

# ENERGY IN THE WORLD

## TOUGH DECISIONS

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ARGENTINA ENERGÉTICA VII

IAE General Mosconi - June 26th, 2013

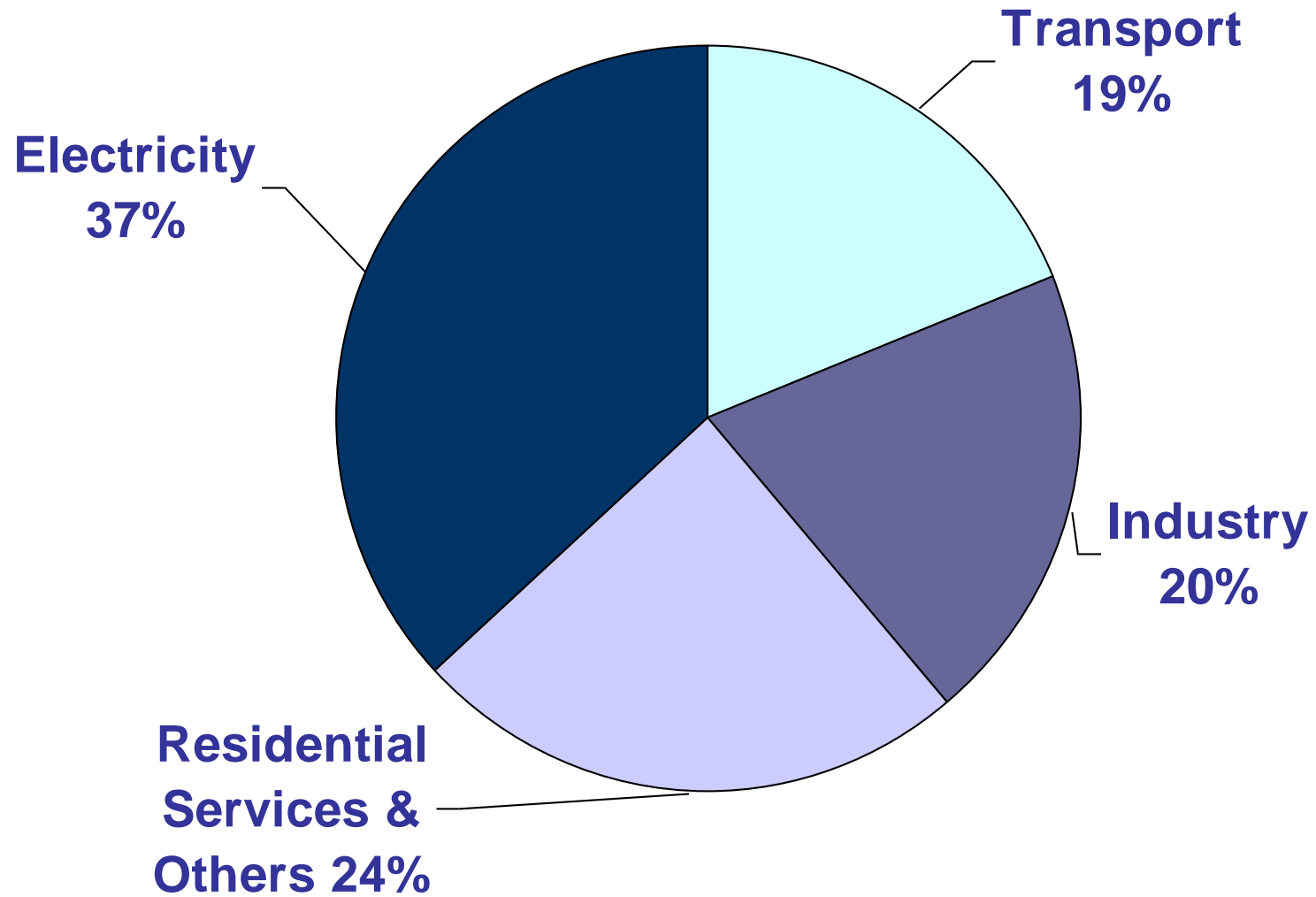
Marcelo Martínez Mosquera

# Energy in the world

## The era of scarcity

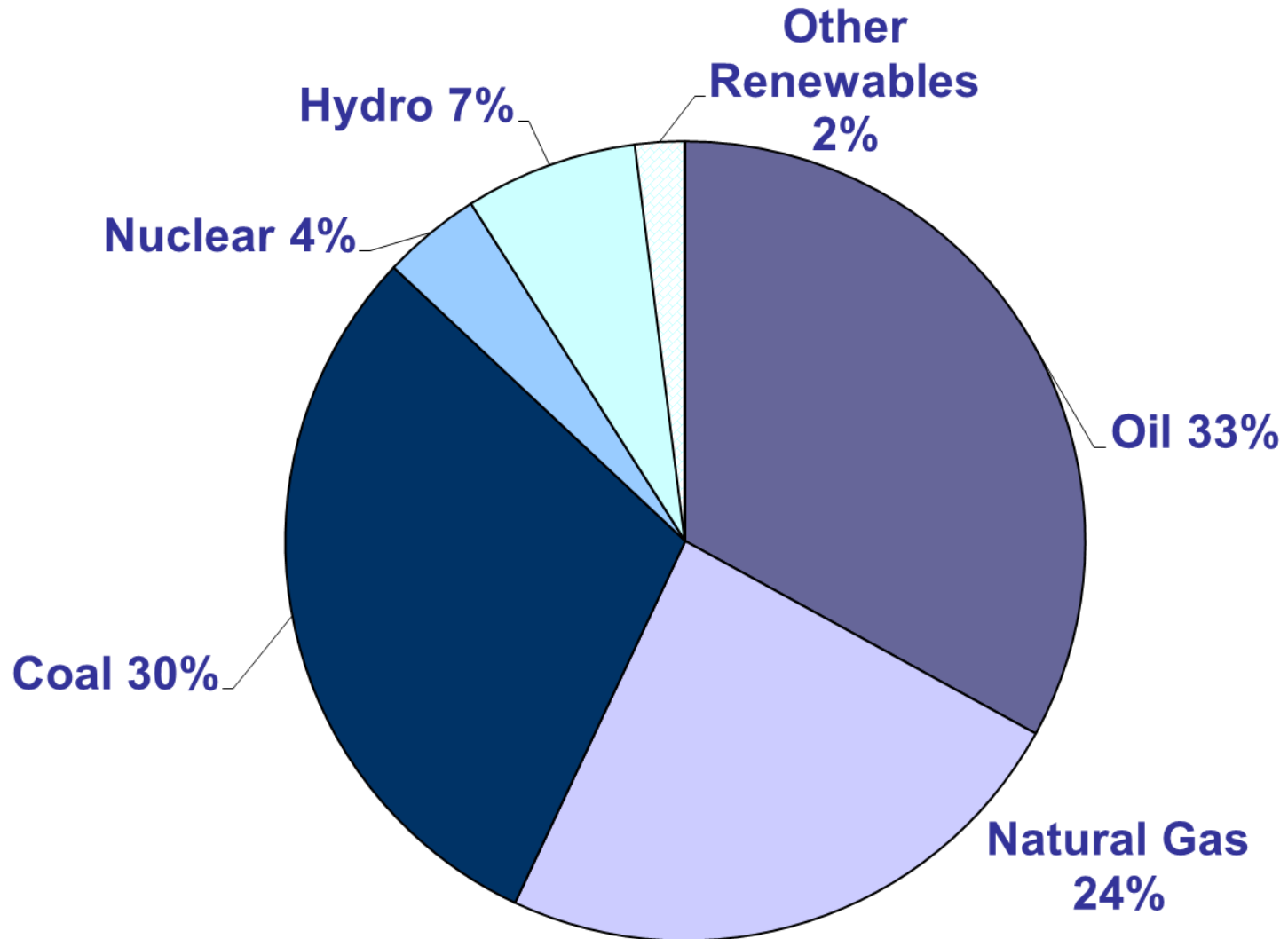
# **1. ENERGY IN THE WORLD**

# WORLD PRIMARY ENERGY DEMAND BY SECTOR



Source: Own research

# WORLD PRIMARY ENERGY SUPPLY BY SOURCE



Source: BP Statistical Review of World 2013

# ENERGY GROWTH

Last 10 years:

**annual growth**

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Oil	1.2%
Natural Gas	2.8%
Coal	4.5%
Nuclear	-0.9%
Hydro	3.3%
Other Renewable	15.1%

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**TOTAL**

**2.7%**

## **2. OIL**

# WORLD OIL PRICES AND PRODUCTION

	90's	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
[USD/bbl]											
<b>WTI</b>	20.7	31.1	41.5	56.6	66.0	72.2	100.1	61.9	79.5	95.0	94.2
<b>Brent</b>									79.5	111.3	111.9
										WTI may-13	95
										Brent may-13	103
[MMbbl/d]											
OPEC		31.0	33.3	35.1	35.4	34.9	35.6	33.5	34.6	35.7	37.6
FSU		10.3	11.2	11.6	12.3	12.8	12.8	13.3	13.6	13.6	13.7
Rest of the World		38.4	38.4	37.8	37.8	38.0	38.0	38.4	39.1	39.1	39.6
<b>TOTAL</b>		<b>79.7</b>	<b>82.9</b>	<b>84.5</b>	<b>85.5</b>	<b>85.7</b>	<b>86.4</b>	<b>85.2</b>	<b>87.3</b>	<b>88.4</b>	<b>90.9</b>

Source: Oil Market Report IEA - Platts



# WTI VS BRENT

## WTI differential – May-13

[US\$/bbl]

	UK BRENT	ARGENTINA ESCALANTE	VENEZUELA MESA 30	USA LLS
Jan-10	-2	-3	+1	+1
Jul-10	-1	-4	-1	+2
Dec-10	+2	-2	-1	+5
May-11	+12	+8	+9	+15
May-12	+16	+11	+10	+13
May-13	+8	+3	+4	+10

WTI May-13: 95  
Brent May-13: 103

# INTERNATIONAL RIG COUNT (OIL & GAS)

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Latin America	214	244	290	316	324	355	384	356	383	424	423
Europe	88	83	70	70	77	78	98	84	94	118	119
Africa	58	54	48	50	58	66	65	62	83	78	96
Middle East	201	211	230	248	238	265	280	252	265	291	356
Far East	171	177	197	225	228	241	252	243	269	256	241
Canada	266	372	369	458	470	343	379	221	351	423	365
USA	831	1 032	1 190	1 380	1 648	1 768	1 878	1 086	1 541	1 875	1 919
<b>TOTAL WORLD</b>	<b>1 829</b>	<b>2 174</b>	<b>2 395</b>	<b>2 746</b>	<b>3 043</b>	<b>3 116</b>	<b>3 336</b>	<b>2 304</b>	<b>2 985</b>	<b>3 465</b>	<b>3 518</b>

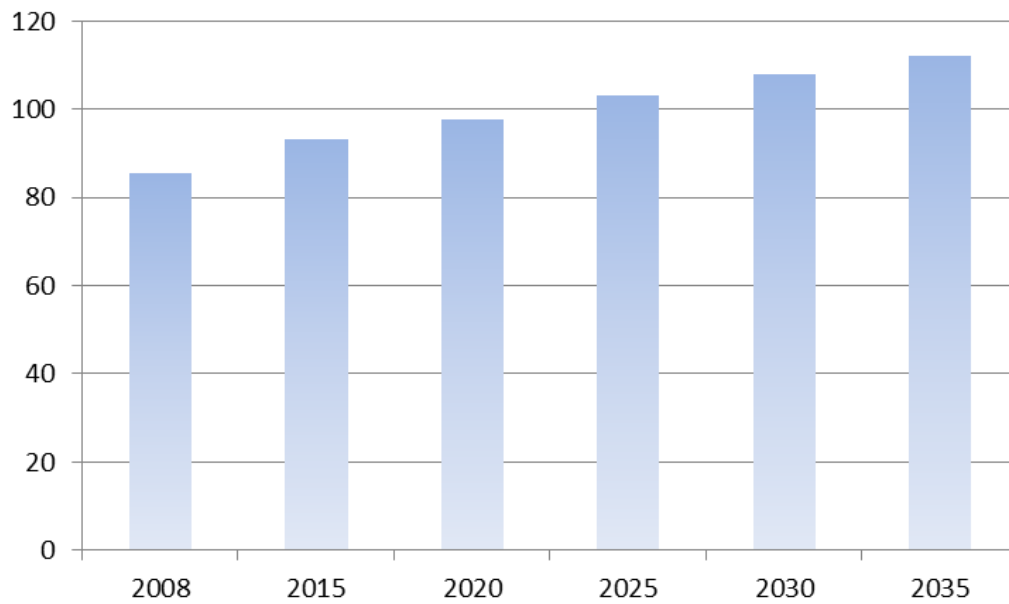
Source: Baker Hughes

# 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	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
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[USD/bbl]

WTI	20.7	31.1	41.5	56.6	66.0	72.2	100.1	61.9	79.5	95.0	94.2
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Brent								79.5	111.3	111.9
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[MMbbl/d]

WORLD DEMAND	79.7	82.9	84.5	85.5	85.7	86.4	85.2	87.3	88.4	90.9
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Source: Oil Market Report IEA - Platts

# CHINA

[MMbbl/d]

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
<b>PRODUCTION</b>	3.4	3.8	3.6	3.7	3.7	3.8	3.9	4.1	4.1	4.2
<b>DEMAND</b>	5.6	6.4	6.7	7.2	7.6	7.8	8.1	8.8	9.2	9.6
<b>IMPORTS</b>	2.2	2.6	3.1	3.5	3.8	4.0	4.2	4.7	5.1	5.4

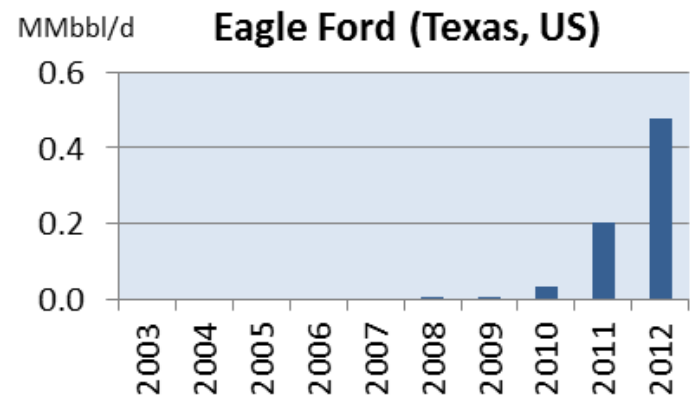
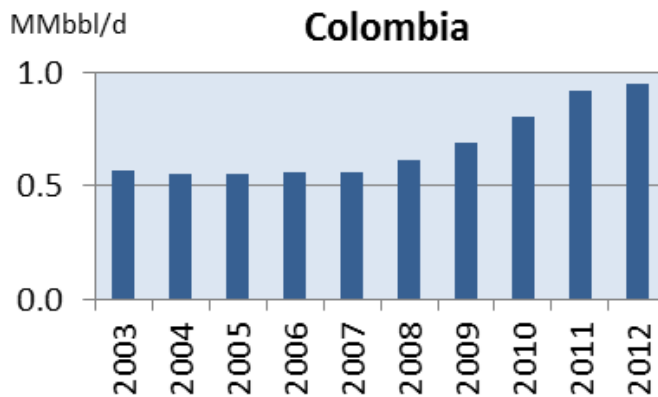
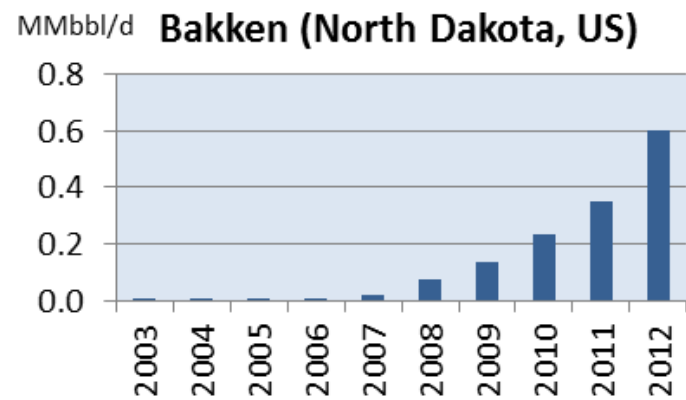
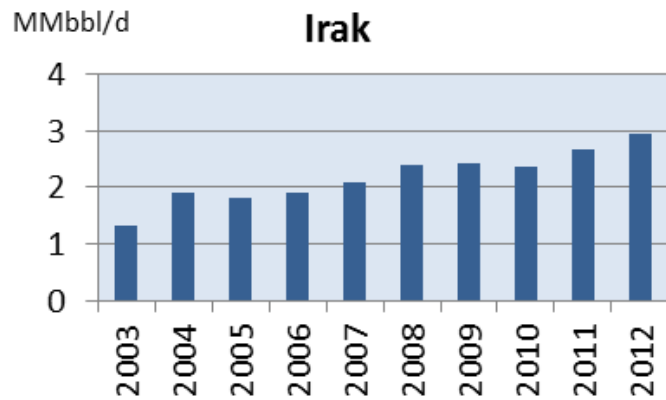
Source: Oil Market Report

*“The oil of tomorrow is not oil”*

*Nick Hodge*

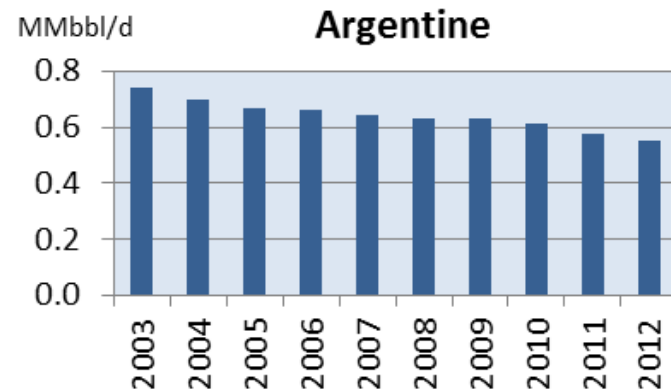
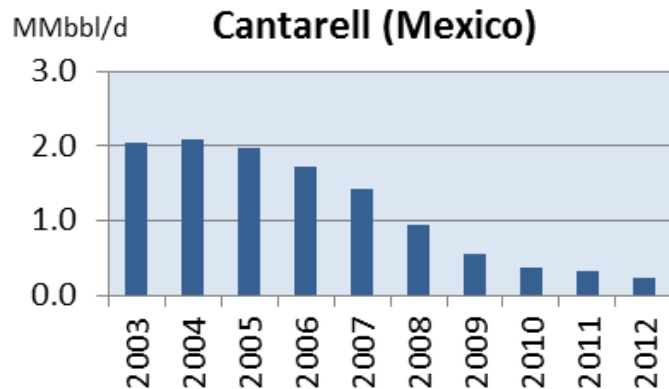
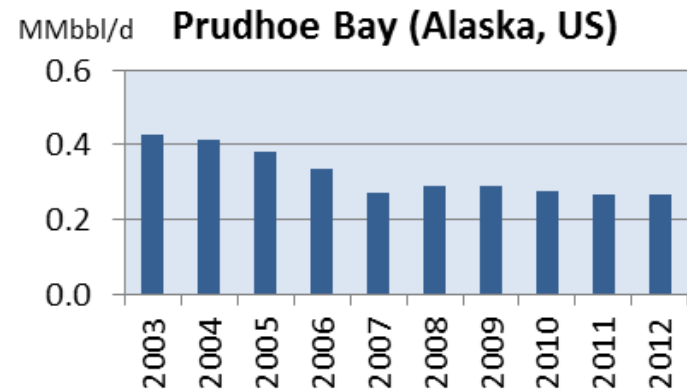
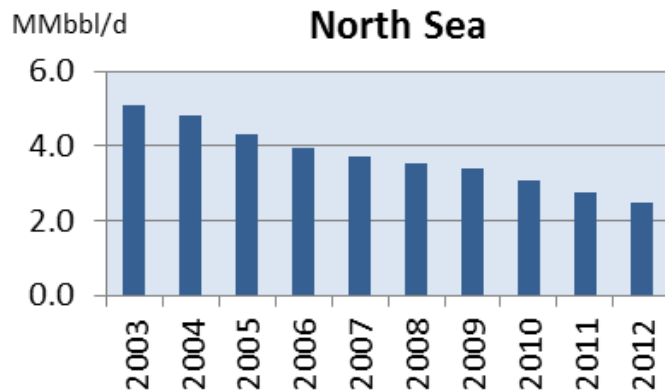
# WHO WILL WIN THE RACE?

## 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\$\$/l]	BIOFUEL	BF equivalent oil	oil@ 102
BIODIESEL from soybean oil	1.17	1.29	0.73
BIOETHANOL from corn	0.60	0.90	0.75
BIOETHANOL from sugar	0.55	0.83	0.75

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**

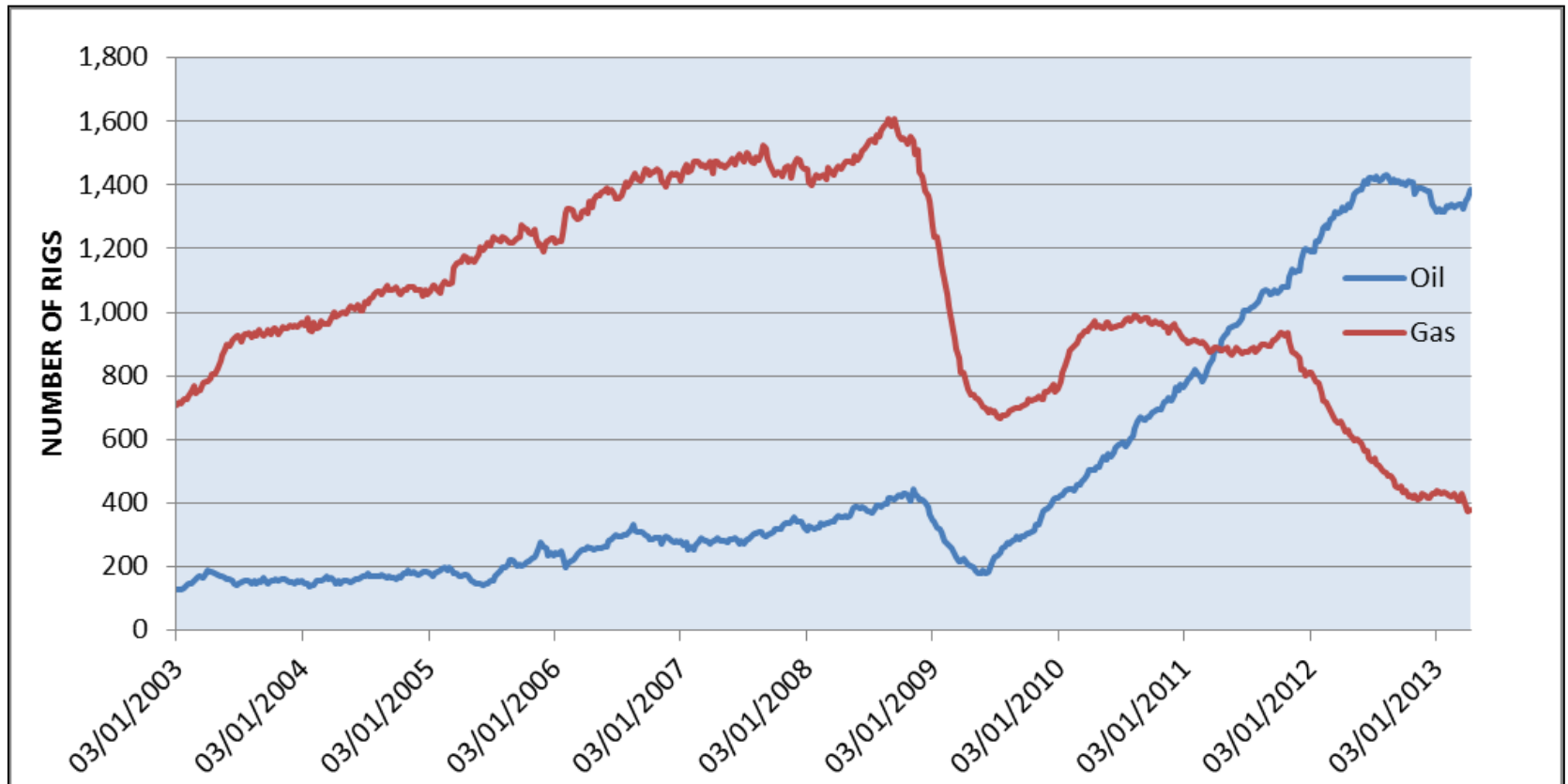
**Declining factor**

**Horizontal drilling**

**Multiple fracs**

**Domestic or global phenomenon**

# US OIL & GAS DRILLING

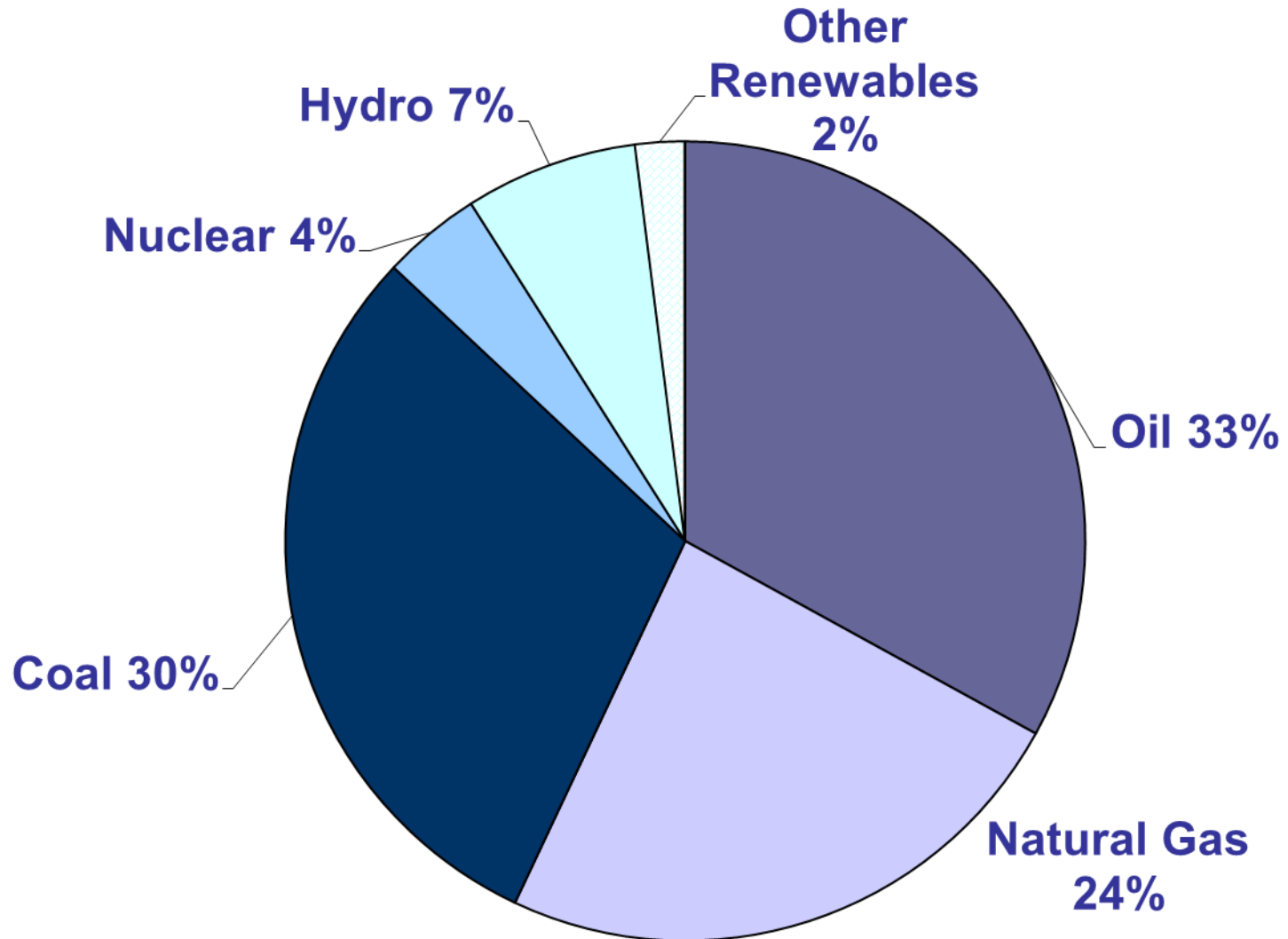


# RETAIL PRICES

[USD/liter]	<b>GASOLINE</b>	<b>DIESEL OIL</b>
US	0.99	1.02
Germany	1.92	1.66
China	1.24	1.22
India	1.17	0.90
Brazil	1.40	1.14
Argentina	1.09	0.80

Source: EIA-DOE, ANP, Argentine Energy Secretariat and own research – May-Jun-13

# WORLD PRIMARY ENERGY SUPPLY BY SOURCE



Source: BP Statistical Review of World 2013

# ELECTRICITY

	INVESTMENT [USD/KW] [USD/MWh]		FUEL COST [USD/unit] [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	85 USD/tn	29.0	8	83
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	2,000	80.5			9	90
Solar	4,500	211.2			17	228

Brent= 100.0

Discount rate : 10%

# **3. NATURAL GAS**



# NATURAL GAS PRICES

[U\$/MMBTU]	90s	2004	2005	2006	2007	2008	2009	2010	2011	2012	jun-13
HH	2.2	5.9	8.8	6.8	7.0	8.9	3.9	4.4	4.0	2.8	3.9
UK		4.5	7.4	7.9	6.0	10.8	4.9	6.6	9.0	9.5	9.4
LNG FAR EAST		5.2	6.1	7.1	7.7	12.6	9.1	10.9	14.7	16.7	14.6

Source: BP Statistical Review of World 2013 given in Natural Gas Week – WGI jun-13

# NATURAL GAS RESERVES AND PRODUCTION

2012 [TCF]	PRODUCTION	RESERVES	R/P years
Russia	20.9	1163	56
US*	24.0	300	12
Iran	5.7	1187	208
Qatar	5.5	885	161
Others	62.4	3079	49
<b>TOTAL</b>	<b>118.5</b>	<b>6,614</b>	<b>56</b>

\*Before non-conventional

Source: BP Statistical Review of World 2013

# NATURAL GAS PRODUCTION

[TCF]	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Russia	19.0	19.8	20.2	20.5	21.0	20.9	21.2	18.6	20.8	21.4	20.9
US	18.9	19.1	18.5	18.1	18.5	19.3	20.1	20.6	21.3	22.9	24.0
Iran	2.6	2.9	3.0	3.7	3.8	4.0	4.1	4.6	5.2	5.4	5.7
Qatar	1.0	1.1	1.4	1.6	1.8	2.2	2.7	3.2	4.1	5.1	5.5
Others	47.6	49.7	51.7	54.3	56.6	57.5	59.5	57.9	61.3	61.4	62.4
<b>TOTAL</b>	<b>89.1</b>	<b>92.6</b>	<b>94.8</b>	<b>98.2</b>	<b>101.7</b>	<b>103.9</b>	<b>107.6</b>	<b>104.9</b>	<b>112.7</b>	<b>116.2</b>	<b>118.5</b>

*Annual average growth 2002-2012*

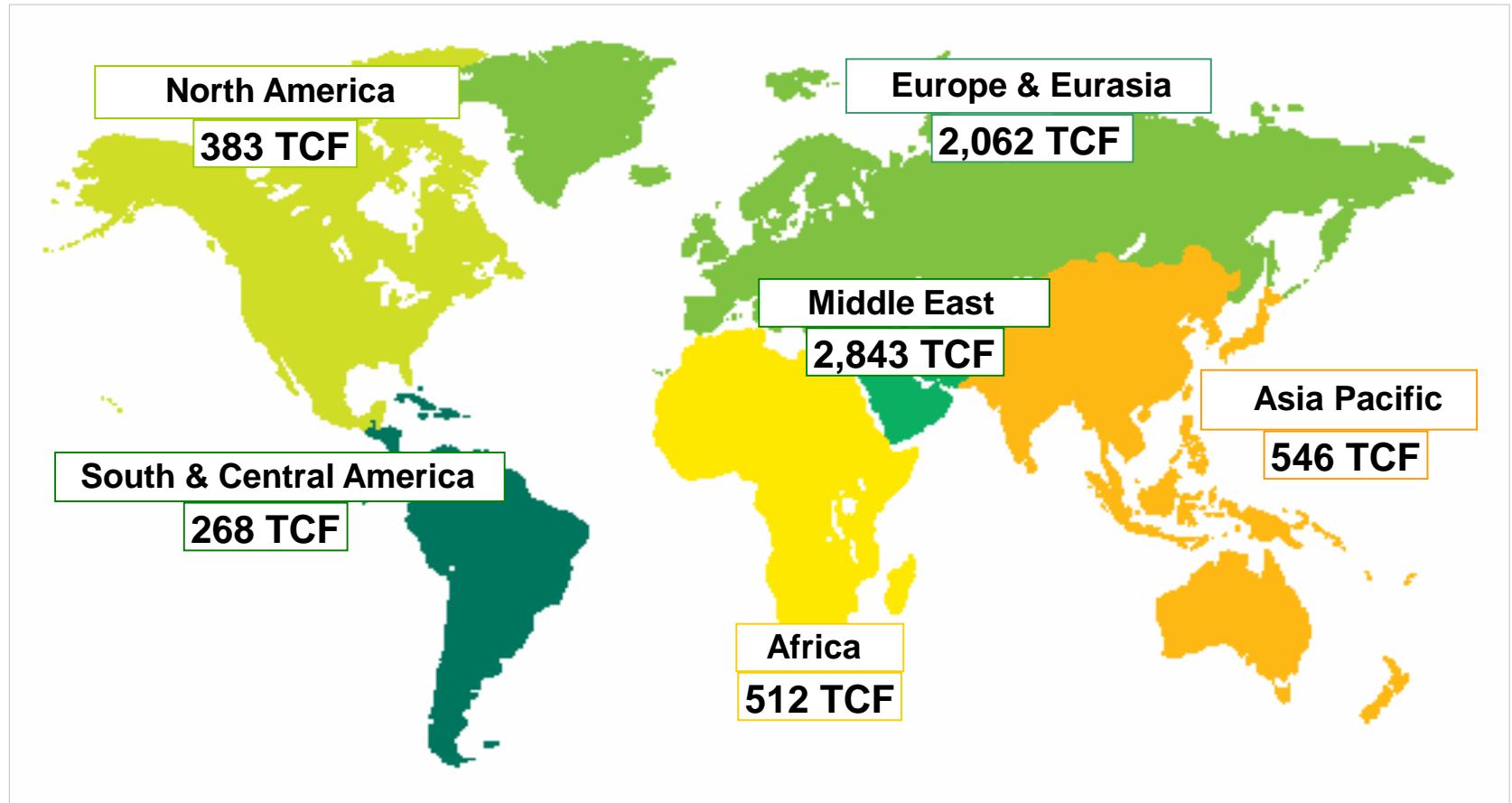
**2.9%**

# NATURAL GAS PROFILE

	2012		
	TCF	MMtn/y	%
Own consumption (via gas pipeline)	81.6	1,696	69%
Exports via gas pipeline	25.3	525	21%
Exports via LNG	11.6	241	10%
<b>TOTAL</b>	<b>118.5</b>	<b>2,462</b>	<b>100%</b>

Source: BP Statistical Review of World 2013

# CONVENTIONAL NATURAL GAS RESERVES



Source: BP Statistical Review of World 2013

# LNG INVESTMENTS

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

\* Depending on distance

# LNG LIQUEFACTION & REGASIFICATION CAPACITY

LNG PRODUCERS	MM tn/y	TCF/y
Qatar	77.5	3.72
Indonesia	34.6	1.66
Malasya	24.2	1.16
Nigeria	21.7	1.04
Australia	19.8	0.95
Rest of the world	103.2	4.95
<b>TOTAL</b>	<b>281.0</b>	<b>13.49</b>
<b>Under Construction</b>	<b>95.9</b>	<b>4.60</b>

LNG REGASIFICATION	MM tn/y	TCF/y
Japan	185.3	8.90
US	126.8	6.09
South Korea	87.4	4.20
Spain	44.5	2.13
UK	37.8	1.82
Rest of the world	169.1	8.12
<b>TOTAL with US</b>	<b>651.0</b>	<b>31.25</b>
<b>TOTAL without US</b>	<b>524.2</b>	<b>25.16</b>

Source : GIIGNL 2011 and own Research

# SHALE GAS

**Low permeability – Low porosity – Source rock**

**Declining Factor**

**Horizontal drilling**

**Multiple fracs**

**4 U\$\$/MMBTU? > 6 U\$\$/MMBTU? > 8U\$\$/MMBTU ?**

**Domestic or global phenomenon**



# SHALE GAS RECOVERABLE RESOURCES

## Conventional Gas

2012 [TCF]

### RESERVES

Russia	1,163
Iran	1,187
Qatar	885
Turkmenistan	618
Saudi Arabia	291
US*	300
Rest of the world	2,170

**TOTAL 6,614**

\* Before non-conventional

Source: BP Statistical Review of World 2013

## Non Conventional Gas (mainly shales)

[TCF]

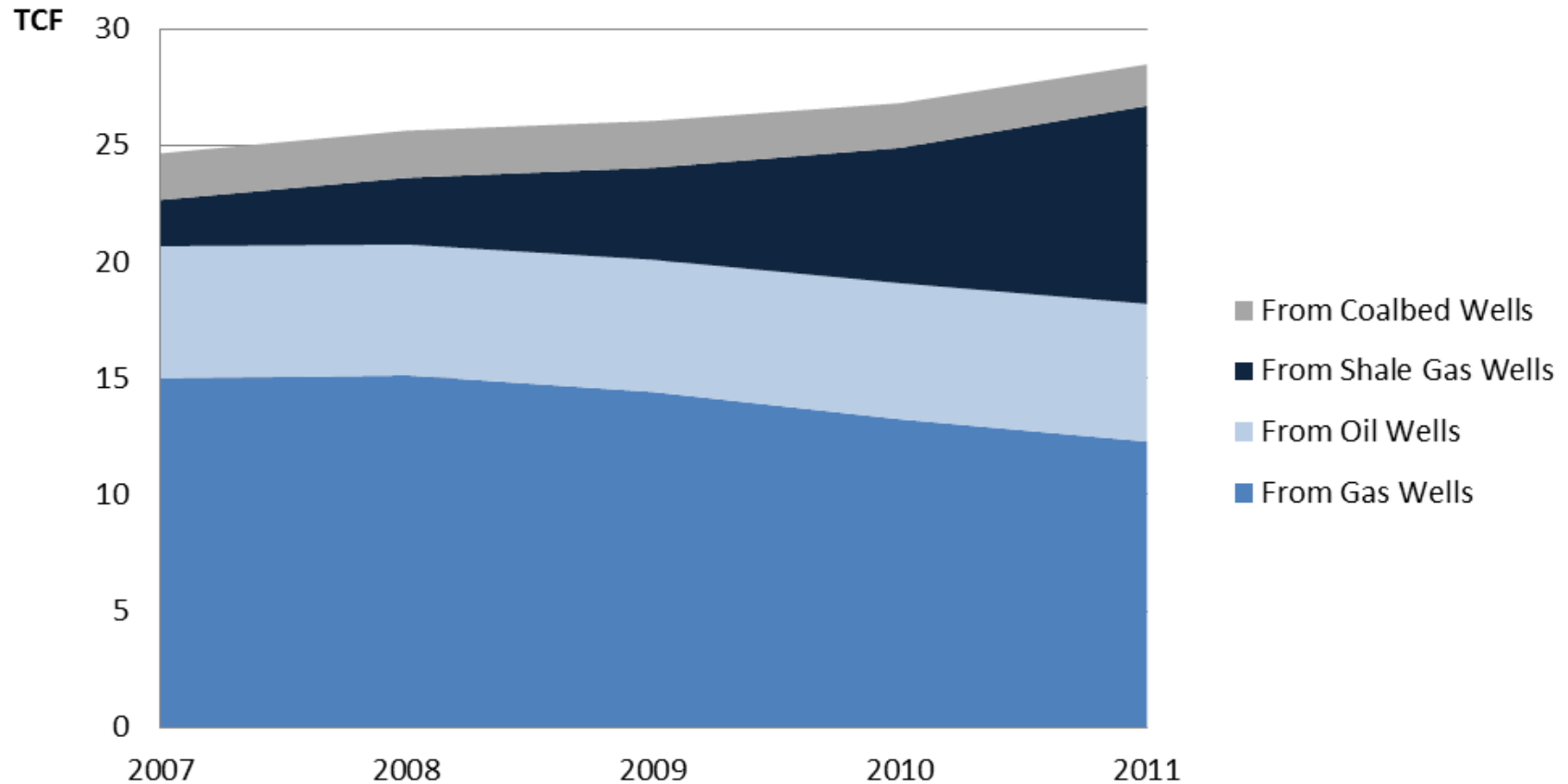
### RESOURCES

China	1,115
Argentina	802
Algeria	707
US	665
Canada	573
Mexico	545
Rest of the world	2,892

**TOTAL 7,299**

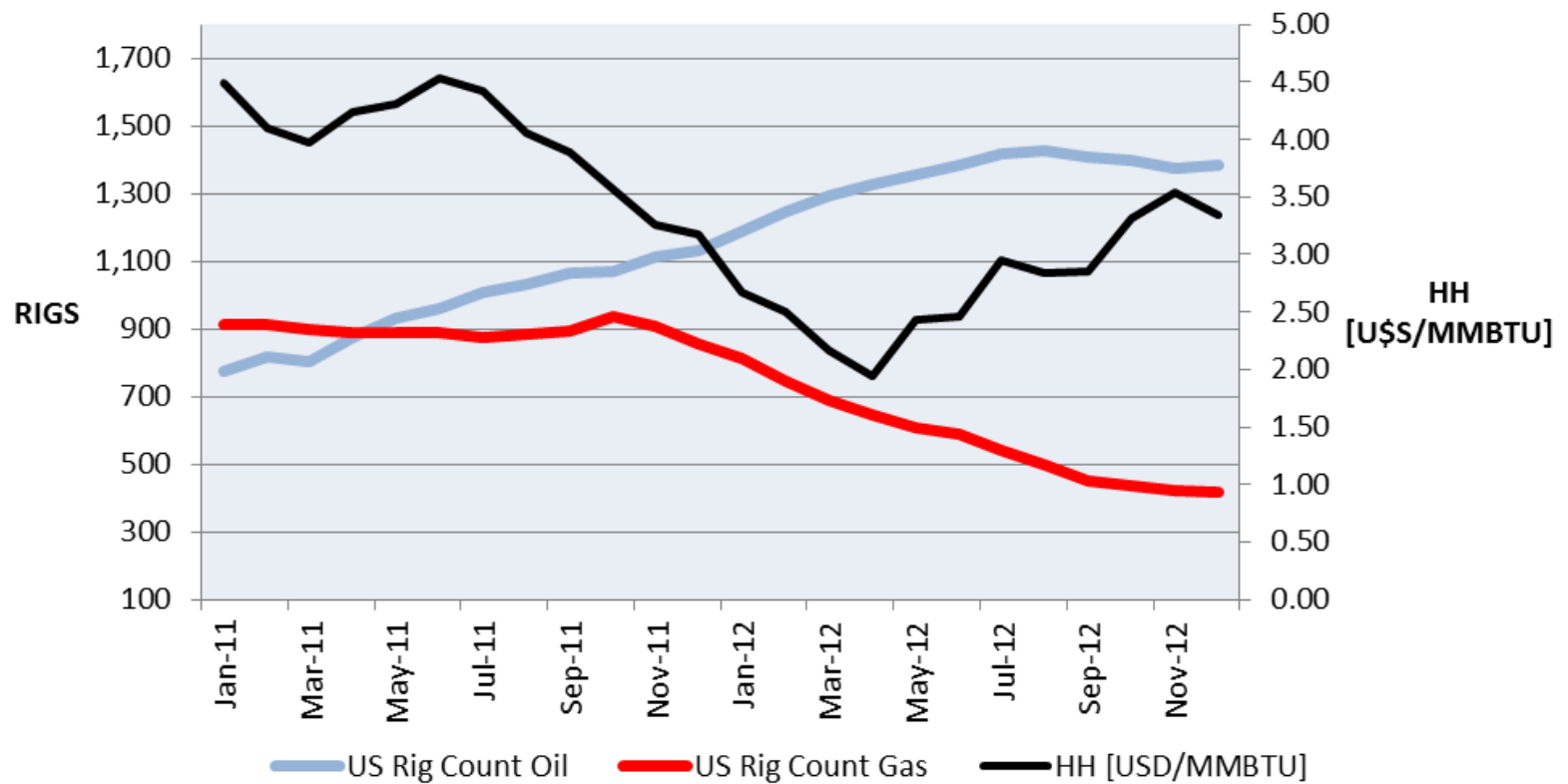
Source: EIA – DOE- Jun-13

# US NATURAL GAS GROSS PRODUCTION



Source: EIA – DOE - Natural Gas Annual (Jan-13)

# 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*

	<b>PRODUCTION</b> [MMtn]	<b>RESERVES</b> [MMtn]	<b>R/P</b> [years]
China	3,650	114,500	31
US	922	237,295	257
India	606	60,600	100
Australia	431	76,400	177
Russia	355	157,010	442
South Africa	260	30,156	116
Others	1,641	184,977	113
<b>TOTAL</b>	<b>7,865</b>	<b>860,938</b>	<b>109</b>

Source: BP Statistical Review of World 2013

# COAL PRICES

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	may-13
[USD/ton]											
FOB RICHARD BAY	30.6	54.3	46.3	51.1	63.6	120.7	64.4	91.9	116.2	92.9	81.7

Source: Bloomberg

# EMISSIONS

[USD/MWh]

CO<sub>2</sub> tn / MWh

@ 30 USD/ CO<sub>2</sub> 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

83

109

Diesel Oil - CC

0.410

171

184

Nuclear

-

138

138

Hydro

-

97

97

Wind

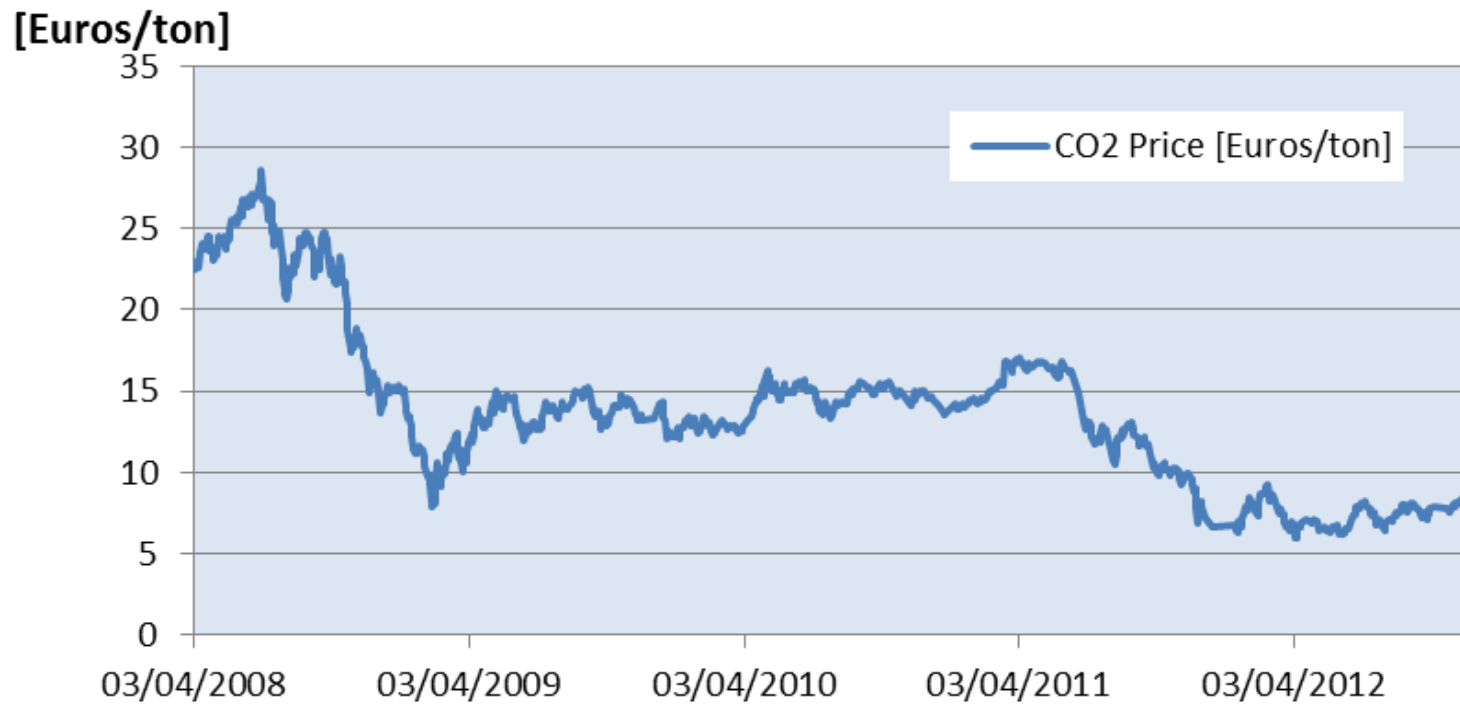
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90

90

Source: Own research

# CO<sub>2</sub> PRICE EVOLUTION



Source: Bloomberg



# CO<sub>2</sub> EMISSIONS

**Kyoto**

**Copenhagen**

**Cancun**

**Cap and trade or Tariff**

# 5. NUCLEAR

# URANIUM RESOURCES AND PRODUCTION

2011	PRODUCTION [TU/year]	RESOURCES [TU]
Canada	9,145	485,000
Australia	5,983	1,673,000
Kazakhstan	19,451	651,000
Namibia	3,258	284,000
Niger	4,351	272,000
Russia (est)	2,993	480,000
Others	8,313	1,559,000
<b>TOTAL</b>	<b>53,494</b>	<b>5,404,000</b>
<b>RESOURCES / PRODUCTION [years]</b>		<b>101</b>

Source: World Nuclear Association



# NUCLEAR REACTORS

	REACTORS May-12		GENERATION 2011
	No.	Capacity [Mwe]	[billion kWh]
US	104	101,607	790
France	58	63,130	424
Japan	50	44,396	156
Russia	33	24,164	162
Korea RO (South)	23	20,787	148
Germany	9	12,003	102
China	15	11,881	83
Others	141	93,454	653
<b>TOTAL</b>	<b>433</b>	<b>371,422</b>	<b>2,517</b>
	<b>Utilization factor</b>		<b>77%</b>

Source: World Nuclear Association

# WIND POWER

[GW]	2006	2007	2008	2009	2010	2011	2012
China	2.6	6.1	12.2	25.8	44.7	62.4	75.6
USA	11.6	16.8	25.2	35.1	40.3	46.9	60.0
Germany	20.6	22.2	23.9	25.8	27.2	29.1	31.3
Spain	11.6	15.1	16.8	19.2	20.6	21.7	22.8
India	1.7	2.2	2.9	3.4	3.7	16.1	18.4
France	3.1	3.1	3.2	3.5	3.8	6.8	7.2
Others	22.9	28.6	36.7	46.1	57.3	55.1	67.2
<b>Total</b>	<b>74.2</b>	<b>94.1</b>	<b>120.8</b>	<b>158.7</b>	<b>197.6</b>	<b>238.0</b>	<b>282.5</b>

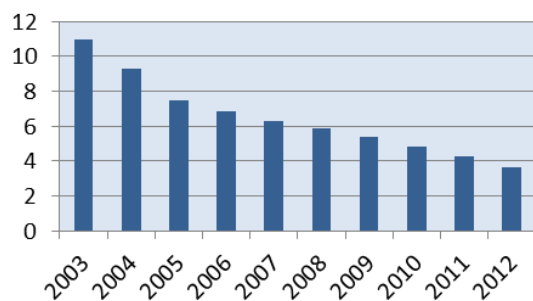
Total World Generation Capacity 2012e (all sources): 5,400 GW

Source: Global Wind Energy Council

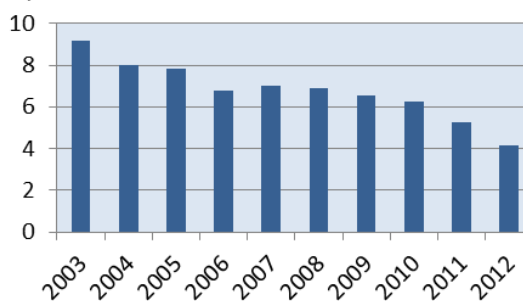
# ARGENTINE

## OIL FIELDS

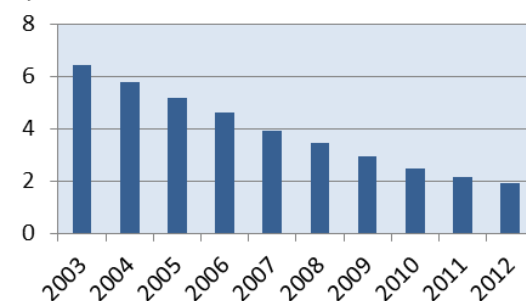
Mm3/d **OIL - Chihuido de la Sierra Negra**



Mm3/d **OIL - Huantraico**

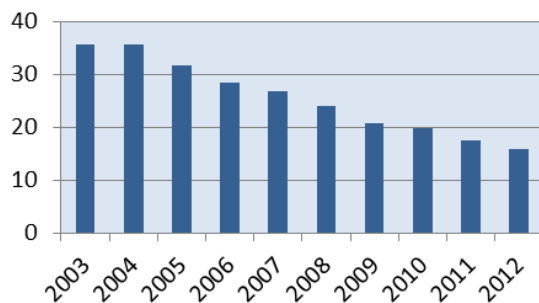


Mm3/d **OIL- Puesto Hernandez**

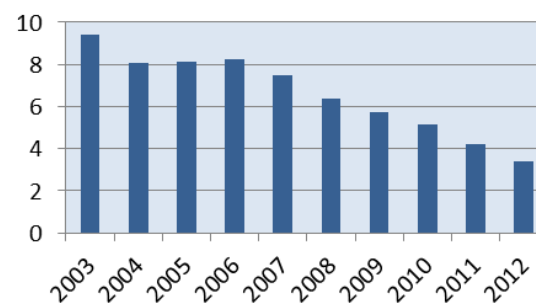


## GAS FIELDS

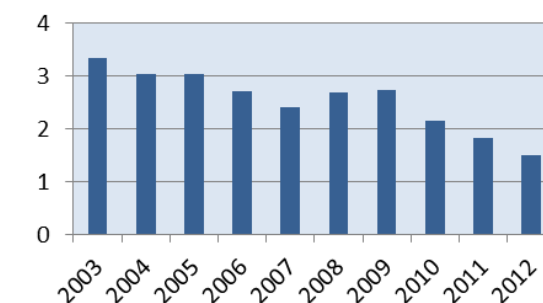
MMm3/d **GAS - Loma de la Lata**



MMm3/d **GAS - Ramos**



MMm3/d **GAS - Aguargüe**



# HOPES

World economic crisis ???

Shale Oil and Shale Gas

Pre Salt Oil

Irak oil

Renewables





# TOUGH DECISIONS ?

**Diversification**

**Security of supply**

**Market liberalization**

**Energy exchange treaties**

**Efficiency & Savings**



# ENERGY IN THE WORLD

TOUGH DECISIONS

THANK YOU

Marcelo Martínez Mosquera

Director Tecpetrol S.A.

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IAE General Mosconi - June 26th, 2013