



TOTAL

COMMITTED TO BETTER ENERGY

The shale oil & gas american revolution From the four pillar of success to the four leverages of exportation.

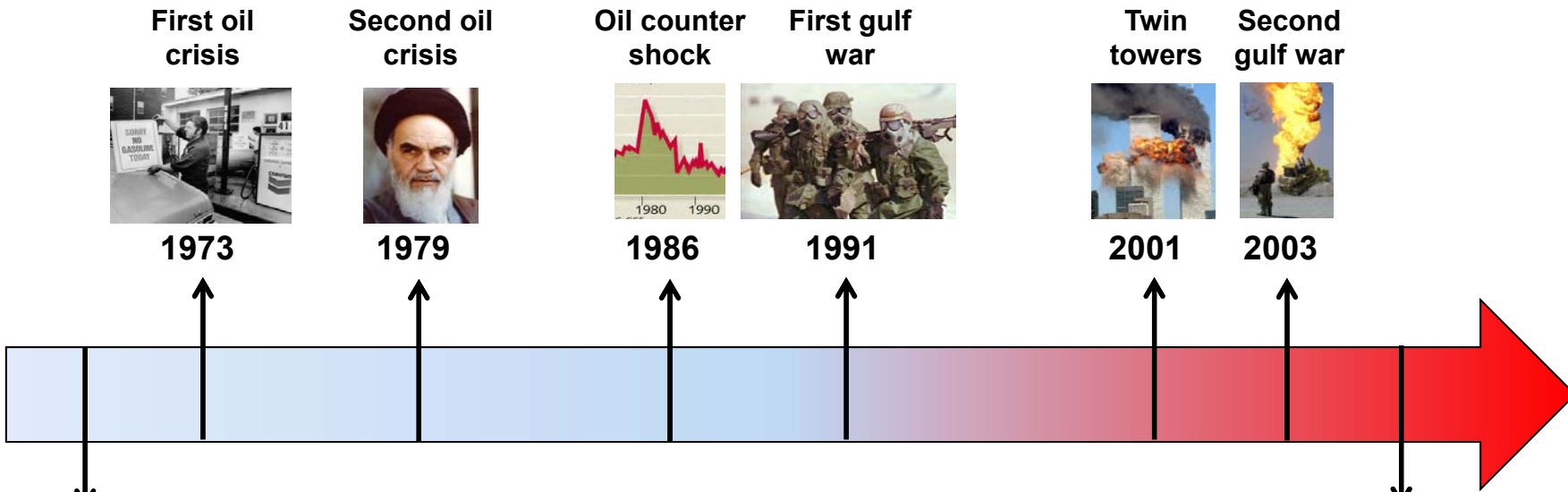
By Philippe Charlez – Total Exploration Production



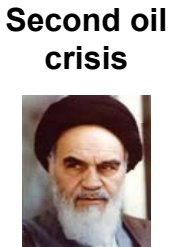
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SBGIMR - Mons 08/12/2014

US oil & gas production and imports



1973



1979



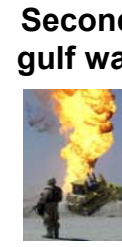
1986



1991



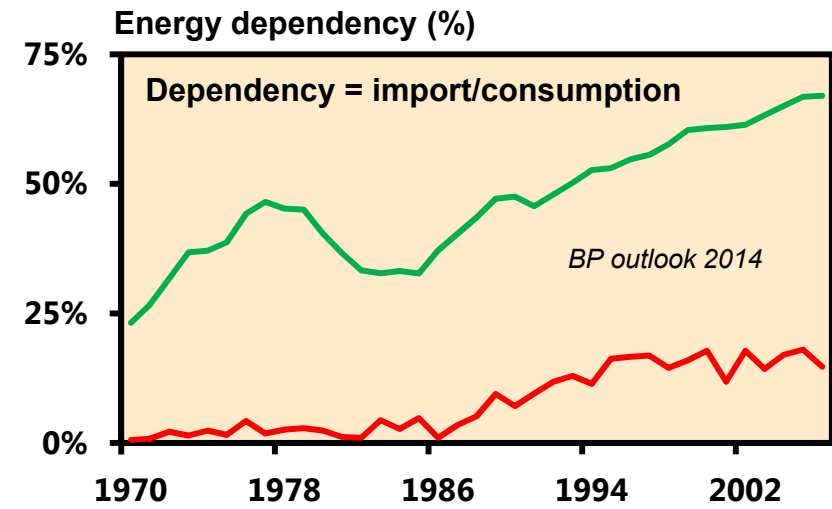
2001



2003

1970
US
production
peak oil

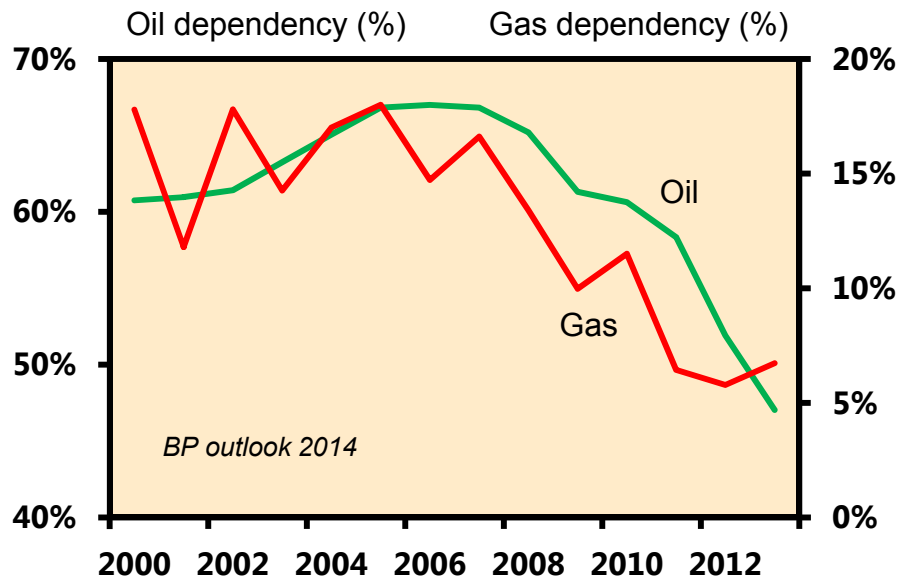
Mbbl/day	1970
Production	11,3
Import	3,4
Consumption	14,7



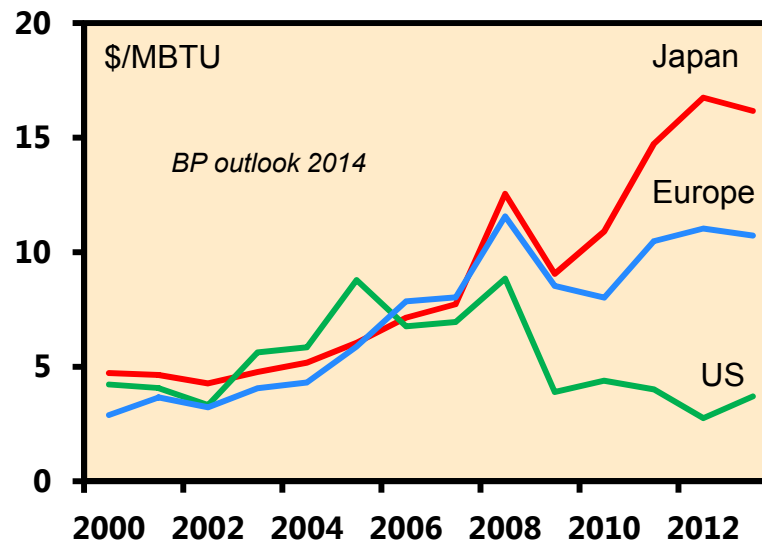
2006
US
import
peak oil

Mbbl/day	2006
Production	6,8
Import	13,9
Consumption	20,7

2006-2008: the start of a revolution



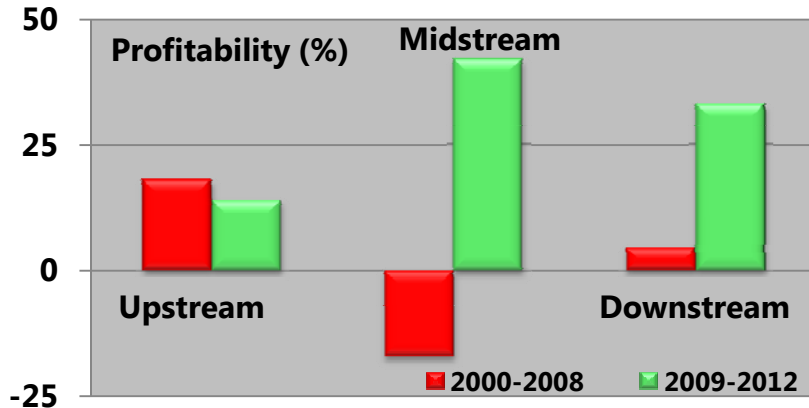
Oil (MMbbls/day)				
	2006	2013	2014	
Production	6,8	10	Irak	3,14
Import	13,8	8,9	US shale oil	3,05
Consumption	20,6	18,9	US 2006 - 2014	3,22
<i>BP outlook 2014</i>				
Gas (Bcf/day)				
	2006	2013	2014	
Production	50,7	66,5	Qatar	21
Import	8,8	4,8	US shale gas	35
Consumption	59,5	71,3	US 2006 - 2014	15,8



The impact on the US economy

The Winners:

Source: McKinsey Corporate Performance Analysis Tool



Cement



Glass



Steel



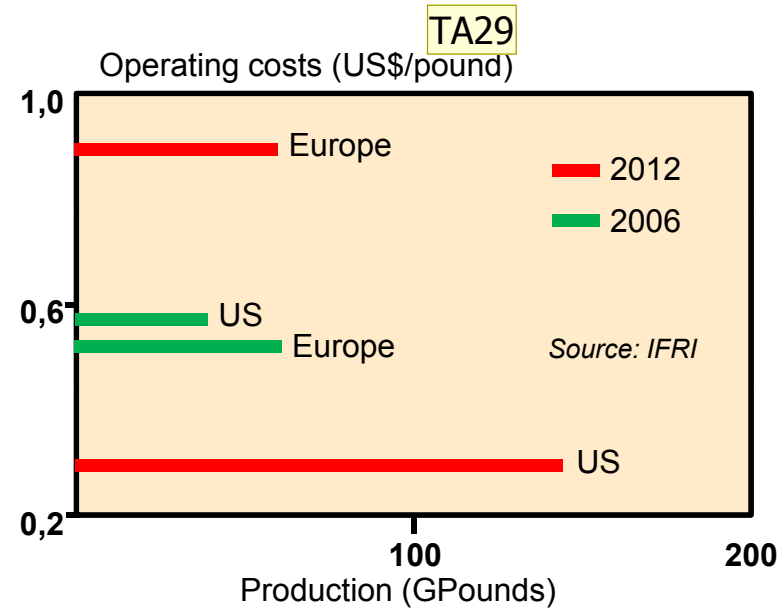
Petrochemicals

Employment

Source: IHS CERA

	2012	2020	2035
Million jobs	1.75	3	4

Job breakdown	
Direct	25%
Indirect	32%
Induced	43%



Diapositive 4

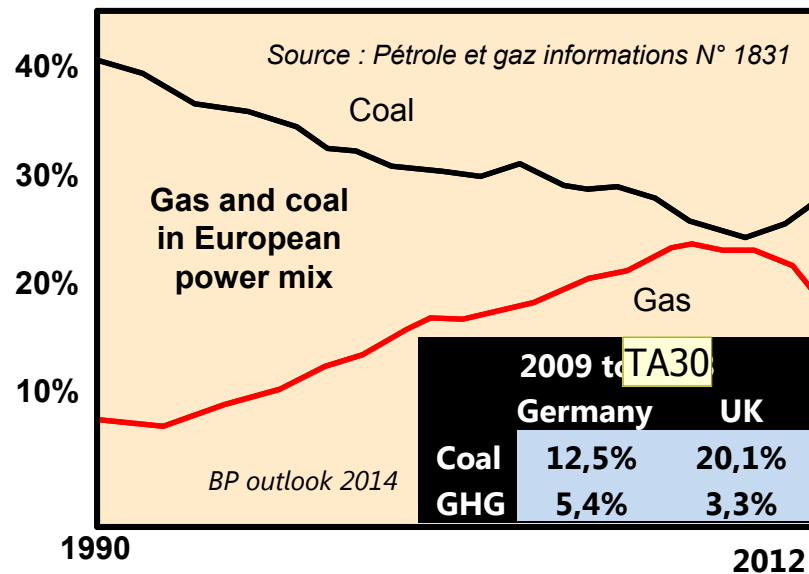
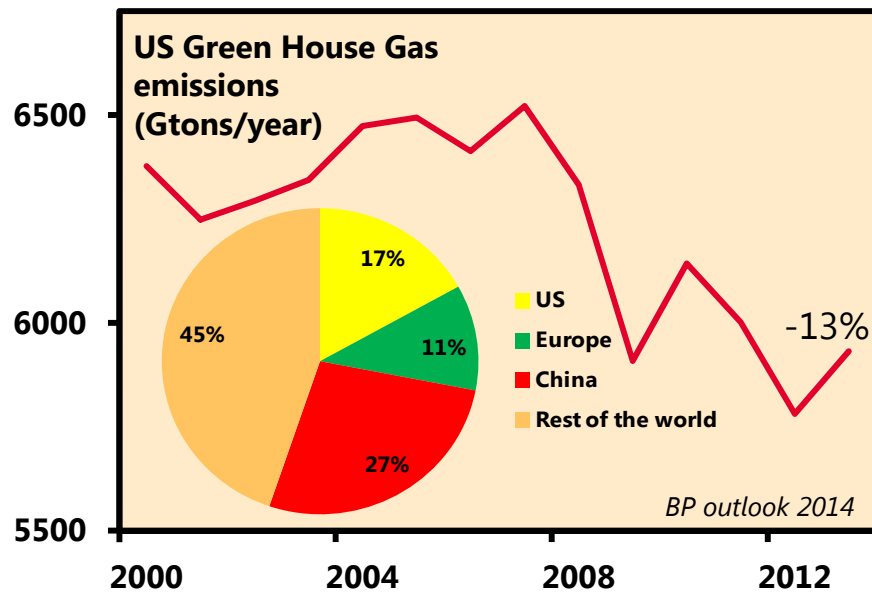
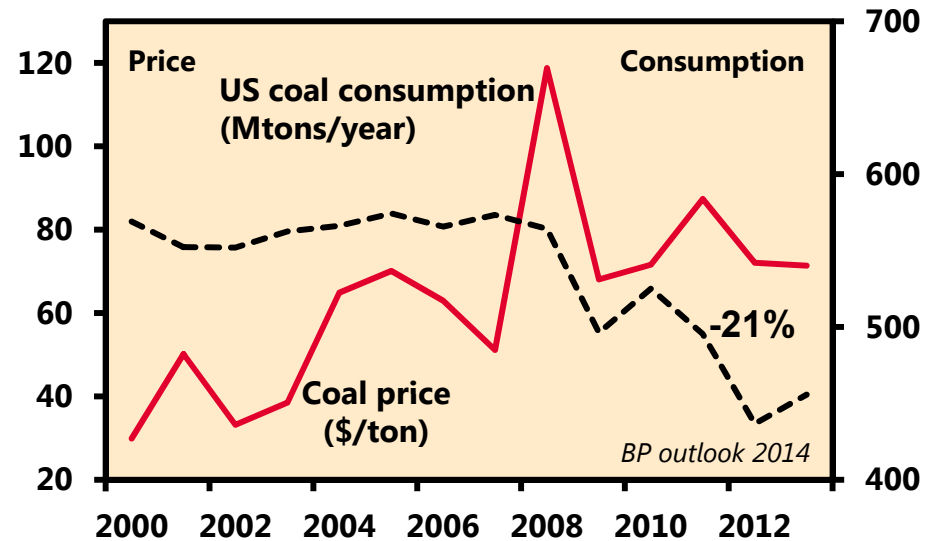
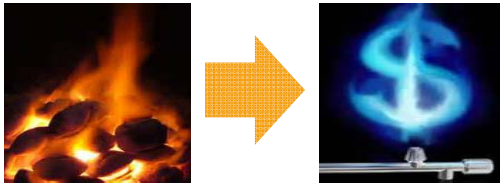
TA29

Source of the operating cost graph?

Torello Alessandro; 19/11/2014

The impact on coal, GHG emissions

Power generation moved from coal to gas



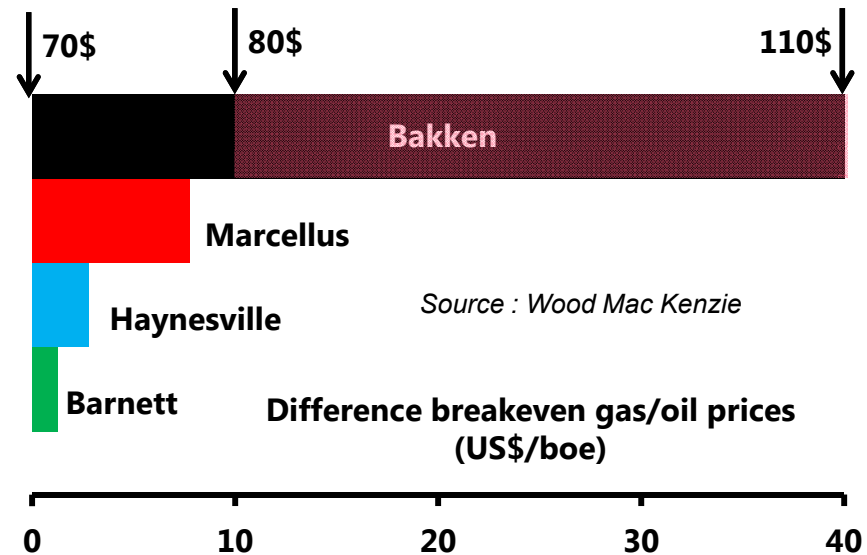
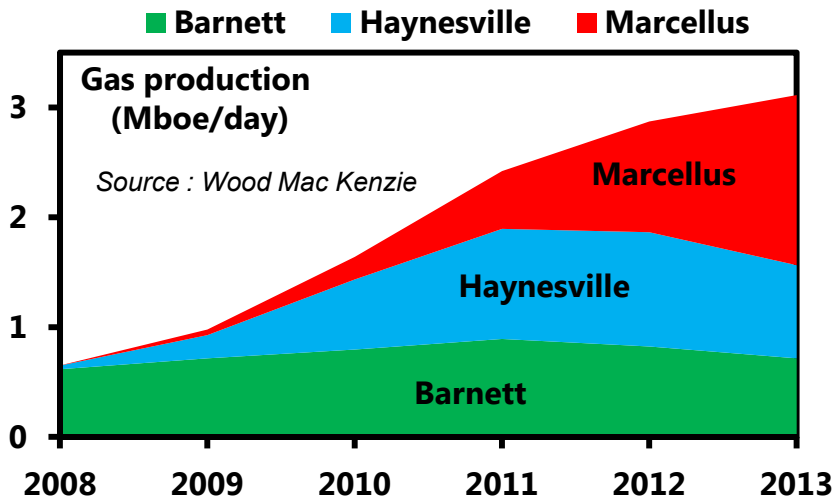
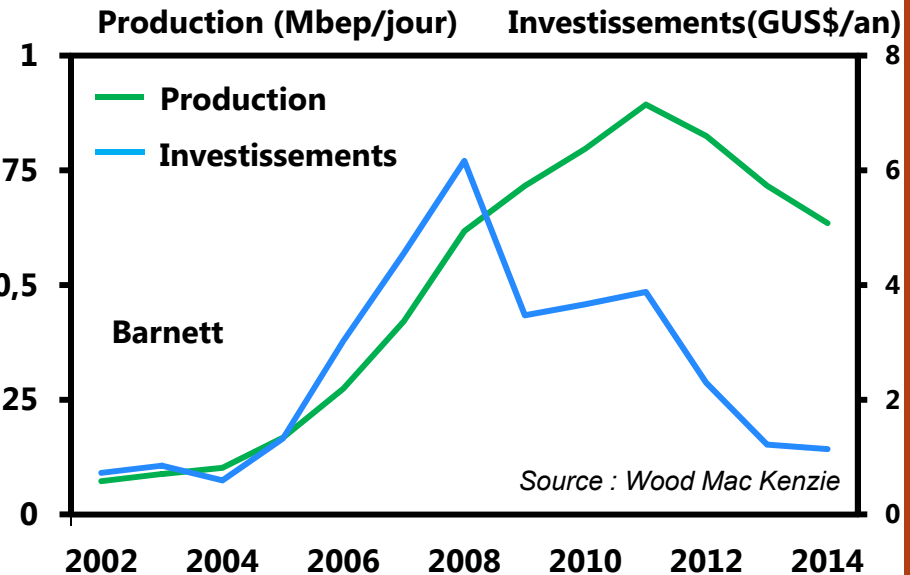
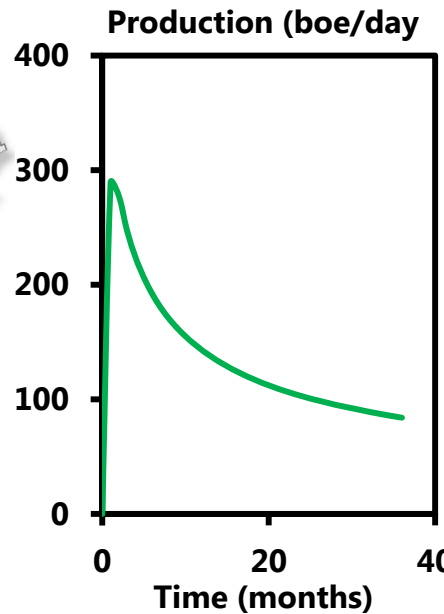
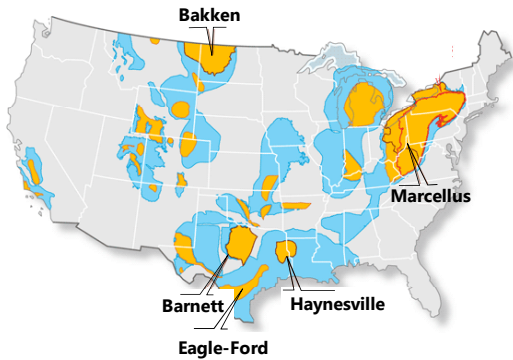
Diapositive 5

TA30

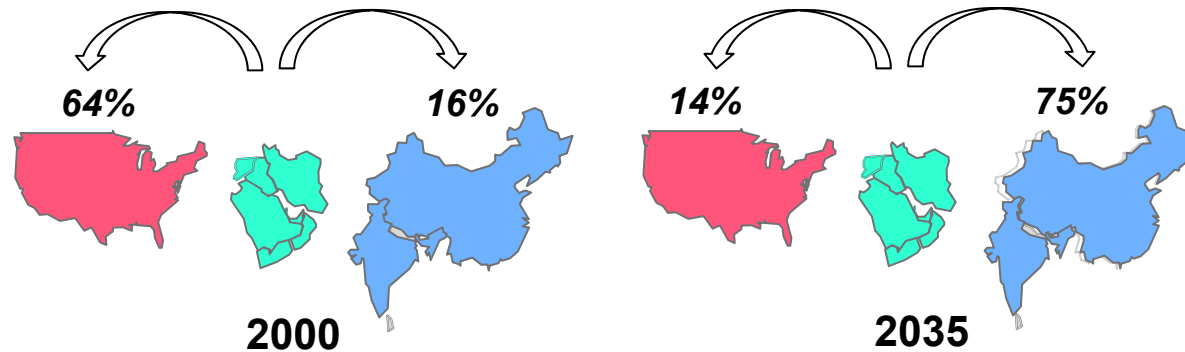
I still have a doubt about these GHG numbers: CO2 emissions from the power sector in Germany must have decreased, as the sector is in the ETS. Where does this increase come from?

Torello Alessandro; 19/11/2014

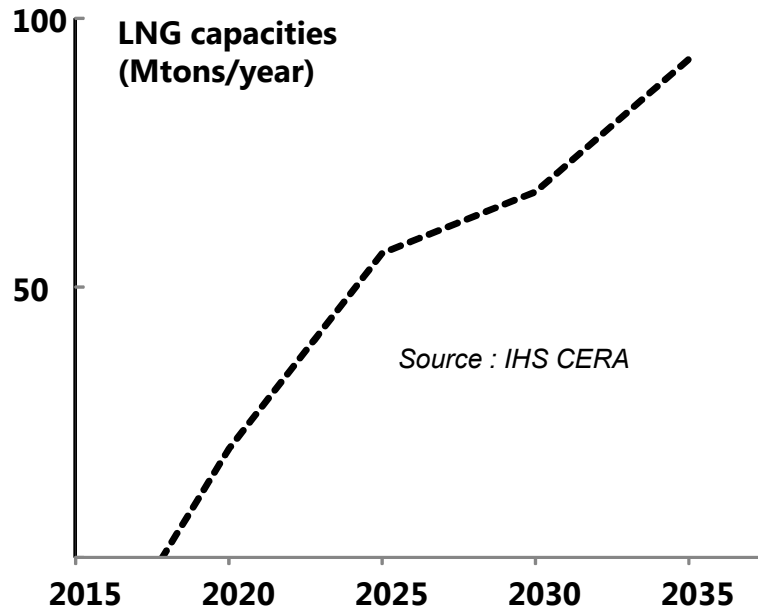
Sustainability or speculative bubble ?



Oil exchanges and LNG flux:



Source : BP outlook 2013, IEA outlook 2012



Geopolitical consequences

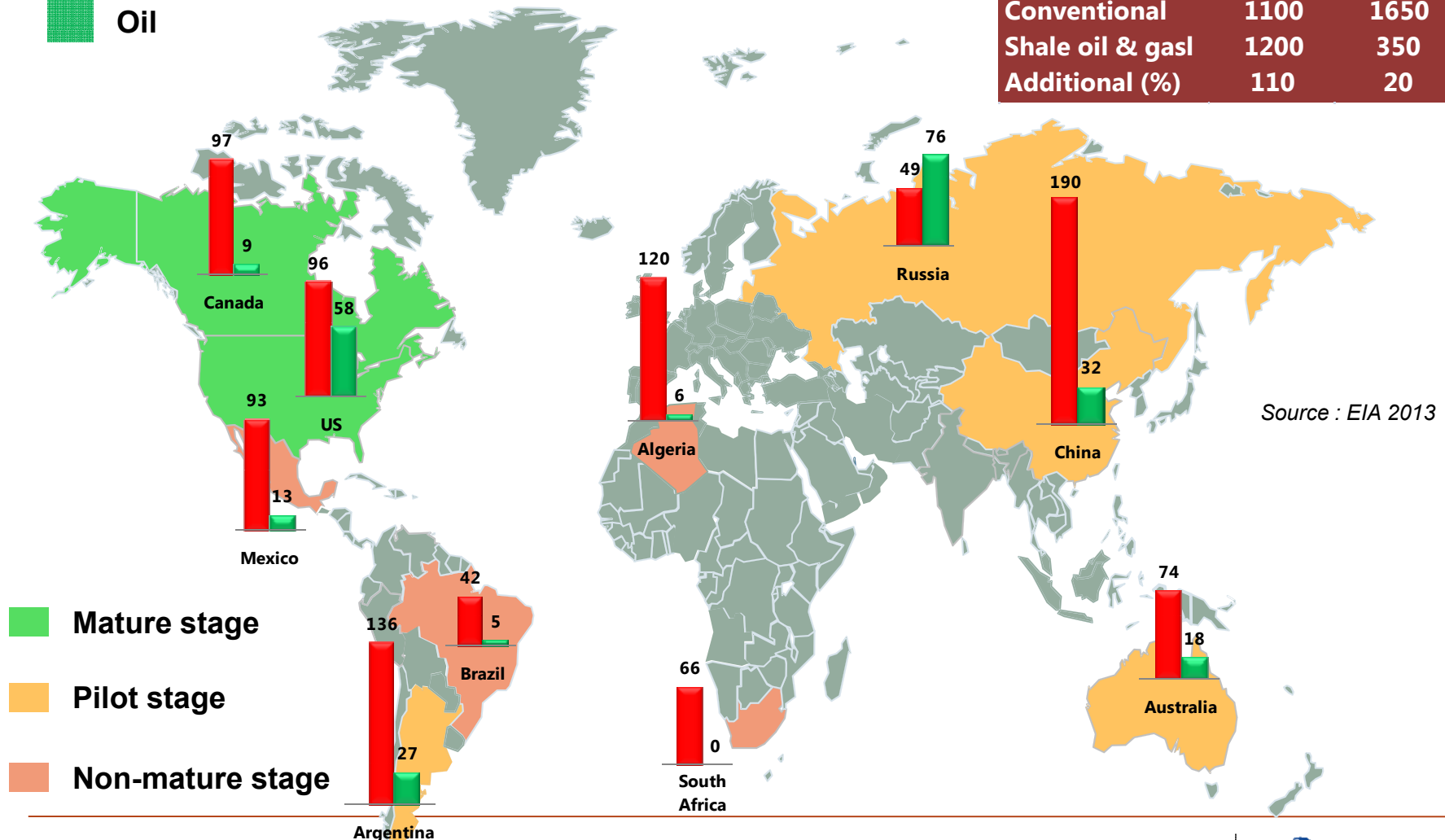
- Oil flow to China & India
- US LNG to Europe
- Sino-Russian axis
- Shale gas in China

- LNG market 2035: 400 Mtons
- US: 90 Mtons in 2035

World shale oil & gas stakes

■ Gas
■ Oil

Notional additional resources		
	Gas Gboe	Oil Gbbbl
Conventional	1100	1650
Shale oil & gas	1200	350
Additional (%)	110	20

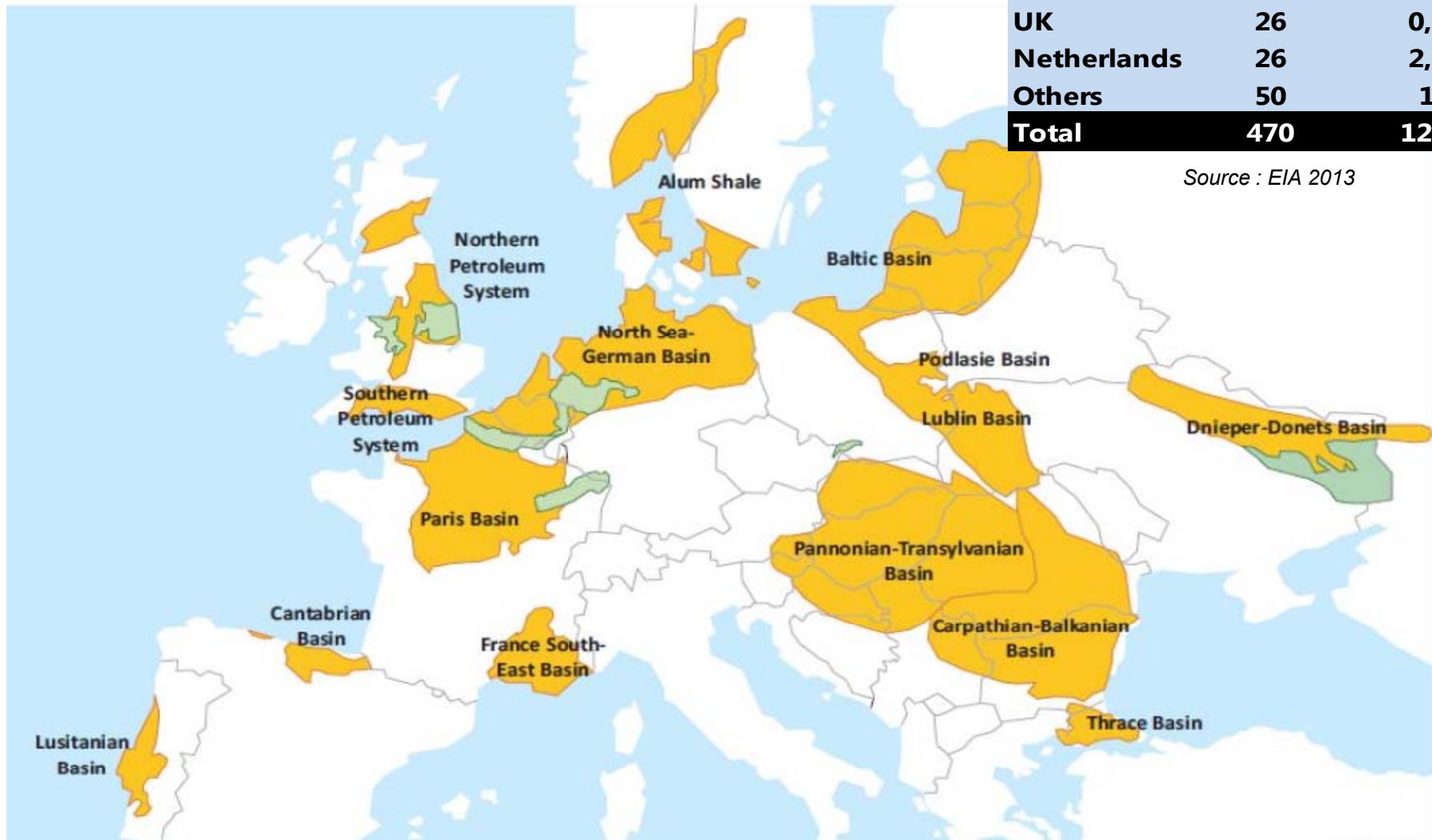


Source : EIA 2013

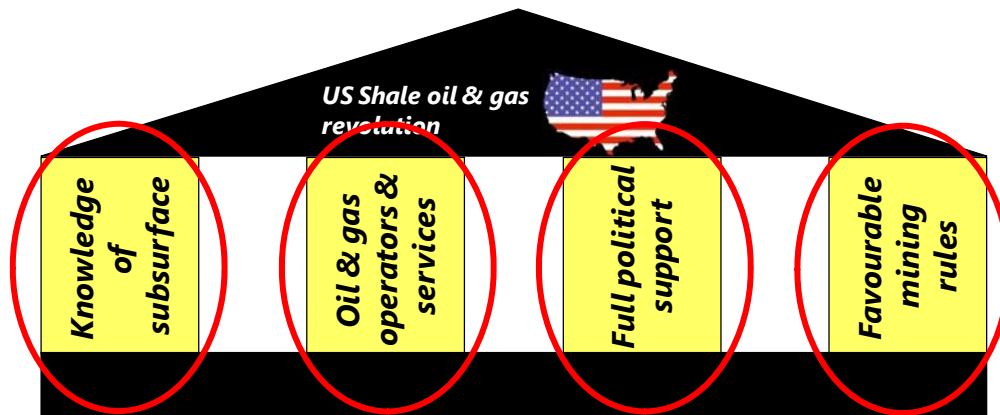
■ Mature stage
■ Pilot stage
■ Non-mature stage

European stakes need an exploration phase

Country	Shale gas	Shale oil
	TCF	Gbbl
Poland	148	3,3
France	137	4,7
Romania	51	0,3
Denmark	32	0
UK	26	0,7
Netherlands	26	2,9
Others	50	1
Total	470	12,9



The four exportation leverages

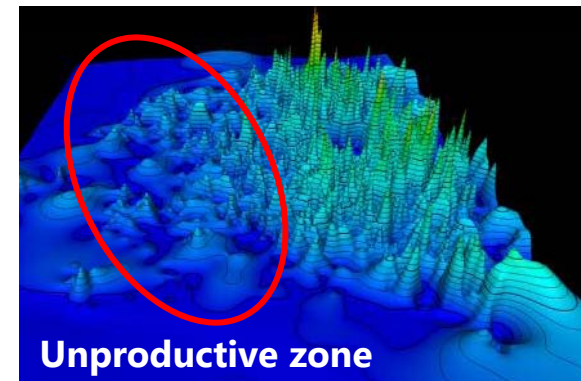


Impressive operational performances

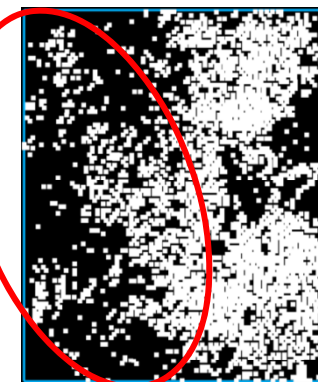
Drilling	Days	11
Lateral length	Feet	4529
Well cost	M\$	2,8

Source : Chesapeake

Trial & error method (statistics)



Unproductive zone

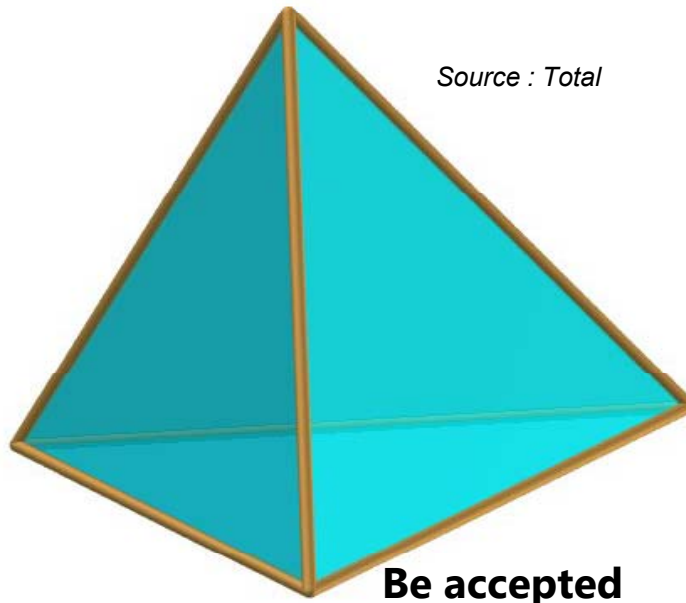


Unproductive wells

Source : SLB Terratek

Maximise reserves

Source : Total



Create value

Optimise cost

Be accepted

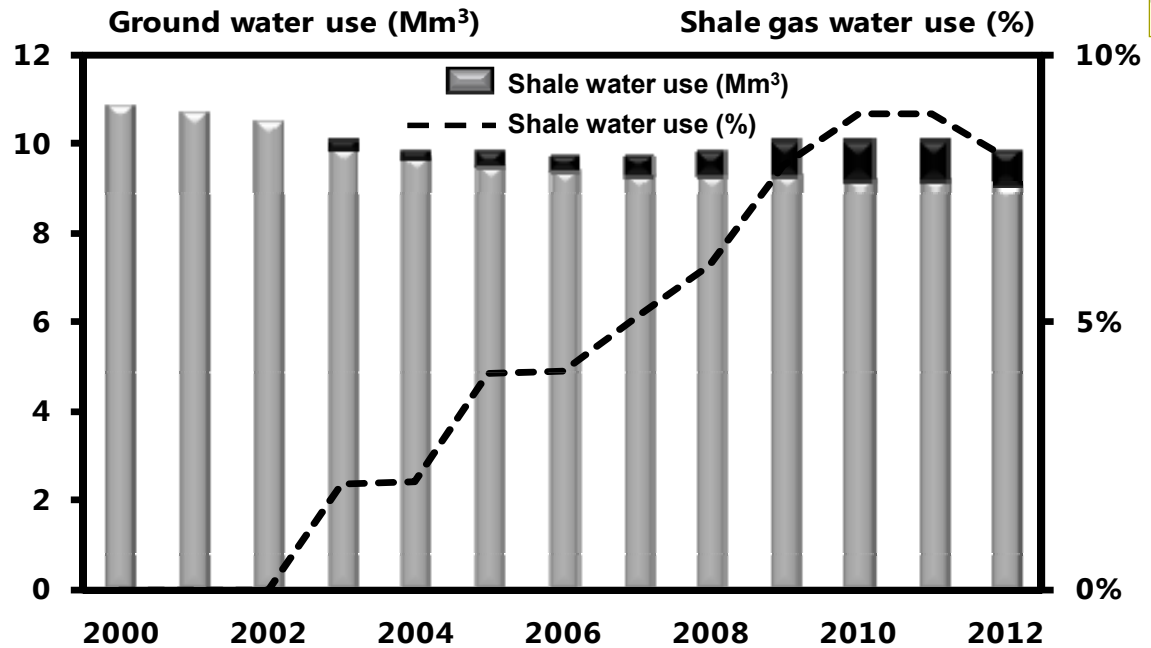
Water use: much less than you think!

TA33

Energy	M ³ /MWh
Nuclear	2,1
Coal	1,9
Gas	1
Shale gas	1,017

No need of high quality water

- Sea water
- Water from salted aquifers



Source : Texas Water Development Board Report



Trucking



Coiled pipe



Rigid pipe



Storage

Diapositive 11

TA33

This graph isn't very clear. I suggest to take it out -- especially as it is about Texas

Torello Alessandro; 19/11/2014

Water produced is handled carefully

1. Produced water (20% to 40%) is treated to be re-used

- No more disposal, only few re-injection

2. Reduce GHG

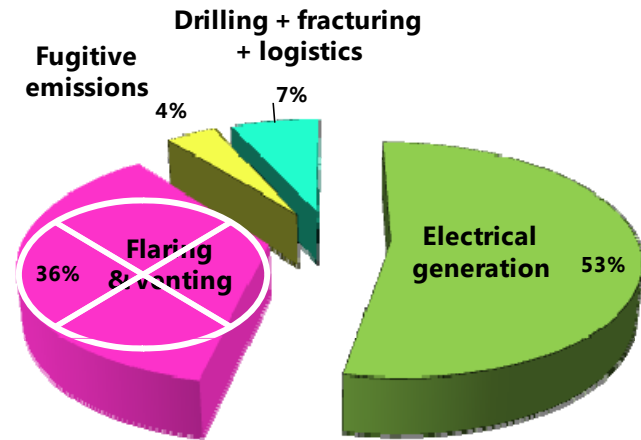
Activity (extraction oil is 1)	
Extraction oil	1
Extraction shale gas	1,5
Gas thermal usage	16
Coal thermal usage	25
Gas power generation	33
Coal power generation	65



3. Is produced water radioactive?

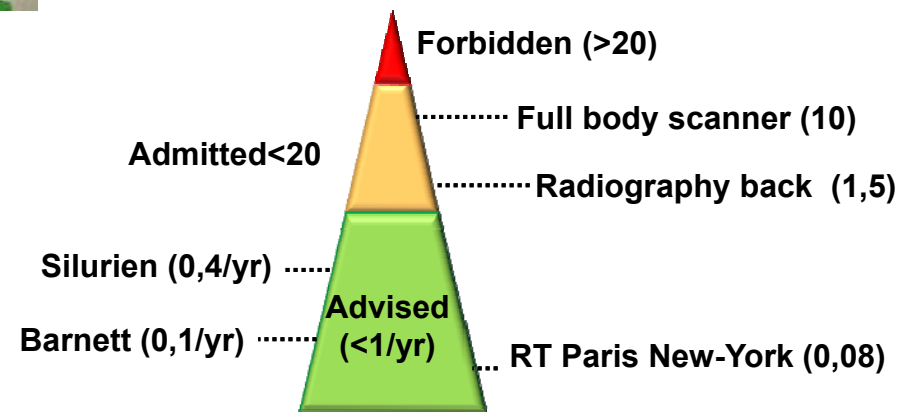
A conventional gas well is 1		
Shale gas	Nuclear	Coal
3 to 15	7250	1000

Source : Almond S., Clancy, S.A., Davies, R.J., Worrall, F. (2014)



JA Costa (2011) Total, T. Stephenson (2012) IPIECA
 J. Broderick, et al (2012) Tyndall Centre University of Manchester
 Allen T et al (2013)

1 medical scanner = 100 years of Barnett



<http://www.developpement-durable.gouv.fr/>

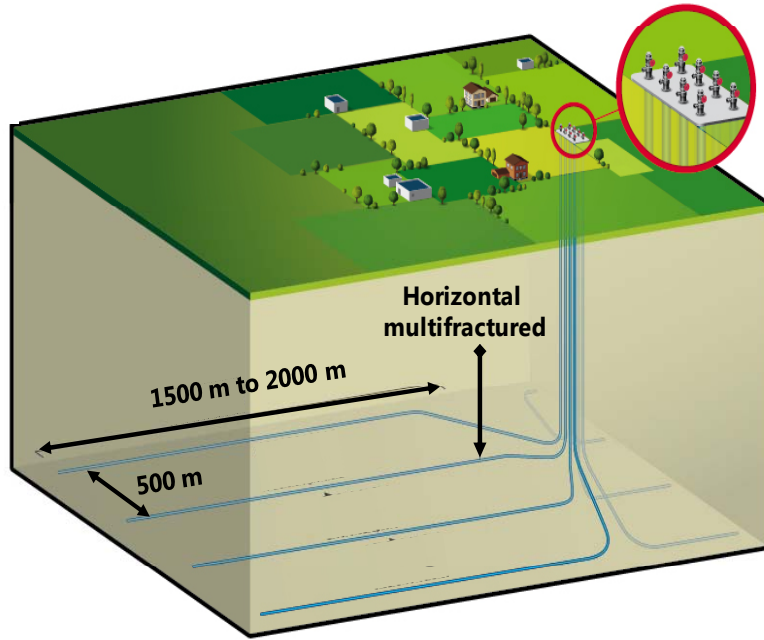
Diapositive 12



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Where is this?

Torello Alessandro; 31/10/2014

A low footprint

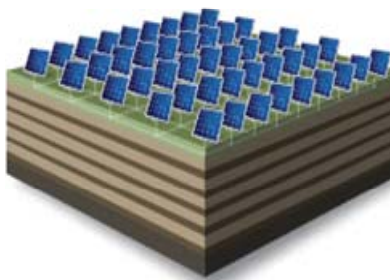


Pad
 = 2 x
 100 m

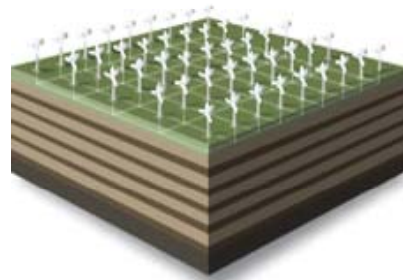


Pad during drilling (1 year)

Solar panels



Wind mills



Equivalent energy = surface x 10 to 30

<http://zebu.uoregon.edu/disted/ph162/l4.html>



Pad during production (20 years)

Source : Chesapeake

TA37

Europe: shale gas not a game changer, but does help the economy

BP 2014 outlook - Eurostat	Unit	2013	2035
Gas consumption	Bcf	41,4	
Gas production	Bcf	13,6	
Gas dependency	%	67,1%	95%



Shale gas boom : horizon 2035

Positive impact on gas and electricity prices
Energy dependency -28%



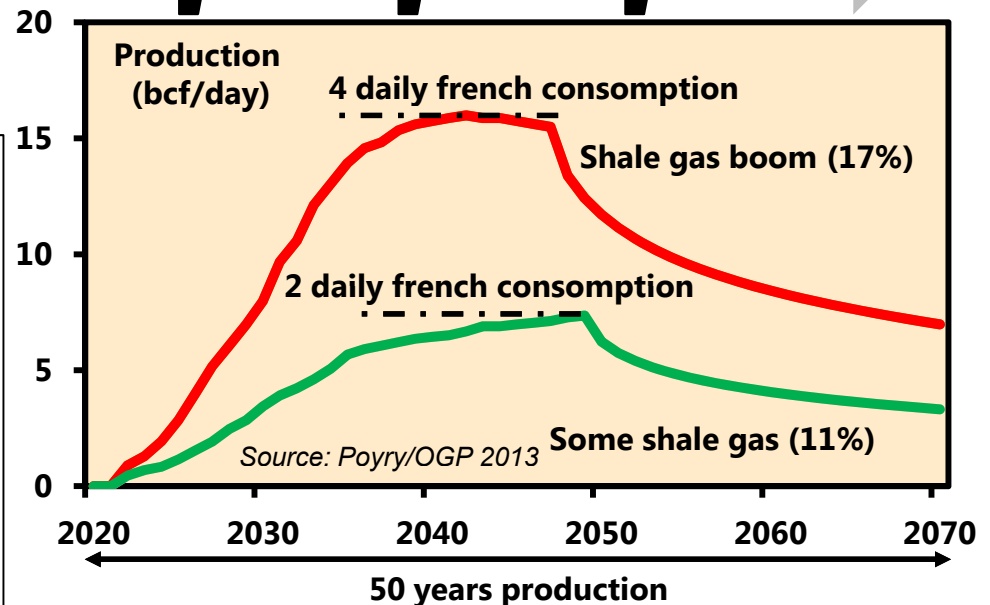
Economic growth +0,65 %/year



Employment +1,000,000



Source: Poyry/OGP 2013



A 30-year development would require:

- 23,000 to 50,000 wells
 - 450 Mm³ to 1 Gm³ water*
 - 230 km² to 500 km²
- * in 2012, France used 33 Gm³

Diapositive 14

TA37

Are these the Poyry numbers?

Torello Alessandro; 30/10/2014