural gas demand as predicted by ExxonMobil. The analysis draws a similar growth conclusion out to 2020, though critically breaks demand down regionally. Despite forecast decent growth in US and better in Europe, the real powerhouse of growth is Asia. In 2000 US gas consumption was 650bcm, Europe c 500bcm and Asia Pacific 300bcm. According to the Exxon estimates by 2030 US demand is forecast to be c750bcm, Europe c680bcm and for Asia Pacific to be the most important demand geography at c800bcm.

Figure 30. United States



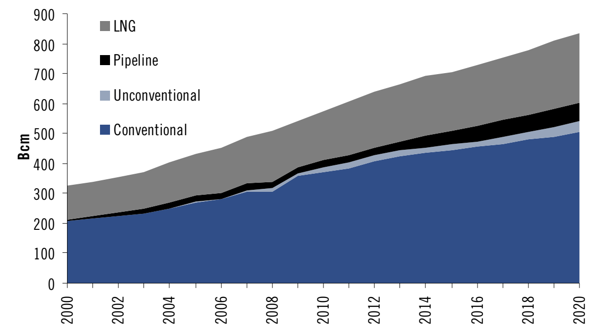
Source: Citi Investment Research and Analysis, Exxon

Figure 31. Europe



Source: Citi Investment Research and Analysis, Exxon

Figure 32. Asia Pacific

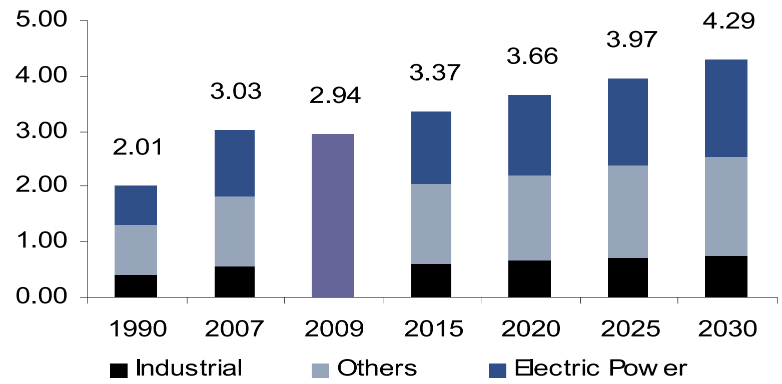


Source: Citi Investment Research and Analysis, Exxon

Carbon intensity is increasingly a determinant of fuel choice. Figure 33 shows the CO2 emissions by fuel type, which shows that gas carbon footprint on per unit basis is c28% lower than coal. The environmental advantage of gas is better illustrated by Figures 35 & 36.

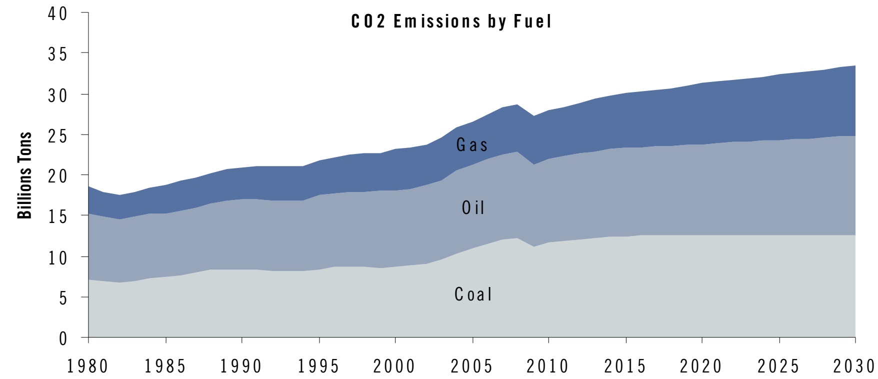
Figure 35 shows the cost of power generation with no carbon cost attached, which clearly makes coal the most advantaged source. However even a $30/ton carbon cost pushes coal generation cost above natural gas. While nuclear and wind are more advantaged as carbon costs increase, widespread political obstacles to nuclear and the unpredictability of wind mean that natural gas should be favoured by energy regulators progressing towards cleaner generation.

Figure 33. Natural gas demand is growing –TCM



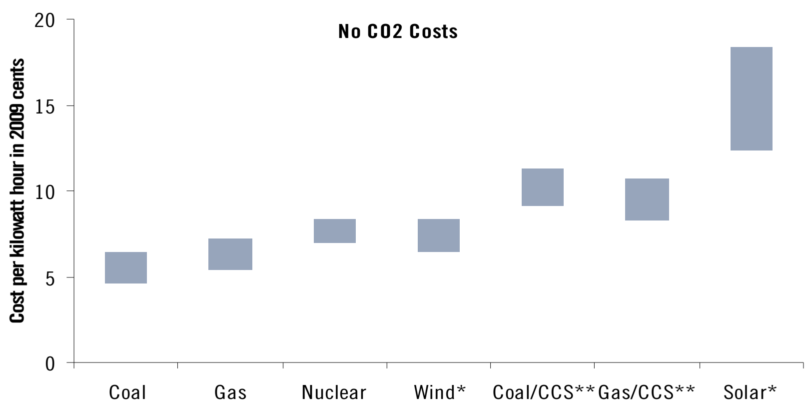
Source: Citi Investment Research & Analysis, IEA, BP stat review

Figure 34. Co2 Emissions by fuel



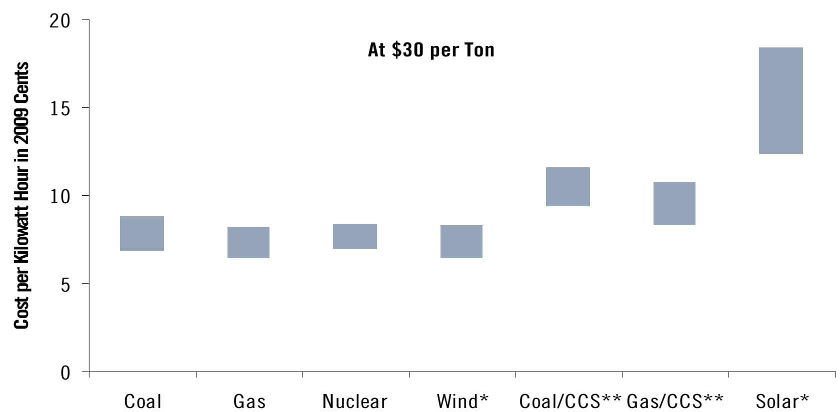
Source: Citi Investment Research and Analysis, ExxonMobil

Figure 35. Power generation cost without carbon emission costs



Source: Citi Investment Research and Analysis, ExxonMobil

Figure 36. Power generation cost with carbon emission at $30 per ton



Source: Citi Investment Research and Analysis, ExxonMobil

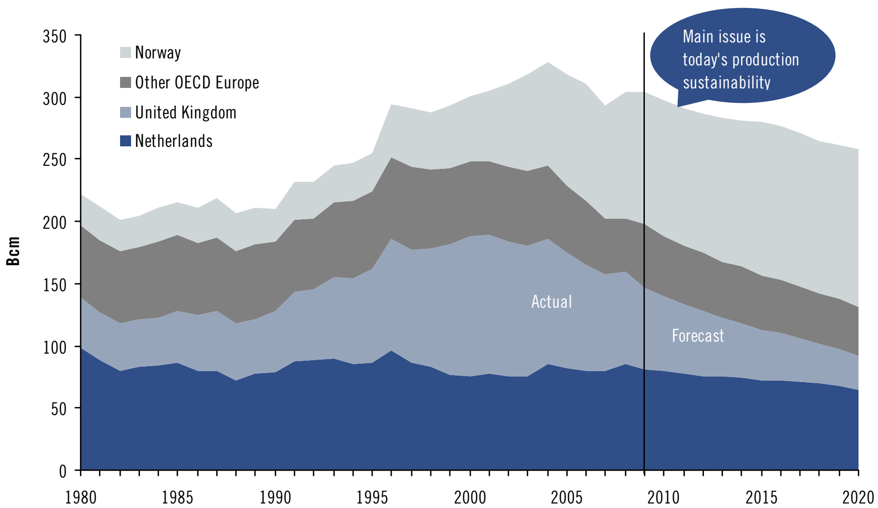
Europe - increasingly dependent on long distance imports to meet demand.

Figure 37shows the IEA forecast of declining European gas output, while Figure 38 shows the organizations prediction that even with c1% underlying demand growth, import requirement will increase from 250bcm in 2007 to 350-400bcm by 2020.

Indigenous European supply has been declining since 2005, ex-Norway. Norwegian supply is not enough to offset production decline in the UK North Sea and Holland beyond 2010 and we see import requirement increasing from c44% in 2009 to c63% by 2020.

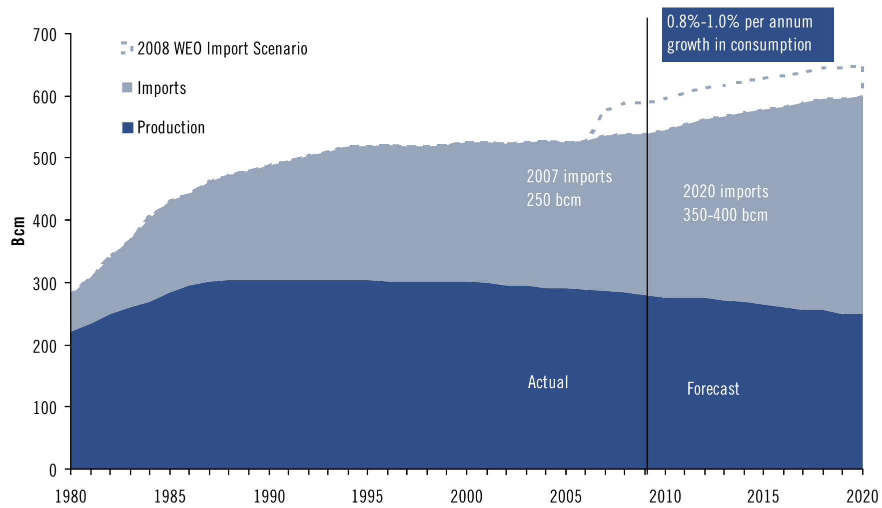
While the UK and Spanish markets in particular should suck in increasing volumes of LNG, east of France and north of the Mediterranean, Europe's most economic source of gas supply remains Russia and Gazprom. The higher LNG volumes consumed in Europe are unlikely to be left completely exposed to spot pricing and market shortage. Base load supply, particularly in a market like the UK which is dependent on gas for 40% of it s primary energy needs, should be contracted with price and volume certainty whether it is LNG or piped gas.

Figure 37. OECD Europe Gas Production



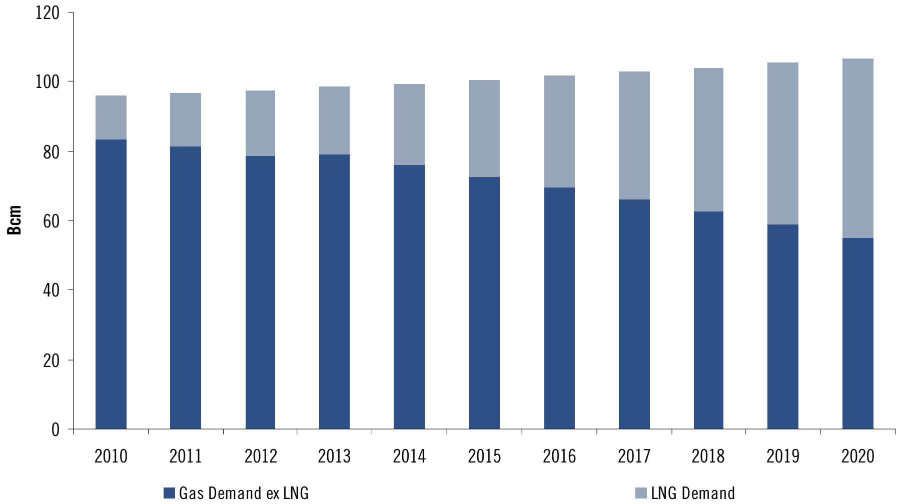
Source: Citi Investment Research and Analysis, BP stats review, IEA

Figure 38. OECD Europe Gas Balance Scenario



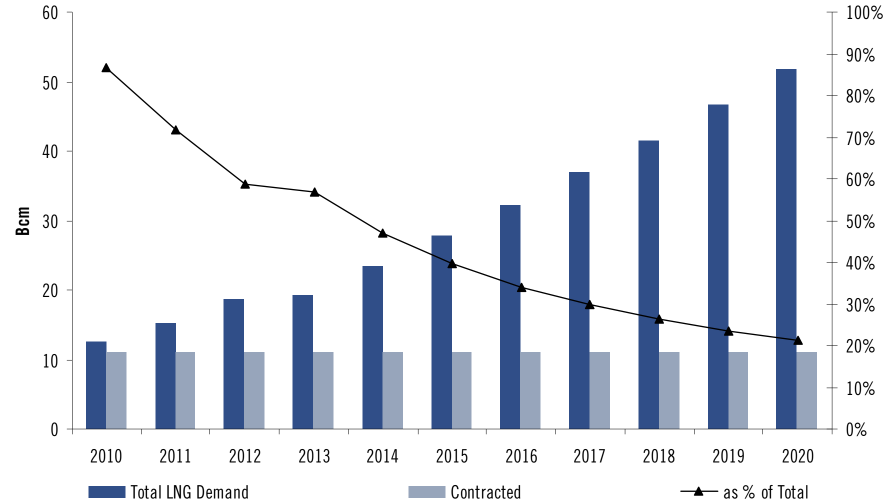
Source: Citi Investment Research and Analysis, BP stats review, IEA

Figure 39. The UK is forecast to become more reliant on LNG for energy…



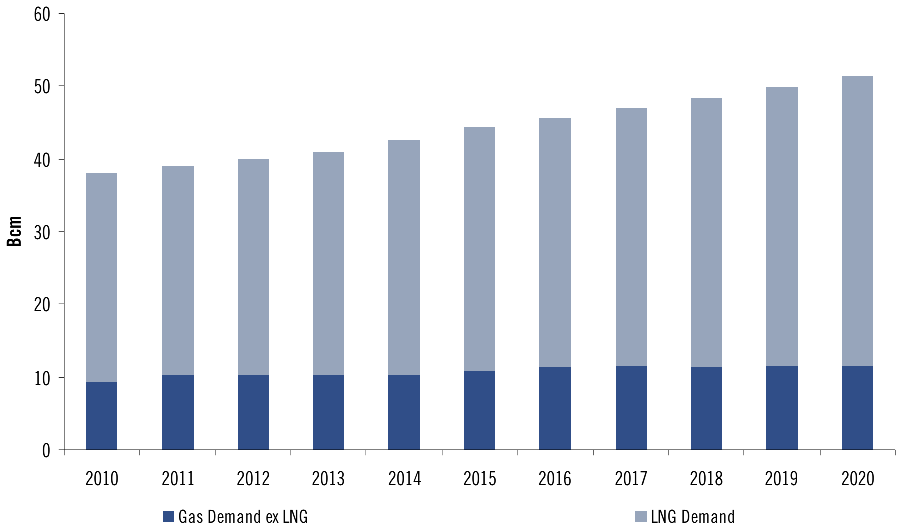
Source: Citi Investment Research and Analysis, IEA

Figure 40. ….but has not yet contracted for that volume



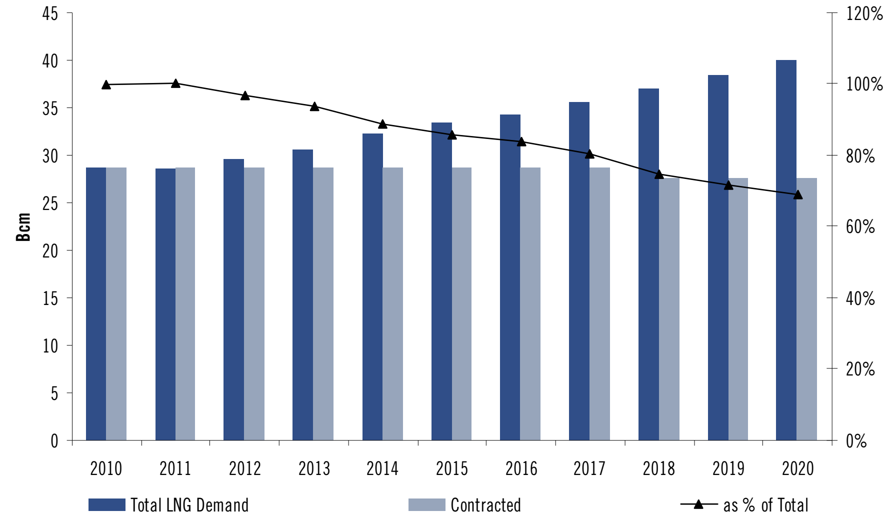
Source: Citi Investment Research and Analysis, IEA

Figure 41. LNG is already a large proportion of Spain's energy supply…



Source: Citi Investment Research and Analysis, IEA

Figure 42. …but is undercontracted



Source: Citi Investment Research and Analysis, IEA

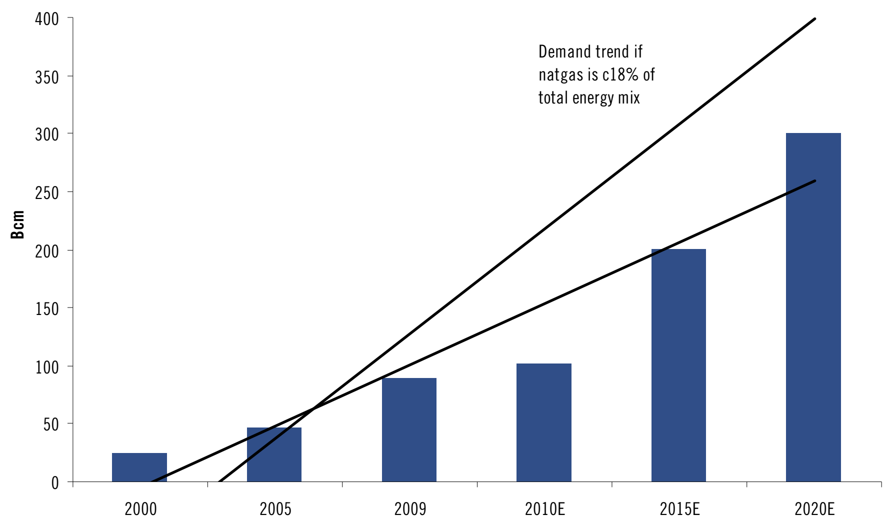
Asian Demand – China's potential to change the global demand picture

Asian and particularly Chinese demand growth are the crucial moving parts to the global gas demand outlook. Figure 43 shows the expectation for Chinese gas demand based on the governments current energy plan, which assumes gas usage grows to c250-300bcm by 2020, from less than 100bcm today, an implied 11.4% cagr.

We anticipate that supply availability is more likely to be a constraint to market growth then demand. Figure 44 shows the sources of supply to meet planned demand, which relies on a large LNG component AND piped gas from Russia and Central Asia. Figure 45 illustrates how little gas represents of Chinese primary Energy demand at c3.8% vs. a global norm closer to 25%. As an illustration of how much a modest in energy policy could have on potential gas demand, figure 43 also shows that if gas moved to c16% of nations mix, demand would be closer to 400bcm by 2020. It should be stressed that this is for illustrative purposes only and at the current time Chinese energy policy does not contemplate such an aggressive policy.

While gas demand growth is a worthy aspiration, natural gas is more expensive than the current base of environmentally unfriendly coal.. Will China pay the price required to consume more gas? While increasing penetration of gas into the energy mix relies on political support, large infrastructure investment and therefore lumpy additions of supply, China does seem willing to pay an appropriate price for gas. Figure 46 shows the city gate gas price paid in the large consumption centers across China, with residential prices ranging from $6/mcf inland to $14/mcf on the coast. Industrial customers pay prices up top $20/mcf in Guangzhou. Such prices are at least in line with prices paid in Europe and above city gate prices in the US.

Figure 43. Natural Gas demand to increase by c11.4% CAGR from 20010-2020E



Source: Citi Investment Research and Analysis, BP Stats review

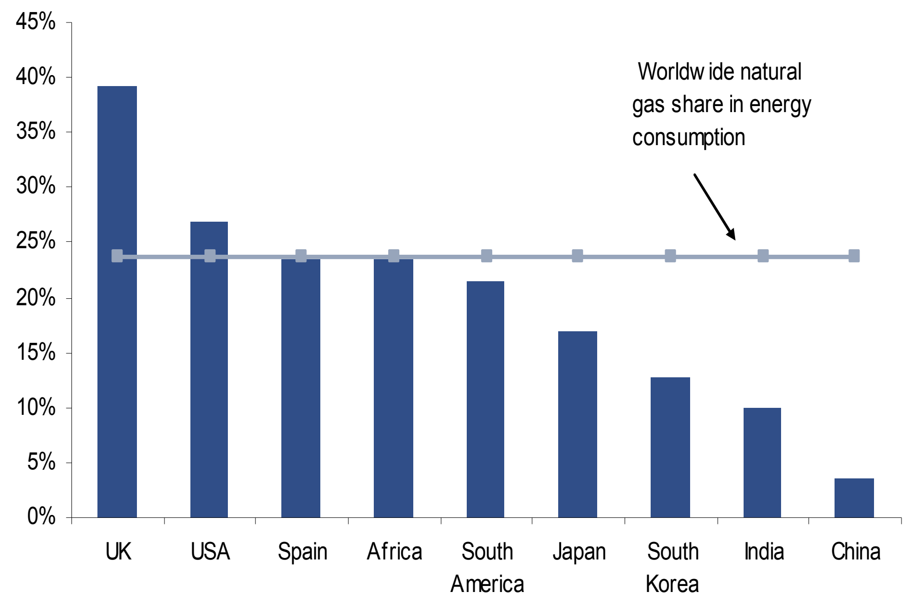
Figure 44. New supply sources include large import component

Rough Sketch of Major Sources of Supply Growth through 2020 (Billion cubic metres p.a.)	
2009 supply	90
Second West-East pipeline	40
Third West to East pipeline	30-50
Sichuan-East Pipeline	12
S. China Sea	20
LNG imports	At least 40
Russian gas*	15-70
Myamar pipeline	5
	250-350

*Up to 70bcm/year according to a preliminary agreement signed in Oct 2009. Pricing has yet to be agreed on.

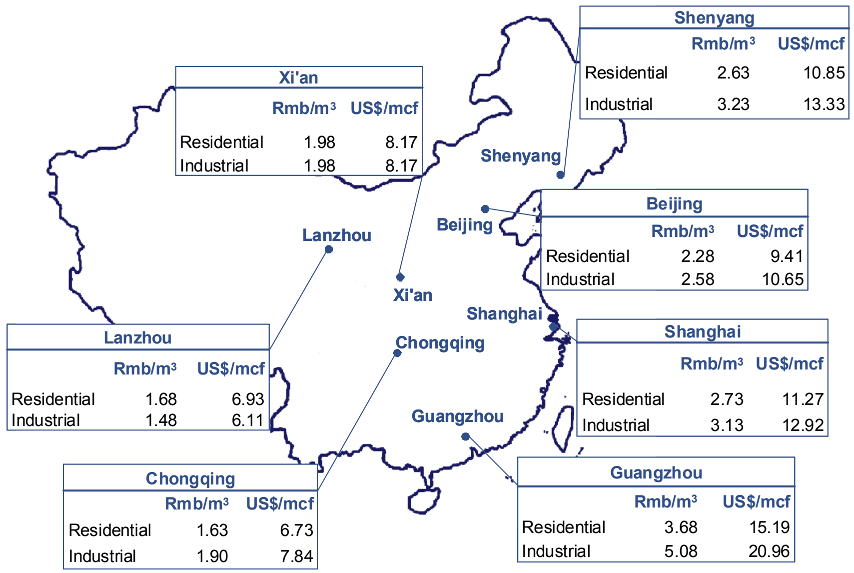
Source: Citi Investment Research and Analysis

Figure 45. Natural gas share in energy consumption -2009



Source: Citi Investment Research and Analysis, BP stats review

Figure 46. China Regional consumption



Source: Citi Investment Research and Analysis, IEA

Natural gas winners

The analysis indicates that the outlook for global natural gas is improving. The gas surplus that became apparent in 2009 is reducing and the market is likely to operate with much reduced flexibility between now and 2015 in our view.

- As in all commodity industries, being as far to the left on the cost curve is what differentiates projects but optionality and flexibility are also key to adding margin, particularly in the LNG business.
- Beyond 2015 the environmental benefits that gas has relative to coal should favour demand growth c3%, though that could accelerate if China shifts energy policy.
- Figure 47 shows that while Gazprom is the most concentrated gas producer globally, even IOC's like Shell, Statoil and BG have 60% or greater of their upstream reserves represented by gas. Virtually all of the majors rely on an increasing proportion of natural gas vs. oil in their production mix.

Figure 47. Large Industry players sorted by gas reserves-1P reserves

	Oil- bn bbls	Gas - Tcf	Total- Bn boe	Gas % of Total Reserves	Total Production (Mn boe/d)	Gas as % of Total production	EV/DACF -2010E	P/E – 2010E
Gazprom#	10	622	117	91%	8.9	92%	4.1	5.5
ExxonMobil	12	68	23	50%	4.4	46%	7.3	11.8
PetroChina	12	63	22	49%	3.3	30%	5.5	12.4
Shell	5.7	49	14	60%	3.3	48%	5.8	10.1
BP	11	45	18	43%	3.9	38%	13.0	5.8
Novatek^	0.5	37	6.9	92%	0.7	83%	22.1	24.2
Rosneft	18	28	23	21%	2.5	9%	5.8	6.8
Total	5.7	26	10	44%	2.3	42%	4.9	8.4
Chevron	7.0	26	11	39%	2.8	31%	4.8	9.2
ConocoPhillips	6.3	24	10	40%	1.8	44%	6.2	10.0
Lukoil	14	22	18	22%	2.2	13%	3.9	5.0
Statoil	2.2	18	5.3	59%	1.7	42%	4.6	9.8
ENI	3.5	18	6.5	47%	1.8	44%	5.1	7.8
BG	0.7	11	2.7	72%	0.7	73%	10.6	16.2
Petrobras	10	11	12	15%	2.6	16%	7.8	9.8
Repsol	0.9	6.7	2.0	57%	0.9	51%	6.0	13.3
Sinopec	2.8	6.7	4.0	29%	1.1	17%	4.4	7.1
Woodside*	0.2	6.6	1.3	88%	0.2	53%	15.5	21.2
CNOOC	1.7	6.0	2.7	38%	0.9	19%	7.2	13.1
Occidental^	2.4	5.2	3.3	27%	0.6	24%	8.7	15.8
Santos*	0.1	3.1	0.6	83%	0.1	78%	7.0	40.5
Hess	1.0	2.8	1.5	33%	0.4	27%	6.0	14.4
Marathon^	0.6	2.7	1.1	43%	0.4	39%	5.1	9.6

Source: Citi Investment Research and Analysis, Company fillings,* Gas and oil split proportionate to 2P reserves,# 2008 reserves numbers, ^ 2008 production numbers

BG – flexible gas

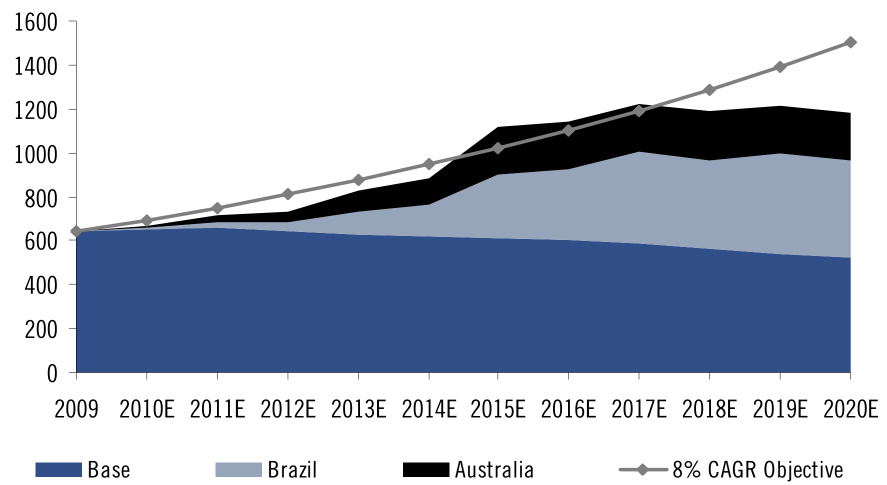
BG remains a key buy in the energy sector. 70% of the company's production and reserves are natural gas, though because of oil price indexation over 60% of production by 2015 is oil price related. We rate BG a Buy (1M) with a £15.00 target price.

- **Growth guidance remains 6-8%** – Production guidance remains at least 6% though the potential for extensions to known extensions and BG's exploration track record mean 8% growth is realistic in our view.

- **LNG business over risked and under appreciated** – BG makes extra margin from 'optimizing' gas deliveries. With 23 importing companies as customers and a portfolio of supply across the globe, BG is perfectly placed to deliver gas to high margin distressed buyers. The group's distinctive business model means that LNG marketing delivers $1.8-2bn of EBIT per year (c25-30%).

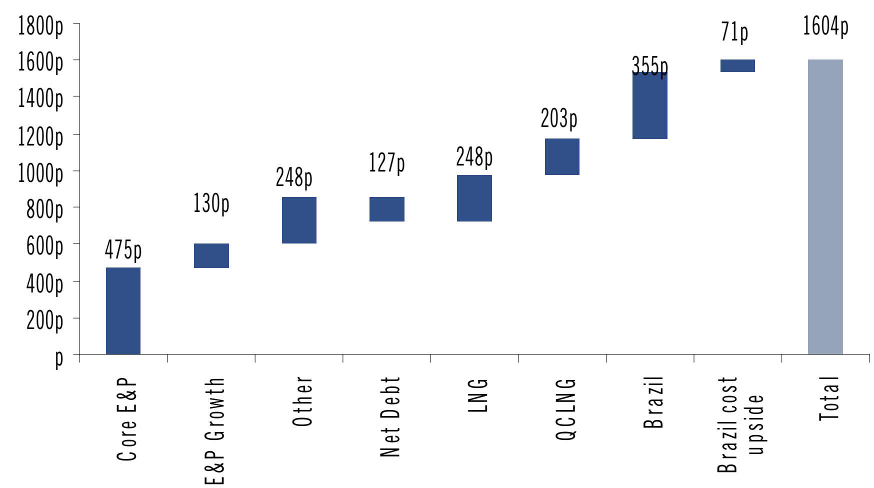
- **Brazil asset revaluation potential** – 23% of BG's resource base is offshore Brazil. Project risk is reducing as operator Petrobras is bringing field's onstream and lower costs are helping increase economic value. The estimated net Brazilian resource of 3.5bnboe was recently upgraded following a re-evaluation of Tupi, Iracema, Iara, Carioca and Guara. Further work on BG' other four fields could yield more upside, while progress on facilities contracting has reduced timing risk, while new cost data suggests the projects are more valuable than we believed.

Figure 48. BG's production (mboe/d) – 6% growth could be 8% with extension projects



Source: Company reports, Citi Investment Research and Analysis

Figure 49. BG-SOTP



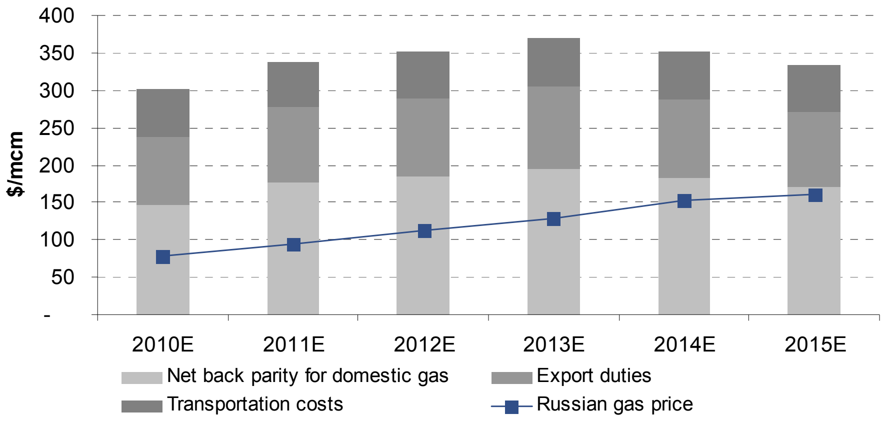
Source: Citi Investment Research and Analysis, company data

Gazprom - the global gas giant

With a reserve base of 117bn boe (90%) gas and as supplier of 25% of Europe's gas, Gazprom occupies a unique position in the gas industry. Increasing demand and competition for the molecules Gazprom produces should improve Gazprom's pricing power. As the LNG cushion deflates and European spot prices recover into 2012 we expect Gazprom to outperform. We rate Gazprom 1M, with a price target of US$8.3/sh.

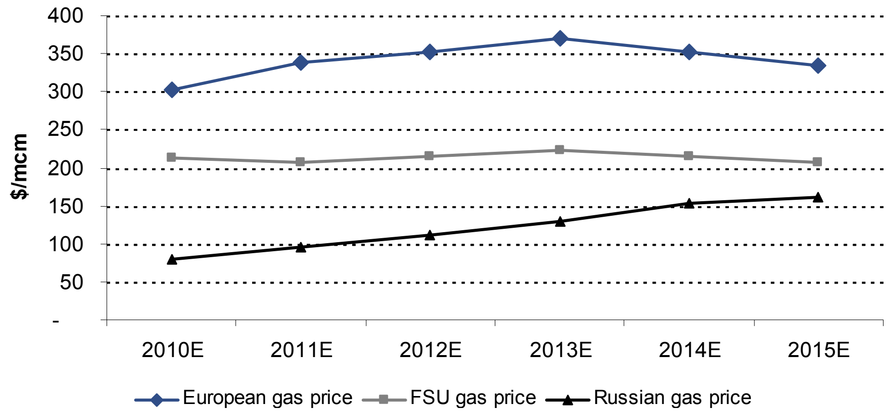
- Domestic gas price liberalization is scheduled to lift domestic prices by around 15% p.a., narrowing the gap of currently 50% between European net back price and Russian domestic gas price by 2016.
- A gas export contract could be signed with China in 2011. China and Russia have an MOU for exports of 30bcm pa and an agreement on pricing is expected by mid 2011. Gazprom will try to index the export price to oil ; China favours coal indexation. If Gazprom is successful the contract would mean an increase in volume sold at lucrative oil-linked price by 20% from 2015, when the Altai pipeline is expected to be completed
- Change in Management – CEO Alexei Miller's contract expires next year presenting an opportunity for debate about strategic direction. Given Gazprom's record on cost efficiency, we believe management change in the company would be perceived as a catalyst for the stock, particularly given the success of restructuring at Rosneft.

Figure 50. Gazprom gas price forecast -$/mcm



Source: Citi Investment Research and Analysis

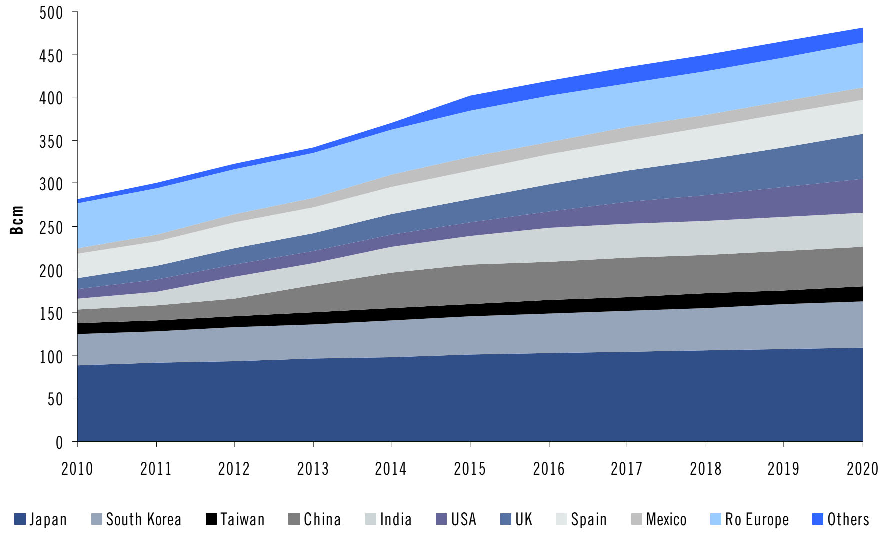
Figure 51. Russia gas price comparison



Source: Citi Investment Research and Analysis

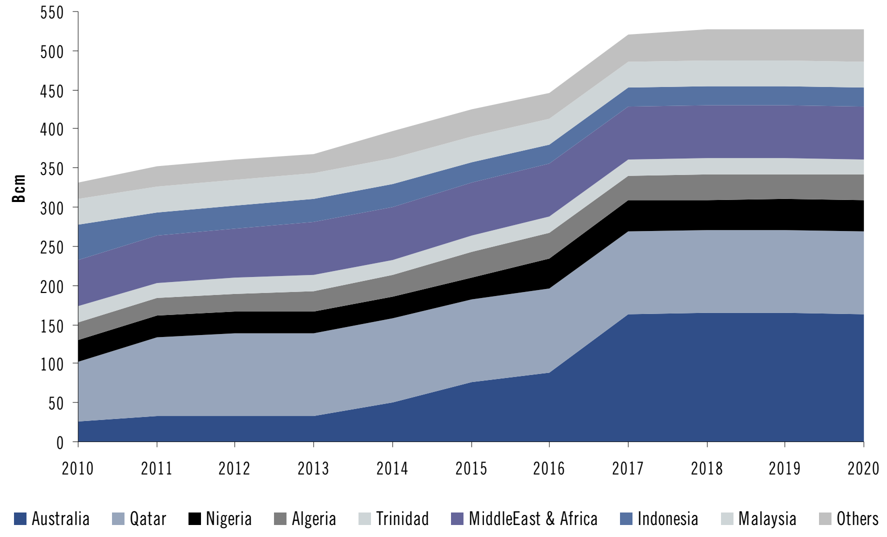
LNG demand and supply by region

Figure 52. LNG demand forecast by country



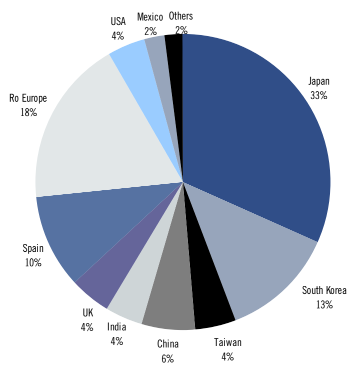
Source: Citi Investment Research and Analysis, IEA

Figure 53. LNG supply forecast by country



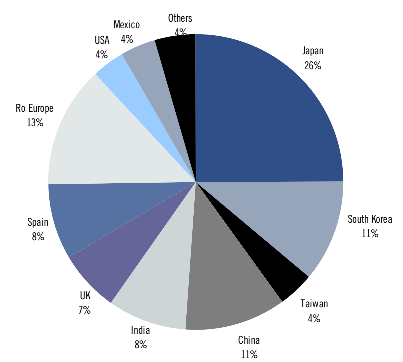
Source: Citi Investment Research and Analysis, IEA

Figure 54. 2010 LNG demand by region



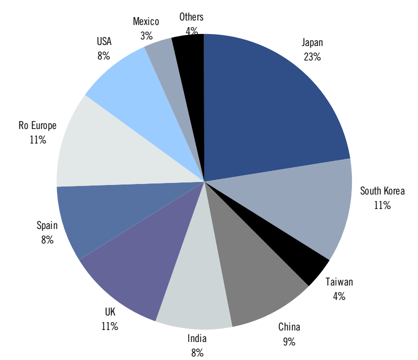
Source: Citi Investment Research and Analysis, IEA

Figure 55. 2015 LNG demand by region



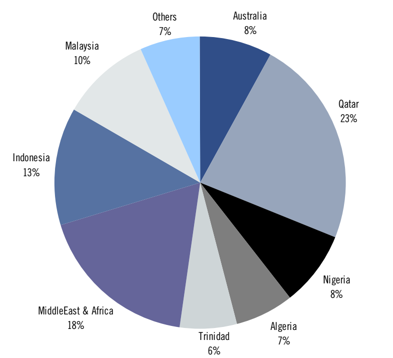
Source: Citi Investment Research and Analysis, IEA

Figure 56. 2020 LNG demand by region



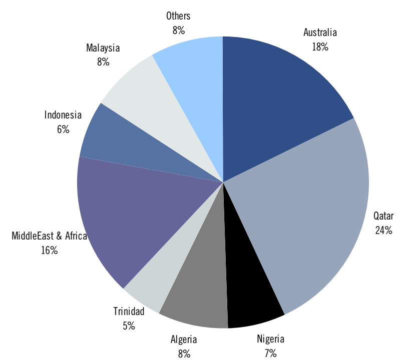
Source: Citi Investment Research and Analysis, IEA

Figure 57. 2010 LNG supply by region



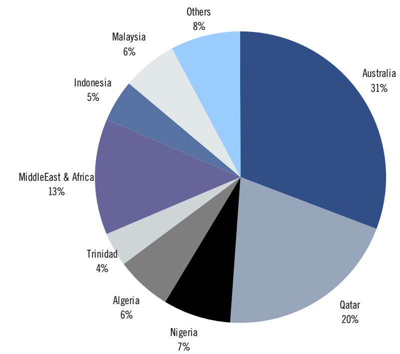
Source: Citi Investment Research and Analysis, company filings

Figure 58. 2015 LNG supply by region



Source: Citi Investment Research and Analysis, company filings

Figure 59. 2020 LNG supply by region



Source: Citi Investment Research and Analysis, company filings

Figure 60. LNG Shipping Cost to key destinations - $/mmbtu

Country		Alaska	Algeria	Australia	Dubai	Egypt	Indonesia	Libya	Nigeria	Norway	Oman	Peru	Qatar	Trinidad and Tobago
	Port/Liquefaction	Kenai	Arzew	Darwin	Das Island	Damietta	Bontang	Marsa El Brega	Bonny	Snohvit	Al Qalhat	Pampa Melchorita	Ras Laffan	Point Fortin
Belgium	Zeebrugge	1.63	0.49	1.55	1.13	0.72	1.56	0.65	0.87	0.47	1.08	1.68	1.14	0.82
China	Shenzhen	0.68	1.27	0.40	0.71	0.91	0.23	1.01	1.30	1.52	0.64	1.40	0.72	1.64
India	Dahej	1.20	0.67	0.53	0.19	0.45	0.53	0.55	0.99	1.06	0.13	1.52	0.19	1.18
Italy	Panigaglia	1.69	0.37	1.30	0.88	0.47	1.31	0.41	0.85	0.76	0.83	1.66	0.89	0.87
Japan	Sodegaura	0.46	1.33	0.52	0.90	1.10	0.36	1.20	1.47	1.71	0.83	1.17	0.90	1.83
South Korea	Inchon	0.57	1.28	0.55	0.85	1.06	0.36	1.16	1.44	1.68	0.80	1.28	0.93	1.79
Spain	Huelva	1.56	0.33	1.39	0.97	0.55	1.40	0.48	0.73	0.58	0.92	1.54	0.98	0.74
Turkey	Marmara Eregli	1.81	0.49	1.21	0.79	0.38	1.16	0.37	0.98	0.88	0.75	1.80	0.80	1.00
UK	South Hook	1.58	0.47	1.53	1.11	0.69	1.55	0.62	0.85	0.48	1.04	1.65	1.11	0.79
USA	Lake Charles	1.18	0.96	2.01	1.60	1.18	1.96	1.11	1.11	1.03	1.55	1.69	1.60	0.58

Source: Citi Investment Research and Analysis, World Gas Intelligence

Figure 61. Gas units conversion table

Natural Gas		Multiply by		
From	BCM	BCF	MTPA	Boe
BCM	1.00	35.30	0.73	6.60
BCF	0.03	1.00	0.02	0.19
MTPA	1.38	48.71	1.00	8.97

Source: Citi Investment Research and Analysis, BP stats review

Figure 62. Global valuation sheet

	Rec	Price 15/12/10	TP	Mkt Cap ($m)	P/E (x) 2010E	P/E (x) 2011E	P/E (x) 2012E	EV/DACF (x) 2010E	EV/DACF (x) 2011E	EV/DACF (x) 2012E	ROCE (%) 2011E	ROCE (%) 2012E	FCFY (%) 2010E	FCFY (%) 2011E	DY (%) 2010E
Majors															
BP	1H	477	590	139,104	6.1	6.4	5.6	13.3	4.1	3.4	19.8%	21.4%	-5.1%	13.1%	1.9%
RD Shell A	1M	2082	2200	113,699	10.3	10.3	8.0	5.8	5.8	4.9	11.5%	14.0%	2.9%	3.5%	5.2%
RD Shell B	1M	2072	2200	84,483	10.3	10.3	7.9	5.8	5.8	4.9	11.5%	14.0%	2.9%	3.5%	5.2%
Total	1M	39.9	49.0	119,481	8.5	8.3	7.3	5.0	4.9	4.4	14.3%	14.9%	5.9%	4.3%	5.9%
ExxonMobil	1M	71.9	86.0	352,155	11.8	10.9	9.4	7.3	6.2	5.5	15.0%	16.4%	5.6%	7.0%	2.4%
Chevron Corp	1H	88.0	101.0	176,509	9.3	8.9	7.9	4.8	4.3	3.7	13.9%	15.1%	6.1%	7.3%	3.2%
Mkt Cap Wtd Average					**9.8**	**9.5**	**8.0**	**7.1**	**5.3**	**4.6**	**14.7%**	**16.2%**	**3.7%**	**6.9%**	**3.5%**
European Integrateds															
BG Group	1M	1301	1500	68,333	16.2	16.0	14.3	10.4	10.3	9.5	12.8%	12.5%	-0.2%	-1.1%	1.1%
ENI	1M	16.4	21.0	78,449	7.9	7.2	6.3	5.2	4.9	4.3	11.3%	12.5%	6.6%	11.3%	6.1%
Repsol YPF	2H	21.0	18.0	33,854	13.3	11.1	8.8	6.0	5.5	4.8	7.3%	8.7%	6.2%	8.1%	4.3%
Statoil	2M	135	150	72,053	9.9	8.6	8.1	4.6	4.4	4.1	17.0%	17.1%	8.1%	9.8%	5.2%
Mkt Cap Wtd Average					**11.4**	**10.5**	**9.3**	**6.5**	**6.3**	**5.7**	**12.8%**	**13.3%**	**5.1%**	**7.1%**	**4.2%**
North America Integrateds															
ConocoPhillips	2H	65.1	56.0	94,543	10.1	9.4	8.3	6.2	5.4	4.9	12.1%	13.2%	5.3%	7.1%	3.2%
Hess Corp	2H	73.2	70.0	24,001	14.1	11.6	10.1	5.9	5.7	5.4	11.3%	11.6%	1.4%	-0.6%	0.5%
Marathon Oil	1H	34.9	43.0	24,812	9.5	8.6	6.8	5.1	4.0	3.4	10.0%	12.1%	3.2%	9.1%	2.8%
Occidental	2M	94.8	90.0	77,146	16.1	12.8	9.7	8.9	7.5	5.9	18.1%	22.2%	5.6%	5.9%	1.6%
Imperial Oil	1M	38.3	45.0	32,711	17.0	14.1	11.4	12.2	106.3	8.9	16.2%	16.0%	-2.2%	-0.2%	1.1%
Mkt Cap Wtd Average					**14.4**	**11.7**	**9.2**	**7.6**	**6.5**	**5.3**	**15.2%**	**18.2%**	**4.4%**	**5.3%**	**1.6%**
CEEMEA & LatAm Integrateds															
Petrobras (Ord)	1H	27.96	50.00	106,669	9.7	8.8	7.5	7.7	8.0	7.6	7.9%	8.5%	-9.7%	-8.5%	2.6%
Petrobras (Pref)	1H	25.37	44	96,788	8.8	8.0	6.8	7.7	8.0	7.6	7.9%	8.5%	-10.6%	-9.4%	2.9%
Polish Oil & Gas	1M	3.67	4.27	7,164	11.5	10.8	10.2	5.6	5.1	4.6	8.2%	8.2%	5.4%	6.0%	2.2%
Alliance Oil	2H	106.70	130.00	2,673	12.8	11.6	7.0	7.6	8.2	5.8	9.0%	13.3%	-0.5%	-0.5%	0.0%
Gazprom	1M	6.35	8.30	145,644	5.5	5.0	4.6	4.2	3.4	3.1	10.8%	10.6%	4.6%	5.9%	1.6%
Gazpromneft	1M	3.81	6.20	18,063	5.8	5.2	4.4	3.5	3.2	2.6	15.0%	16.4%	13.3%	12.1%	3.1%
LUKoil	1L	56.40	74	44,068	4.9	5.3	4.3	3.8	4.0	3.4	12.1%	13.3%	16.1%	6.9%	3.8%
Rosneft	1L	7.19	9.10	69,045	7.0	6.2	7.0	6.0	5.5	5.5	14.5%	12.1%	11.2%	9.1%	1.6%
Surgutneftegas	2H	0.98	1.02	35,011	19.7	9.8	10.8	3.0	2.8	2.3	7.3%	5.6%	5.5%	11.0%	0.8%
Tatneft	3H	4.78	5.25	10,123	7.6	7.5	4.8	8.3	7.5	5.3	8.6%	12.0%	-3.8%	0.8%	2.5%
TNK-BP Holding	1H	2.78	2.94	41,691	6.3	5.8	5.0	5.1	4.5	3.9	26.4%	26.9%	14.7%	11.0%	6.2%
Sasol	1M	332	370	29,758	12.6	10.0	7.5	8.8	7.2	5.7	19.4%	22.9%	4.0%	5.6%	3.2%
Mkt Cap Wtd Average					**8.0**	**6.9**	**6.2**	**5.7**	**5.5**	**5.0**	**11.3%**	**11.3%**	**2.0%**	**1.9%**	**2.5%**
Asia-Pac Integrateds															
Origin Energy	1M	17.10	19.30	14,871	22.1	22.4	19.2	na	na	na	na	na	-11.3%	0.2%	2.9%
Petrochina	2L	9.64	9.20	226,893	12.1	10.8	9.5	5.4	5.0	4.6	14.1%	15.4%	3.9%	5.2%	3.7%
Sinopec	1L	7.23	11.60	81,626	7.2	6.4	5.6	4.3	3.9	3.6	14.1%	14.7%	2.7%	10.9%	2.4%
CNOOC	1L	17.96	18.50	103,546	13.0	12.4	12.2	7.1	6.4	6.3	30.0%	29.1%	3.8%	5.7%	2.8%
ONGC	2L	1321.80	1315	62,330	14.6	11.5	10.3	7.1	6.1	5.6	26.0%	26.4%	3.1%	5.4%	2.5%
Mkt Cap Wtd Average					**11.8**	**10.8**	**9.8**	**5.8**	**5.1**	**4.8**	**18.6%**	**19.1%**	**3.1%**	**6.1%**	**3.1%**

Source: Citi Investment Research and Analysis

Additional companies discussed: Novatek OAO (NVTKq.L; US$111.70; 2M); Woodside Petroleum Ltd (WPL.AX; A$43.40; 2M); Santos Ltd (STO.AX; A$12.97; 1M)

Appendix A-1

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