



Profitable unconventional gas

Is it possible in Europe or only in America?

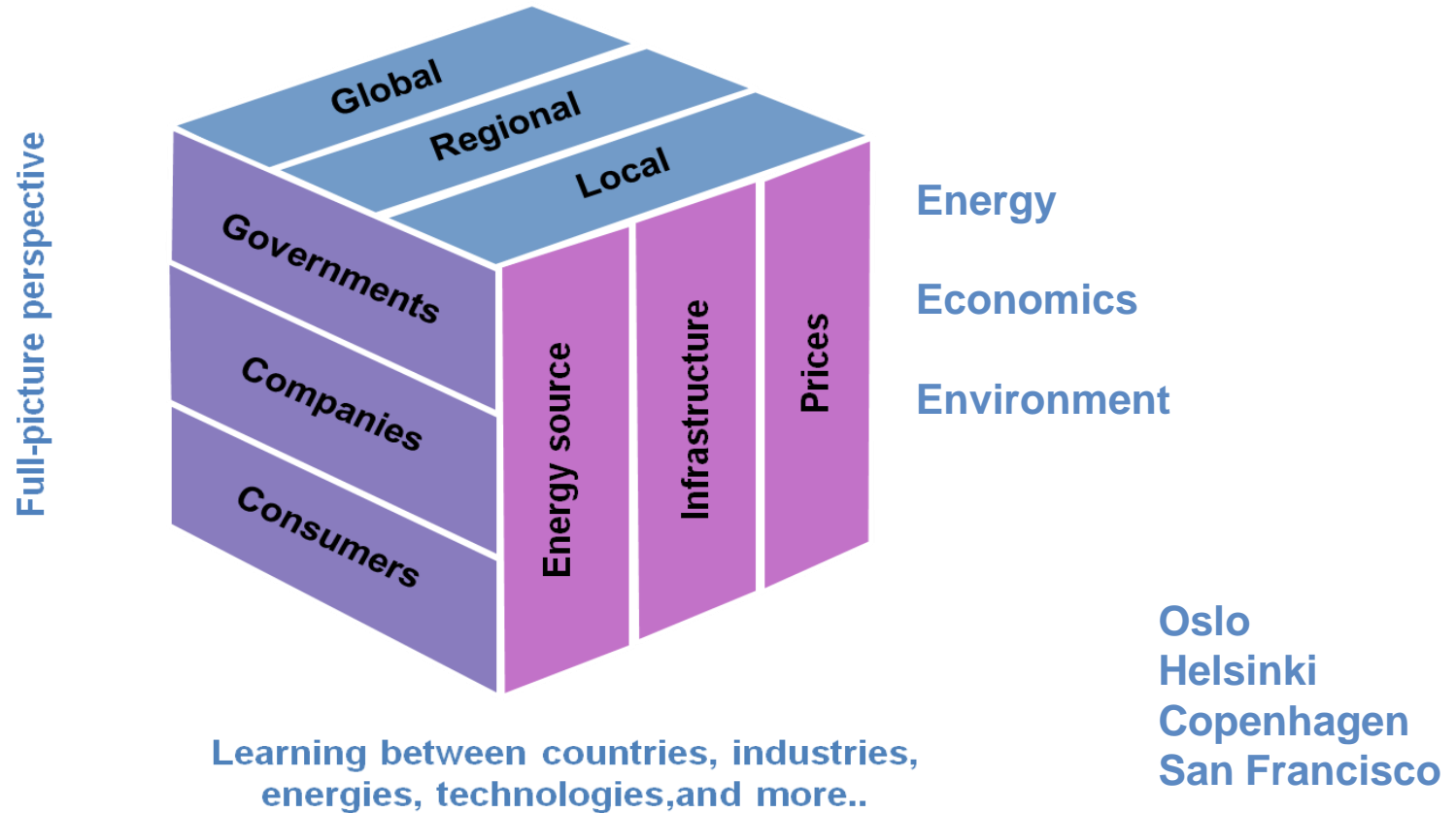
Karen Sund

20 September 2011

2nd Unconventional Gas Conference

www.sundenergy.com

Sund Energy helps navigate into the energy future...



...by understanding the full picture of stakeholders

Impact of unconventional gas reserves on Europe

Profitability: Income vs costs

- Most focus on cost in general – here some focus on income & margin
- US, Asia and Europe – differences

Areas of use and payability

- Future scenarios for Europe
- Value of own, variable production
- Balancing has a margin – who should have it?
 - Oil producers internationally?
 - Storage?
 - Variable domestic production?
- Learning or comparisons from those ahead of us?
- New logic – easier to replace oil (US and China)



April 2011

Conclusion

Large investments in unconventional gas

Many years of small scale by small companies

- Lower investments and shorter lead times
- Attention to detail and creativity important

Suddenly large scale and entry of majors

- Competitive advantage of global technology?
- Cheap way to increase "oil equivalent" reserves

Does this mean it is profitable?

- Varying costs, but US around \$4/mmbtu
 - Europe expected to be twice that...
- Liquids (NGL, crude oil) help economics
 - Strong focus in US now: Bakken, Eagle Ford
 - Paris Basin has oil, too...
- Some flexible supplies could get higher prices
 - What is the alternative? Storage, LNG, or no gas?



Several factors to consider - economics

Lower capex and higher opex than alternatives

- Opposite to nuclear and coal?
- Very different from large gas fields exporting to Europe
 - High capex and low (even negative at times) opex

Where does it fit in the supply cost curve?

- Based on own perception of profitability – not waiting for others

More suited to variable production

- This could have value in the market

How will it be packaged for payability?

- Local, flexible, secure, clean enough?

Europe is behind many – that could add to learning

US: “Unconventional is becoming conventional – half of all gas”

- Some bad reputation and negative stories – but contribution, too!
- Economics with liquids – different focus
- Gas has been kept down due to rising dependency on imported LNG
- Now perhaps the easiest way to reduce oil imports and emissions

China: Distributed production of energy – that can replace oil

- Want to keep down oil prices and imports
- Also focus on local emissions – sulphur, particulate matter etc.
- Using more gas fixes several problems – and is good for the economy!
- Good at commercialisation - especially transportation sector

Others, too – impacting the global gas outlook!

- Australia, Argentina, Ukraine, Russia, South Africa...

Unconventional gas sources are large in China...

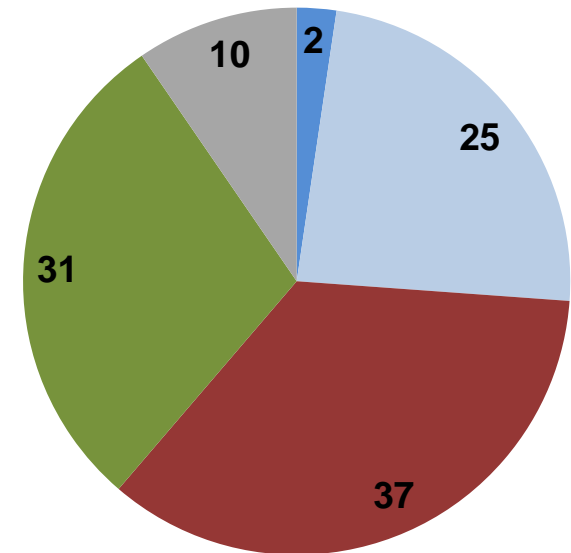
Domestic gas production is growing...

- Especially coal-bed methane
 - First commercial project in 2005
- Plans for rapid scale-up by Chinese majors
 - Petrochina, Sinopec and more
- Private players also active in the market
 - Green Dragon Gas, Far East Energy, Fortune Oil, Enviro Energy
- Profitability seems clear
 - Higher prices than US – lower cost?
 - Players and government interested

...but imports may also increase

- Petrochina already imports pipeline gas from Central Asia
- More capacity is planned, both by pipeline and as LNG
- Slower growth in imports after boost of own production, but still significant!

China's gas reserves by type



- Conventional
- YTF conventional
- CBM
- Shale gas
- Tight gas

Data: Bernstein Research, 2010

... could China be an inspiration for Europe?

Full value chain possible

- From CBM directly to CNG for transportation – at a profit:
 - \$ 9.1/mmbtu to wholesale/ large industry
 - \$14.6/mmbtu on average to cars at own and partner retail gas stations

Great value of distributed energy in large countries like China

- Unconventional gas, wind, other



Source: Green Dragon Gas, 2011

Europe has less shale than US & China, but not little!

Top 10 European shale gas resources*	Natural gas reserves** (Tcm)	Importers (✓)/ Exporters(X)	Shale gas resources* (Tcm)	Shale gas production by 2020***
Poland	0.16	✓	5.30	✓
France	0.01	✓	5.10	✓
Norway	2.04	X	2.35	?
Ukraine	1.10	✓	1.19	✓
Sweden	–	✓	1.16	?
Denmark	0.06	X	0.65	✓
UK	0.25	✓	0.57	✓
Netherlands	1.39	X	0.48	✓
Turkey	0.01	✓	0.42	✓
Germany	0.17	✓	0.23	✓
Others			0.54	

Source: World Shale Gas Resources: An Initial Assessment of 14 Regions Outside the United States, April 2011

* Technically recoverable shale gas resources

** Proved conventional natural gas reserves

*** Sund Energy estimates

**Assuming only 5% recovery
from likely countries: 750 bcm**

Will we beat the prejudices against us?

“Europe is not like Texas – there is not enough space”

- Poland, France, Italy, Ukraine, even UK has open countryside



“Europe is full of environmentalists that would never accept it”

- Compared to open-cast lignite mining, more nuclear, expensive wind...
- Not all unconventional is as bad as some of the reputation of shale gas
- Environmentalists do not agree – local, national, global, fossil, nuclear
- Accidents can be prevented with good regulation

“Europe has no rigs”

- The industry is global, there is onshore drilling already
- These rigs take 6 months to build...

“Europe has no entrepreneurs”

- Really? No hungry business people in any country??

Public opposition to shale drilling in France



Source: Berg & Coiron, March 2011

UK has started with CBM, UCG and shale

Coal-bed methane onshore

- Often small, little visible impact
- Small crews, horizontal drilling
- Shallower than shale

Permitting and water important

- Permits often under coal authorities

Government support could help

- Not impossible in light of potential
- Positive impact on domestic economy
- Access, regulation, funding, feed-in tariffs relevant

Other aspects in the UK

- “New” domestic gas could be preferred in economic turn-around
- CBM, shale, UCG (underground coal gasification), and even biogas

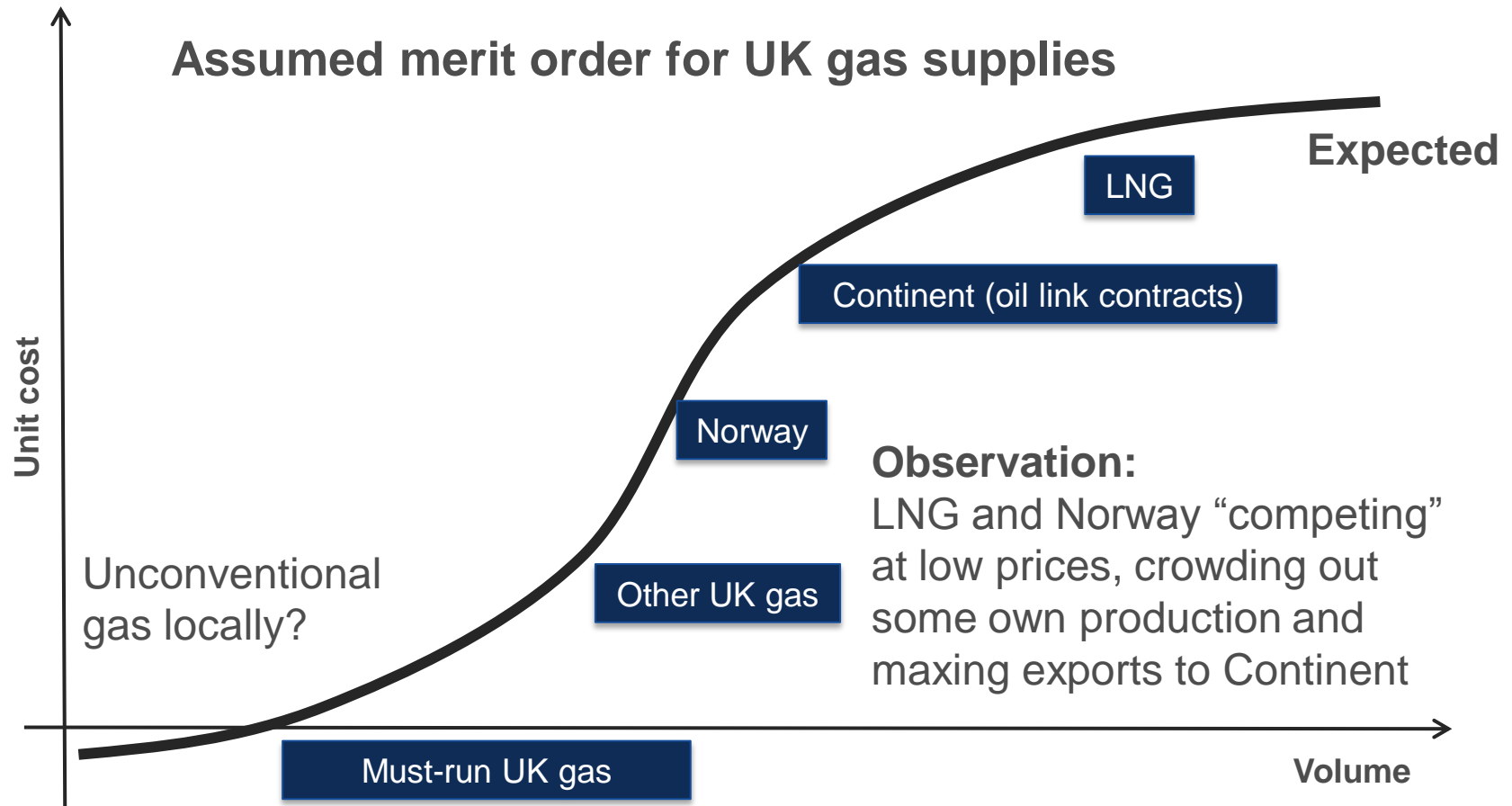
As with other issues, stakeholder management is important

- If there is a perception that shale production causes earthquakes...



CBM field in Scotland, Source: Dart Energy

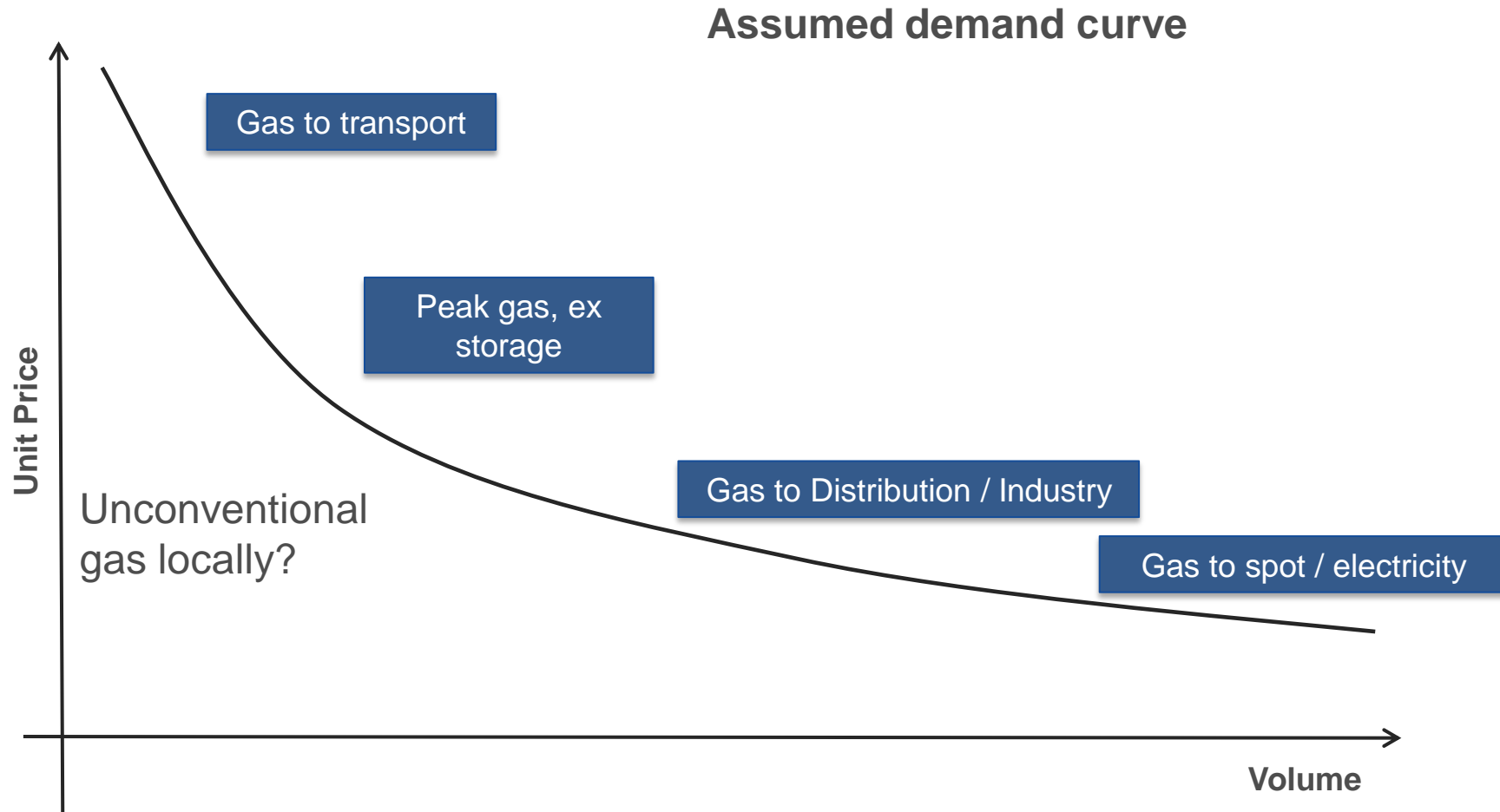
Observing the UK, supply costs curves may not work



Gas is more difficult to balance than some expect

- Many oil companies are not prepared to turn down production – increasing oversupply
- On the other hand, if there is little gas available, extremely high prices may not be enough!

On the other hand, gas has different payability



Transportation – the next gas frontier with unconventional?

Not having own gas has kept consumption down in many markets

- With unconventional gas, availability has improved
- Less clean electricity may be available than expected
- Expensive oil imports for transportation sector with emissions



Natural gas could fuel land and sea transportation...

- Cheapest option to reduce GHG (as well as NO_x, SO_x and particulate) emissions in transportation?
 - Also fewer hurdles compared to hybrid and electric vehicles
- ...increasingly in combination with “bio-methane”

CNG Cars
LNG Ships
Heavy vehicles
Trains
Planes??

} Volume

Local unconventional gas could speed up the transition

- Domestic and affordable CNG/ LNG instead of expensive oil imports



Source: Mongabay



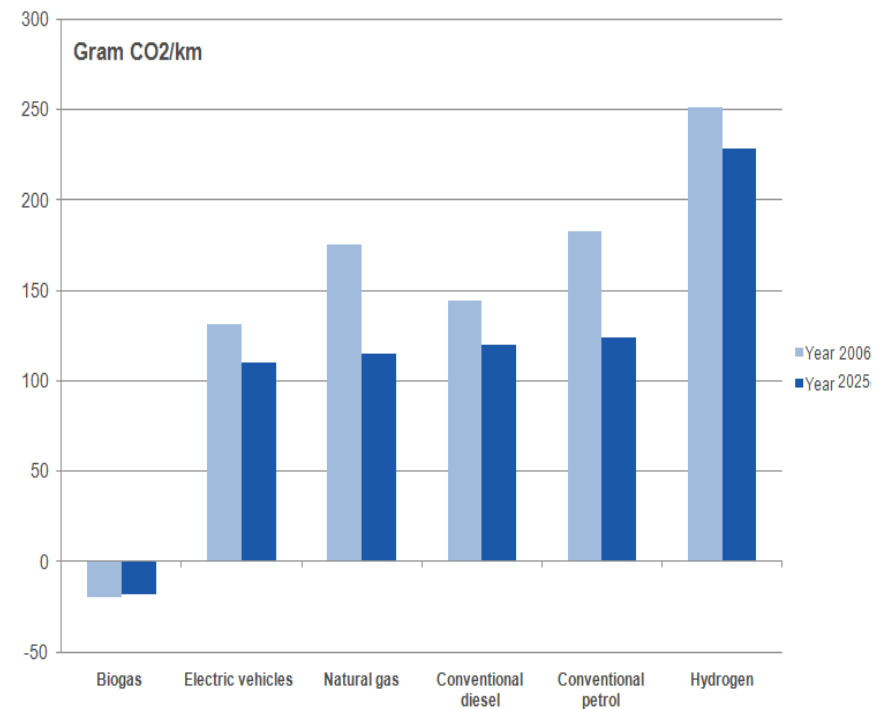
Natural gas and especially biogas reduce emissions

Transportation sector is struggling to reduce emissions in the EU

- Growth in demand overall – beyond many expectations
- Low share of new fuels and electric cars – for now
- Large potential, if gas is economic

Adding biogas to the natural gas could get EU green certificates

- Using biogas in transportation could be “CO₂-negative”!
- Sweden leader in this – using natural gas to facilitate biogas
 - Would even be positive to shale (if Shell discovery had been viable)
- Relative environmentalism?



Data: COWI for Danish Government, 2010

In Poland, unconventional gas could outcompete CCS

Poland largely relies on coal for power...

- Low cost domestic reserves
- Reducing dependence on Russian gas

... but capacity needs replacing by 2030

- Old, inefficient plant breach EU standards

Will Poland build new coal plant with CCS...

- CCS costs estimated at €130 billion by 2030

...or use more gas?

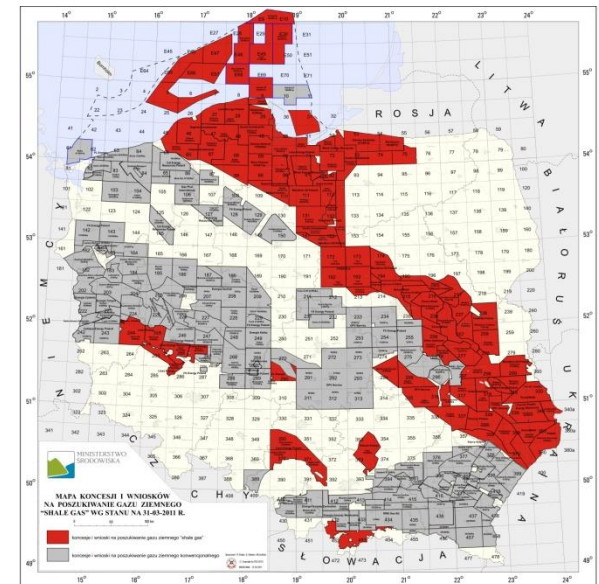
- Recently planned LNG imports from Qatar
- Now most active EU country in developing unconventional gas
- Potential to replace imported gas, some coal
- Even export potential: Lithuania, Germany, and others (even LNG!)
- Want to be a leader in development!

Belchatow – largest coal plant in EU



Source: coalpowerplants.blogspot.com,

Poland – gas exploration licenses



Source: Gazlupkowy.pl, March 2011

ExxonMobil: Large German gas volumes!

North-Rhine Westphalia could have 2100 bcm of shale gas and CBM gas reserves (second largest deposit in Europe)

- ExxonMobil has secured options on several areas to start exploration
- Other companies also interested

6.5 bcm/yr could be produced as industry builds up capacity

- Increasing Germany's self-sufficiency in gas to 25-30%
- Creating jobs and bringing royalties to the local municipalities

Exploration permits valid for 5 years

- EUR 100 million in exploration costs for ExxonMobil alone
- Production still uncertain – gas prices impact profitability
- However, border prices perhaps less relevant...



Gernot Kalkoffen,
Head of Exxon Mobil Central Europe
Source: Handelsblatt, January 2011

Merkel: Easier to turn down nuclear with own gas?

Meanwhile – strong resistance from environmentalists

Gas prices differ in type and in the value chain...

Wholesale prices most discussed

- German border price
 - Quite stable due to oil link
- Spot prices are more volatile
- LNG prices – oil link or spot

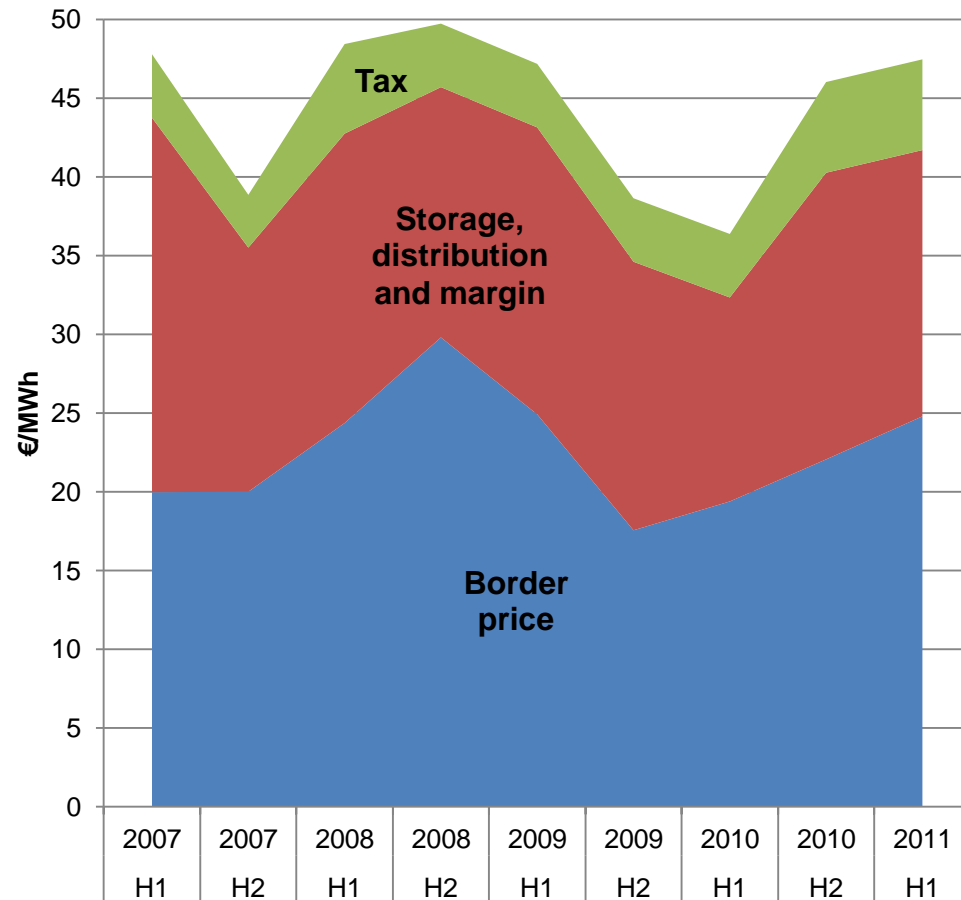
But gas is transported and stored

- Modulated, factory gate gas is therefore normally at a much higher price
- Perhaps this is the most relevant price to compare with cost of unconventional?

Local gas may get high feed-in

- Some countries are planning high entry prices for biogas into the gas system – even higher!

Build-up of German gas prices to industry - illustrative



Data: Eurostat, Destatis, Montel

France could see gas production by 2020 – or not...

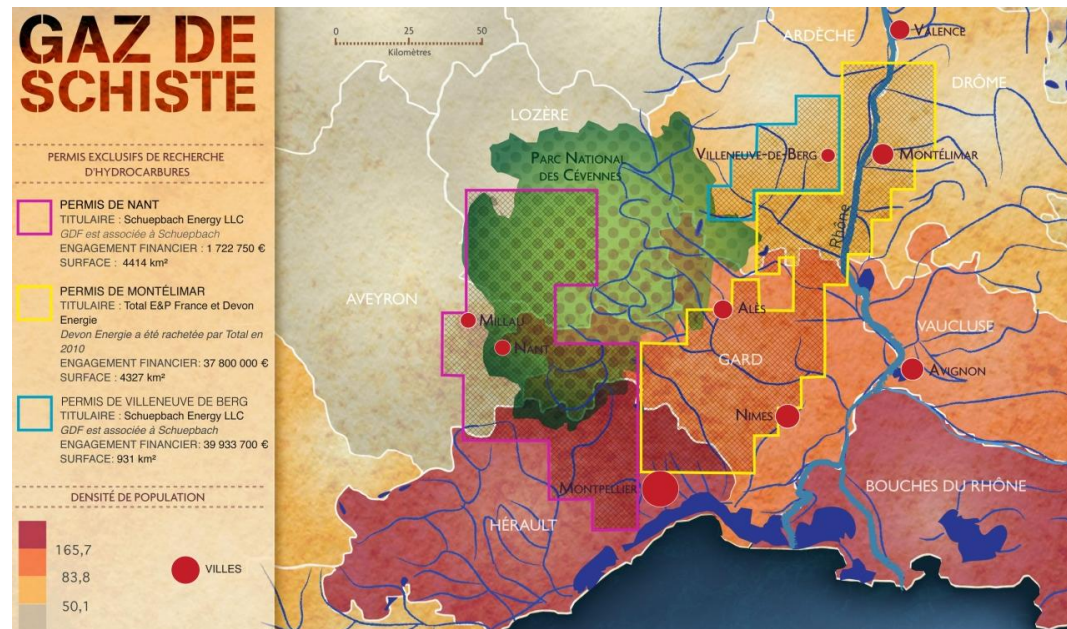
A total of 500 bcm of shale gas could be produced in the Cévennes area

- Significant compared to current production of about 1 bcm/ year
- Raising interest of GDF Suez, Total and others

Environmental concerns have lead to a temporary moratorium on drilling

- Protests from local communities and even politicians
 - “Shale revolution” has taken many by surprise
 - Some mistrust
- 2-3 years to map and build capacity and trust before industry can “take off”

Map of shale gas licenses in (Southern) France



...partly depending on alternatives?

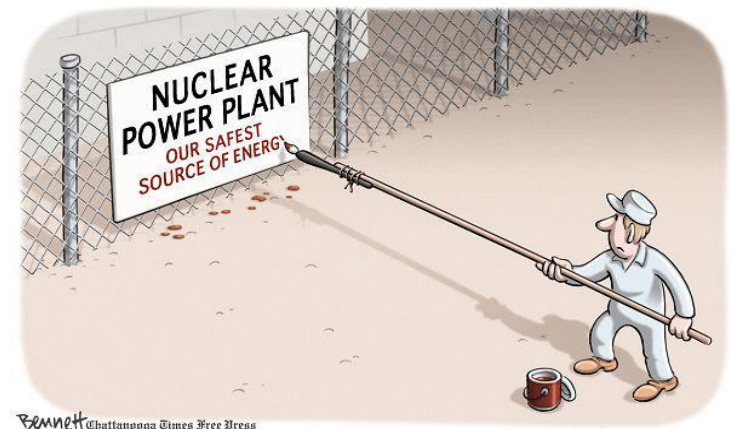
Impact of Japanese disaster on France

- Even the industry agrees that safety dose not comes with a guarantee
- Socialist party has said no to nuclear
- The Government feels the tremors but are there options...

Could unconventional gas be an alternative?

- Government & industry seem to be interested
- Government being criticized for being too permissive
- Moratorium on new drilling since June
- How to change the French mindset?

What is it worth?



Bennett Chattanooga Times Free Press

Is it economic? That depends on who/ how you ask

Politicians look at alternatives, their costs, prices and timing

- Renewables are taking time and costing more than was hoped for
 - Even with monetary support to research, smart grids, feed-in...
 - Partly motivated by expected high cost imports of LNG
- Could we see support to local, flexible gas in the future?
 - Cheaper than offshore wind, Nabucco, and other SoS...
- How to sell the story – now that concerns are here?

Oil companies and other investors look at cost and price

- Need to grow reserves – part of drive to buy acreage
 - Fewer exciting prospects on the oil side than before
 - Buying shale acreage is cheaper in BOE than oil
- Margin better than many think
 - Expect better technology to reduce costs, now around \$4.20/mmbtu in US
 - Income expected to be steady with more liquid markets and higher demand
 - Also additional income from liquids – with high prices: Oil, NGLs
- Believe in gas being the best solutions for the future energy mix!
 - Willing to offer at lower prices to avoid falling demand, it seems...

US sees very much production at \$4/ mmbtu

Unconventional really took off at \$8/ mmbtu

- Easy to get land, new technology available, LNG the alternative
- Costs have fallen, and extra income found in liquids (at times higher)
- Many unconventional gas producers are still happy at \$4/mmbtu

Henry Hub is the universal references price

- Some adjustments for location
- Well developed pipeline system

What can Europe learn?

- Cost reduction, stakeholder management, packaging for value
- Higher costs in Europe, but (much) higher prices, too (for now)

So, what about Europe?

Income could well be higher – with higher market prices

- Also growing need for balancing, if using gas to balance wind
- Costs are expected to be higher – more than double?
 - Deeper, more difficult, unclear permitting, land etc
- Liquids, too, but less focus on this now....

What is local and variable gas worth in Europe?

- More than LNG imports?
- Similar to gas ex storage?
- Enough to like it??
 - Impact on politicians, regulators, people?
 - Environmental & payability relative?

Impact on demand – replacing other fuels?

- Gas demand less constrained with own reserves: US, China, Poland
- Better than importing oil, but will it be better than nuclear?

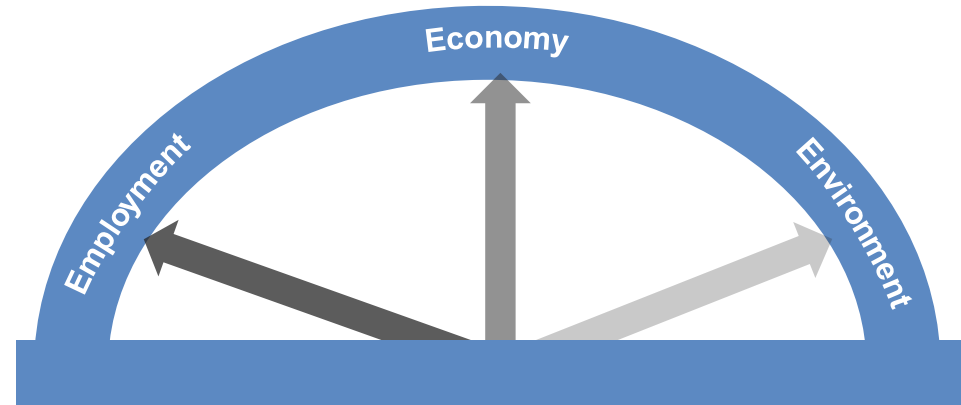
Environmental packaging: Good or bad?

Production of unconventional varies

- Shale could be more messy and intrusive than CBM, UCG, and more
- Still better than open-cast lignite mining, perhaps?

Use of gas is also relative

- Better than coal
- Better than nuclear?
- Worse than wind or solar?



New tone of voice from politicians

- Less focus on emissions, climate, CCS
- More on replacing oil imports and reducing use of electricity (eco-design)
- Less on subsidies to energy, more on fuel poverty
- Is this the start of saying that gas is green enough?

How can we predict the future with so much bias?



Energy policy and best mix is a very complex and changing

- Politicians try to understand voters' wishes
- Often missing picture, cost levels, system impacts, alternatives etc

Private investors go for what they think will be economic

- Perhaps more prudent than some politicians had hoped
- Different view of cost and risk – more realistic or overly careful?
- Politicians often do not see that they add to perceived risk by wavering

Long term investments are impacted by the short term

- Nuclear in Europe now seems more negative than several years ago
 - Even if they are not in areas prone to earthquakes and tsunamis
- Offshore wind and CCS are being delayed with low spot gas prices
 - Solar is the flavour of the month...

So, in addition to complexity, there is much bias!

- Perceptions and favourites, impacted by hype and setting
 - Legends “truths” very different from industry science (often quiet)
- Even industry people want simple binary (yes/no) answers

Traditional industry binary thinking has bias

Often, the oil industry will want a yes/no answer to questions

- Is it more economic than traditional oil production? NO
- Will there be a shale gas revolution? NO
- Will it replace all imports? NO

Politicians and voters are more diverse and impressionable

- Often easier to reject what is not understood

Three key questions that may be easier to relate to

- Will unconventional gas happen in Europe? YES
- Will it impact political preference for gas? YES
- Will there be space, people and rigs? YES

We are happy to discuss further!

Selected recent work by Sund Energy that may be of interest

- Scenarios for European gas 2020 – prices and flows
- Impact of Japan on global LNG prices
- Gas for transportation (road + sea)
- Security of supply – values

We also offer strategic and commercial advice – partner selection

- Producers, TSOs, traders, large buyers, governments
- Gas, electricity, CCS and more

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So, let's consider two scenarios

Unconventional gas takes off

- Technology works
- Preferred environmentally
- Removes some SoS fears
- Could reduce oil dependency

Total emissions fall...

- Especially from transportation:
Ships, heavy vehicles and cars
- Next step could be biogas and power

...without ruining economy

- Reducing other imports
- Possibility for export?
- LNG becomes backup

Europe says no to shale gas

- Technology does not work
- Reservoirs too deep
- Very much cheaper in other places
- Strong public opposition
- Less opposition to CCS and wind
- Not enough to remove SoS fears?
- Gas still considered fossil and oil linked in pricing
- Less focus on climate

- OR nuclear OK again

- OR other restrictions on demand:
Less heating, cooling, driving...

- OR there are