ENERGIA EN EL MUNDO

IMPACTO DEL SHALE OIL Y SHALE GAS

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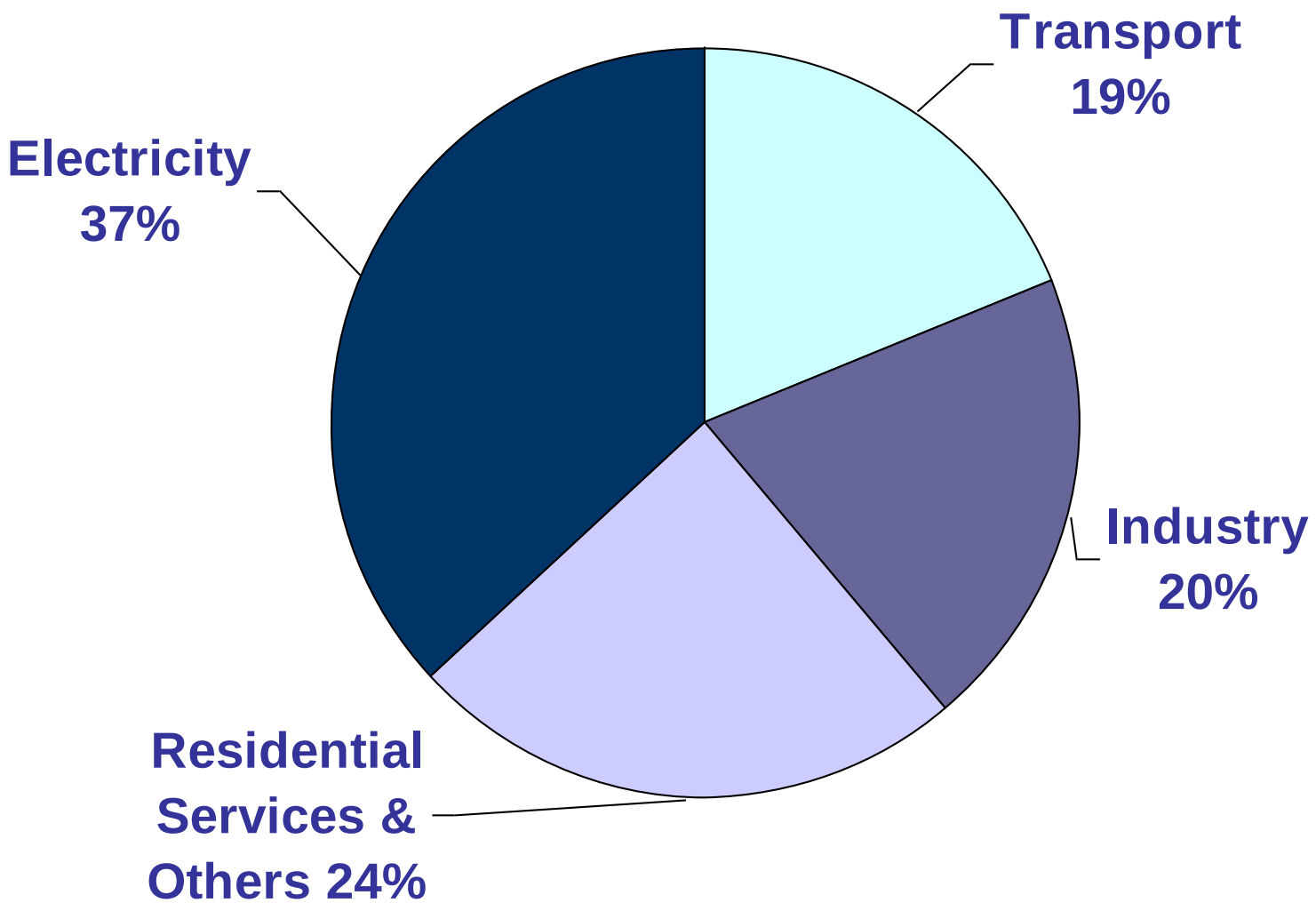
Marcelo Martínez Mosquera

Energy in the world

The era of scarcity

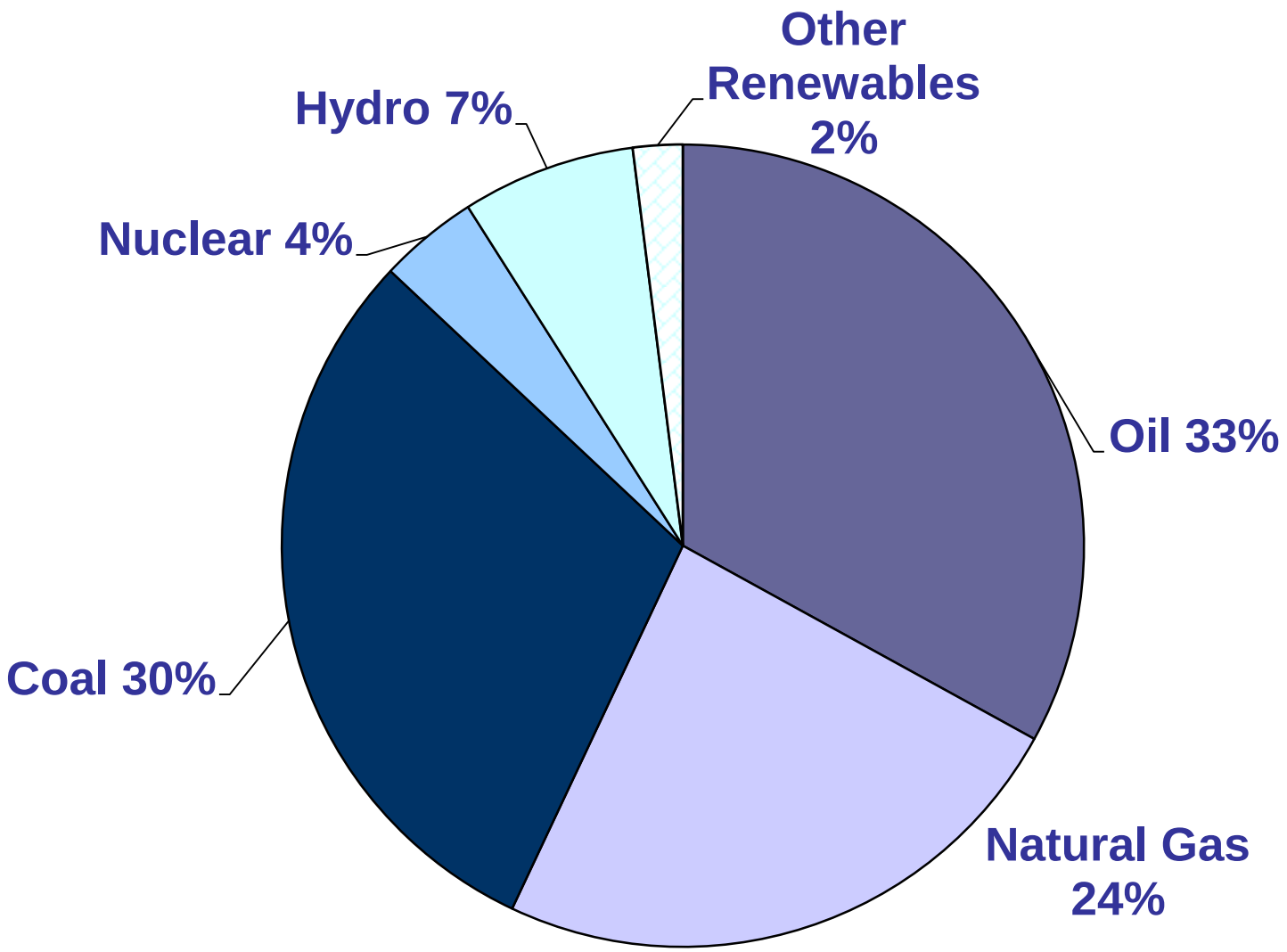
1. ENERGY IN THE WORLD

WORLD PRIMARY ENERGY DEMAND BY SECTOR



Source: Own research

WORLD PRIMARY ENERGY SUPPLY BY SOURCE



Source: BP Statistical Review of World 2014

ENERGY GROWTH

Last 10 years:

	annual growth
Oil	1.1%
Natural Gas	2.6%
Coal	3.9%
Nuclear	-0.6%
Hydro	3.7%
Other Renewable	15.5%
TOTAL	**2.5%**

Source: BP Statistical Review of World 2014

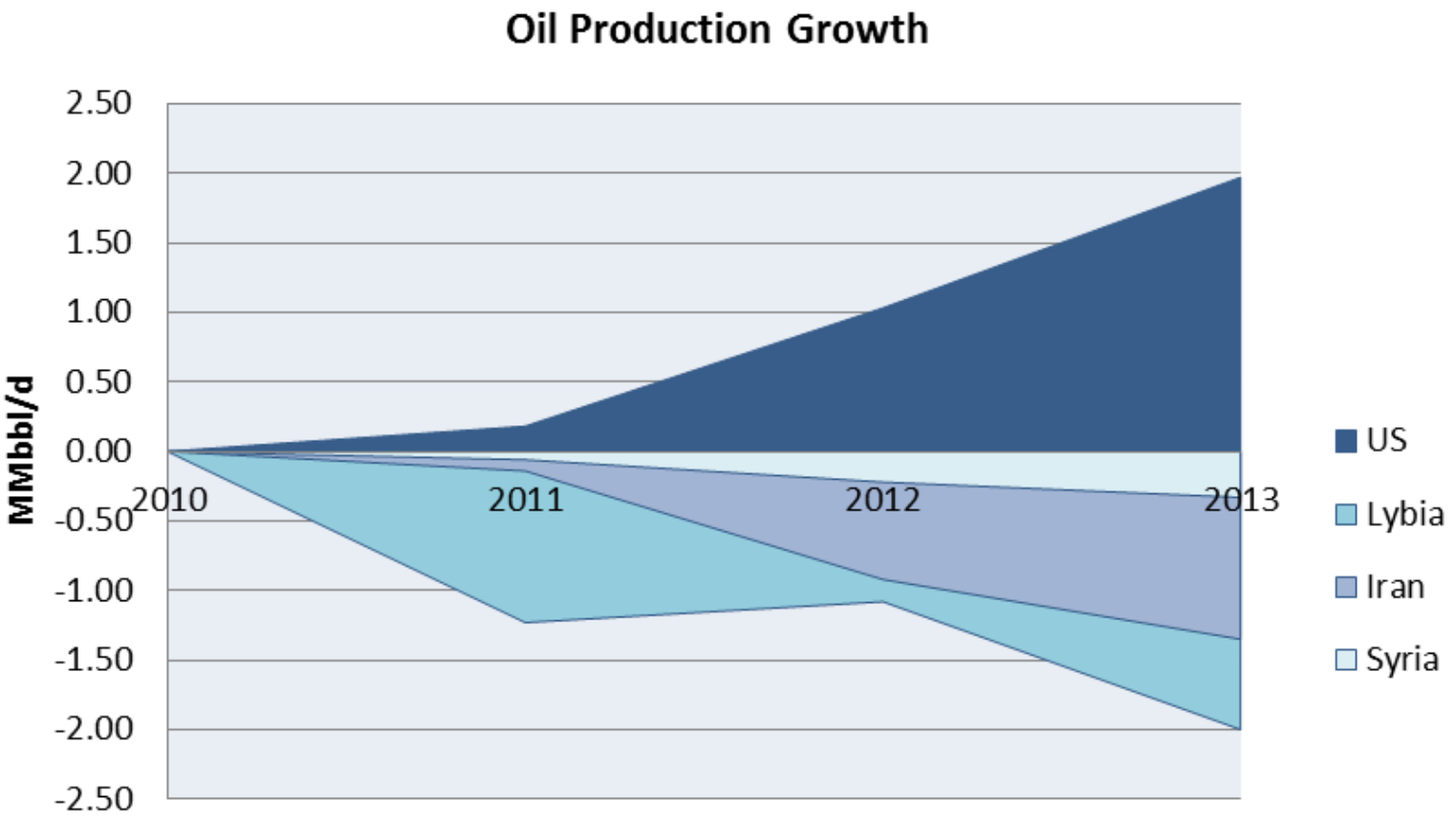
2. OIL

WORLD OIL PRICES AND PRODUCTION

	90´s	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
[USD/bbl]											
WTI	**20.7**	**41.5**	**56.6**	**66.0**	**72.2**	**100.1**	**61.9**	**79.5**	**95.0**	**94.1**	**98.0**
Brent								**79.5**	**111.3**	**111.9**	**109.1**
									WTI sep-14		93
									Brent sep-14		98
[MMbbl/d]											
OPEC		33.3	35.1	35.4	34.9	35.6	33.5	34.6	35.7	37.6	36.9
FSU		11.2	11.6	12.3	12.8	12.8	13.3	13.6	13.6	13.6	13.9
Rest of the World		38.4	37.8	37.8	38.0	38.0	38.4	39.1	39.1	39.7	40.8
TOTAL		**82.9**	**84.5**	**85.5**	**85.7**	**86.4**	**85.2**	**87.3**	**88.4**	**90.9**	**91.5**

Source: Oil Market Report IEA - Platts

SELECTED COUNTRIES



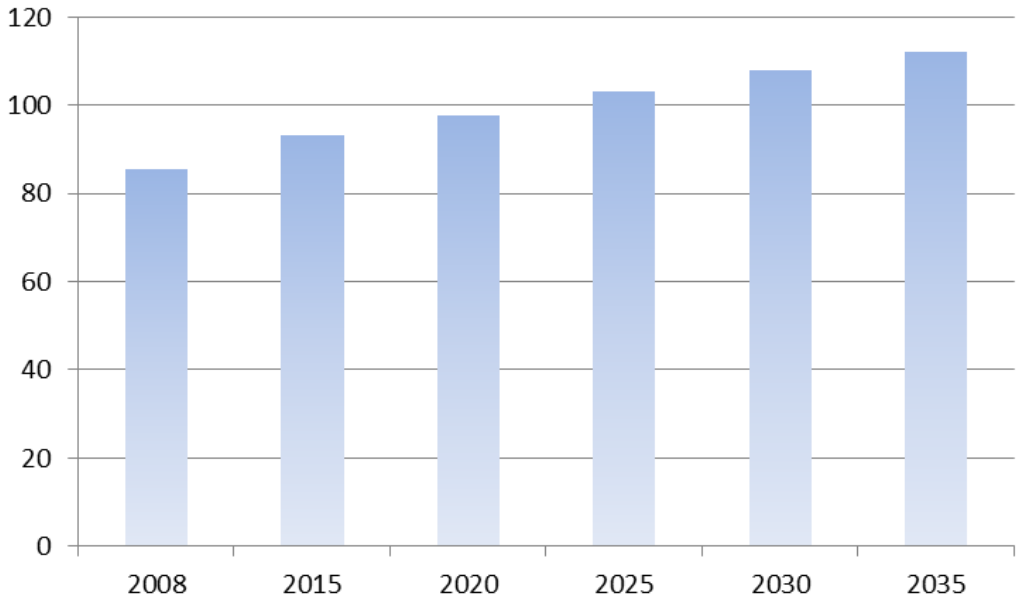
INTERNATIONAL RIG COUNT (OIL & GAS)

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Latin America	290	316	324	355	384	356	383	424	423	419
Europe	70	70	77	78	98	84	94	118	119	135
Africa	48	50	58	66	65	62	83	78	96	125
Middle East	230	248	238	265	280	252	265	291	356	372
Far East	197	225	228	241	252	243	269	256	241	246
Canada	369	458	470	343	379	221	351	423	365	355
USA	1 190	1 380	1 648	1 768	1 878	1 086	1 541	1 875	1 919	1 761
TOTAL WORLD	**2 395**	**2 746**	**3 043**	**3 116**	**3 336**	**2 304**	**2 985**	**3 465**	**3 518**	**3 412**

Source: Baker Hughes

LONG TERM OIL DEMAND

[MMbbl/d]	2008	2015	2020	2025	2030	2035
EIA-DOE - Reference Case	85.7	93.3	97.6	103.2	108.0	112.2



Source: International Energy Outlook 2011 – EIA - DOE

WORLD OIL DEMAND

"The problem with oil is that demand is too young and supply is too old". Matthew Simmons

	90´s	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
[USD/bbl]											
WTI	20.7	41.5	56.6	66.0	72.2	100.1	61.9	79.5	95.0	94.1	98.0
Brent								79.5	111.3	111.9	109.1
[MMbbl/d]											
WORLD DEMAND		82.9	84.5	85.5	85.7	86.4	85.2	87.3	88.4	90.9	91.5

Source: Oil Market Report IEA - Platts

CHINA

[MMbbl/d]	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
PRODUCTION	3.8	3.6	3.7	3.7	3.8	3.9	4.1	4.1	4.2	4.2
DEMAND	6.4	6.7	7.2	7.6	7.8	8.1	8.9	9.3	9.8	10.1
IMPORTS	*2.6*	*3.1*	*3.5*	*3.8*	*4.0*	*4.2*	*4.8*	*5.2*	*5.6*	*5.9*

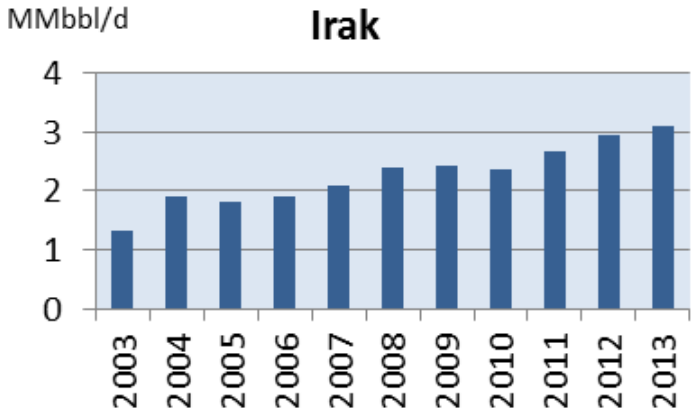
Source: Oil Market Report

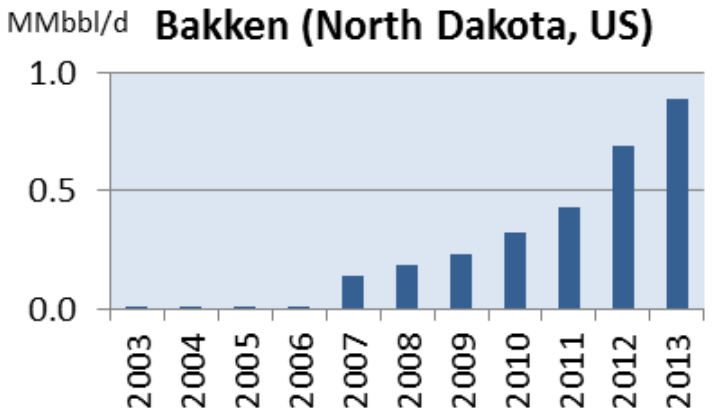
“The oil of tomorrow is not oil”

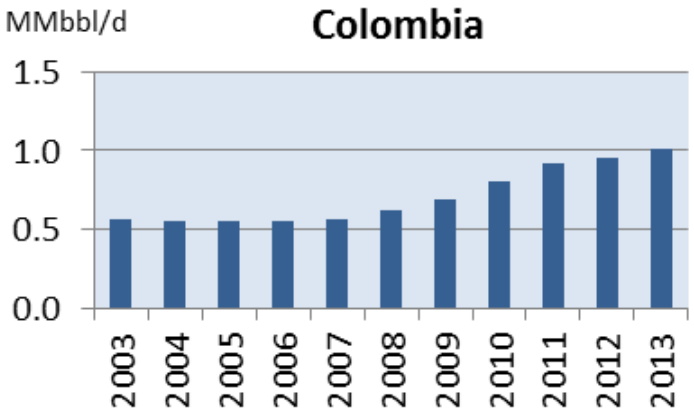
Nick Hodge

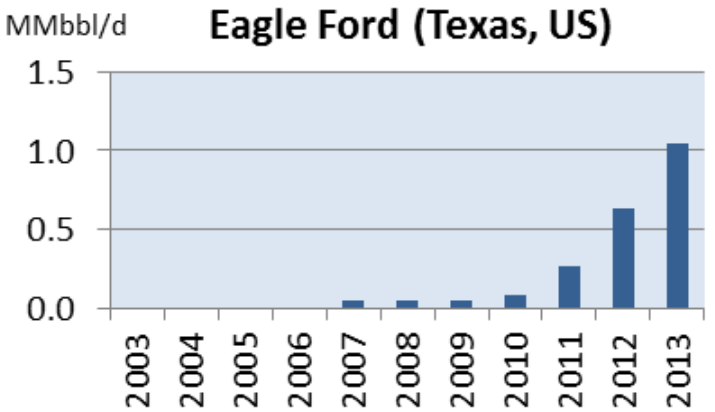
WHO WILL WIN THE RACE?

These rising oil fields?



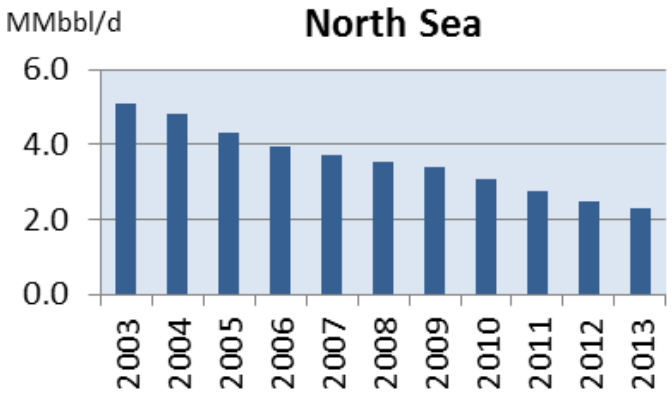


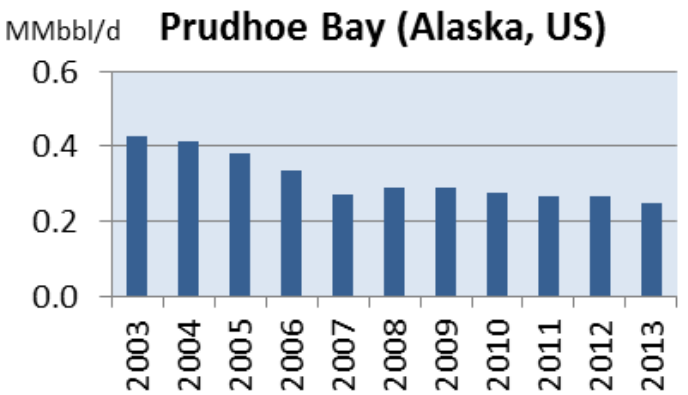


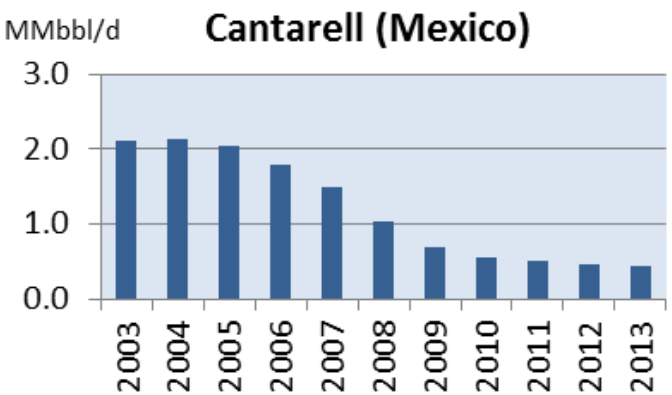


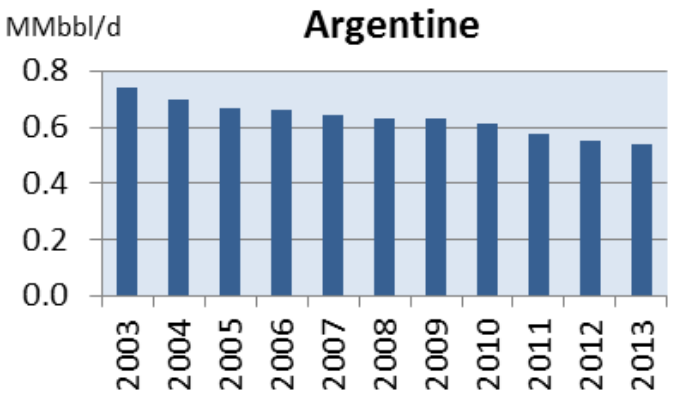
WHO WILL WIN THE RACE?

These declining oil fields?









ATHABASCA OIL SANDS & ORINOCO FAJA

THE OIL FACTORY

Process:

• **Mining**: deforestation, elimination of non-bitumen soil, mining, transport to the mill (3 tonnes of mineral are needed for every barrel produced) crushing and filtering, “primary refining” to obtain bitumen, transport of the by-products to the place of origin, transport of the bitumen mixed with a solvent to an ad hoc refinery which transforms the bitumen into synthetic oil, then sold to normal refineries around the world.

• **Steam Injection:** drilling a dual well with two horizontal conduits, sourcing water and then natural gas to produce steam and inject it into the well through one of the horizontal conduits, producing hot bitumen through the other conduit and repeating the double refinery process in the same way as in the Mining process.

BIO-FUELS

- Ex-Refinery Cost

[U$S/l]	BIOFUEL	BF equivalent oil	oil@ 98
BIODIESEL from soybean oil	0.89	**0.99**	**0.69**
BIOETHANOL from sugar	0.55	**0.83**	**0.72**

Source: IOWA State University

- ALL seed oil production => 7% of diesel oil demand
- ALL sugar and corn production => 20% of gasoline demand

SHALE OIL

Low permeability – Low porosity – Source rock

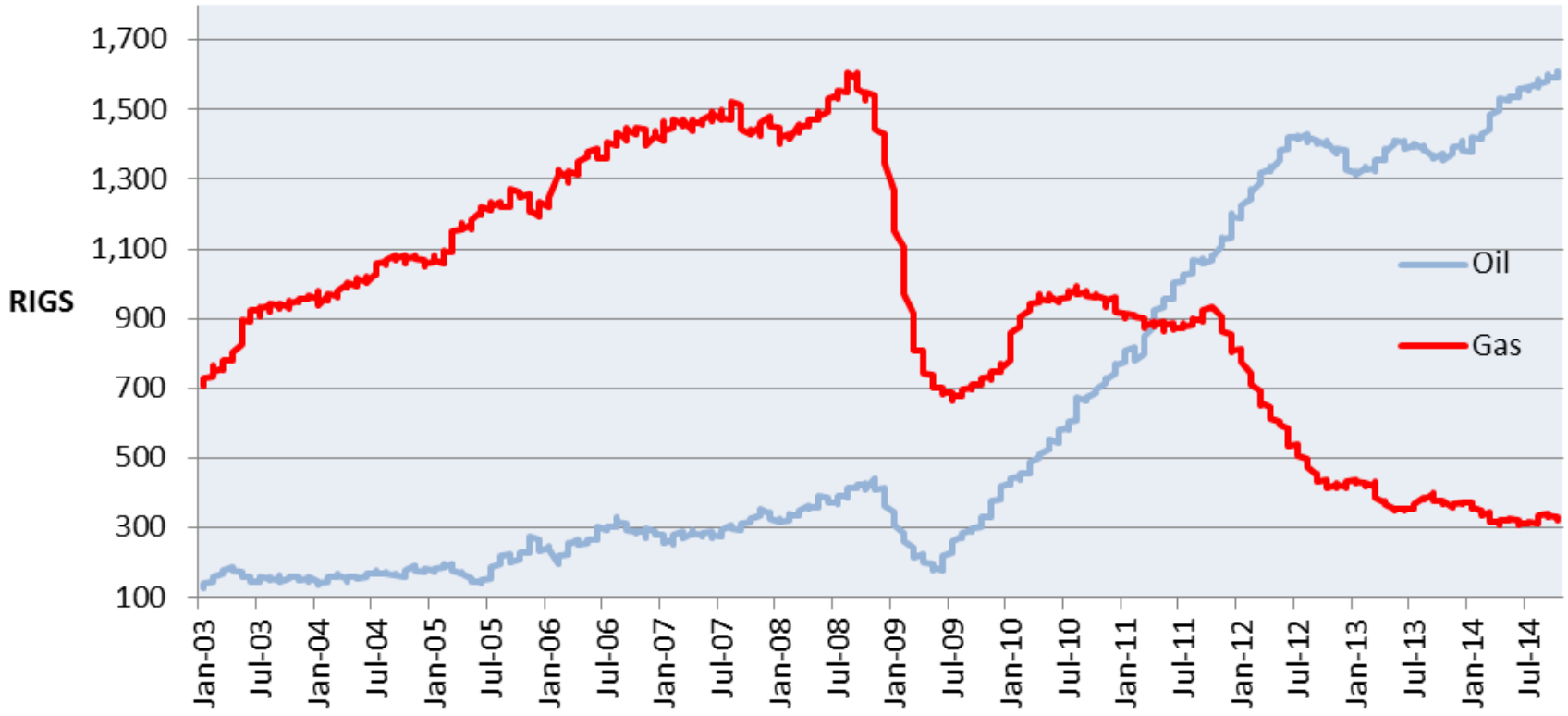
Declining factor

Horizontal drilling

Multiple fracs

Domestic or global phenomenon

US OIL & GAS DRILLING



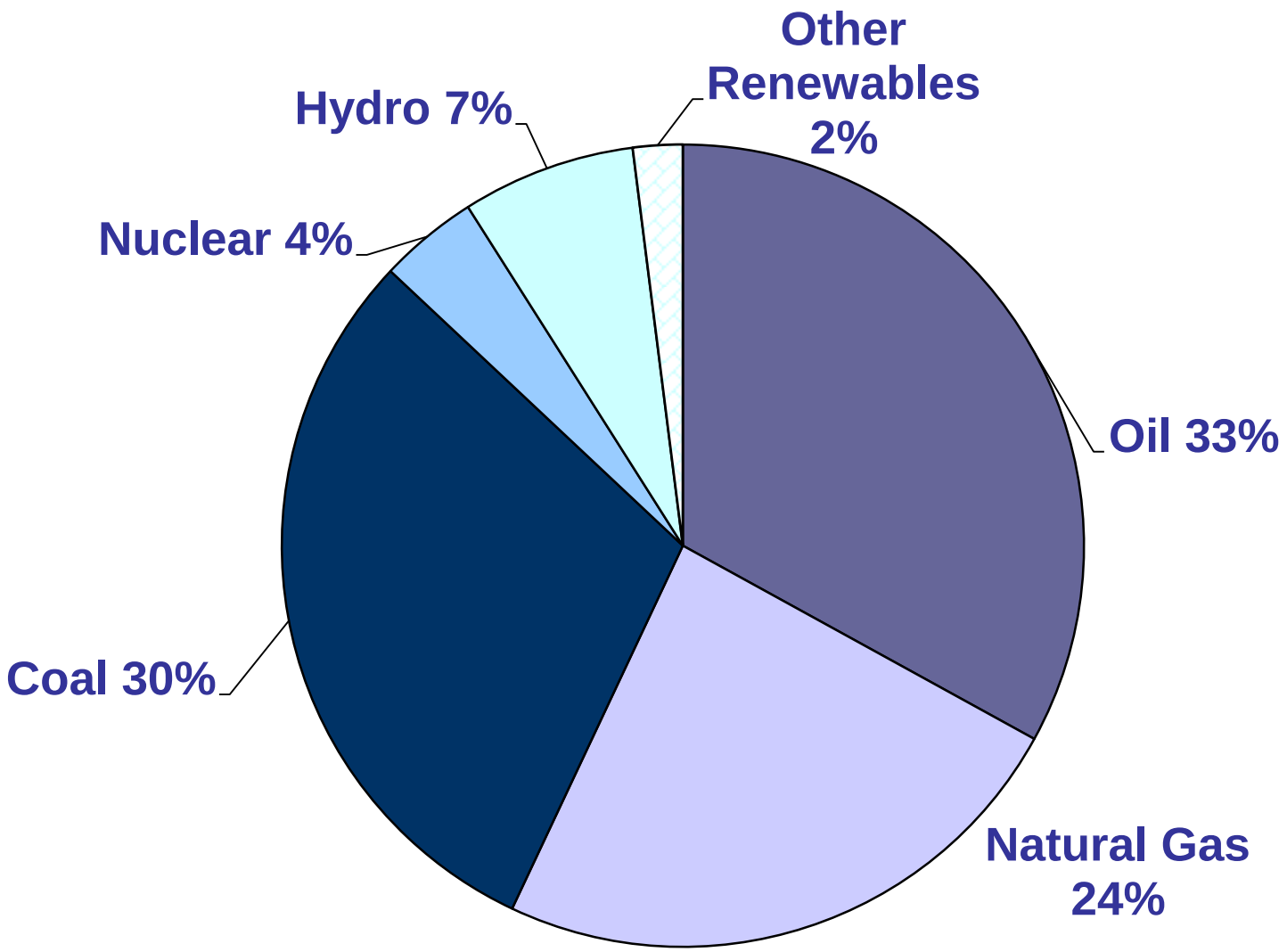
Source: Baker Hughes

RETAIL PRICES

[USD/liter]	GASOLINE	DIESEL OIL
US	0.92	0.99
Germany	1.98	1.72
China	1.33	1.24
India	1.11	0.96
Brazil	1.24	1.05
Argentina	1.41	1.29

Source: EIA-DOE, ANP, Argentine Energy Secretariat and own research – Sep-Oct-14

WORLD PRIMARY ENERGY SUPPLY BY SOURCE



Source: BP Statistical Review of World 2014

ELECTRICITY

	INVESTMENT [USD/KW]	INVESTMENT [USD/MWh]	FUEL COST [USD/unit]	FUEL COST [USD/MWh]	O & M [USD/MWh]	TOTAL [USD/MWh]
Natural Gas CC	1,000	**15.5**	4 USD/Mmbtu	**27.0**	**6**	**49**
			10 USD/MMbtu	**67.5**	**6**	**89**
Coal	2,500	**45.5**	80 USD/tn	**27.3**	**8**	**81**
Diesel Oil CC	1,098	**18.0**	941 USD/tn	**148.8**	**4**	**171**
Nuclear	6,000	**114.6**	286 USD/kg	**10.0**	**13**	**138**
Hydro	2,500	**87.6**			**9**	**97**
Wind	1,800	**72.4**			**15**	**87**
Solar	2,500	**117.3**			**17**	**134**

Brent= 100.0
Discount rate : 10%

3. NATURAL GAS

NATURAL GAS PRICES

[U$S/MMBTU]	90s	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	oct-14
HH	2.2	5.9	8.8	6.8	7.0	8.9	3.9	4.4	4.0	2.8	3.7	3.9
UK		4.5	7.4	7.9	6.0	10.8	4.9	6.6	9.0	9.5	10.6	8.0
LNG FAR EAST		5.2	6.1	7.1	7.7	12.6	9.1	10.9	14.7	16.7	16.2	14.7

Source: BP Statistical Review of World 2014 given in Natural Gas Week – WGI oct-14

NATURAL GAS RESERVES AND PRODUCTION

2013[TCF]	**PRODUCTION**	**RESERVES**	**R/P years**
Russia	21.4	1104	52
US	24.3	330	14
Iran	5.9	1193	202
Qatar	5.6	871	156
Others	62.5	3060	49
TOTAL	**119.7**	**6,558**	**55**

Source: BP Statistical Review of World 2014

NATURAL GAS PRODUCTION

[TCF]	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Russia	19.8	20.2	20.5	21.0	20.9	21.2	18.6	20.8	21.4	20.9	21.4
US	19.1	18.5	18.1	18.5	19.3	20.1	20.6	21.3	22.9	24.0	24.3
Iran	2.9	3.4	3.6	3.9	4.4	4.7	5.1	5.4	5.6	5.8	5.9
Qatar	1.1	1.4	1.6	1.8	2.2	2.7	3.2	4.1	5.1	5.3	5.6
Others	49.9	52.0	54.9	57.4	58.7	60.0	58.5	61.6	62.0	62.5	62.5
TOTAL	**92.8**	**95.5**	**98.7**	**102.6**	**105.5**	**108.7**	**106.0**	**113.2**	**117.0**	**118.5**	**119.7**

Annual average growth 2003-2013 ***2.6%***

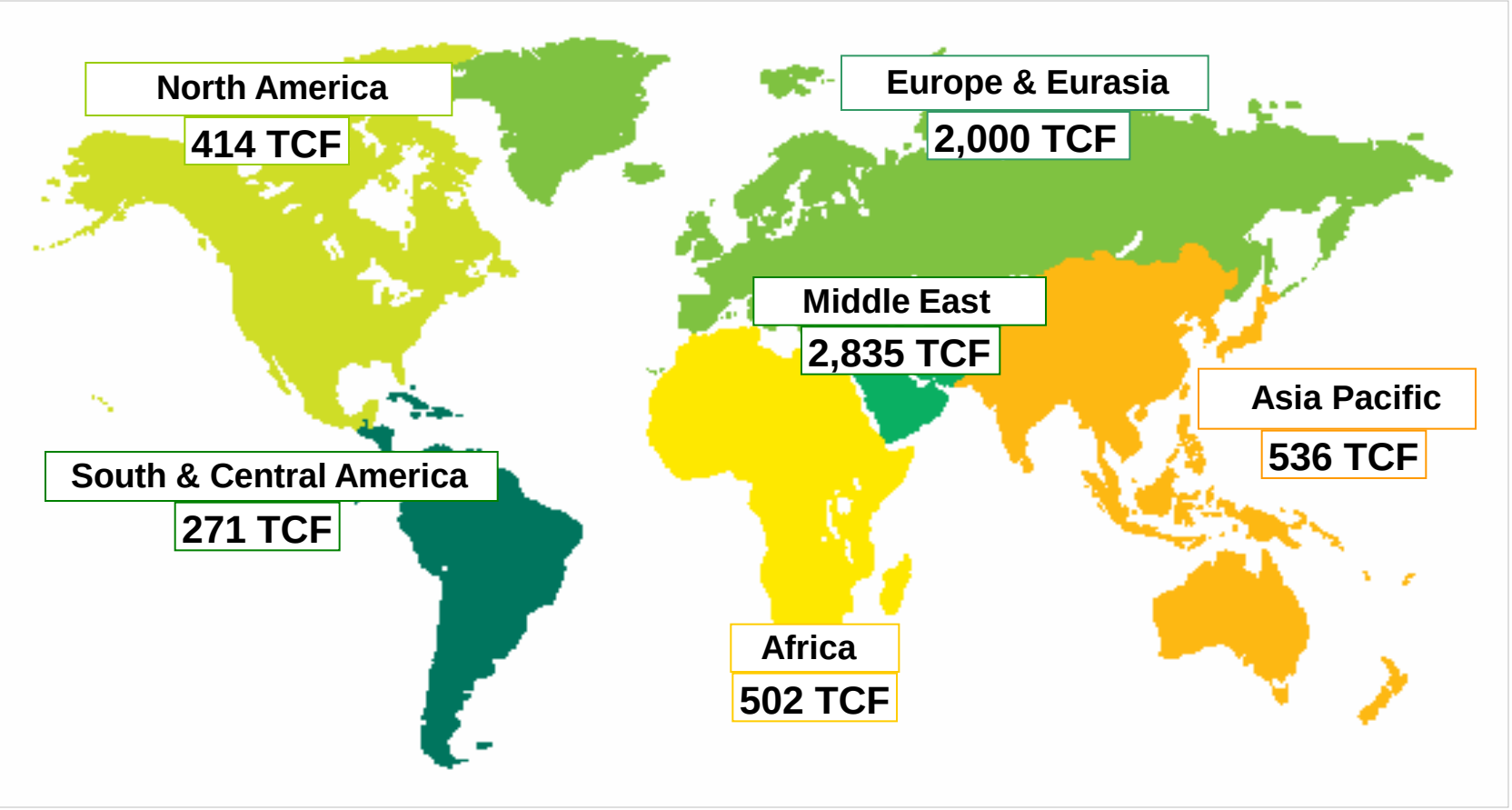
Source: BP Statistical Review of World 2014

NATURAL GAS PROFILE

	2013		
	TCF	MMtn/y	%
Own consumption (via gas pipeline)	82.8	1,720	*69%*
Exports via gas pipeline	25.5	529	*21%*
Exports via LNG	11.5	239	*10%*
TOTAL	**119.7**	**2,488**	***100%***

Source: BP Statistical Review of World 2014

CONVENTIONAL NATURAL GAS RESERVES



Source: BP Statistical Review of World 2014

LNG INVESTMENTS

1 Train - 4 MMTn/y	INVESTMENT **MM U$S**	TO RECOVER INVESTMENT **U$S/MMBTU**
Liquefaction	5,000	5.0
Transport*		2.0 - 4.0
Regasification	1,200	1.2
TOTAL		**8.2 - 10.2**

* Depending on distance

LNG LIQUEFACTION & REGASIFICATION CAPACITY

LNG PRODUCERS	MM tn/y	TCF/y
Qatar	77	3.7
Indonesia	34	1.6
Malasya	24	1.2
Australia	24	1.2
Nigeria	21.8	1.0
Rest of the World	104.8	5.0
TOTAL	**286**	**13.8**
Under Construction	**92.6**	**4.5**

LNG REGASIFICATION	MM tn/y	TCF/y
Japan	194.1	9.3
US	137.9	6.6
South Korea	94.4	4.5
Spain	44.5	2.1
UK	39.6	1.9
Rest of the World	210.3	10.1
TOTAL	**720.8**	**34.7**
TOTAL without US	**582.9**	**28.1**

Source : GIIGNL 2013

SHALE GAS

Low permeability – Low porosity – Source rock

Declining Factor

Horizontal drilling

Multiple fracs

4 U$S/MMBTU? > 6 U$S/MMBTU? > 8U$S/MMBTU ?

Domestic or global phenomenon

SHALE GAS RECOVERABLE RESOURCES

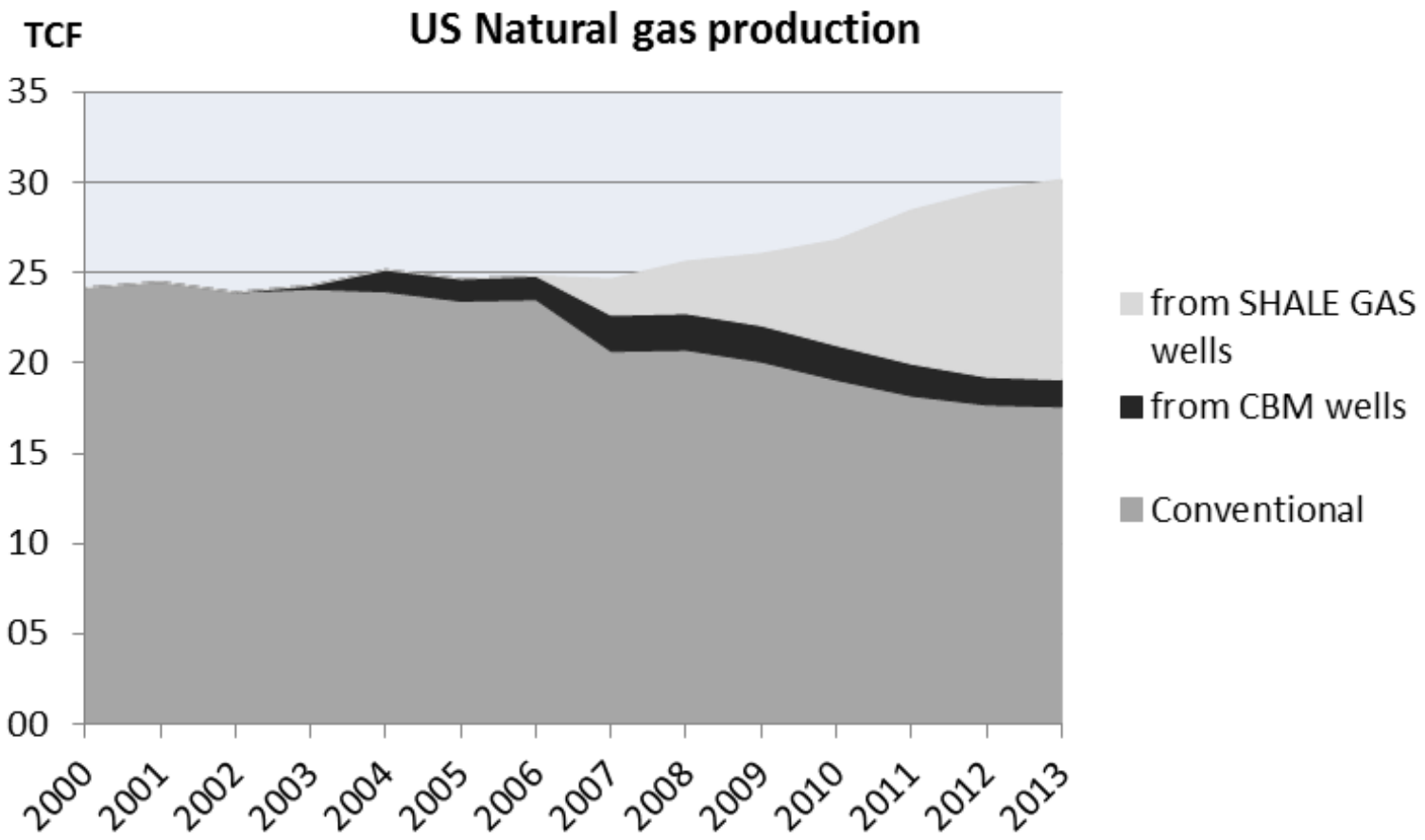
Conventional Gas	
2013 [TCF]	**RESERVES**
Russia	1,104
Iran	1,193
Qatar	871
Turkmenistan	617
Saudi Arabia	291
US	330
Rest of the world	2,152
TOTAL	**6,558**

Source: BP Statistical Review of World 2014

Non Conventional Gas (mainly shales)	
[TCF]	**RESOURCES**
China	1,115
Argentine	802
Algeria	707
US	665
Canada	573
Mexico	545
Rest of the world	2,892
TOTAL	**7,299**

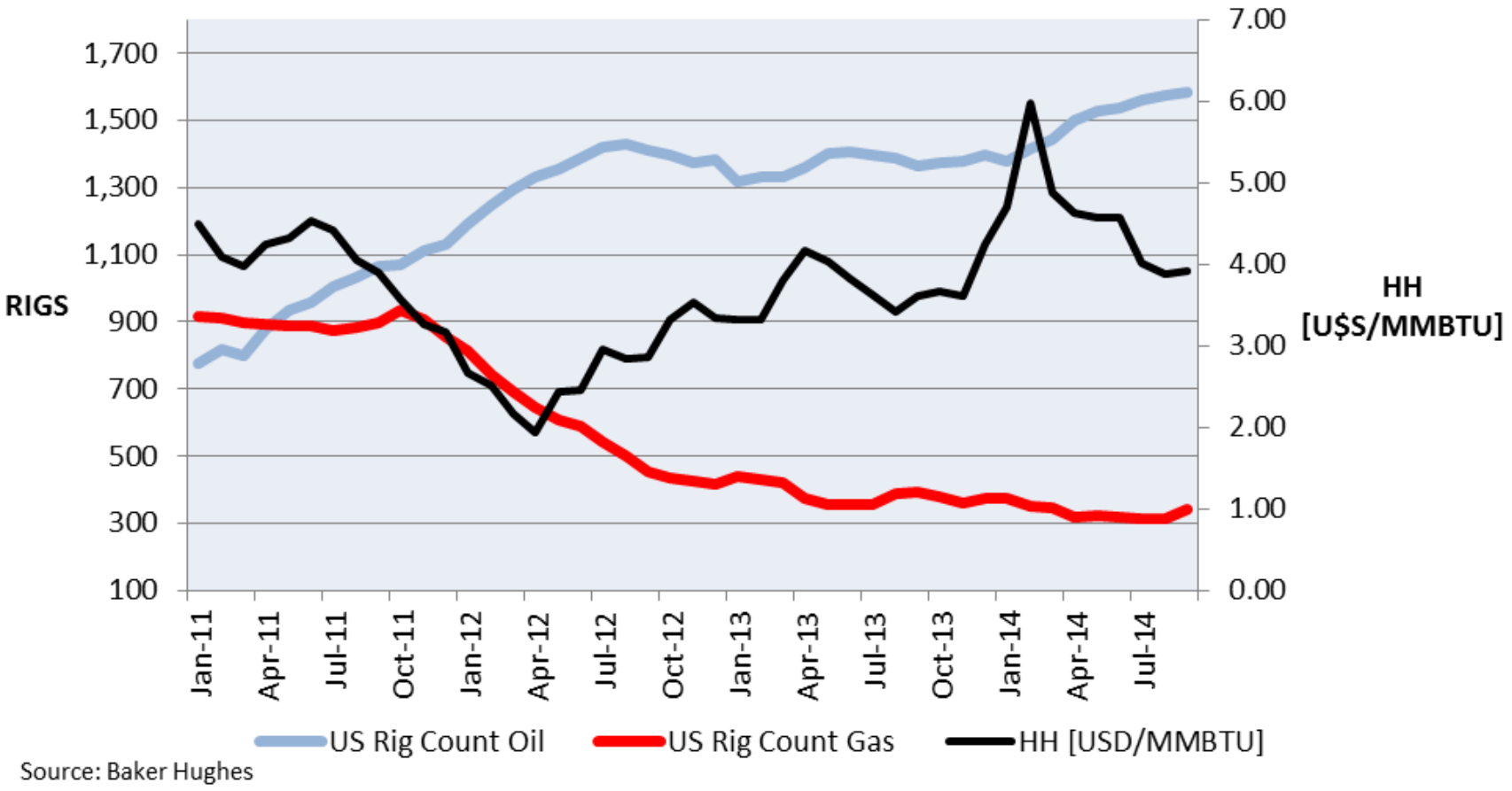
Source: EIA – DOE- Jun-13

US NATURAL GAS GROSS PRODUCTION



Source: EIA – DOE - Natural Gas Gross Production @ oct-14

US RIGS OIL & GAS SPLIT



Source: Baker Hughes

4. COAL

COAL RESERVES AND PRODUCTION

"Coal is the best of fuels, coal is the worst of fuels"
Kenneth Deffeyes

	PRODUCTION [MMtn]	RESERVES [MMtn]	R/P [years]
China	3,680	114,500	31
US	893	237,295	266
India	605	60,600	100
Australia	478	76,400	160
Russia	347	157,010	452
South Africa	257	30,156	117
Others	1,636	215,570	132
TOTAL	**7,896**	**891,531**	**113**

Source: BP Statistical Review of World 2014

COAL PRICES

[USD/ton]

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	sep-14
FOB RICHARD BAY	54.3	46.3	51.1	63.6	120.7	64.4	91.9	116.2	92.9	80.3	67.9

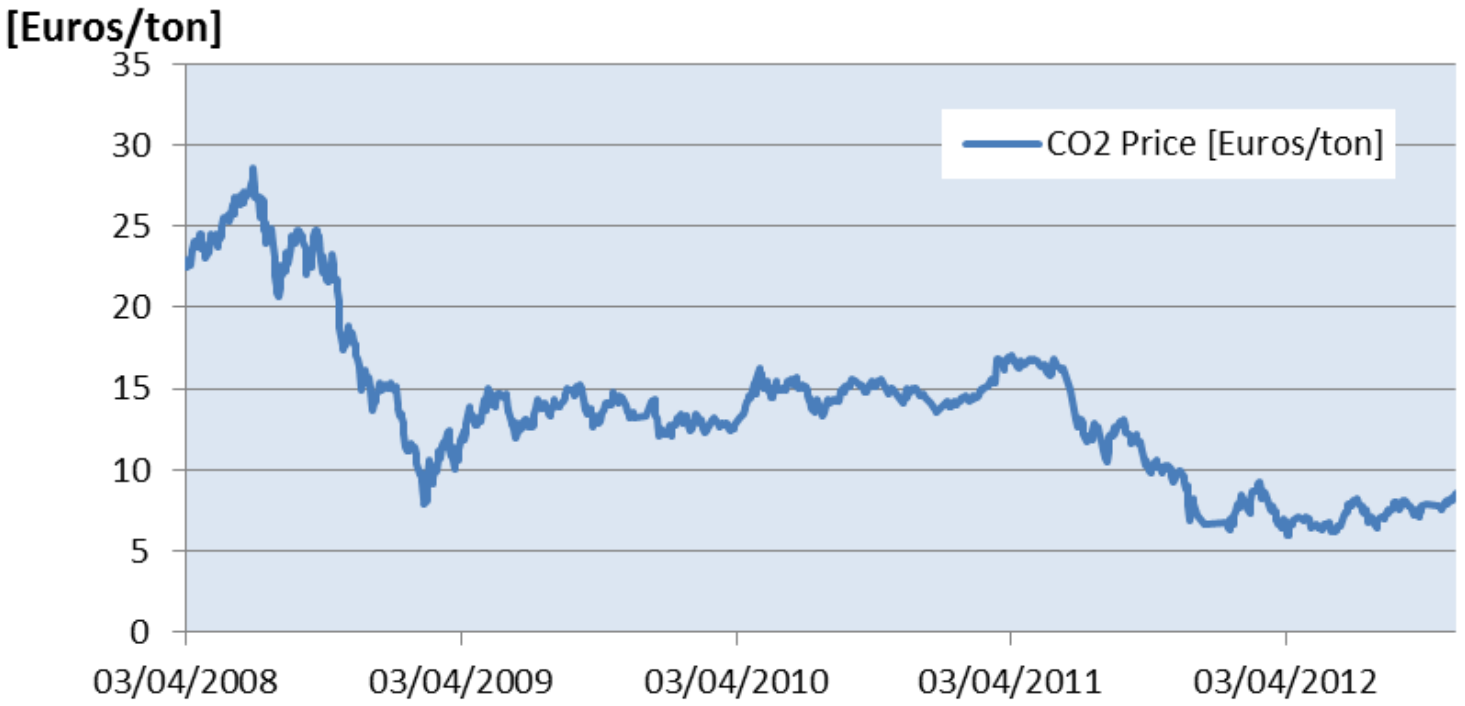
Source: Bloomberg

EMISSIONS

[USD/MWh]	CO_2 tn / MWh	@ 30 USD/ CO_2 tn	
		FROM	TO
Natural Gas CC @ 4 USD/Mmbtu	0.343	49	59
Natural Gas CC @ 10 USD/Mmbtu	0.343	89	99
Coal ST	0.894	81	108
Diesel Oil - CC	0.410	171	184
Nuclear	-	138	138
Hydro	-	97	97
Wind	-	87	87

Source: Own research

CO_2 PRICE EVOLUTION



Source: Bloomberg

CO_2 EMISSIONS

Kyoto

Copenhagen

Cancun

Cap and trade or Tariff

5. NUCLEAR

URANIUM RESOURCES AND PRODUCTION

2012	PRODUCTION [TU/year]	RESOURCES [TU]
Canada	8,999	468,700
Australia	6,991	1,661,000
Kazakhstan	21,317	629,000
Namibia	4,495	261,000
Niger	4,667	421,000
Russia (est)	2,872	487,200
Others	9,053	1,399,300
TOTAL	**58,394**	**5,327,200**
RESOURCES / PRODUCTION [years]		**91**

Source: World Nuclear Association

URANIUM PRICES

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
[US$/kg]										
Price U_3O_8	41	64	110	200	136	100	100	125	108	86

Sep-14	78	US$/kg

Source: Trade Tech – www.uranium.info

NUCLEAR REACTORS

	REACTORS Jun-14 No.	REACTORS Jun-14 Capacity [Mwe]	GENERATION 2013 [billion kWh]
US	100	99,361	790
France	58	63,130	406
Japan	48	42,569	14
Russia	33	24,253	162
Korea RO (South)	23	20,656	133
China	20	17,055	105
Germany	9	12,003	92
Others	143	95,584	658
TOTAL	**434**	**374,611**	**2,359**
Utilization factor			**72%**

Source: World Nuclear Association

WIND POWER

[GW]	2006	2007	2008	2009	2010	2011	2012	2013
China	2.6	6.1	12.2	25.8	44.7	62.4	75.3	91.4
USA	11.6	16.8	25.2	35.1	40.3	46.9	60.0	61.1
Germany	20.6	22.2	23.9	25.8	27.2	29.1	31.3	34.3
Spain	11.6	15.1	16.8	19.2	20.6	21.7	22.8	23.0
India	1.7	2.2	2.9	3.4	3.7	16.1	18.4	20.2
France	3.1	3.1	3.2	3.5	3.8	6.8	7.6	8.3
Others	22.9	28.6	36.7	46.1	57.3	55.1	67.6	80.0
Total	**74.2**	**94.1**	**120.8**	**158.7**	**197.6**	**238.0**	**283.0**	**318.1**

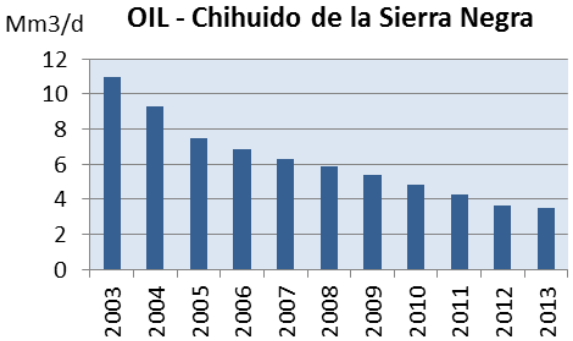
Total World Generation Capacity 2012*e* (all sources): 5,400 GW

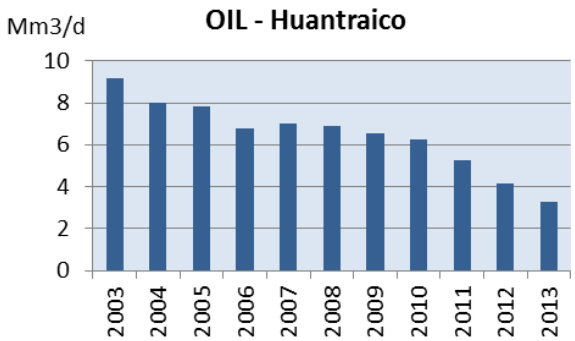
Source: Global Wind Energy Council

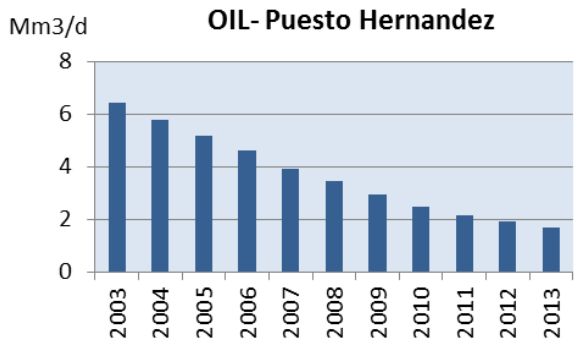
ARGENTINE

Present Reality vs Uncertain Vaca Muerta

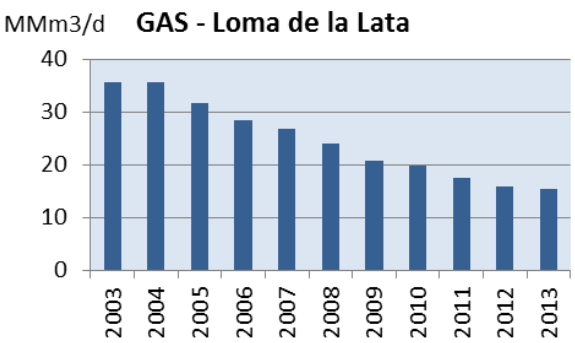
OIL FIELDS

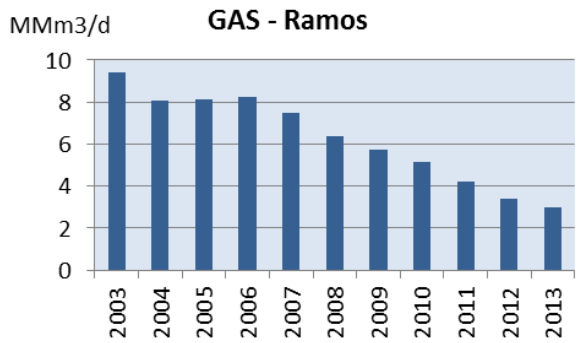


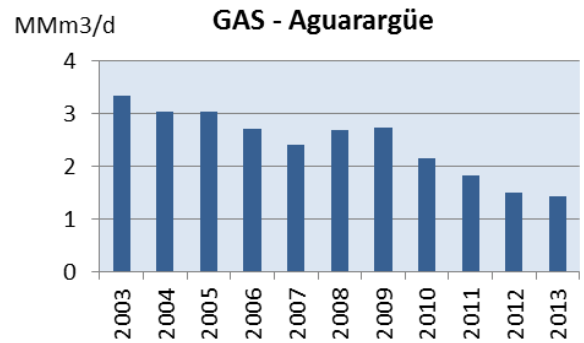




GAS FIELDS







HOPES


World economic crisis ???
Shale Oil and Shale Gas
Pre Salt Oil
Irak oil
Renewables

TOUGH DECISIONS ?

ENERGIA EN EL MUNDO

IMPACTO DEL SHALE OIL Y SHALE GAS

GRACIAS

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Ingeniería 2014 – Latinoamérica y Caribe

Buenos Aires – 4 de Noviembre de 2014