

Finding Petroleum Conference

How unconventional gas fits into the gas market

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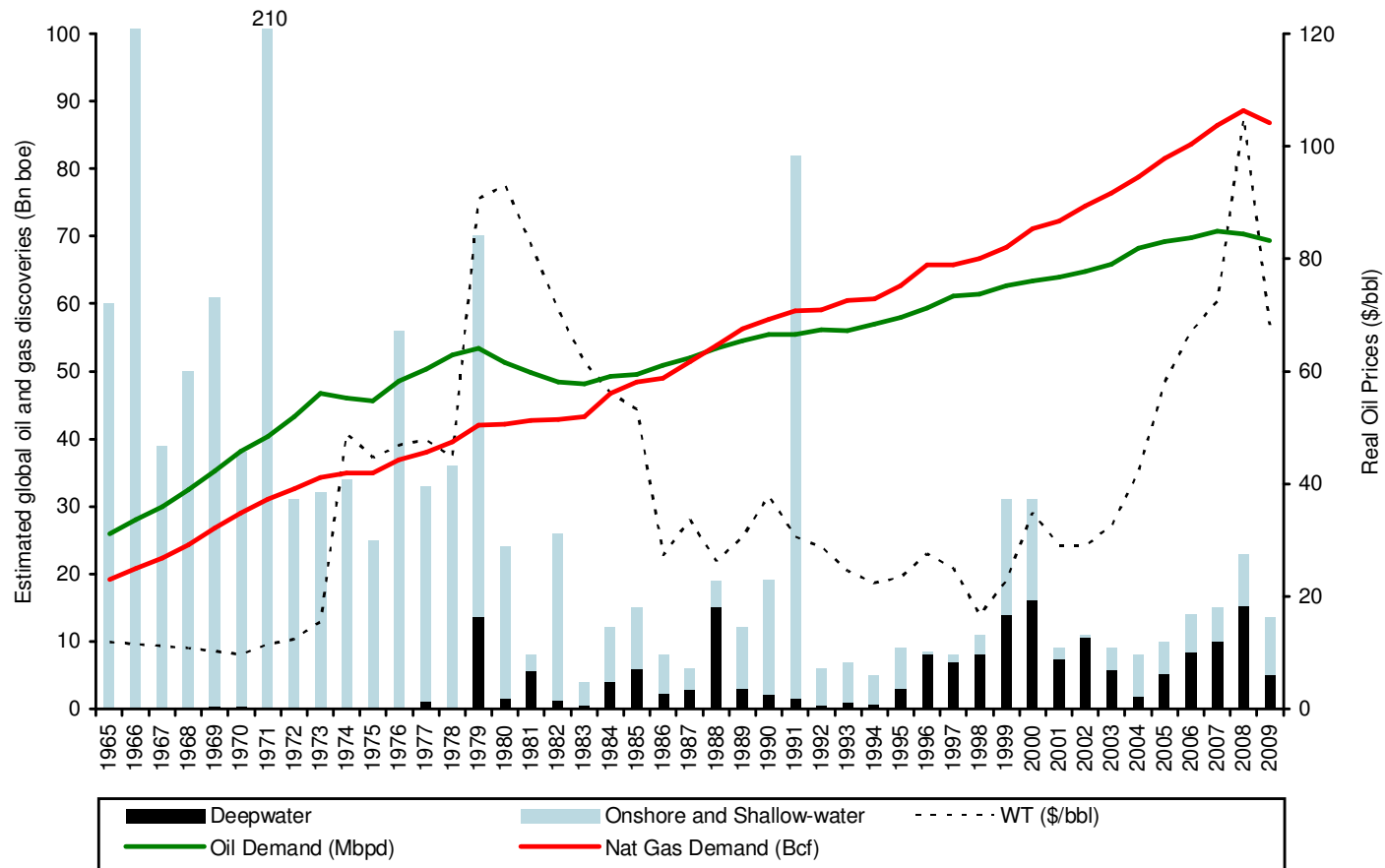
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Unconventional gas is needed because conventional is tougher to find

- Global natural gas demand has grown at 3.5% CAGR over the 1965-2009 period versus 2.3% for oil demand. Yet total discoveries during the last 10 years were only 1 fifth of those found during 1965-1975



Source: BP Stat Review, World Oil, IHS, Bloomberg and Bernstein estimates

Which is a problem as demand trends point to increasing gas needs

- Across South America, the Middle East, China and Europe/FSU our analysis leaves us to believe that more gas will be needed

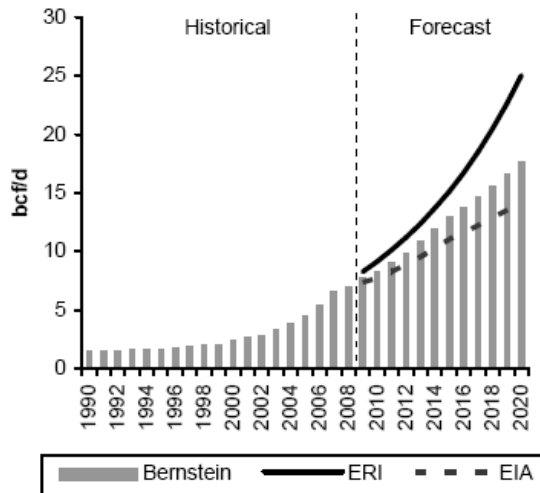
South America

Bernstein Base Case (in bcf/d)	2010E	2011E	2012E	2013E	2014E
Net Exports:					
Bolivia	1.17	1.21	1.24	1.28	1.32
<i>Total</i>	<i>1.17</i>	<i>1.21</i>	<i>1.24</i>	<i>1.28</i>	<i>1.32</i>
Net Imports:					
Brazil	1.03	1.13	1.21	1.31	1.38
Argentina	0.16	0.27	0.38	0.51	0.63
Chile	0.70	0.74	0.77	0.81	0.85
<i>Total</i>	<i>1.88</i>	<i>2.13</i>	<i>2.37</i>	<i>2.62</i>	<i>2.86</i>
Difference:	0.71	0.92	1.13	1.34	1.54

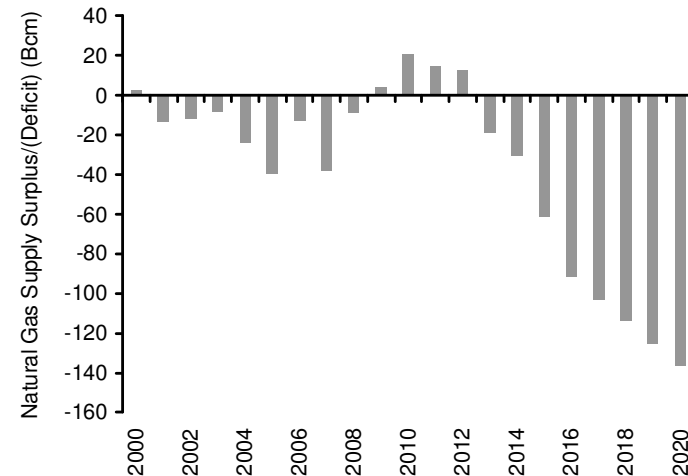
Middle East

(bcfd)	2010E	2011E	2012E	2013E	2014E
Production					
Iran	11.8	12.1	12.2	12.3	12.4
Kuwait	1.2	1.3	1.3	1.4	1.4
Oman	2.5	2.5	2.6	2.7	2.7
Qatar	9.5	10.8	11.4	11.6	11.8
Saudi Arabia	7.9	8.0	8.4	8.9	9.3
United Arab Emirates	5.0	5.1	5.3	5.4	5.7
<i>Total</i>	<i>37.9</i>	<i>39.8</i>	<i>41.2</i>	<i>42.3</i>	<i>43.3</i>
Consumption					
Iran	11.9	12.1	12.2	12.3	12.4
Kuwait	1.4	1.6	1.6	1.6	1.7
Oman	1.5	1.5	1.6	1.7	1.7
Qatar	2.1	2.2	2.3	2.4	2.5
Saudi Arabia	8.4	8.9	9.5	10.1	10.8
United Arab Emirates	6.3	6.7	7.2	7.7	8.3
<i>Total</i>	<i>31.6</i>	<i>33.0</i>	<i>34.3</i>	<i>35.8</i>	<i>37.3</i>
Difference	6.3	6.8	6.8	6.4	6.0

China



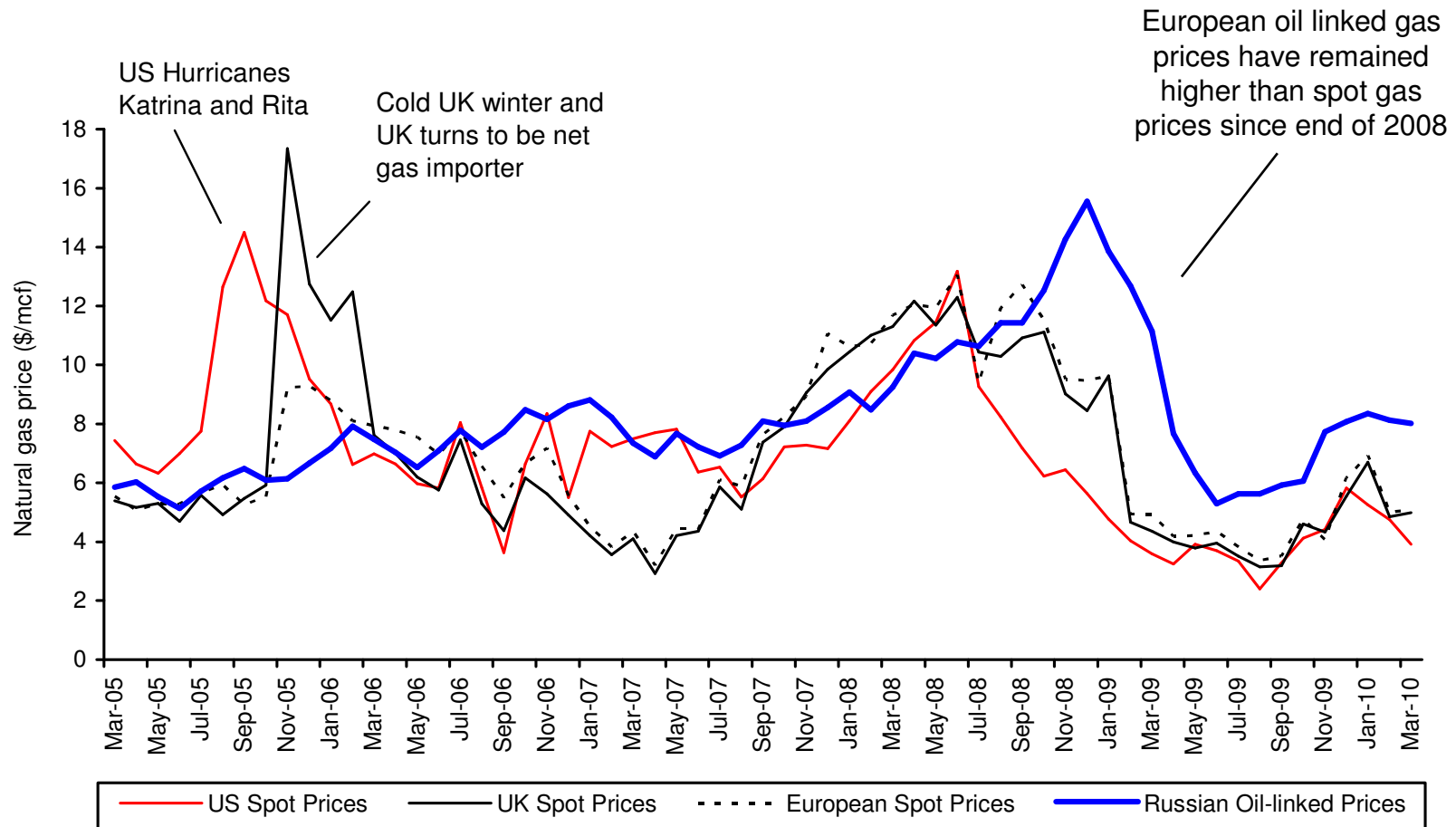
Europe and FSU



Source: BP Stat Review, Bloomberg and Bernstein estimates

US shale has provided a solution in the US but this is now impacting global gas prices

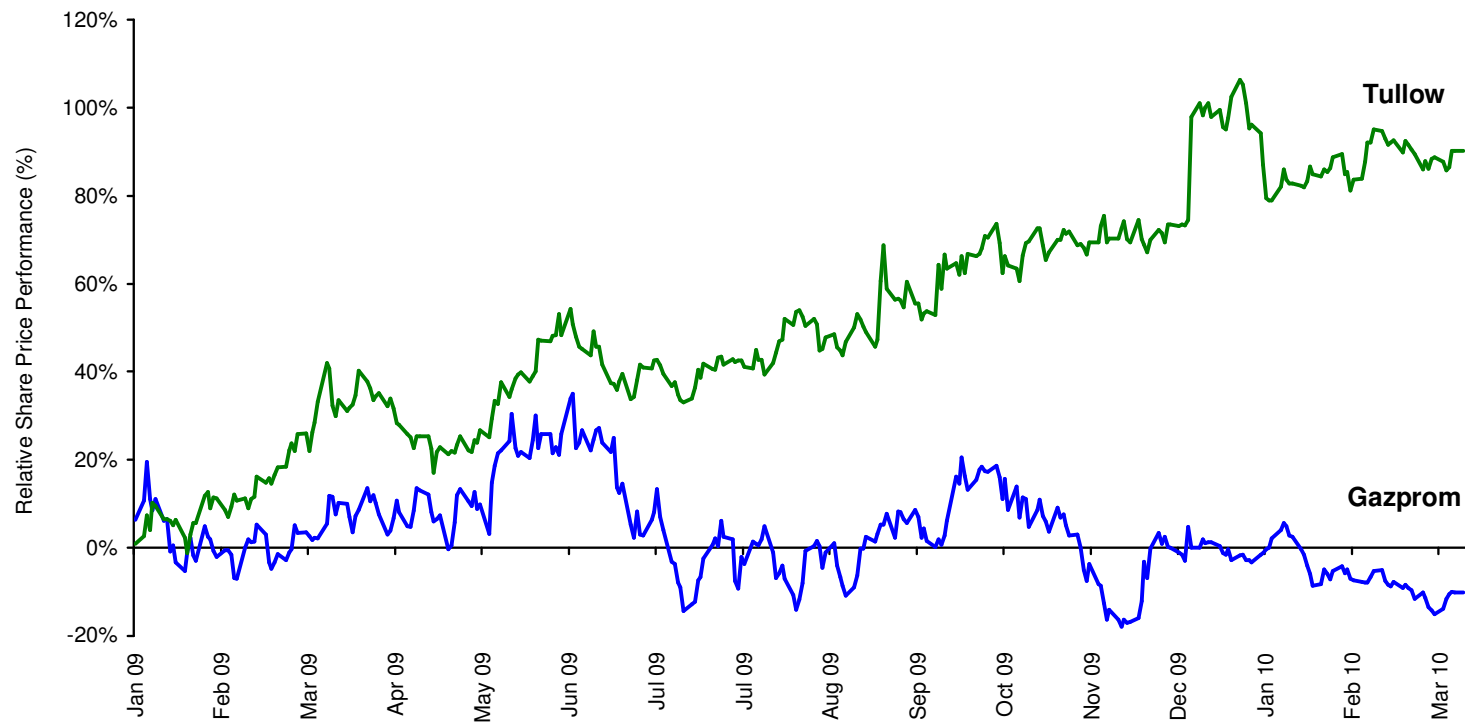
- While US gas markets are largely self contained, the rise of US unconventional gas is starting to impact gas prices outside of the US market



Source: Bloomberg and Bernstein estimates

US Shale and potential success elsewhere is also affecting share prices of exposed companies

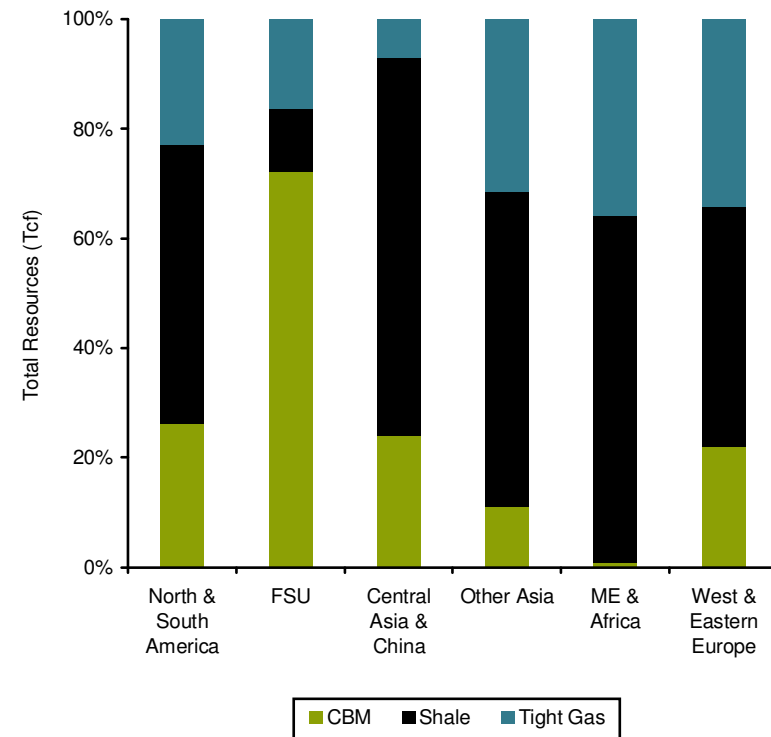
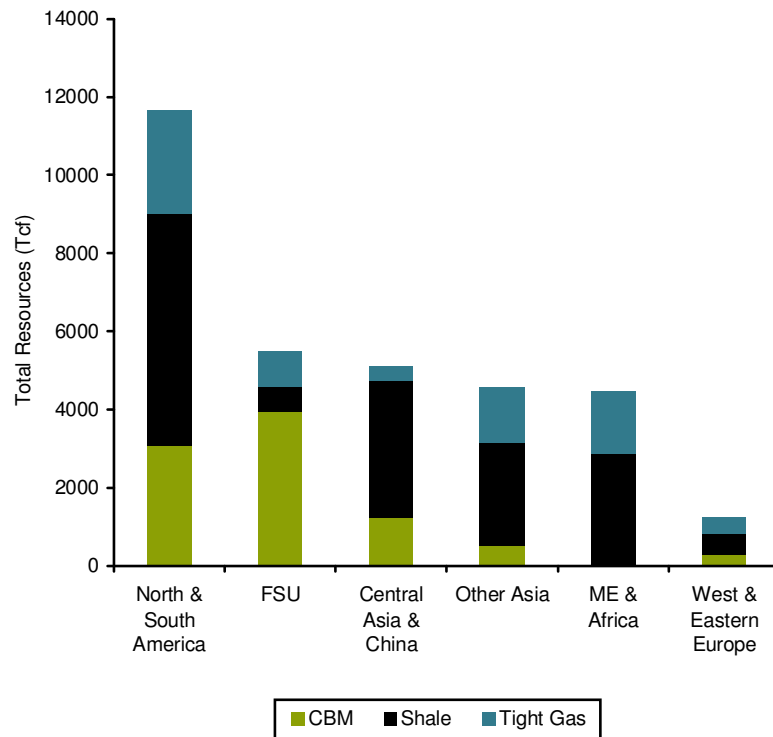
- Gas exposed companies such as Gazprom as suffering from this effect relative to non-exposed oil focused Upstream companies



Source: Bloomberg and Bernstein estimates

Global unconventional resources is the obvious answer

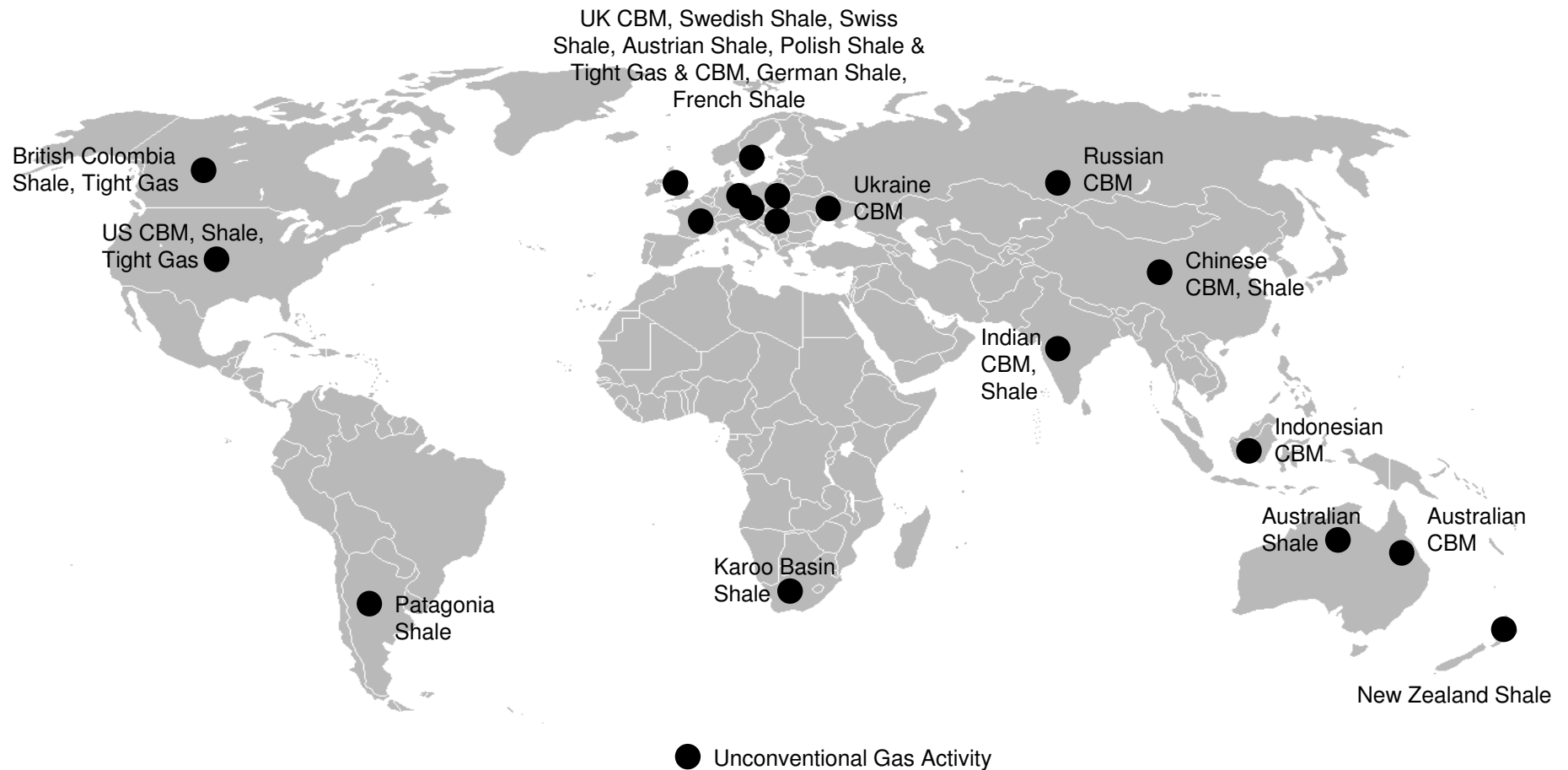
- With estimates of 33,000Tcf, unconventional resources are 5x currently the proven conventional natural gas reserves of 6500Tcf. 50% of these gas resources are held within 'Shale', which dominates in all regions except the FSU. While N. America has the largest estimated resource base, Europe has the smallest



Source: National Petroleum Council

Forcing the industry to quickly pick up positions and begin testing

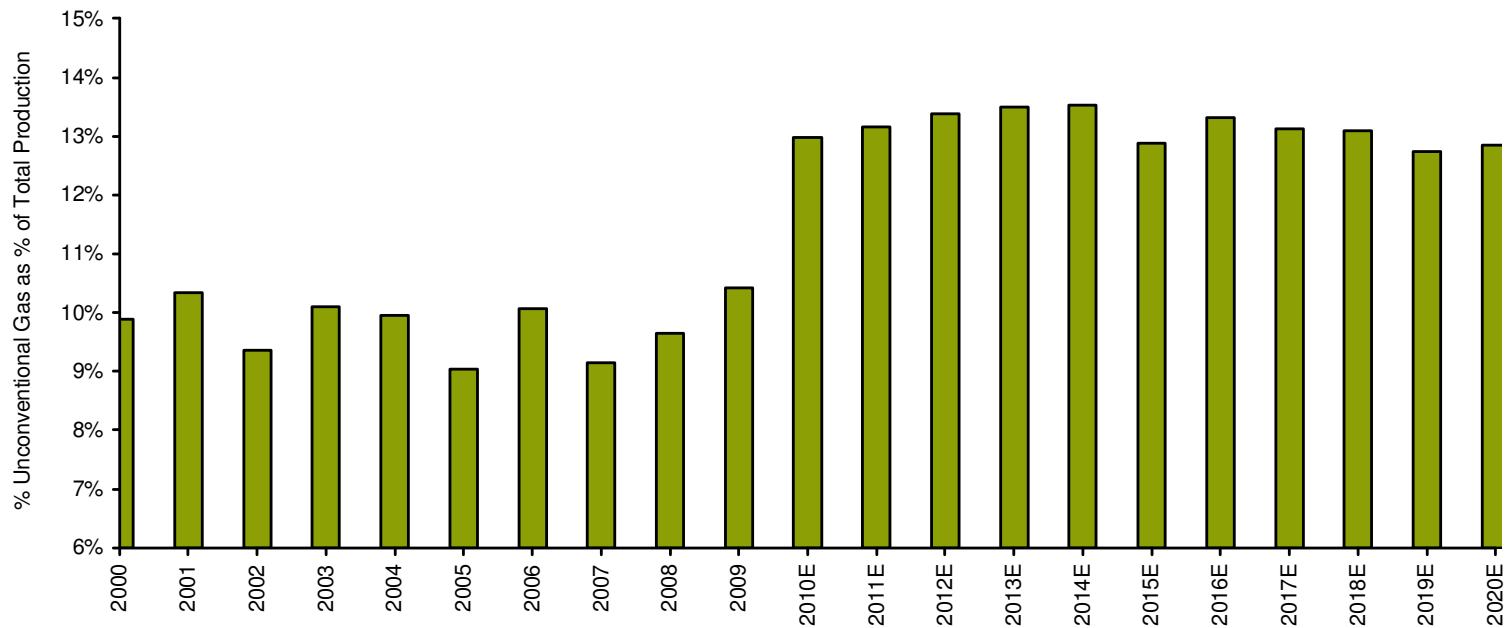
- After the US E&P entrepreneurs mastered the technology to unlock unconventional resource, the industry is now seeking new testing grounds globally



Source: Bernstein estimates

Which feed through to production profiles over the next decade

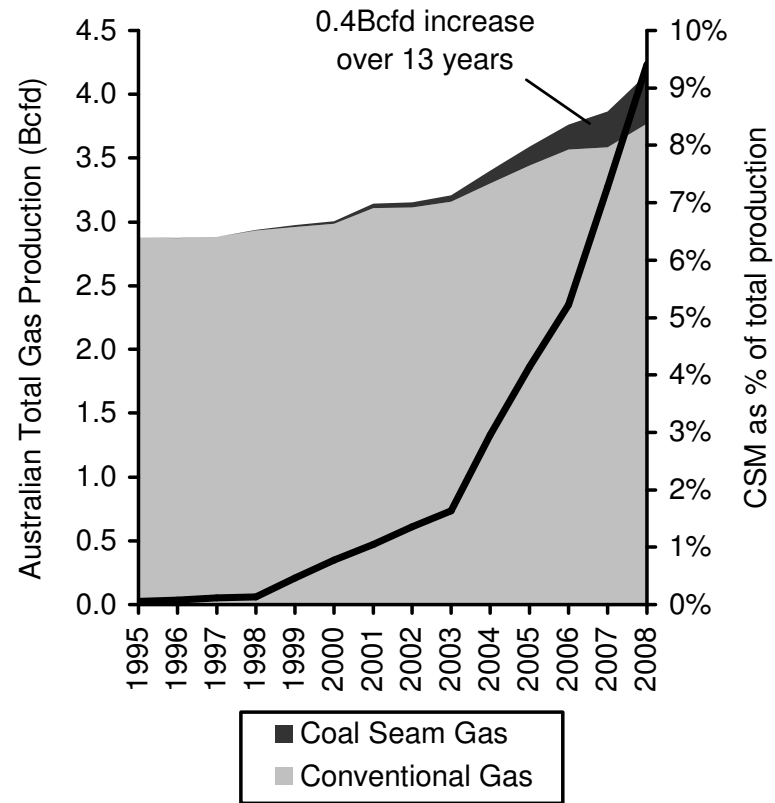
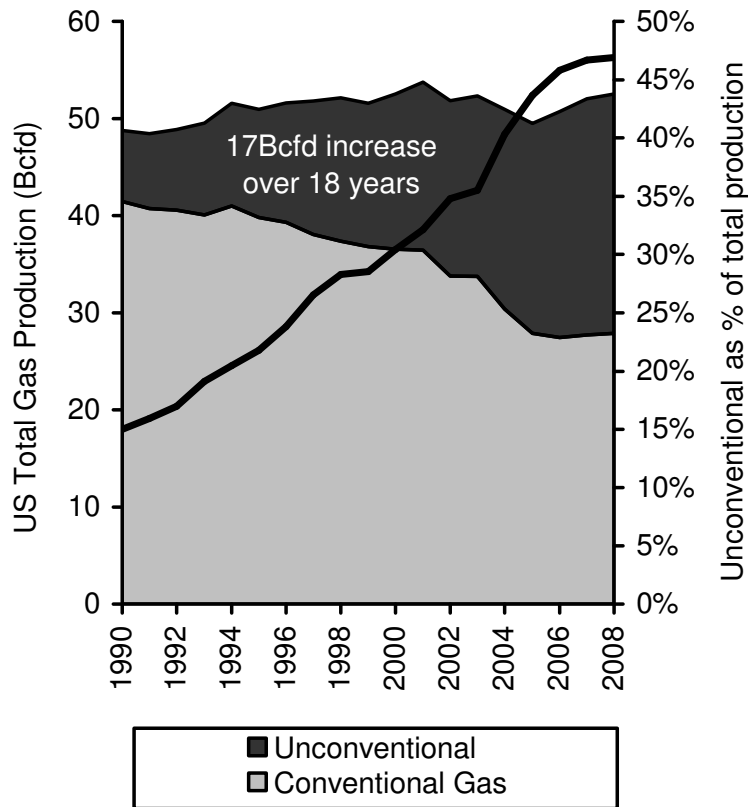
- The next decade will see unconventional gas across the largest western energy producers rise from around 9-10% in 2000-2009 to 13%-14% in 2010-2020



Source: Company reports and Bernstein estimates

Everyone will want to repeat the development success of the US

- US unconventional gas rose by 17Bcfd over the last 18 years, while Australian coal bed methane rose by only 0.4Bcfd over the last 13 years.



Source: EIA, BP Statistical Review, APPEA and Bernstein estimates

Europe's unconventional gas options



■ Shale gas ■ Tight gas ■ Coalbed methane

Source: Schlumberger

Europe's first attempt to make unconventional gas work

Hungary's \$50M tight sandstone program – Földeák-1 Frac Results

- Three hydraulic fracture stimulation tests in Szolnok Formation

– Frac #1 at 4,358 m

- average gas flow rate of ~200,000 scfpd (6,000 m³pd)
- average water flow rates of ~ 5 to 370 bwpd (2.5 to 60 m³pd)
- over a 10 day period
- H₂S rates averaged at 400ppm
- CO₂ averaged 16%

– Frac #2 at 4,200 m

- average gas flow rate of ~50,000 scfpd (1,145 m³pd)
- average water flow rates of ~1,200 to 3,100 bwpd (200 to 500 m³pd)
- over a 46 hour period
- H₂S rates averaged at 400ppm
- CO₂ averaged 16%

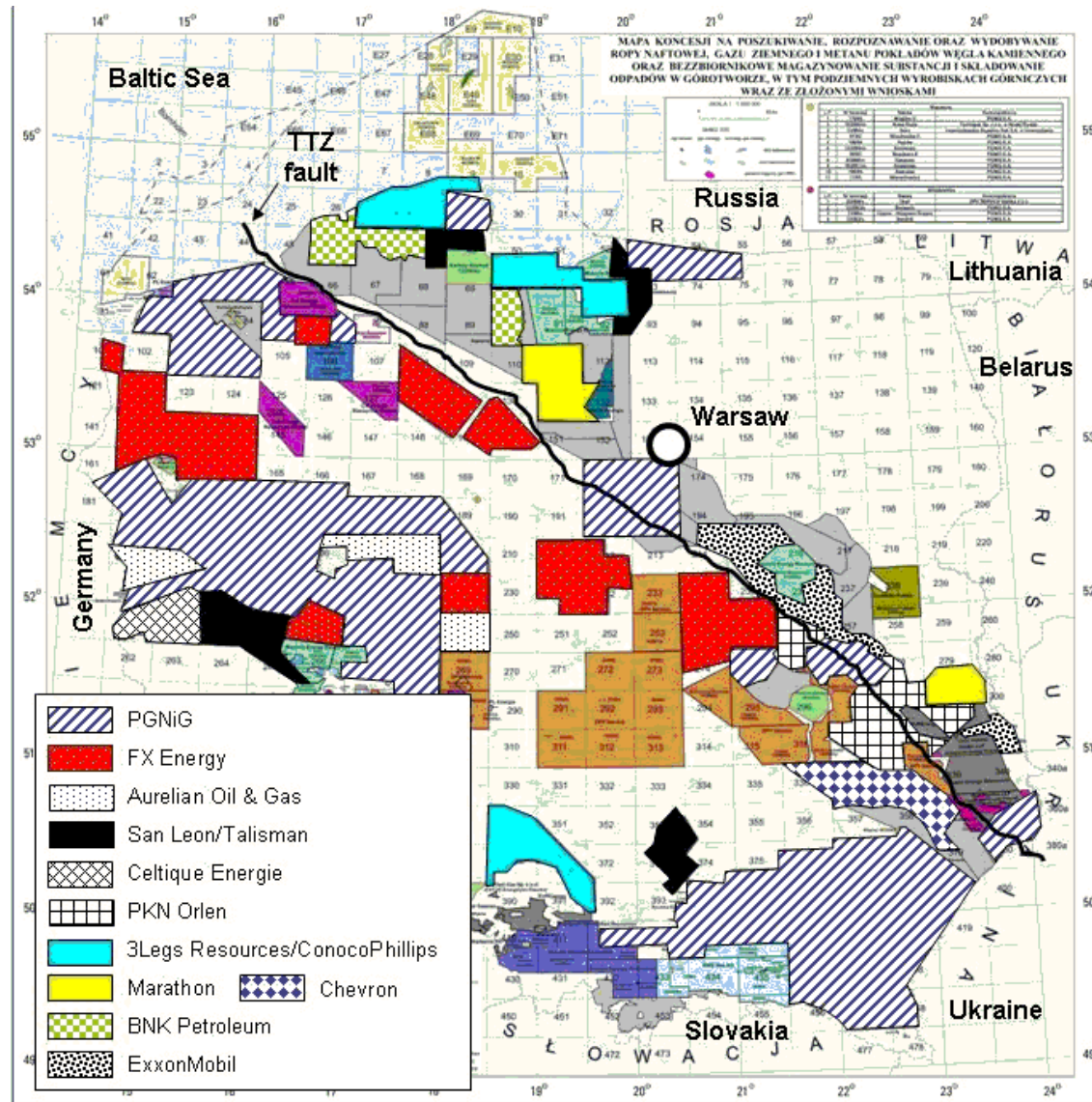
– Frac #3 at 3,850 m

- gas flow rate of ~20,000 scfpd (560 m³pd) down to 7,000 scfpd (200 m³pd)
- water flow rate of ~3,400 bwpd (540 m³pd) down to 300 bwpd (50 m³pd)
- over a 130 hour period
- H₂S rates averaged at 50ppm
- CO₂ averaged 10%

– Fresh water (10,000 ppm NaCl recovered in all tests)

Source: Company reports

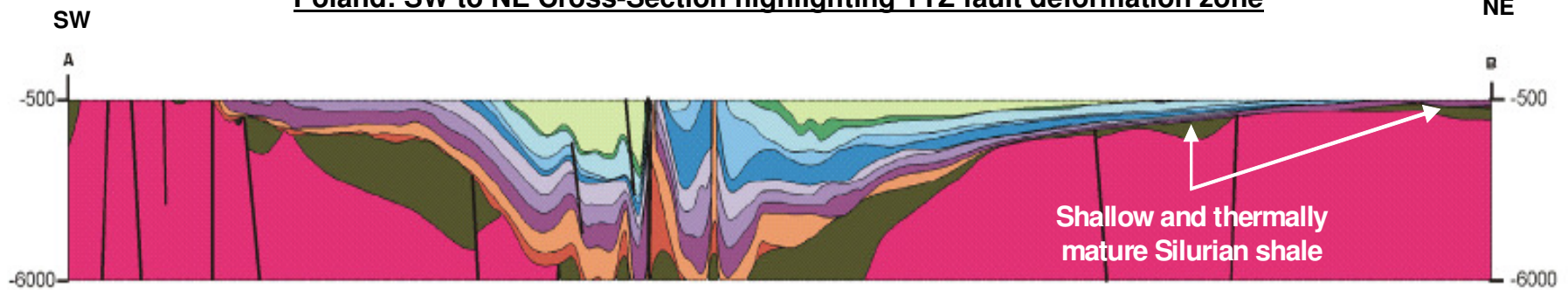
What about Europe's second testing ground – Poland?



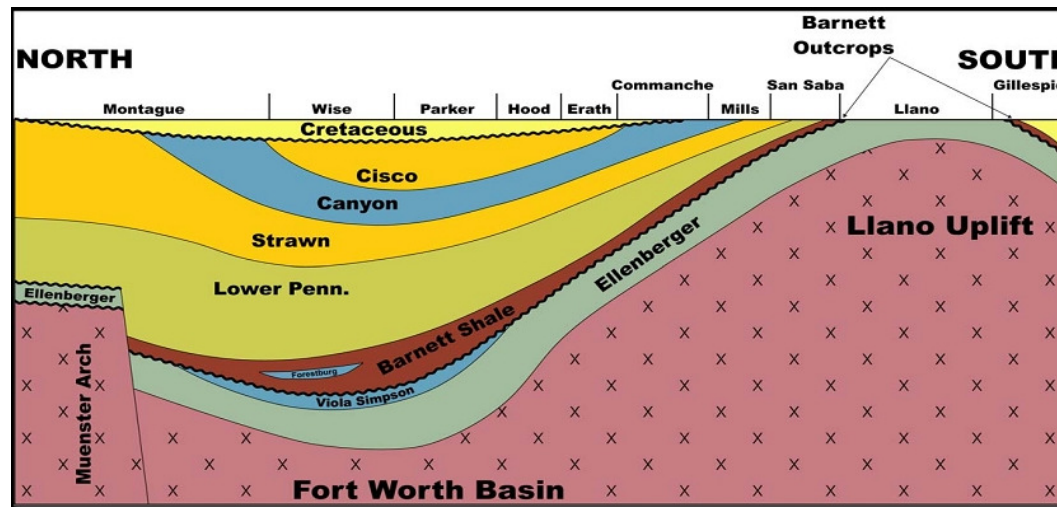
Source: Polish Ministry of Environment

1. Geology is likely to focus drilling away from the TTZ fault zone

Poland: SW to NE Cross-Section highlighting TTZ fault deformation zone



US Barnett shale: North to South Cross-Section

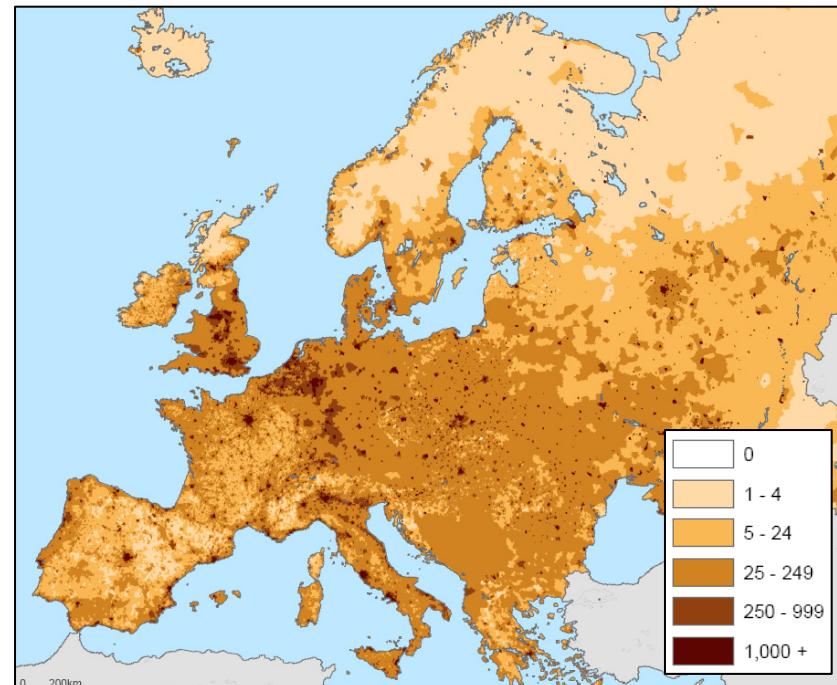
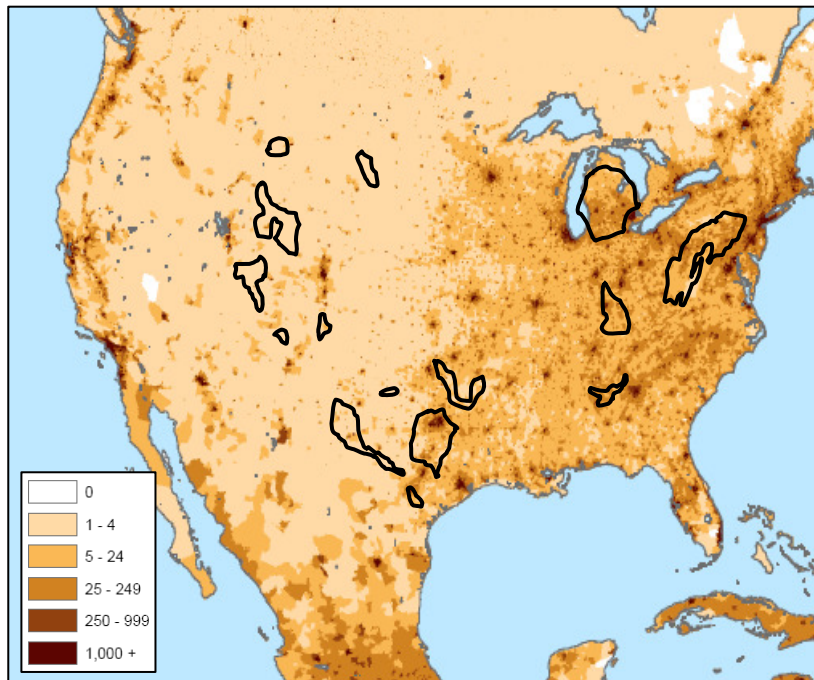


Barnett is located at depths of 1.9km – 2.6km

Source: Polish Geological Institute, Humble Geochemical

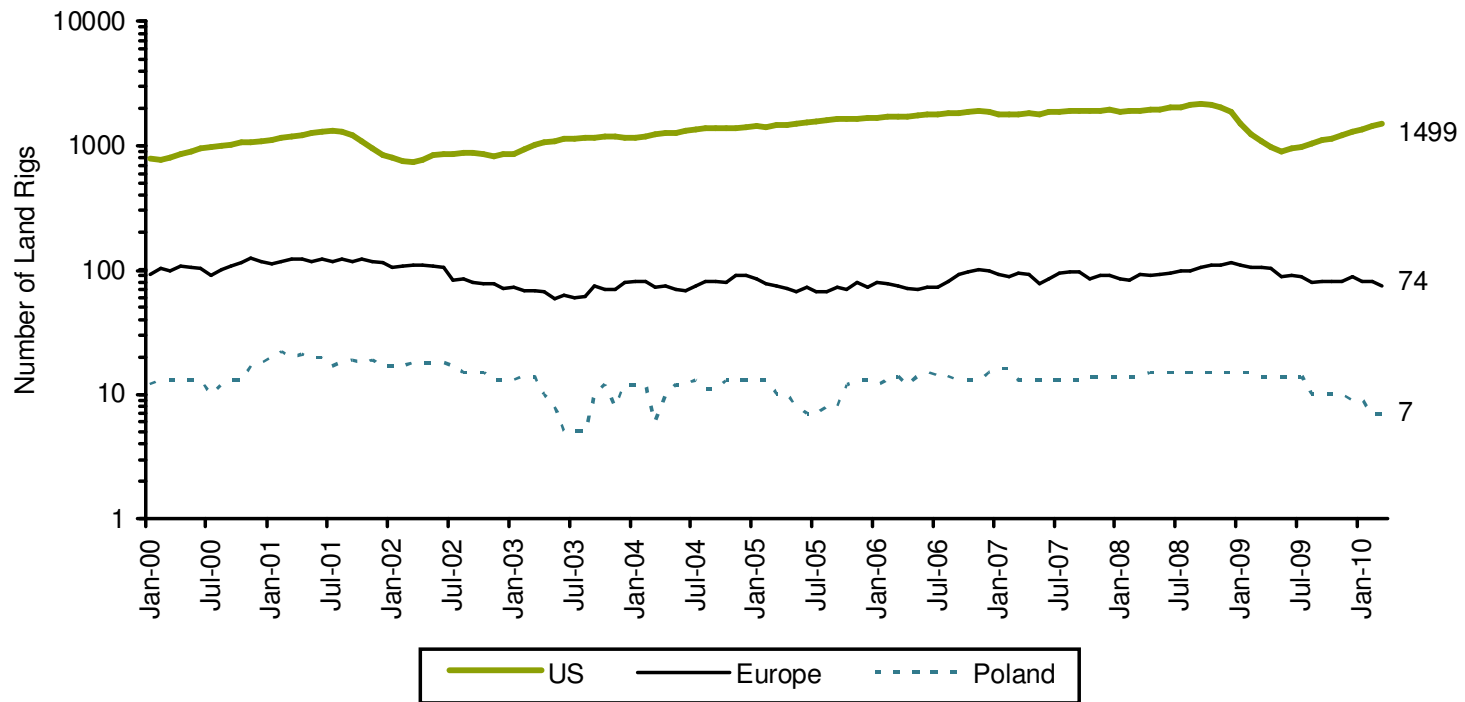
2. Population density is much more restrictive in Europe

- Poland and its European cousins are disadvantaged due to higher population densities of 100+ people/km², versus only 32 people/km² on average for the US



Source: CIESIN

3. Rig capacity will need to rapidly increase



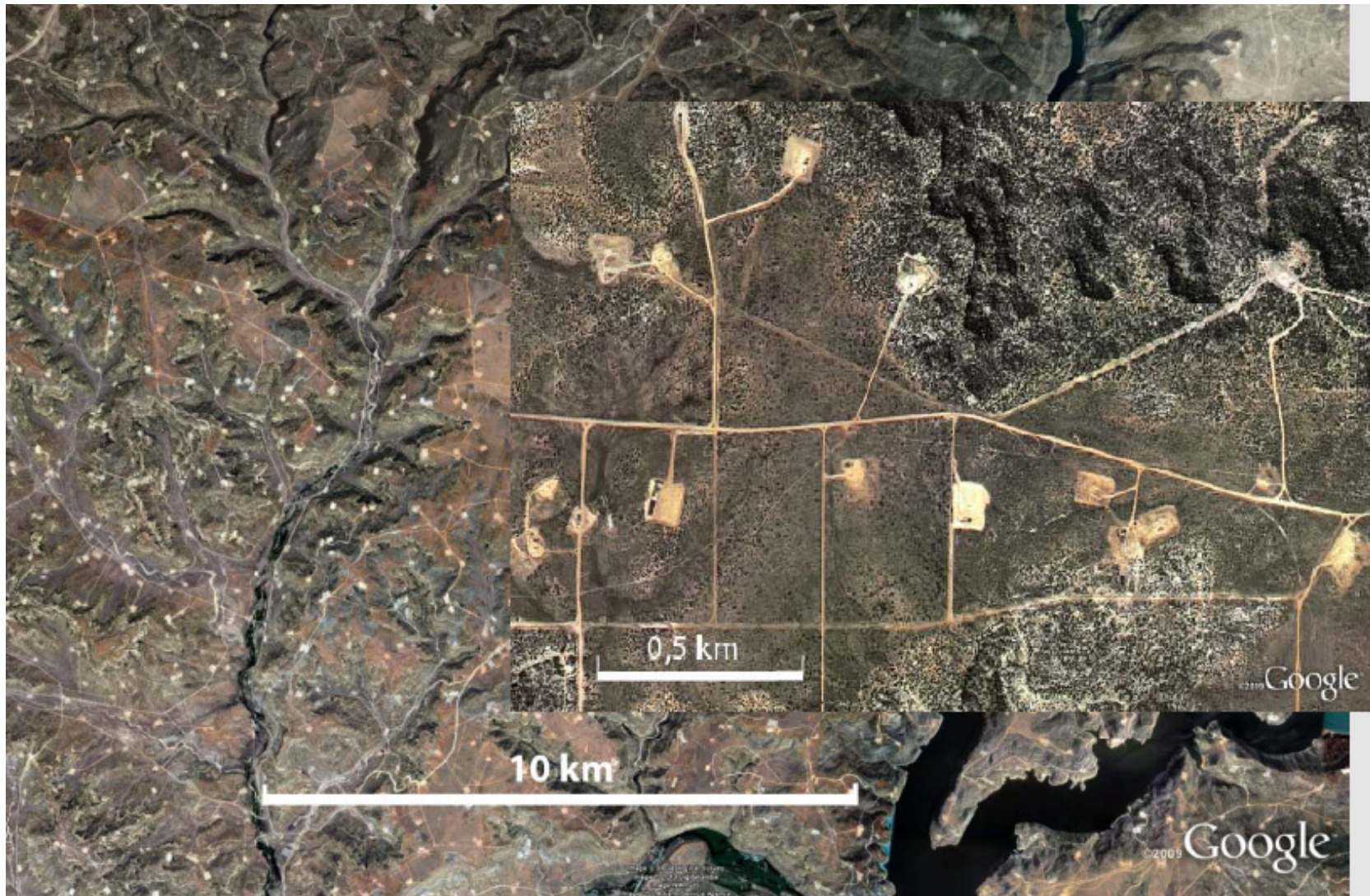
Source: Schlumberger and Bernstein estimates

4. Land Access - Barnett shale gas field, Texas



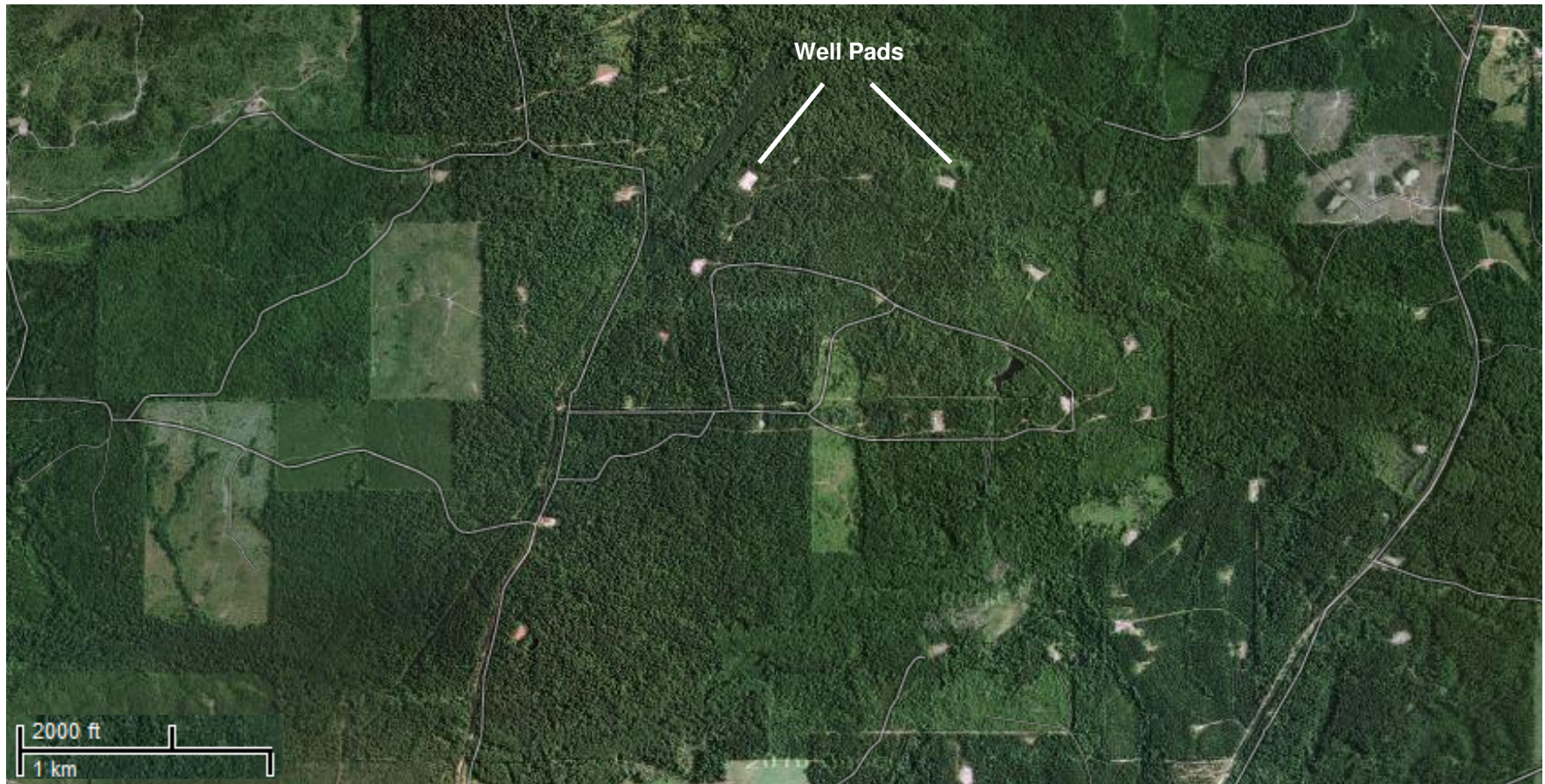
Source: Google Maps

4. Land Access - San Juan shale gas field, New Mexico

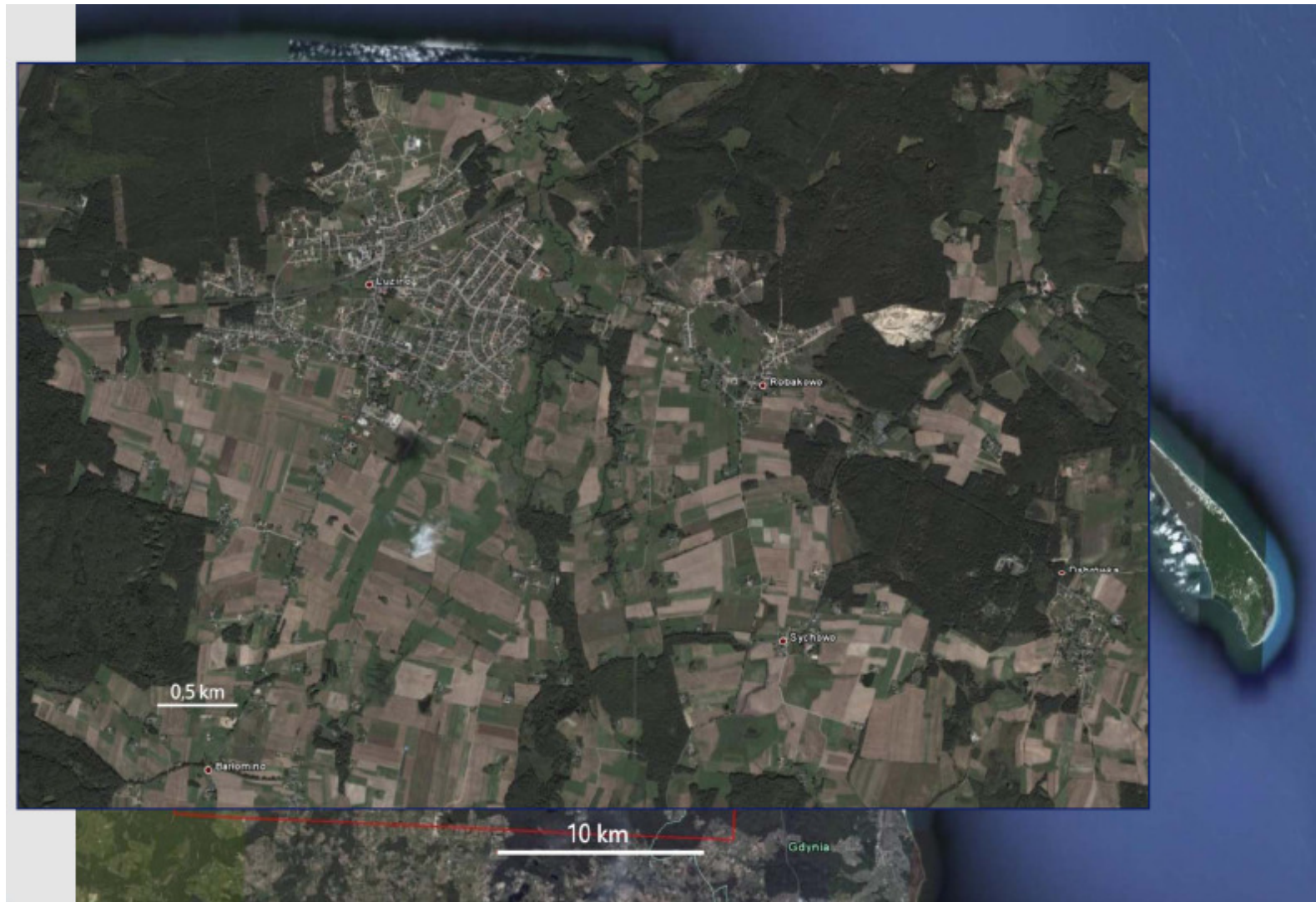


Source: Google Maps

4. Land Access - Marcellus shale gas field, Pennsylvania



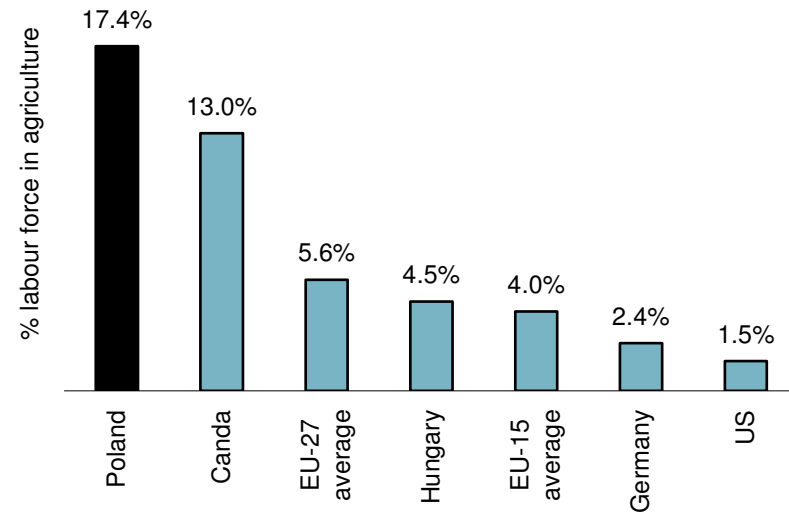
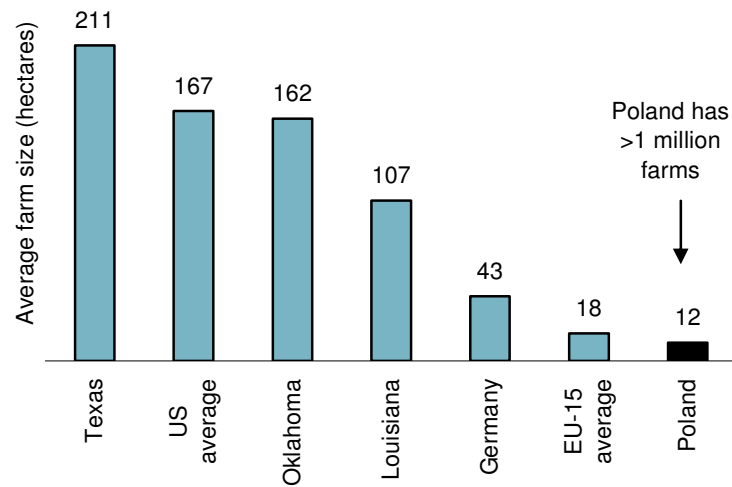
4. Land Access - How Poland compares to the US



Source: Google Maps

Dependence on agriculture and small farm sizes likely to lower development pace compared to US

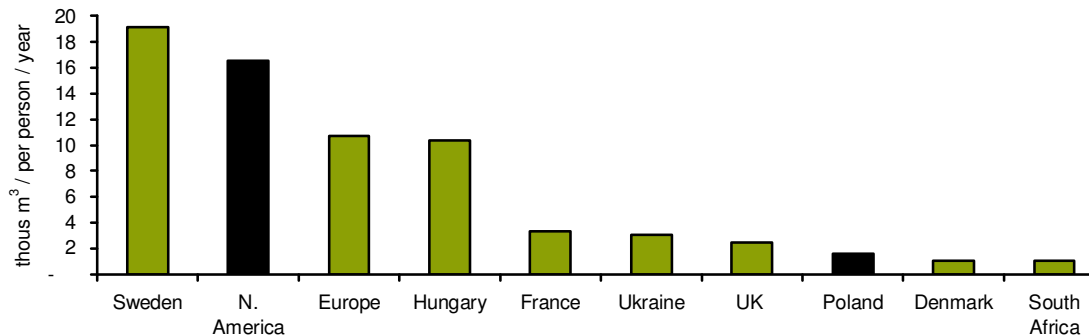
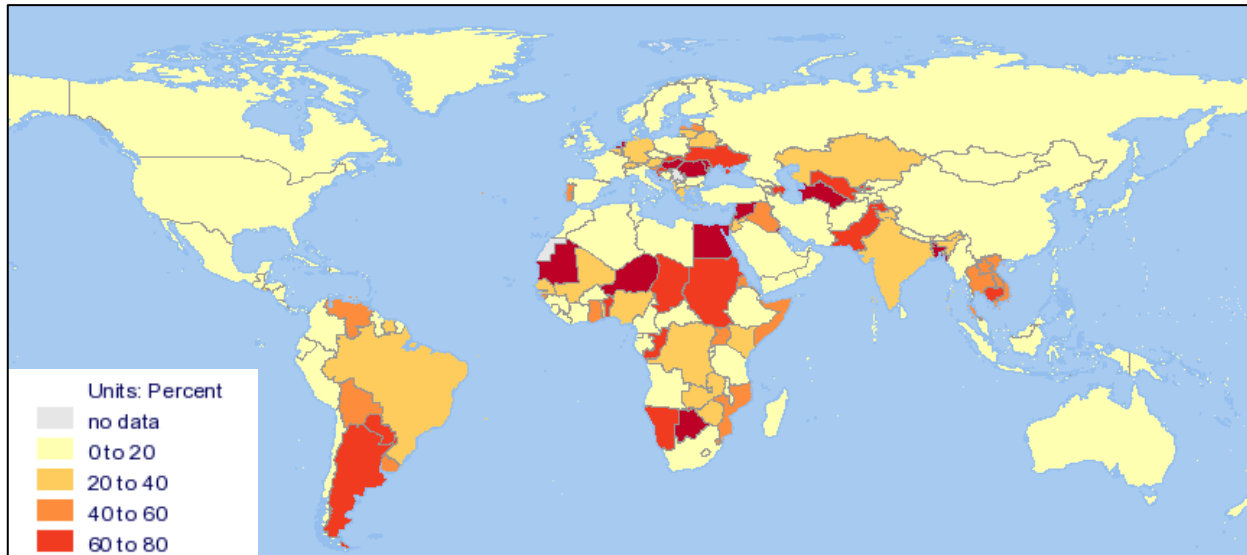
- The Polish landscape is littered with small farms with an average plot size of just 12 hectares versus 160 hectares in Oklahoma or 210 hectares in Texas. Agriculture remains a core part of the Polish economy with a 17% share compared to just 6% in EU-27 and 1.5% in the US



Source: Eurostat and US Department of Agriculture, CIA World Factbook

4. Water is not as freely available outside the US

- Water dependency outside of the US, excluding China, Australia and Russia is much higher and is likely to compete with hydro-fracturing drilling requirements



Source: United Nations Environmental Program, Water Resources Institute

How does Polish shale stack up against its US cousin?

	US							Poland
	Ohio	Lewis	Marcellus	Fayetteville	Barnett	Woodford	Haynesville	Baltic Basin
Basin Area (Sq Miles)	5000	1100	95000	9000	5000	11000	9000	9000
Depth (ft)	2,000-5,000	3,000-6,000	4,000-8,000	1,500-6,500	6,500-8,500	6,000-11,000	11,000-13,000	7,500-11,000
Gross thickness (ft)	300-1,000	500-1,900	50-300	50-325	150-700	320-400	1,200-1,300	500-1,600
Net thickness (ft)	30-400	200-300	n.a.	20-200	100-600	300-380	200-350	300-800
Shale Maturity (Ro, %)	0.4-1.3	1.6-1.88	0.7-2.15	>3.0	0.8-1.3	0.9-1.7	1.8-2.5	1.0-2.3
Total Organic Content (%)	0-4.7	0.45-2.5	0.4-10.5	4.0-9.5	0.8-8	6-6.5	0.5-4	0.7-9.9
Silica content (%)	34-52	36	20-60	20-60	35-50	52-70	34	25-63
Clay content (%)	13-52	35	20-35	20-40	<35	<30	33	34-44
Porosity (%)	4.7	3.0-5.5	4-14	2-8	4.5	4-12	8-15	5?
Pressure (psi)	Normal	Normal	Normal	?	Normal / Over-pressured	Normal	Over-pressured	Possibly Over-pressured
Gas content (scf/ton)	60-100	15-45	60-100	60-220	300-350	200-300	100-330	?
EUR per well (Bcf)	?	?	?	2.2	2.65	<2	6.5	?
Initial production rates (mmscfd)	na	na	4-5	1-3	1-3	1-4	6-12	?
Cost per well (\$M)	?	?	?	2-3	2-3	4-6	12	10
Frac spacing	na	na	6-12	10	6-8	12	12	?

Source: Company reports and Bernstein estimates

In the end, it all boils down to the cost of drilling

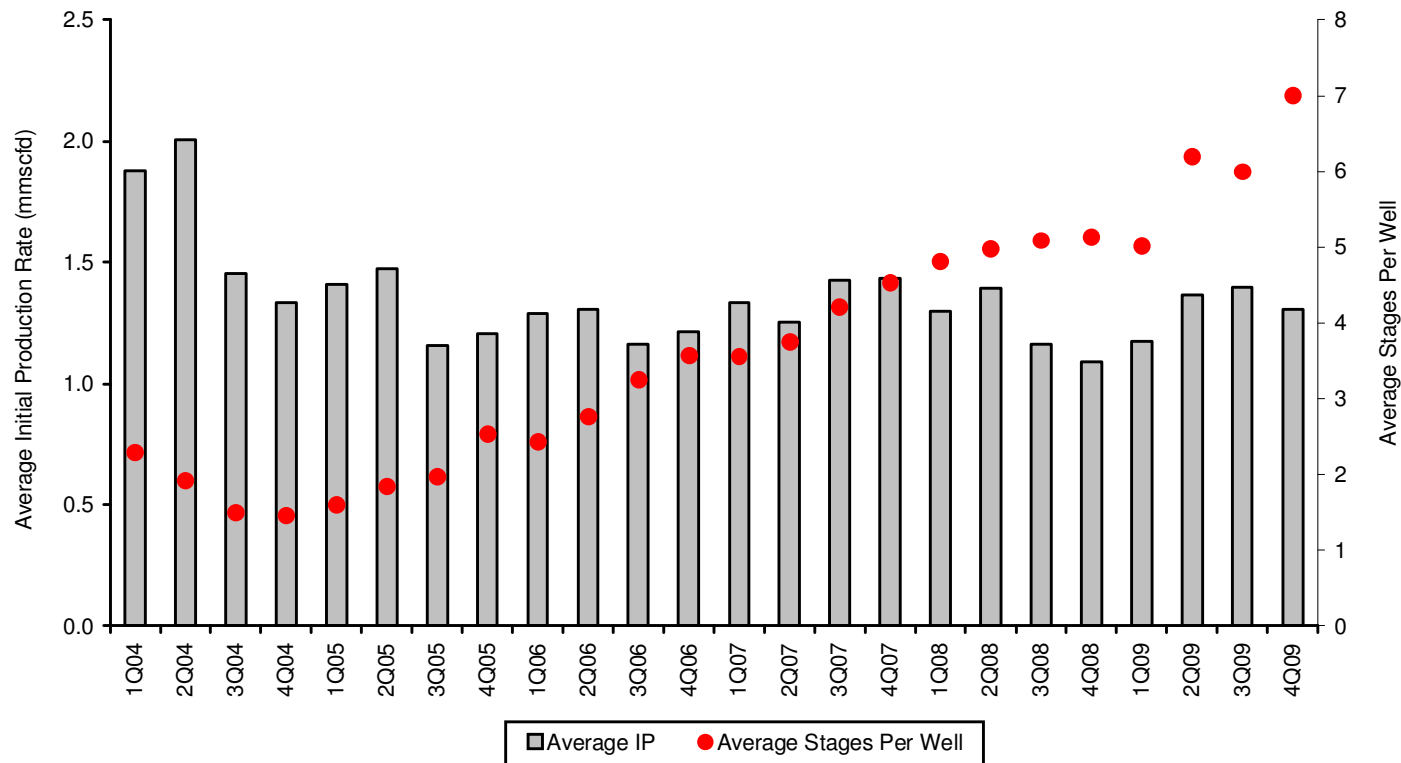
Poland Model Assumptions	
Initial production (mmscfd)	3.0
EUR (Bcf)	2.1
Acreage cost (\$)	0.55
Natural Gas Price (\$/mcf)	9.30
Gas Price Inflation	2.5%
Operating Costs (\$/mcf)	1.05
Op Cost Inflation	2.5%
Royalties (%)	0.83%
Tax	19%
Discount Rate	10%
Drill Capex (\$M)	2.0
Tie in cost (\$M)	4.0
Completion Capex (\$M)	4.0
SG&A (\$/mcf)	0.5
Resulting Economics	
NPV	\$0.4M
IRR	13%

Poland Model Assumptions	
Initial production (mmscfd)	3.1
EUR (Bcf)	2.1
Acreage cost (\$)	0.55
Natural Gas Price (\$/mcf)	6.80
Gas Price Inflation	2.5%
Operating Costs (\$/mcf)	1.05
Op Cost Inflation	2.5%
Royalties (%)	0.83%
Tax	19%
Discount Rate	10%
Drill Capex (\$M)	2.0
Tie in cost (\$M)	4.0
Completion Capex (\$M)	4.0
SG&A (\$/mcf)	0.5
Resulting Economics	
NPV	-\$2.6M
IRR	n/a

Poland Model Assumptions	
Initial production (mmscfd)	4.5
EUR (Bcf)	2.1
Acreage cost (\$)	0.55
Natural Gas Price (\$/mcf)	6.80
Gas Price Inflation	2.5%
Operating Costs (\$/mcf)	1.05
Op Cost Inflation	2.5%
Royalties (%)	0.83%
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Discount Rate	10%
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Tie in cost (\$M)	4.0
Completion Capex (\$M)	4.0
SG&A (\$/mcf)	0.5
Resulting Economics	
NPV	\$0.4M
IRR	13%

Costs should come down with new technology but not always so

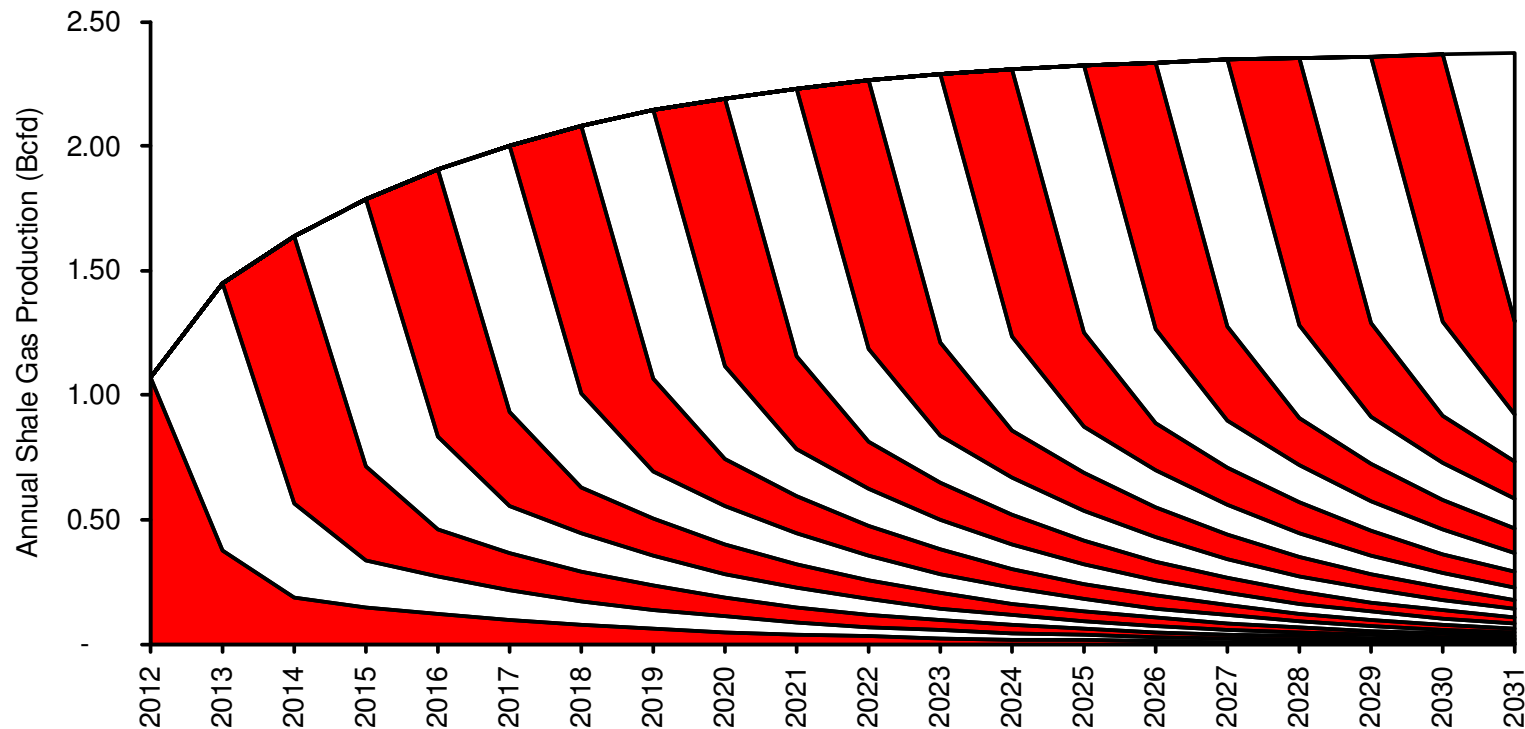
- In the Barnett shale play in the US, this producers costs rose over time as increasing numbers of ‘frac’s’ were needed to maintain initial production rates. Indeed, the Barnett economics peaked in 2005, when the play was at just 10% of peak production



Source: Company reports and Bernstein estimates

If it did work – how much gas could we expect in Europe?

- If we assume Europe's 67 land rigs are moved to Poland and consistently drill 10-11 wells per year with an average first year production of 3mmscfd, then plateau production would reach 2.2Bcfd (803Bcf, 22.4Bcm) by 2020 or 4.5% of current annual European consumption



Source: Bernstein estimates

What about China?

- China has some the third largest coal reserves in the world, with 14% of global reserves which explains why CBM is the largest estimated available unconventional resource. Most are in Central China’s Ordos region and in western China (Junggar and Tarim basins)

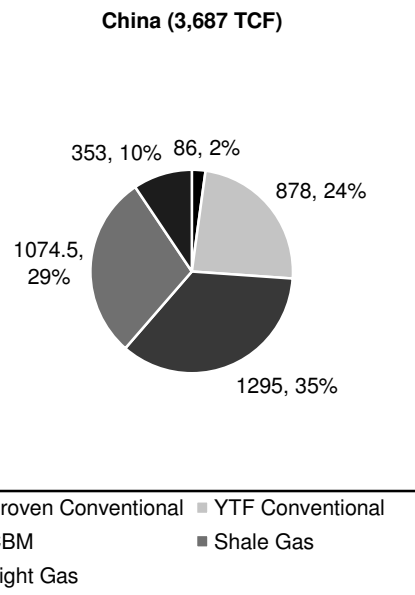


TABLE 2—COMPARISON OF CHARACTERISTICS FROM SELECTED COMMERCIAL COALBED-GAS PROJECTS

Basin	Field	Area (sq miles)	Coal Thickness (ft)	Coal Rank	Gas Content (scf/ton)	Permeability (md)	Well Spacing (acres)	Well Count	Gas Rate/ Well (Mscf/D)	OGIP (Bscf)	FF (%OGIP)	Reserves (Bscf/well)
San Juan (US)	Ignacio Blanco	60	40–70	Bituminous	300–600	5–50+	60–320	130	1,500	1,760	66	3–15
Uinta (US)	Drunkard's Wash	120	4–48	Bituminous	425	5–20	160	450	500	1,571	57	1.5–4
Black Warrior (US)	Cedar Cove	65	25–30	Bituminous	250–500	1–25	80	520	100	809	53	0.5–1.5
Powder River (US)	Recluse Rawhide Butte	75	40–90	Subbituminous	30–70	5+	80	600	150	288	62	0.2–0.5
Western Canadian Sedimentary (Alberta)	Horseshoe Canyon	620	35–110	Subbituminous	55–110	0.1–100	80–160	3,300	45	4,393	28	0.25–0.5
Bowen Basin (Australia)	Fairview	430	50–100	Bituminous	200–400	100	250	80	700	450	60	2.5–3.5
Qinshui Basin (China)	Yangcheng-Qinshui	22	20–40	Anthracite	300–900	<1–5	80	40	70–140	100	20	0.4–0.8

Source: BP Stat Review, Shale Gas In China; Liu 2008; Coal Bed Methane in Exploration in China, Qiu 2009, Coal Bed and Shale Gas reservoirs, SPE, Jenkins, DeGolyer and McNaughton and Boyer 2008

Disclosure Appendix

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12-Month Rating History as of 4/26/2010

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BG/.LN - O (IC) 1/22/2009
CNE.LN - O (IC) 1/22/2009
GALP.PL - M (IC) 1/22/2009
LKOD.LI - U (IC) 1/15/2009
NVTK.LI - O (IC) 1/15/2009
OGZD.LI - O (RC) 7/16/2009, M (IC) 1/15/2009
PMO.LN - O (RC) 2/19/2010, M (IC) 1/22/2009
ROSN.LI - U (IC) 1/15/2009
SGGD.LI - U (IC) 1/15/2009
STL.NO - M (IC) 1/22/2009
STO - M (IC) 1/22/2009
TLW.LN - O (IC) 1/22/2009

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