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Asia-Pac Energy: China Coal Bed Methane X Factor. Who Has What It Takes to Be a Winner?

Ticker	Rating	CUR	19 Jul 2011 Closing Price	Target Price	TTM Rel. Perf.	EPS 2010A	EPS 2011E	EPS 2012E	P/E 2010A	P/E 2011E	P/E 2012E	Yield
857.HK (PetroChina)	M	HKD	11.46	11.50	14.5%	0.86	1.03	1.17	13.3	11.1	9.8	3.5%
PTR	M	USD	145.40	148.35	12.7%	11.13	13.29	15.03	13.1	10.9	9.7	3.5%
SPX			1305.44			85.28	99.75	113.11	15.3	13.1	11.5	2.0%
MXAPJ			472.63			32.22	37.17	42.36	14.7	12.7	11.2	2.9%

O – Outperform, M – Market-Perform, U – Underperform, N – Not Rated

Highlights

Production of coal bed methane in China will accelerate sharply over the coming years. Chinese oil majors will lead the expansion, but it will not move the earnings needle of these companies. While there are small cap ways to play the sector, it is not without risk. We outline what it will take to be a winner in this sector.

- **Long term fundamentals for China coal bed methane (CBM) continue to look attractive**. Rapid demand growth, significant reserves, plans to increase production by an order of magnitude over the next 5 years and a production cost which is below the cost of imported LNG or pipeline gas all point towards a promising outlook for China CBM.
- **The arrival of CNOOC will add momentum to China's embryonic CBM industry.** CNOOC (parent co.) entered the coal bed methane industry in the first half of this year through a 50/50 joint venture with CUCBM. This will lead to greater activity within the sector in our view given CNOOC's ambitious plans to increase output.
- **There will be a separate CBM plan within China's 12th 5 year energy plan to further stimulate CBM development.** We expect the new CBM plan to be announced shortly which will include production targets of 9bcm by 2015 (currently 1bcm) and a doubling of the wellhead subsidy for CBM to encourage development and production.
- **While large cap oil companies (Petrochina, CNOOC) will grow production, small caps within the sector face a number of challenges**:-
  - *Regulatory:* Timely approval of development plans (ODP) remains an important milestone for large scale development of CBM acreage in our view. Although a number of companies are actively trying to secure ODPs so far none have been approved. While this may only be a matter of time, the absence of approved ODPs is causing uncertainty in the sector.
  - *Financing:* Large capital investments will be required for the development of CBM acreage. Most of the small caps will require additional funding to execute on longer term development plans. Investors risk large scale dilution through rights issues or convertible bonds until companies are able to generate meaningful cash flows.
  - *Other:* The ability to monetize gas though pipeline gas sales agreements, technical ability to execute on the ground in China and relationship with Chinese major oil and gas companies are critical to longer term success. Most companies have some but not all of these in place.

Asia-Pacific Oil & Gas

See Disclosure Appendix of this report for important disclosures and analyst certifications.

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- **Winners will be companies who can deliver tangible production and have the right relationships to navigate the complicated regulatory environment**. Increasingly we believe the government wants to see companies that can 'walk the walk' and not just 'talk the talk'. Ability to invest and deliver production growth counts more than acreage and reserves. Having the 'right relationships' with Chinese partners will also be important in gas monetization and ultimately a viable long term business within China.

Investment Conclusion

The fundamentals for coal bed methane (CBM) in China remain compelling; strong demand growth, large reserves, rising production targets and gas imports which are becoming increasingly expensive. For China, CBM seems to tick a lot of boxes and over time we believe China will develop a material coal bed methane industry, in the same way we have seen in the US and are seeing in Australia. Although coals in China are more challenging to develop relative to some of the more prolific basins in the US and Australia, China CBM should yield attractive returns at current domestic gas prices.

While coal bed methane won't move the earnings needle of China's largest CBM producer PetroChina or newcomer CNOOC, investors can play the sector through a number of smaller companies (Dart, Far East Energy, Enviro Energy, Green Dragon Gas, Sino Oil and Gas, Sino Gas Energy) which are listed in HK and internationally. While the industry fundamentals are attractive there are risks however. The two greatest challenges are ability to secure development approval and financing projects which have significant capital requirements off of small balance sheets. Other issues equally important are relationship with Chinese partners, access to infrastructure and ability to execute upstream developments using the right drilling and completion technology. Ultimately only the best capitalized, technically capable companies with strong local relationships will be successful. While this does not apply to all, we do believe that there will be some companies which will emerge as winners over the next 12 months. Development plan approval remains a key milestone in our view. Among the listed small caps, we note that Sino Oil and Gas (HK:0702) appears to be furthest advanced in this area.

Details

Since we last published on coal bed methane in China **China Unconventional Gas: Key Take Away From Our China Unconventional Gas Investor Day** there have been a number material changes within the sector. Some of these changes have been positive and some negative.

Among the positive changes, the outlook for gas in China continues to look attractive. Demand is expected to increase from 100bcm to 250bcm by 2015 and reach 350-400bcm by 2020. The cost of imported gas is also increasing. Central Asian pipeline gas is likely to require a price of 3RMB/m^3 to be economic and LNG prices continue to rise with oil. The upshot of this is that China should continue to place more emphasis on unconventional gas.

Supporting the development of CBM in China, we expect NDRC will announce a plan to increase CBM production from 1bcm to 9bcm over the next 5 years (US currently produces over 50bcm of CBM). In addition we expect the subsidy which CBM producers receive to double, which will continue to enhance the economic viability of this sector. On the corporate level, the biggest change over the past 6 months has been the entrance of China's largest E&P Company CNOOC (parent co.) into the sector which now has a 50/50 JV with CUCBM. We expect CNOOC will take a more aggressive stance in the development of CBM.

For smaller E&P companies, exploration, appraisal and development plans are largely unchanged over the past 6 months, although there have been delays in drilling in a number of blocks. On a positive note, there has been progress on pipeline sales agreements, with a number of companies announcing well head sales

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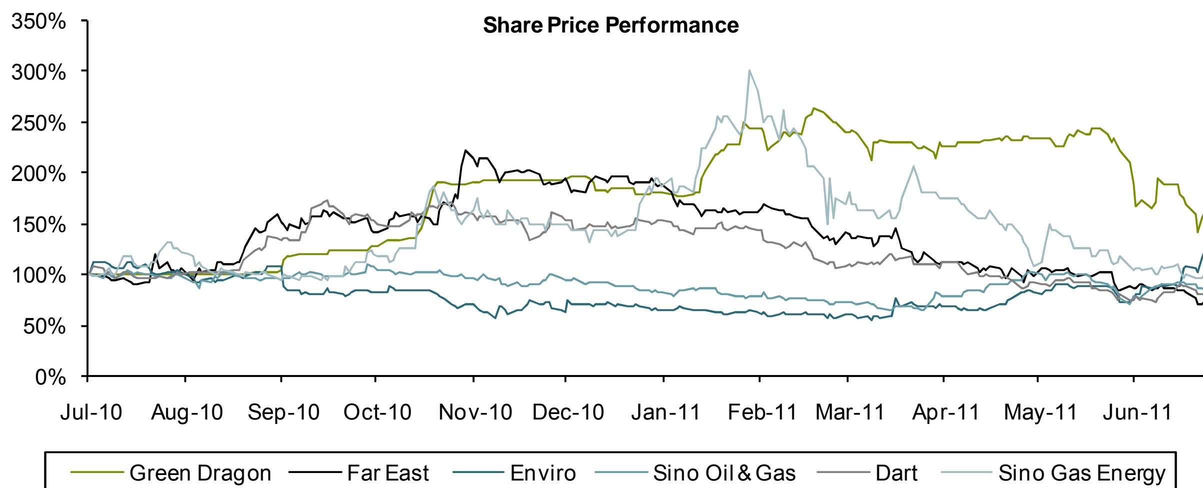
prices close to USD7/mscf which should enable a positive return on pilot and early production schemes. On a more negative note, there has yet to be a development plan approved among the smaller E&P Companies (to our knowledge) which is causing some uncertainty in the small cap sector given that the government is also anxious to see this sector develop.

In this research note we update our outlook for the rapidly evolving CBM sector in China.

Performance of the Small Cap CBM Companies

Performance among the small caps E&P companies in the China CBM sector over the past six months has been relatively muted (**Exhibit 1** and **Exhibit 2**). Although the sector as whole is up over the past 12 months, the past 6 months have seen prices come off the highs that were reached at the start of the year. While the entire market has 'come off', some companies have experienced delays to drilling which has slowed down exploration and appraisal work and delayed some of the key catalysts which were expected. We expect to see more progress in the second half of 2011.

Exhibit 1
Share price performance of independent CBM companies in past year



Source: Bloomberg

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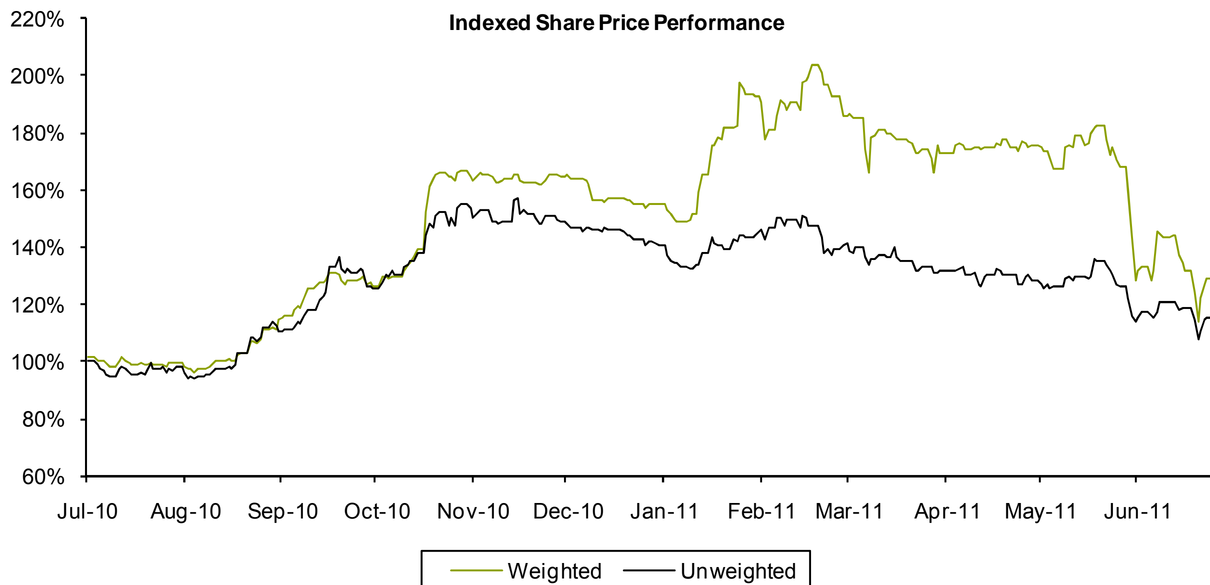
Exhibit 2
These stocks have retreated from earlier high levels



Source: Bloomberg

Outlook for Gas and CBM in China

The fundamentals for CBM have never looked better in our view. There are four reasons why we are optimistic on the outlook for this sector.

Government target is to raise production from 1bcm to 9bcm by 2015

China is about to embark on a period of rapid development of its CBM industry. After missing its original goal of producing 5bcm of CBM annually by 2010 and producing only 1.5bcm, China has reset its goal of 9bcm of the gas by 2015 (**Exhibit 3**). We expect a new development and planning strategy drafted by the central government to be made public later this month.

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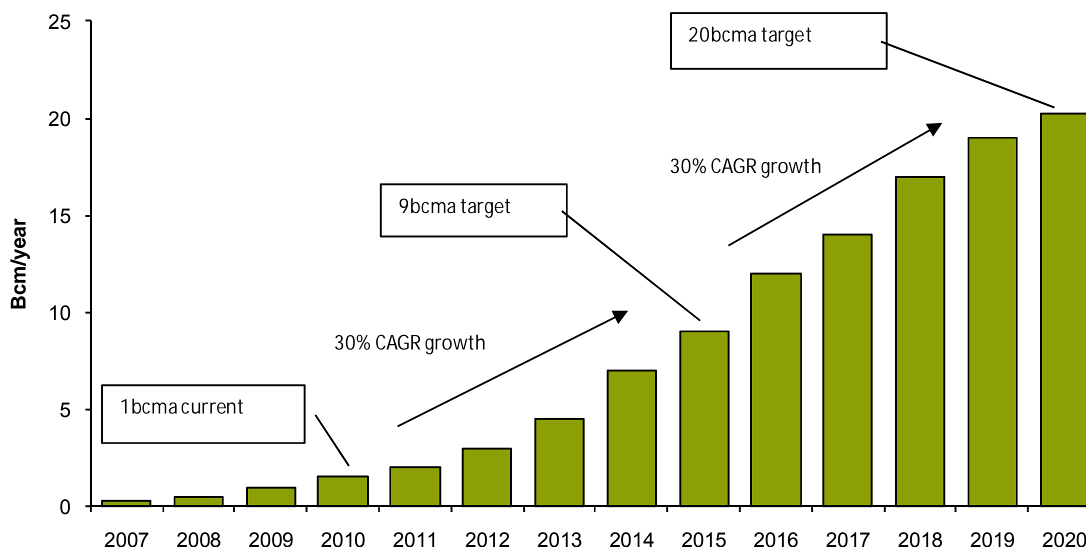
Exhibit 3
Estimated China CBM production growth



Source: Bernstein estimates

In our recent North America non-deal road show with PetroChina, the company reiterated its goal of producing 4bcm of coal bed methane by 2015. Overall PetroChina expect gas demand to grow from over 100bcm in 2010 to 240-260bcm by 2015. Domestic supply is estimated to be 160bcm with 60bcm of imports or close to 30% of total supply. By 2020 PetroChina expect gas demand to reach 400bcm.

By 2020 gas production is likely to reach 200bcm with unconventional gas (shale gas, tight gas and coal bed methane) accounting for 62bcm/d or 30% of total supply – compared with current levels of less than 10% (**Exhibit 4**). Within the unconventional gas production output, CBM production is estimated to be 20bcm or 10% of total supply. This implies growth of 20 times the current output. PetroChina's own plan is to increase CBM production from 0.4bcm in 2010 to 4bcm by 2015 and 10bcm by 2020 (or 50% of China's total CBM output).

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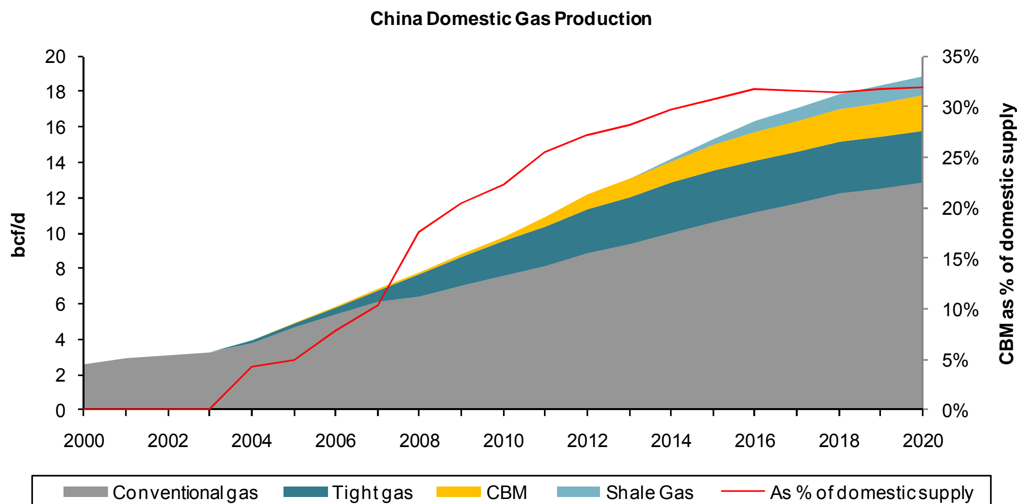
Exhibit 4

Unconventional gas production (tight gas, CBM and shale gas) grow to 6bcf/d by 2020 or 30% of domestic supply mix



Source: Company reports, Bernstein analysis

CBM Reserve Base is Enormous – Equivalent to 1/3 of China's Total Gas Resources

According to PetroChina and independent assessments, CBM resources in China are just under 1000TCF or 30TCM (**Exhibit 5**). Total CBM acreage in China is 212,000km^2 and gas in place is estimated at 835TCF implying a resource concentration of 4bcf per km^2. At present only a fraction of the resource base has been proven and total output is 1bcm. This is equivalent to where the US was in the late 1980's. Over the last 20 years US CBM production has increased to over 50bcm, highlighting what might be possible in China.

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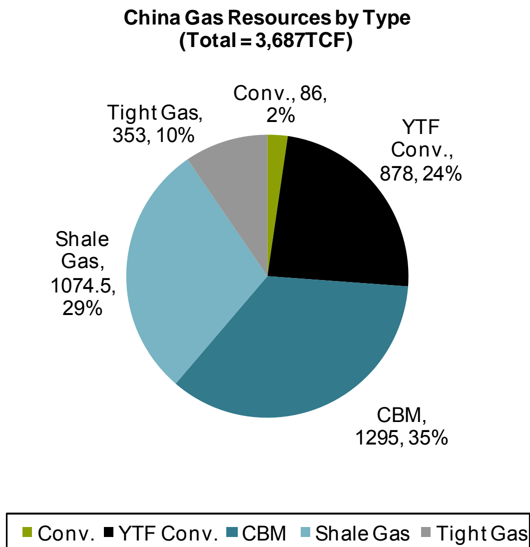
Exhibit 5

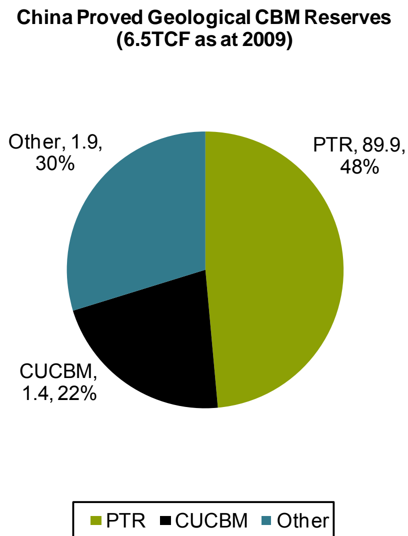
Coal Bed Methane Accounts for a third of China's undeveloped resource base



Source: BP Stat. Review, Shale Gas in China; Liu 2008; Coal Bed Methane Exploration in China, Qiu 2009

Exhibit 6

Ordos and Qinshui account for a third of China's CBM



Source: Coal Bed Methane Exploration in China, Qiu 2009

CBM is Cheaper than Imports………

One reason why China should want to see the active development of CBM in China is the cost of imports. Conventional gas is prices at between $4-5/mscf. Imported gas however is much more expensive. Imported gas from Central Asia is around $8/mscf at the Chinese western border and will be around $12/mscf in Shanghai. LNG at current oil linked prices is around $14-15/mscf. We believe that domestic CBM is significantly more competitive that the price of imported gas and provides as strong driver for its development.

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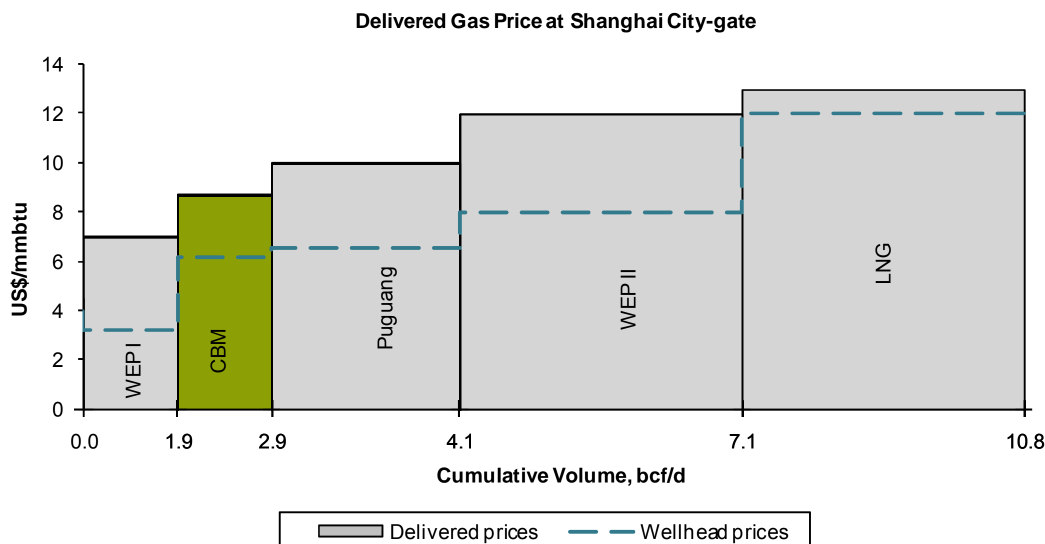
Exhibit 7

CBM pricing in China is competitive to gas imports



Source: Company reports, Bernstein estimates

At current prices, economics for CBM are attractive…..

While conventional gas prices are low in China, CBM is not. Pricing of CBM in China is unregulated, unlike conventional gas. No VAT is applied to CBM sales. In addition, the Chinese government currently has RMB0.2/m^3 of subsidy on CBM production. Some local provincial governments also provide additional subsidies (Shanxi local subsidy is RMB0.05/m^3). This allows CBM suppliers to charge a c.50% premium at the wellhead relative to domestic conventional gas and c.30% at the city gate. At the same time, it is still competitive relative to imported pipeline gas and LNG (**Exhibit 7**). Recently, there have been indication of a doubling the current central government subsidies to RMB0.4/m^3 as reported by the Chinese media.

Over recent years the local gas price in Shanxi and neighboring provinces has been increasing (**Exhibit 8**). City gate prices are around $8/mmbtu while industrial pricing can be as high as $12/mmbtu (close to fuel oil parity). Sales to CNG users have been a popular way to monetize CBM gas given the lack of infrastructure connections (**Exhibit 9**). CNG retail prices are high at $13/mmbtu which gives a net back of $7 to $8/mmbtu at the wellhead.

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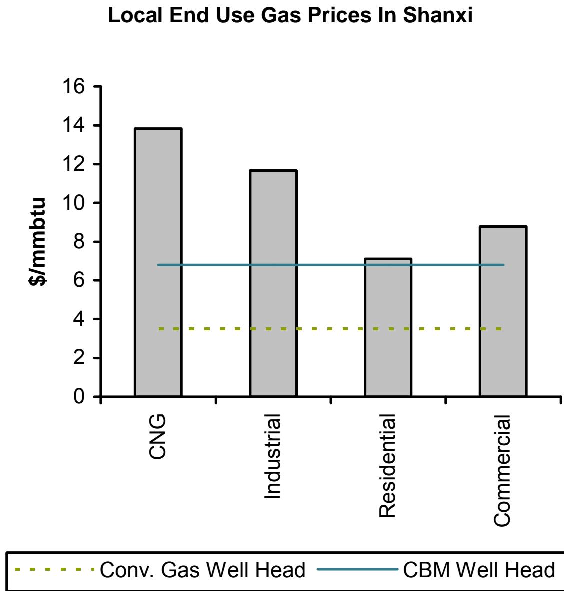
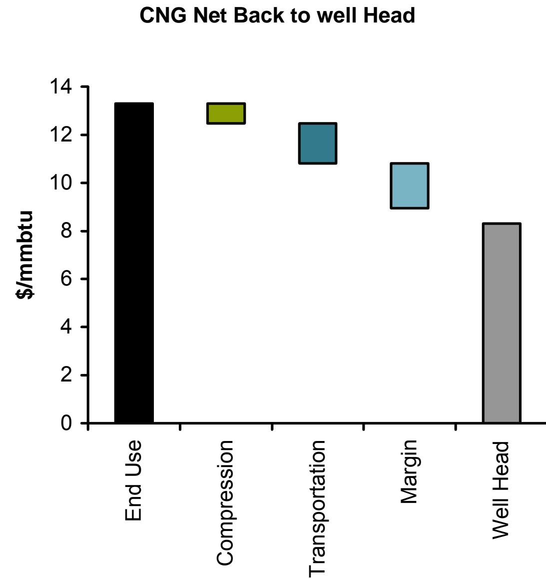
Exhibit 8
End Use Gas Prices in China



Source: Green Dragon Gas Corporate Report, Bernstein estimates

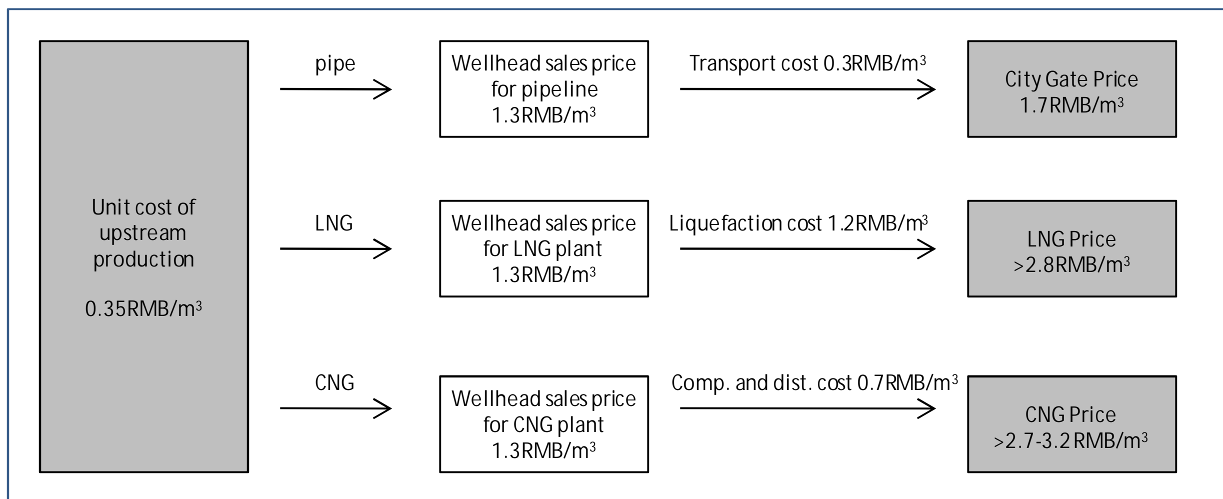
Exhibit 9
CNG Netbacks to Wellhead



Source: Bernstein estimates

As an illustration of the value chain, unit costs of CBM production is RMB0.35/m^3 while they are able to sell the gas to their customers at RMB1.3/m^3 before the government subsidies (**Exhibit 10**). End user prices can be as high as 1.7-3.2RMB/m^3 for pipeline gas through to LNG and compressed natural gas.

Exhibit 10
Economics look good for CBM producers – Sino Oil and Gas as an example



Source: Bernstein Estimates

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We estimate the present value of a CBM development to be around $1 to 1.5/mscf but this could vary depending on final costs and gas price assumptions. Assuming a $7/mscf price at the well head we believe an IRR of close to 30% is highly achievable for a CBM project (Exhibits **11** and **12**).

Exhibit 11
Present Value of CBM per mscf

NPV per mscf, $									
		Wellhead gas price, $/mscf							
F&D costs, $/mscf		3	4	5	6	7	8	9	10
	1.4	0.1	0.4	0.6	0.9	1.2	1.4	1.7	2.0
	1.3	0.1	0.4	0.7	0.9	1.2	1.5	1.8	2.0
	1.2	0.2	0.4	0.7	**1.0**	**1.3**	1.5	1.8	2.1
	1.1	0.2	0.5	0.8	**1.0**	**1.3**	1.6	1.8	2.1
	1.0	0.3	0.5	0.8	1.1	1.3	1.6	1.9	2.2
	0.9	0.3	0.6	0.8	1.1	1.4	1.7	1.9	2.2
	0.8	0.3	0.6	0.9	1.2	1.4	1.7	2.0	2.3

Source: Bernstein estimates

Exhibit 12
Project IRR of CBM developments

Project IRR									
		Wellhead gas price, $/mscf							
F&D costs, $/mscf		3	4	5	6	7	8	9	10
	1.4	11%	15%	19%	22%	25%	28%	31%	33%
	1.3	12%	17%	20%	24%	27%	30%	33%	35%
	1.2	13%	18%	22%	**26%**	**29%**	32%	35%	37%
	1.1	14%	20%	24%	**28%**	**31%**	34%	37%	40%
	1.0	16%	22%	26%	30%	34%	38%	41%	44%
	0.9	18%	24%	29%	33%	37%	41%	45%	48%
	0.8	21%	27%	33%	38%	42%	46%	50%	53%

Source: Bernstein estimates

Issues facing Chinese CBM companies

Despite the generally positive outlook for coal bed methane, there are a number of issues that face some of the small cap companies in this sector.

Regulatory issues

Most Chinese coal bed methane projects operate under PSC's (production sharing contracts). Within most PSCs there is an exploration and development phase. Assuming exploration is successful then the license holder can apply for approval of the ODP (development plan) which enables the company to move into the development phase. For companies who do not secure ODP approval during the exploration phase, the ability to extend PSC is subject to endorsement by Chinese partners and approval by the relevant government ministry (MLR).

Exhibit 13
Estimated timeline for Chinese reserves report and ODP approval

	1H2010	2H2010	1H2011	2H2011	1H2012	2H2012	1H2013
Sino Oil and Gas - Sanjiao			◊	♦			
Dart - Liulin	◊				♦		
Green Dragon - GSS				◊	♦		
Sino Gas Energy - Linxing/Sanjiaobei					◊	♦	
Far East - Shouyang					◊	♦	
Enviro - Liuhuanggou					◊		♦

Source: Companies, Bernstein estimates

Note: ◊ reserves report approval; ♦ ODP approval

At present no CBM project with a foreign partner has (to our knowledge) been awarded approval of its ODP. While this may be a matter of time, there remain uncertainties over what regulations or restrictions the government may put in place prior to the first developments being awarded. Moreover, some of the PSCs have requirements to complete the exploration and appraisal phase within 3-5 years of signing. If

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companies have been unable to deliver on this, there is a residual risk that extensions may not be granted. Over the next 24months a number of companies will be actively seeking ODP approval. In our view, ability to secure timely ODP approval will be a critical for some of the small caps.

Pipeline access and marketing channels

Without access to pipelines, CBM production is mainly compressed into CNG and trucked to nearby customers. More recently, some companies are pursuing small scale LNG. This is too small for large scale material development of CBM in our view. While compressed natural gas or small scale liquefaction units may help to support small scale or early development schemes, they are not suitable for large scale development of CBM bocks in China. Ultimately CBM producers need to connect with pipelines to major markets. The good news is that most of the CBM blocks are proximal to major pipelines (Ordos to Beijing, WEP). The more difficult part is that PetroChina controls access to most pipelines and has strong bargaining power in any gas off-take agreements.

As part of the incentive plans for the development of CBM, the government has said that CBM has a higher priority in selling to the pipelines compared with conventional gas. Furthermore, to facilitate the transportation and marketing of CBM, the Chinese government had planned to build 10 dedicated CBM pipelines with total length of 1,441km during the 11th five-year plan period, designed to transmit 6.5bcm of CBM a year. Most of the small cap companies are making good progress in the sale to pipeline networks for pilot schemes or early development projects which we see as a positive.

Exhibit 14
Companies have made arrangements to sell the gas produced

Company	Gas sales arrangement
Dart - Liulin	Signed take or pay gas sales agreement for 1.4bcf/year with CUCBM
FEEC - Shouyang	Signed 20-year sales contract with Shanxi Guoxin for 16bcf/year
Enviro - Liuhuanggou	To sell to nearby Urumqi or West-East pipeline
Green Dragon - GSS	Currently selling CNG; signed 20-year contract with PetroChina Huabei to sell up to 6.45bcf/year
Sino Oil - Sanjiao	Currently selling CNG; signed gas sales cooperation agreement with PetroChina
Sino Gas - Linxing/Sanjiaobei	Working to conclude gas sales agreement with CUCBM, PetroChina

Source: Companies

Financing Capability

Large scale development of CBM blocks in China will require US$1b to US$2bn in capex. Even if capex is phased over several years the costs will be significant for some of the smaller E&Ps who have relatively weak balance sheets and low levels of cash. As a result it seems likely that the independents will have to dilute their equity and raise capital through rights issues or develop at a much slower pace that currently envisioned.

Since the beginning this year, independent CBM companies have raised or secured about $350 million (**Exhibit 15**), exceeding their 2011 capital expenditure plan. While most companies will have sufficient capital for the next 12 months, additional financing will be needed over the coming years to meet development plan needs.

Project financing will be difficult without longer term approved development plans. Debt financing may also be difficult given the tighter credit markets in China and again some of the regulatory issues. Instead it seems likely the more of these companies will have to raise capital over the next 3 years to fund development obligations. Those who are unable to do so will not be able to complete work programs which

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are tied to license obligations. The ability to secure financing again is a key differentiator between companies which will be successful and those who will not.

Exhibit 15
Summary of funds needed in the next three years and funding secured

US$mm	Cash **	Raised or secured	Total Funds	2011	2012	2013	Total Capex	1 Yr	3 Yr
Dart*	57	100	**157**	136	n.a.	n.a.	**136**	+21	n.a.
Enviro	20	11	**31**	15	27	54	**96**	+16	-65
Far East	28	17	**44**	20	na	n.a.	**20**	+24	n.a.
Green Dragon	148	50	**198**	125	125	n.a.	**250**	+73	n.a.
Sino Oil and Gas	31	100	**131**	105	120	118	**343**	+26	-212
Sino Gas Energy	5	71	**77**	15	13	n.a.	**28**	+62	n.a.

Source: Company reports, Bernstein estimates

Note: * Dart expenditure including all assets in and out of China

** Cash position prior to fund raising

Technical Capability

While coals in China have a high gas content they have low permeability, which means that flow rates are lower than in prolific basins found in the US or Australia. Moreover, Chinese coals tend to be brittle and are significantly faulted which complicates development drilling. While these issues can be overcome, CBM production in China does require specific technology solutions to the geological conditions in China. Over the past few years there has been significant progress, such a multi-lateral drilling and the use of seismic data to guide well location selection, but further refinement is needed to develop low permeability coal seams in China.

Although the gas in place is relatively constant across most blocks (from 3-6bcf/m2) the quality of the coals can vary considerably. Across CBM blocks in China a number of different technologies are being used from vertical wells (fracced and un-fracced) to horizontal wells (single and multi-lateral). No single technology fits all and much depends on the individual setting (coal thickness, permeability, gas content etc). Given the challenges of coal bed methane development in China only companies with strong enough technical capability and operating experience will be able to reach commercial flow rates required for commercial development and progress towards development.

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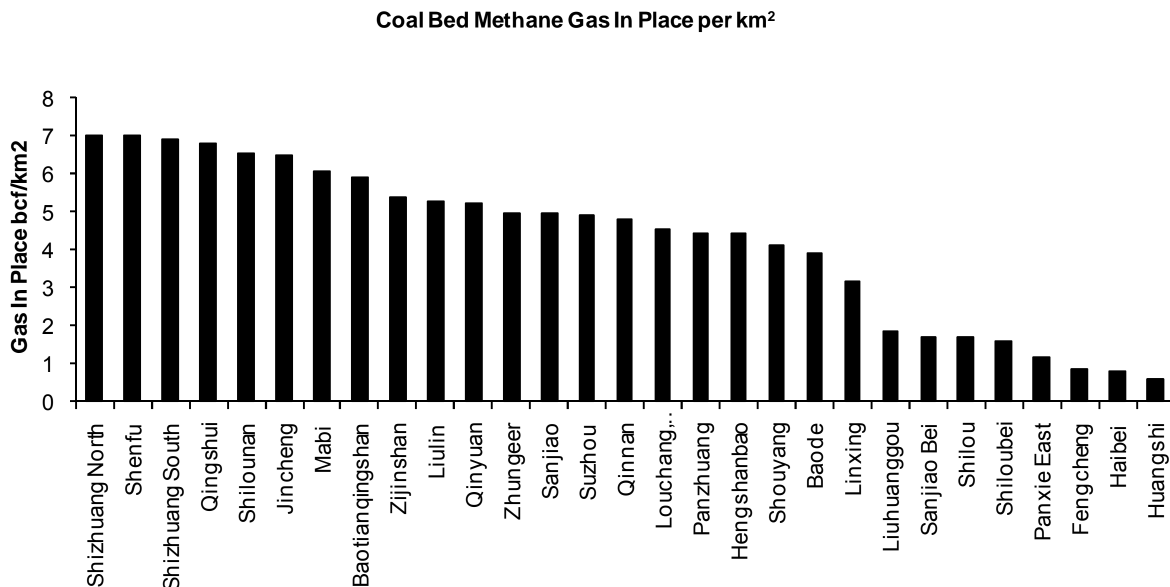
Exhibit 16
Gas In Place Per km²



Source: Bernstein estimate

Latest development in CBM

There have been a number of positive developments in the past few months in the CBM space. The Chinese government will release its 12th Five Year Plan on the CBM industry, later this month at the earliest. The target CBM production by the end of 2015 will reach 9bcm. To facilitate the development of the industry, there have been press reports that the government is considering raising the current CBM subsidy from 0.2rmb/m^3 to 0.4rmb/m^3. This will be very positive for the CBM producers and will further improve the economics of the projects.

Another major development in the industry is the reorganization of CUCBM. CUCBM was originally established as a 50-50 venture between CNPC and China National Coal in 1996. Progress was slow initially which lead to the split of the venture and PetroChina CBM (PCCBM) was established to look after the blocks that belonged to CNPC. Earlier this year, CNOOC took over 50% of CUCBM. CNOOC's role in CBM development may spur faster development and provide additional capital to the sector.

For the purpose of analyzing individual independent CBM companies, it makes sense to look at who these independents' domestic partner is (**Exhibit 17**). PetroChina, as we understand, regards the development of unconventional gas as a high priority whereas things may be a bit more complicated with CUCBM.

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Exhibit 17
Foreign operators' blocks and their partners

Company	Block	Basin	Chinese partner	Equity Interest
Dart	Liulin	Ordos-Qinshui	CUCBM	22.5%
	Dajing	Junggar	PetroChina	49%
Enviro	Liuhuanggou	Junggar	PetroChina	30%
Far East	Shouyang	Ordos-Qinshui	CUCBM	70%
	Yunnan	Yunnan Guizhou	CUCBM	60%
Fortune	Liulin	Ordos-Qinshui	CUCBM	27.5%
Green Dragon	Shizhuang South	Ordos-Qinshui	CUCBM	60%
	Shizhuang North	Ordos-Qinshui	CUCBM	60%
	Qinyuan	Ordos-Qinshui	CUCBM	60%
	Fengcheng	Jiangxi	CUCBM	49%
	Panxie East	Anhui	CUCBM	60%
	Guizhou	Guizhou	PetroChina	49%
Sino Oil	Sanjiao	Ordos-Qinshui	PetroChina	70%
Sino Gas	Sanjiaobei	Ordos-Qinshui	PetroChina	49%
	Linxing	Ordos-Qinshui	CUCBM	65%

Source: Company reports, Bernstein analysis

Update from companies

Enviro

Enviro Energy holds a net 30% share in a CBM PSC in Xinjiang through TerraWest. The Liuhuanggou block is estimated to have a gas in place of 3.2TCF with gross recoverable reserves of close to 2.2TCF. The block is still at a very early stage of appraisal. The company has updated us that drilling plans are being carried out as planned. It is in the middle of its pilot program during which it will drill 10 wells. Three wells were drilled last year and the company is testing these wells which showed flow rate of 3,000cf/day. Another 7 will be drilled this year.

Other than the pilot drilling program, major events from Enviro could be plans to fracture the wells to test the possibilities of drilling horizontal wells and contracting NSAI for reserves report. It currently has NI51-01 reserves evaluation on 5% of the block. More details will be released in the later part of this year.

Assuming the pilot production is successful, Enviro will commence phase 1 development of the block. This will involve the drilling of 180 wells over the next 3 years from 2012-14 at a cost of $160MM. Target production by 2014 is 22mmscf/d (gross). It is likely that most of the gas will be monetized in nearby Urumqi or through the West to East Pipeline which runs close to the block (**Exhibit 18**). The wellhead price is likely to be greater than $5.50/mscf.

The company currently has cash of $15 million and will come to the market to raise more money to fund its capital expenditure as the drilling plan proceeds. That is after the company issued warrants in May, raising about HK$87 million.

The upside for Enviro shareholders could be the shale gas play which sits below the CBM acreage. This Jurassic (non-marine) shale which has high organic carbon content and a gas content of 30-50scf/t. Reserves could be as much as 2TCF, although this remains highly speculative. Appraisal of the shale gas play is likely to take place in 2011 or 2012.

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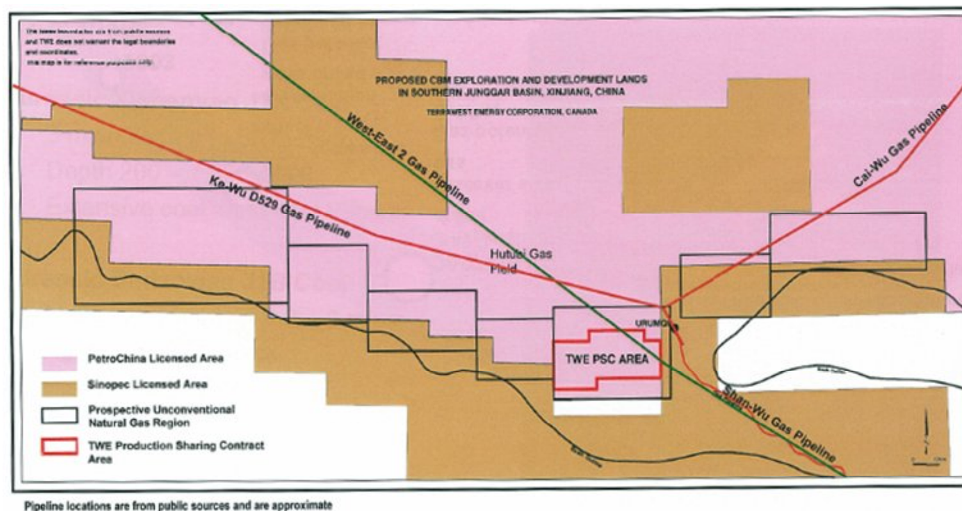
Exhibit 18

Enviro's block in Xinjiang is close to the West to East Pipeline



Source: Company presentation

Sino Oil & Gas

Sino Oil and Gas has a 70% share in the key Sanjiao block in eastern Ordos which is one of the most promising blocks in the basin and highlighted by PetroChina. Gas in place is estimated for this block at 2.1TCF with net 3P reserves to Sino oil and gas of 577bcf. In addition Sino Oil and Gas have a 90% share in the Jinzhuang field which is thought to have 704bcf of proven reserves.

Sino Oil is likely to become the first company to receive ODP approval in the third quarter from the Chinese government regarding the development of the Sanjiao CBM block. The company's Chinese reserves report has already been approved.

Like Green Dragon, Sino Oil and Gas is developing the block with horizontal wells but with multi-laterals rather than a single lateral. Sino Oil and Gas has an aggressive campaign to develop the block and plans to spend $100 million this year. Half of the financing was secured by loans from domestic Chinese banks and investors and the other half was raised through issuance of convertible earlier this month.

Sino Oil and Gas is targeting sales of 2.9mmscf/d by the end of 2011 and 77mmscf/d of CBM sales by 2013. The company signed agreement with PetroChina to sell gas from the Sanjiao block, an important milestone towards commercial operations. It is planning to spend $344 million over the next three years to develop the block which is the greatest expenditure planned by any of the CBM companies (**Exhibit 19**). The plan envisages the drilling of about 350 horizontal wells.

To reach this target Sino Oil and Gas will have to raise additional funds given their current cash position and we anticipate a number of fund raising issues in 2011/12. Sino Oil and Gas has signed an LOI for sales gas at $6.20/mscf. In addition, Sino are exploring options of selling gas through local CNG sales and LNG which could boost netbacks over and above these estimates.

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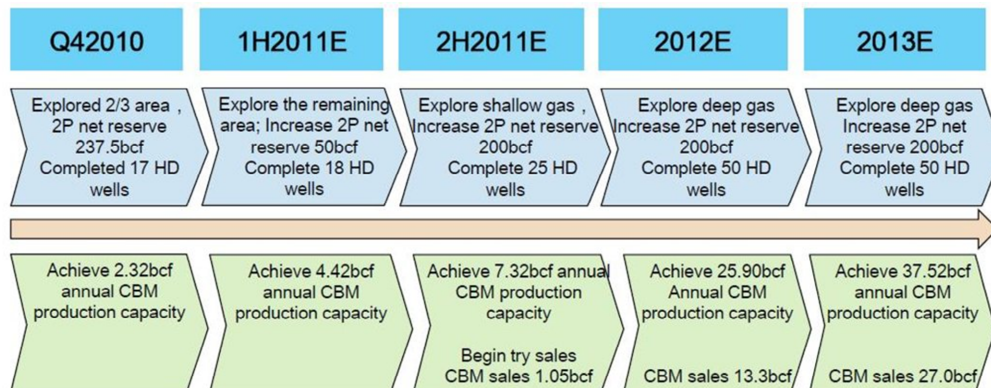
Exhibit 19
Sanjiao CBM Project Timeline



Source: Company reports

Far East Energy

Far East Energy has 3 PSCs with two blocks in Qinshui basin and one in Yunnan. The most important of these blocks is the Shouyang block which has an area of 1,963km2 and a gas in place of 6.9TCF. This block is distinctive among the CBM blocks in China in that permeability is considerably higher than any of the other blocks. Far East Energy has wells in the 10-100md permeability range compared with the average permeability of coal in China which has permeability of 1-10md.

As a result of better permeability, Far East Energy plans to drill vertical fracced wells which will have lower cost than horizontal wells. Far East estimates that production per well could reach 0.3mmscf/d. FEEC plans to drill over 200 wells in 2012. By late summer this year, the company will have 56 wells hooked into the gathering system and it will have drilled between 75 and 90 wells by the end of the year.

FEEC believe that all in costs are lower for this block given the higher permeability's which results in an all in cost of $1/mscf compared to other blocks which have an all in cost of $2/mscf. By the end of 2011 FEEC aims to produce around 7-10mmscf/d and has a target to increase in the longer term to 40mmscf/d.

FEEC have signed a take or pay contract at $6.50/mscf for gas volumes up to 10mmsc/d. The first pipeline has connected to FEEC Shouyang block with a capacity of 40mmscf/d. A second pipeline is being constructed which will add a further 50mmscf/d of pipeline capacity which could significantly enhance the options for gas sales.

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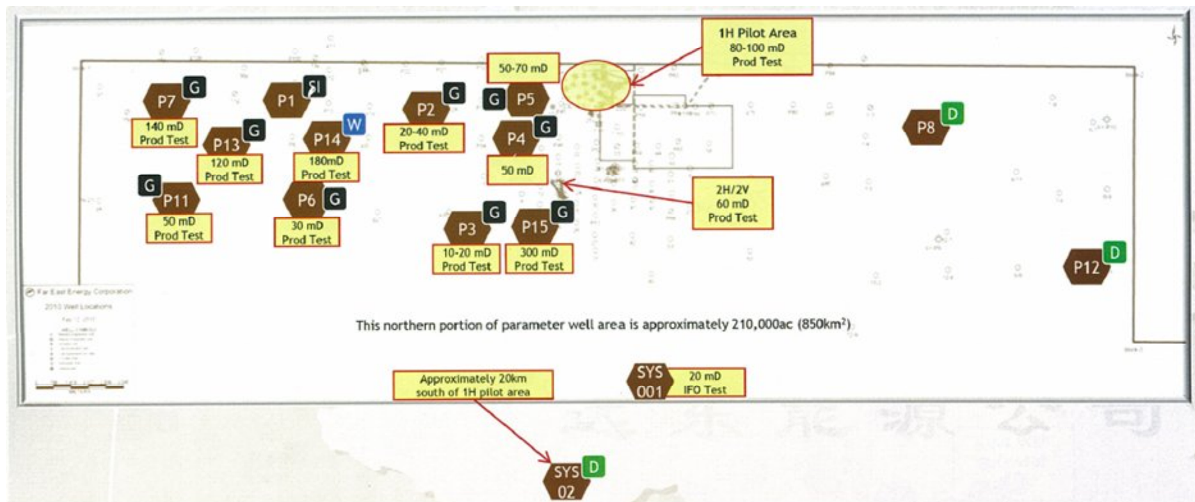
Exhibit 20
Shouyang Block Parameter Well Development



Source: Company reports

Dart Energy

Dart Energy is unique amongst the CBM independent companies in that they operate across a number of countries (Australia, China, India, Indonesia, Vietnam and Europe). It was spun off from Australia's Arrow Energy, which was acquired by PetroChina and Shell.

In China Dart's CBM interests are the Liulin block in eastern Ordos (in partnership with Fortune Oil) which has 85bcf of proven reserves and over 800bcf of gas in place and the Dajing block in Xinjiang. Dart Energy has been progressively deepening their equity interest and has options to grow to 75% equity. The 2011 work program includes 5 MLD wells, 3 vertical frac wells and pipeline design and installation. It plans to produce 3bcf a year from the pilot which is due to start next year.

Dart and Fortune have signed a gas sales agreement with CUCBM. The exploration period for Liulin runs to March 29, 2012. The Liulin block acquired Chinese reserves certification in early 2010 and ODP approval is expected in the next twelve months.

Another asset for Dart in China is the Dajing block in Xinjiang province which is largely unexplored but could have large reserves (**Exhibit 21**). Dart plan to start drilling shortly and will have test results for gas content and permeability from the first well by the end of third quarter or early fourth quarter this year. This is a large block and success in this block could be material for Dart Energy.

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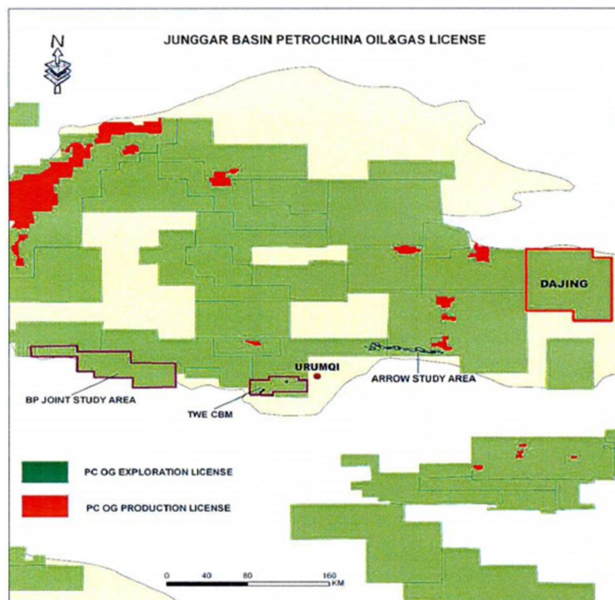
Exhibit 21
Dart Energy's Dajing Block is located in the Junggar Basin



Source: Company reports

Green Dragon Gas

In March this year, CUCBM announced the PSC agreements on the Fengcheng, Qinyuan, Shizhuang North and Panxie East blocks ended as the exploration period expired. Green Dragon later stated the company had undertaken all the investments in the PSC in accordance with its contractual obligations and the contracts are in full force and effect.

We have no reason to doubt Green Dragon but the announcement made by CUCBM highlights the complicated nature of upstream CBM development in China and partnership issues. On a more positive note Green Dragon did announce recently that it has signed an agreement with PetroChina to sell gas to the first west to east pipeline. The focus for Green Dragon is the GSS block in Shanxi which has 3.3TCF of gas in place and net 3P reserves of 1083bcf the Green Dragon 60% equity share.

After years of optimizing the drilling technique, Green Dragon have opted for extended horizontal wells which are twinned with a vertical well and a slotted PVC liner to ensure the coal seam does not cave into the well bore. The challenge remains faulting within the block which requires careful well planning to ensure continuous drilling within coal seams though the use of vertical control wells.

Over the next 2 years GDG plan to spend $250MM to develop the block. We anticipate 100 horizontal wells will be drilled in an effort to bring production up to 50mmscf/d (gross) or 18bcf/year by the end of 2012/early 2013. The key for Green Dragon in our view is to deliver on these targets.

Unlike other CBM companies, Green Dragon Gas is pursuing a downstream strategy through CNG and will seek gas swaps with PetroChina and Sinopec to monetize gas through their own downstream assets. This should maximize netbacks for Green Dragon. Further updates on reserves, drilling progress and production growth towards the 18bcf target remain key catalysts for the stock.

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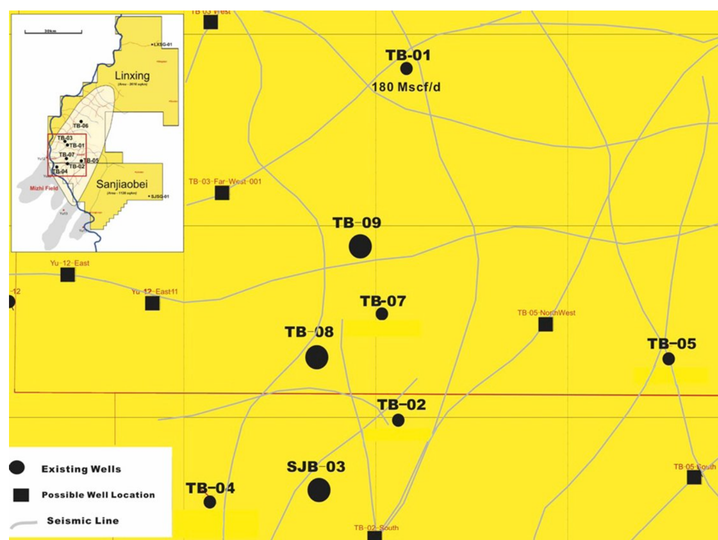
Sino Gas Energy

Sino Gas Energy has 65% interest in the Linxing PSC with CUCBM and 49% interest in the Sanjiaobei block with PetroChina (**Exhibit 22**). The Linxing block covers 2,615km^2 in the Ordos basin. Certified reserves, contingent and prospective resources stood at 1.7tcf as of February. The adjacent Sanjiaobei block covers 1,126km in Ordos basin and has certified reserves, contingent and prospective resources of 455bcf.

Sino Gas has achieved commercial well rates at the TB09 well (1,150,500scf/day) and the TB03 well (326,500scf/day). Given the depth of burial, our understanding is that the relatively high flow rates arise from tight sandstone formations which are inter-bedded with the coals.

For 2011, Sino Gas will focus on the expansion of the pilot program and further stimulate and test the TB09, TB08, TB03 and TB06 wells. It will carry out an extensive 2D seismic program of the Sanjiaobei block and drill up to 5 new wells in both PSC areas. In order to get ODP approval, Sino Gas has hired a consultant to prepare the Chinese reserves report.

Exhibit 22
Sino Gas Energy's Linxing and Sanjiaobei blocks



Source: Company presentation

Sino Gas plans to drill 50 wells in the first phase. Each well will cost $123,000 to drill and $92,000 to complete, which brings the total cost to $11 million. To fund the capital spending program, Sino Gas has secured funding for about $71 million.

Valuation

Our understanding of drilling schedule, capex and production targets are shown on **Exhibit 23**

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Exhibit 23

Summary of phase 1 development plan by company

Dart - Liulin	2010	2011	2012	2013	2014	2015	Total	
Capex $MM							0	
Wells		8					8	2011 drilling plan
Production mmscf/d			7					
Production bcf			3					

Enviro Energy - Liuhuanggou	2010	2011	2012	2013	2014	2015	Total	
Capex $MM		15	27	54	70		166	Phase 1 capex
Wells		10	30	54	100		194	Pilot
Production mmscf/d				16	22			2014 target
Production bcf				6	8			

Far East Energy - Shouyang	2010	2011	2012	2013	2014	2015	Total	
Capex $MM		20					20	2011 capex
Wells	26	82	200	350	500		1,158	
Production mmscf/d		1						
Production bcf								

Green Dragon - GSS	2010	2011	2012	2013	2014	2015	Total	
Capex $MM		125	125				250	Phase 1 capex
Wells	12	50	50				112	
Production mmscf/d				49				End 2012/early 2013 target
Production bcf				18				

Sino Oil and Gas - Sanjiao	2010	2011	2012	2013	2014	2015	Total	
Capex $MM		105	120	118			344	Total capex
Wells	17	60	110	160			347	Total wells count
Production mmscf/d	6	20	71	103				2013 target
Production bcf	2	7	26	38				

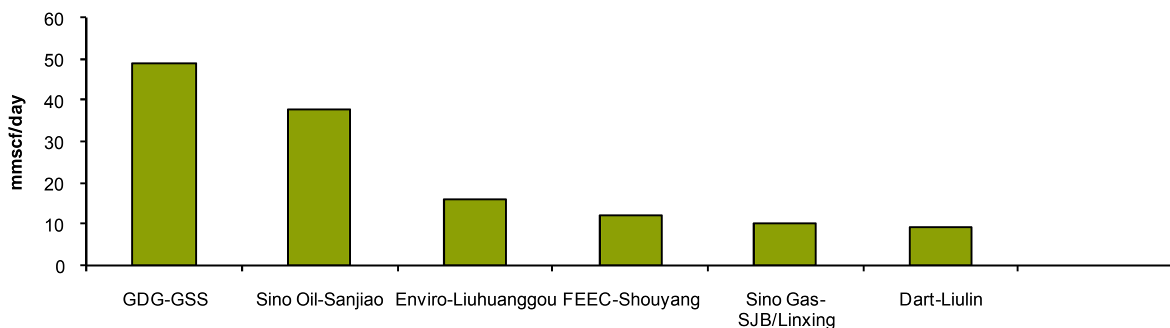
Sino Gas Energy	2010	2011	2012	2013	2014	2015	Total	
Capex $MM		15	13				28	
Wells		5					5	2011 drilling plan
Production mmscf/d								
Production bcf								

Source: Companies, Bernstein estimates

While Green Dragon Gas and Far East Energy have the largest acreage position, Green Dragon and Sino Oil and Gas have the largest capex and production targets over the next 3 years within China (Exhibits **24**, **25** and **26**).

Exhibit 24

Estimate 2013 daily production

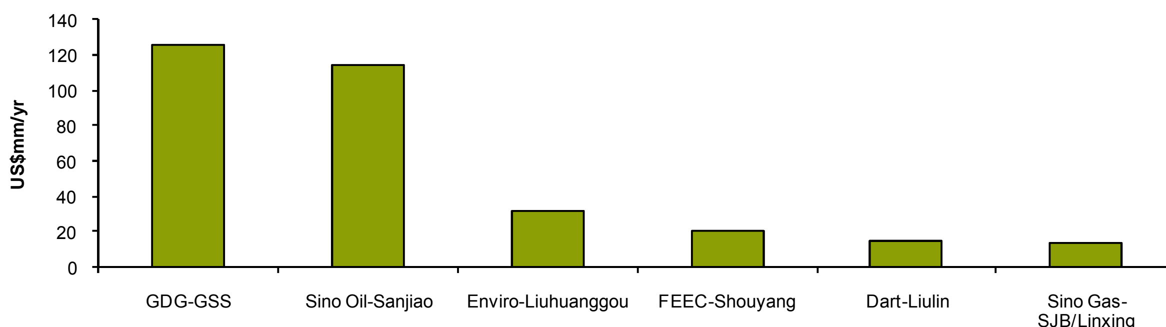


Source: Companies, Bernstein estimates

As projected by the companies, Green Dragon will achieve 49mmscf/d of production in 2013 from its Shizhuang South block (GSS) while Sino Oil and Gas is expected to produce 38mmscf/d from its Sanjiao Block. The company has an aggressive plan to spend $344 million between 2011 and 2013 and looks on track to be the first to secure ODP approval. We also note that they have signed a joint marketing agreement with PetroChina which we would consider to be another positive.

Exhibit 25

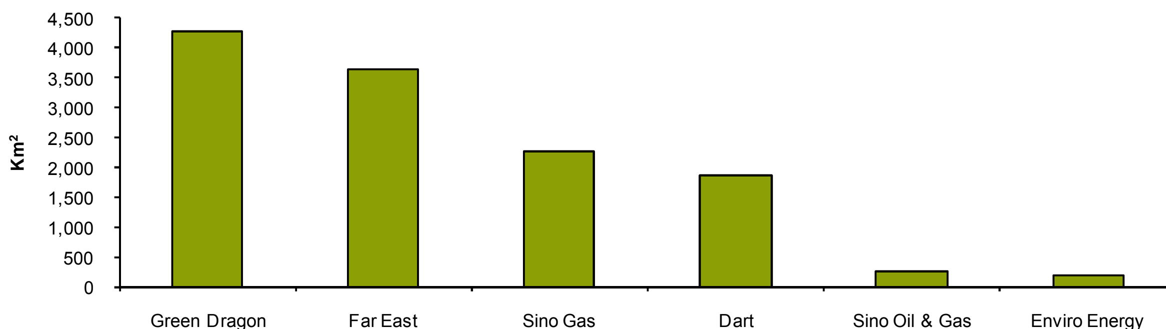
Estimated annual capital spending (3 year average or 1 year where applicable)



Source: Companies, Bernstein estimates

Exhibit 26

Green Dragon and Far East have the largest net acreage



Source: Companies, Bernstein estimates

We compared independent CBM companies' valuation by net reserves and net acreage of their CBM blocks (Exhibits **28**, **29**, **30** and **31**). While these metrics indicate which Companies may be cheaper than other on an acreage or gas in place basis, we would stress that it is production and investment which is likely to be more important determinants of success over the coming 12 months.

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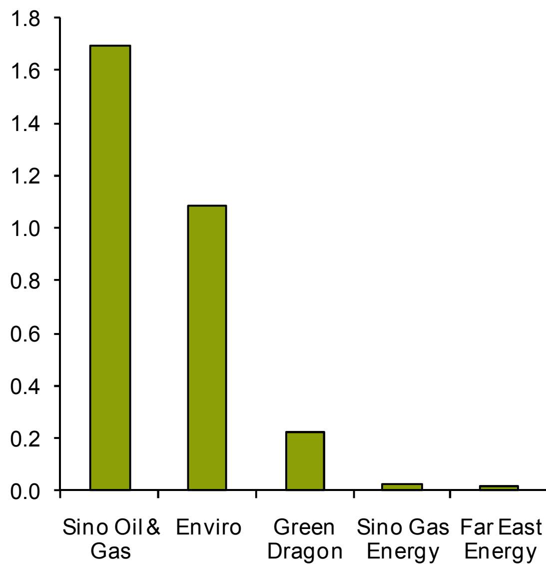
Exhibit 27
Independent CBM companies in China

US$m	Dart	Enviro	Far East	Green Dragon	Sino Oil & Gas	Sino Gas Energy
Bloomberg ticker	DTE AU	1102 HK	FEEC US	GDG LN	702 HK	SEH AU
Exchange	Australia	HK	US.OTCBB	London	HK	Australia
Resources						
Net Acreage (km^2)	1,852	195	3,639	4,267	267	2,252
Net GIIP (BCF)	3,542	1,100	9,511	14,669	2,400	1,470
Valuation (US$m)						
Market Cap	471	196	86	1,042	490	61
EV	460	212	55	960	453	52
EV/km^2 ($m)		1.09	0.02	0.23	1.70	0.02
EV/GIIP ($m)		0.19	0.01	0.07	0.19	0.04

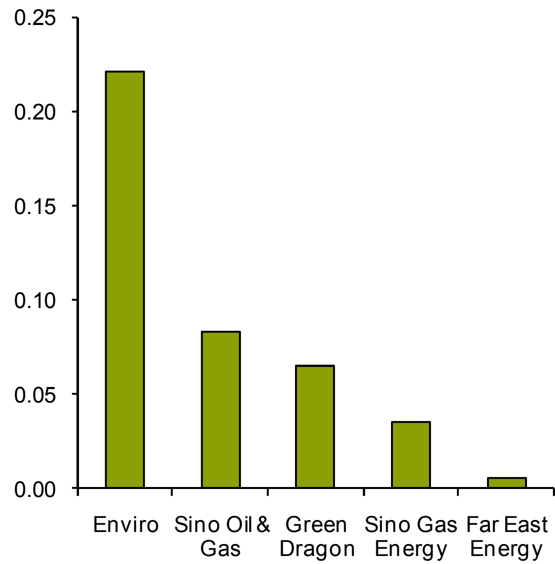
Source: Company reports, Bloomberg, Bernstein analysis

Exhibit 28
EV ($mm)/net acreage ($km^2$)



Source: Companies, Bernstein estimates

Exhibit 29
EV ($mm)/net GIP (bcf)



Source: Companies, Bernstein estimates

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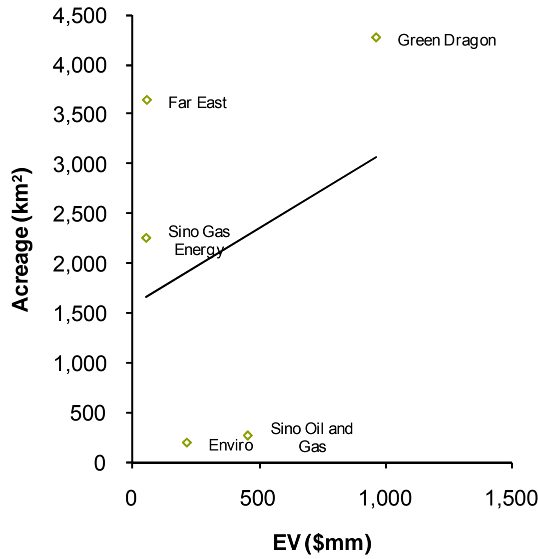
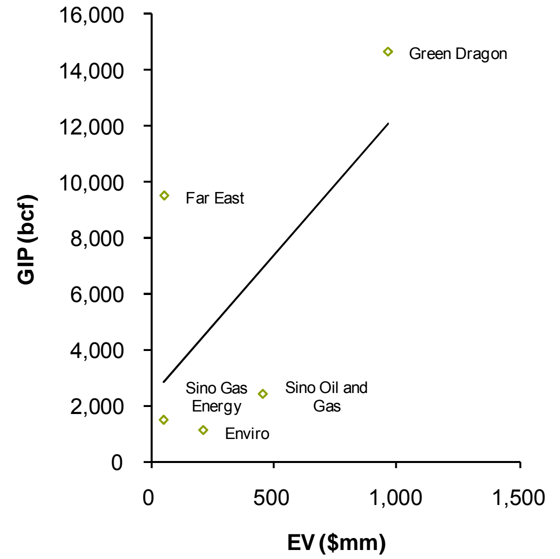
Exhibit 30
EV and net acreage



Source: Companies, Bernstein estimates

Exhibit 31
EV and net GIP



Source: Companies, Bernstein estimates

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Disclosure Appendix

Valuation Methodology

We value large cap oil and gas companies by identifying the forward price to book multiples they should trade at based on returns on equity, long term earnings growth expectations, dividend payout ratio and cost of equity. Our starting point is that Fwd P/B = (ROE x PO) / (Ke – g), where is our estimates of ROE for 2012, PO is the dividend payout ratio, Ke is the cost of equity, and g is the long term growth rates. A summary of our price target calculations is shown in (**Exhibit 32**).

Exhibit 32
Summary of price target

Summary of price targets						
Company	Cur	2012E BVPS	x	P/B	=	Price Target
PTR	HKD	7.6		1.5		11.50

Source: Bernstein analysis and estimates

Risks

PetroChina: Downside risks to our PetroChina price target include a decline in oil prices given the high correlation and beta with oil, accelerated production decline at Daqing oil field and larger than expected losses in their refining division as a result of government fuel price subsidies. The introduction of resource tax is a further downside risk. Better than expected refining margins and domestic gas prices as a result of policy changes represent an upside risk to our price target.

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  Market-Perform: Stock will perform in line with the market index to within +/-15 pp in the year ahead.

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  Not Rated: The stock Rating, Target Price and estimates (if any) have been suspended temporarily.

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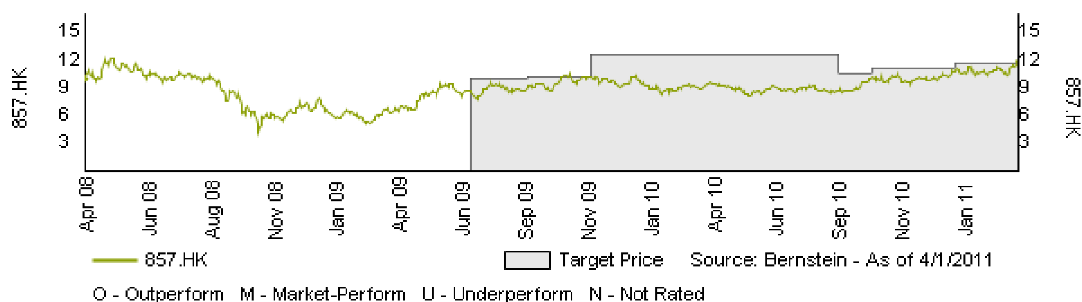
Ticker	Rating Changes	
857.HK	M (RC) 04/20/11	O (IC) 06/29/09
PTR	M (RC) 04/20/11	O (IC) 06/29/09

Rating Guide: O - Outperform, M - Market-Perform, U - Underperform, N - Not Rated
Rating Actions: IC - Initiated Coverage, DC - Dropped Coverage, RC - Rating Change

857.HK / PetroChina Co Ltd

Date	Rating	Target(HKD)
06/29/09	O(IC)	9.80
09/04/09	O	10.10
11/17/09	O	12.50
09/02/10	O	10.50
10/12/10	O	11.00
01/19/11	O	11.50

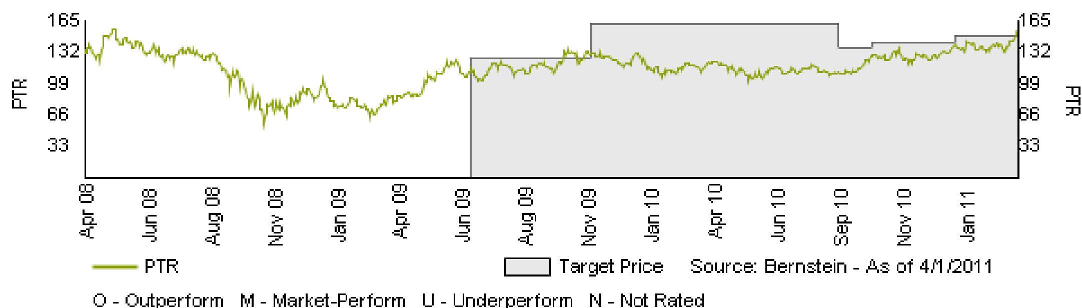
IC - Initiated Coverage



PTR / PetroChina Co Ltd

Date	Rating	Target(USD)
06/29/09	O(IC)	126.00
11/17/09	O	161.00
09/02/10	O	135.50
10/12/10	O	141.90
01/19/11	O	148.35

IC - Initiated Coverage



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Approved By: CDK

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