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ASOCIACIÓN REGIONAL DE EMPRESAS DEL SECTOR PETRÓLEO,
GAS Y BIOCOMBUSTIBLES EN LATINOAMÉRICA Y EL CARIBE

SEMINARIO
**Desarrollo
de Mercados de
Gas Natural**



Optimización de la Matriz Energética

Complementariedad entre las energías renovables y el gas natural

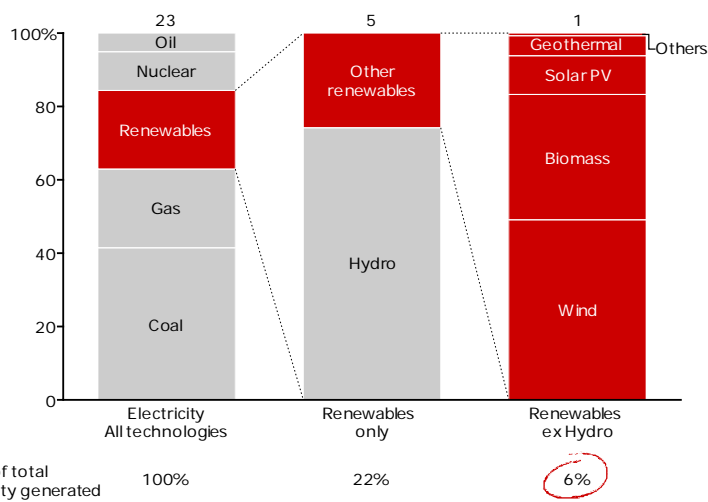
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Este documento es una publicación de la Asociación Regional de Empresas del Sector Petróleo, Gas y Biocombustibles en Latinoamérica y el Caribe.

Renewables currently contribute only a small share to total electricity generated

Global

Global energy/ electricity generation in 2013 (PWh)



Note: Other renewables includes Concentrated Solar Power (CSP) and Marine
Source: IEA Electricity Information 2014 (excerpt)

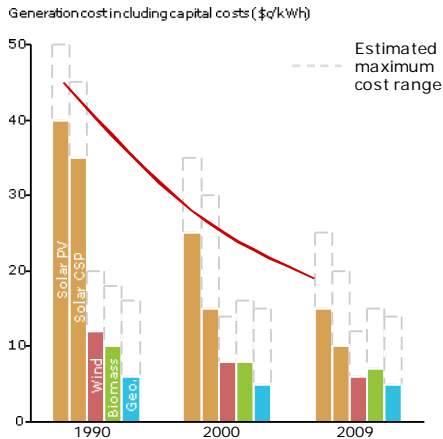
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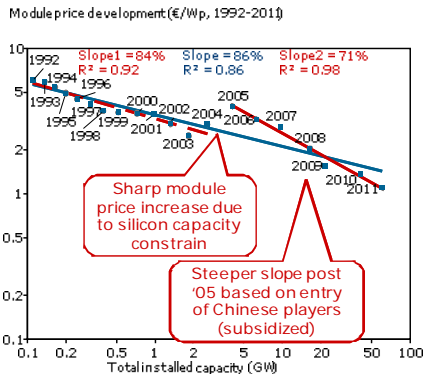
Cost of renewables has declined significantly over last 20 years

Global

LARGEST COST REDUCTIONS IN SOLAR



PV * MODULE PRICE DECREASE EFFECT



Historic reasons for PV cost decline

- Increase in efficiency
- Increase in production output (throughput/yield/uptime)
- Decrease in production costs
- Increase of subsidies for Chinese manufacturers

Source: Department of Energy (EIA, Energy Efficiency and Renewable Energy), Energy Information Administration (www.eia.doe.gov); National Renewable Energy Lab (NREL); MIT; Industry interviews; Hydro Research Foundation; Wellington West; Berkeley Lab Database cited in US DOS "Annual Report on US Wind Power," May 2007; AWEA; Bain analysis and literature search.
For Solar experience curve: Photex project, NREL, IEA-PVPS, EPIA, Bain analysis, *Photovoltaic

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Most renewables expected to be competitive with hard coal and combined cycle gas turbines in 2020

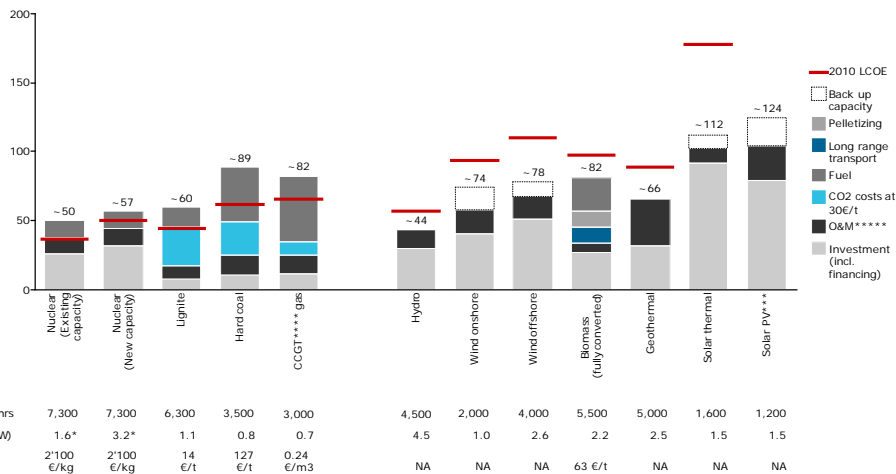
Global

CONVENTIONALS

RENEWABLES

GERMANY

2020 LCOE** (in €/MWh)

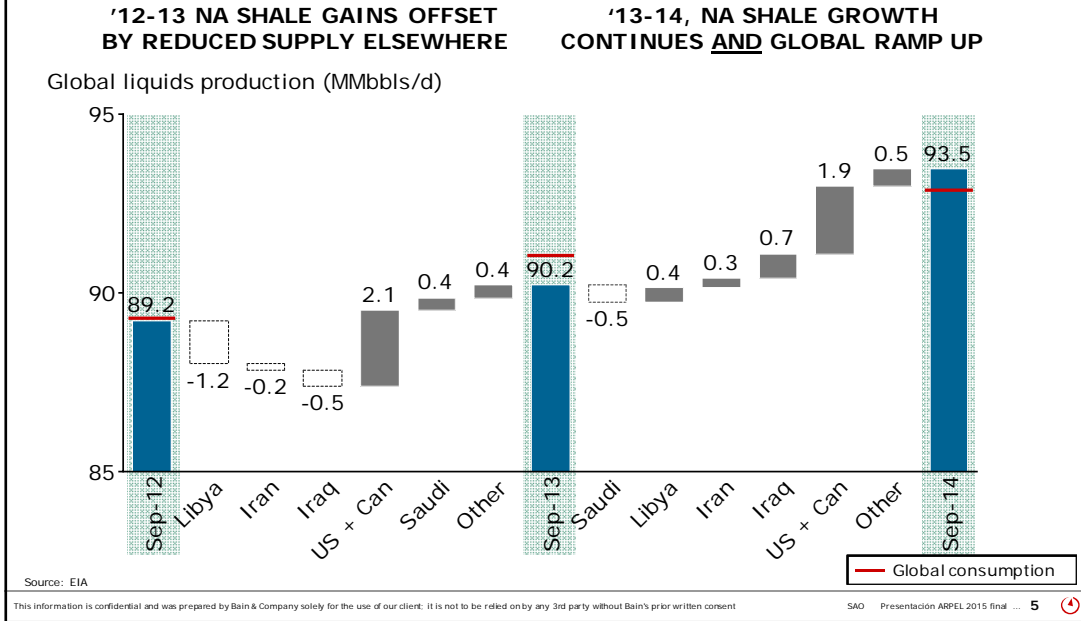


* Invest in data row excluding retrofit, deconstruction and disposal, ** LCOE = levelized cost of electricity, *** Photovoltaic, **** Combined cycle gas turbine, ***** Operations & Maintenance. Source: Several relevant industry and market reports; Bain analysis and experience

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Starting in 2014 the world has become awash in oil



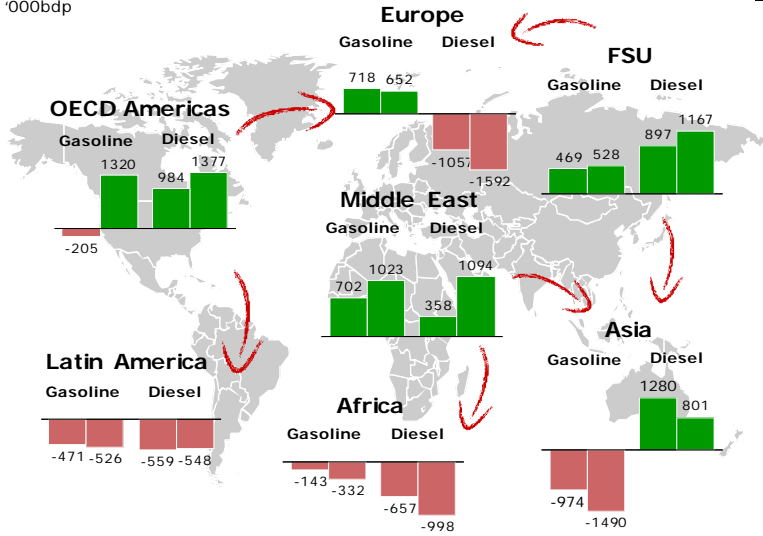
Where we are headed: Three distinct scenarios to 2020

Scenario	How long (to beginning of recovery?)	How strong (what will marginal bbl be?)	Description/ key drivers
"New Normal"	2020+	Low cost tight oil	<ul style="list-style-type: none"> OPEC grows production by ~6 Mbpd between 2014 and 2020 Deep water receives less capital; production goes from 8.8 Mbpd in 2014 to 10.4 Mbpd in 2020 Excess inventory clears in 2019 The marginal barrel becomes U.S. tight oil with a resulting 2020 price below \$50
"Trouble then Recovery"	2017	Mid-cost tight oil + low-cost deepwater	<ul style="list-style-type: none"> OPEC grows production by ~4 Mbpd between 2014 and 2020 Deep water production goes from 8.8 Mbpd in 2014 to 11.2 Mbpd in 2020 Excess inventory clears in 2017 The marginal barrel becomes mid-cost U.S. tight oil with some low-cost deep water resulting in 2020 price between \$60-\$70
"Return to the Old Paradigm, but not Old Price"	2016	Mid-cost deepwater	<ul style="list-style-type: none"> OPEC grows production by ~2 Mbpd between 2014 and 2020 Deep water production goes from 8.8 Mbpd in 2014 to 11.6 Mbpd in 2020 Excess inventory clears in 2016 The marginal barrel becomes mid-cost deep water with a resulting 2020 price between \$75-\$85

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The dynamics of shale lead North America to become the largest global exporter of derivatives

Regional Balances in 2013 and 2019*
'000bdp



KEY LEARNINGS

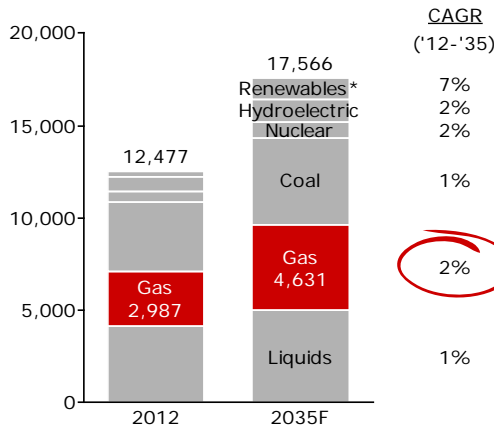
- US becomes **largest exporter** of derivatives
- Europe **shutting down capacity** as not competitive with US
- Latam also supplied by US due to **cost advantages & difficulties in expanding local output**
- Middle East **adding on capacity** diversifying from oil to more added-value products
- Asia and Africa imports growing, as refinery **capacity lags consumption**

Note: Brent & WTI are coming online making up for the deficit in Latam. This information is confidential and was prepared by Bain & Company solely for the use of our client. It is not to be relied on by any 3rd party without Bain's prior written consent.

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Natural Gas is expected to remain the most dynamic fossil fuel going into the future

Energy consumption (Mtoe)



UNDERLYING FACTORS DRIVING DEMAND

- Need for **secure, diversified, flexible energy strategy** for major consuming countries
- **De-carbonization of growth** (shift away from coal) and reduced nuclear dependence
- Large supply due to increasing economic viability of **unconventional sources**

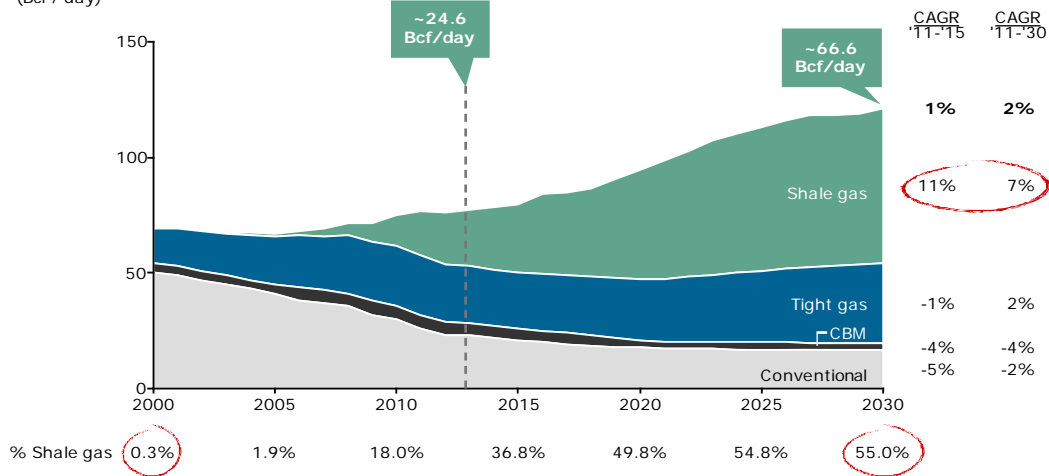
Source: BP energy outlook 2035 (Jan 2014), Bain analysis

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US shale is a big part of this growth story...

North America natural gas production by source (Bcf / day)



Source: Wood Mackenzie; Ziff Energy Group, 2013; Bain analysis

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... but upstream innovations are making gas exploration cheaper and increasing geographical reach...

NEW TECHNOLOGY IMPROVES ACCURACY & GEOGRAPHIC REACH...

- **4D Seismic Imaging**, enabling 3D high-definition model of how subsurface characteristics evolve over time for more accurate identification of natural gas
- Various **remote sensing** techniques, facilitating remote detecting of oil and gas in hard-to-reach locations based on electrical resistivity
- **Direct Hydrocarbon Indicator (DHI) analysis** enabling detection of hydrocarbon accumulation based on seismic anomalies

... LEADING TO NEW OPPORTUNITIES & SIGNIFICANT COST SAVINGS



"In 2009-2010, Shell's use of wide-angle seismic surveying led to the discovery of four major fields in the Gulf of Mexico, adding hundreds of millions barrels of oil and gas to the regions resources."



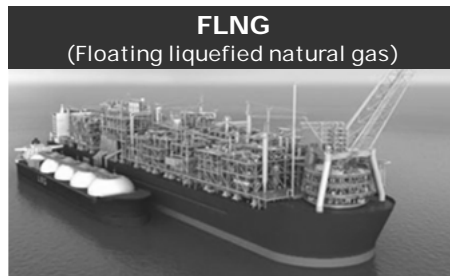
"Seismic imaging also helps well-site teams optimize drilling before it actually starts. A precise seismic image and subsurface model can ensure major savings during every phase of operation."

Source: American Association of Petroleum Geologists; Lit search; ExxonMobil; Corporate websites

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... and infrastructure innovations further driving broader adoption of LNG



Description:

- Offshore plant used for deepwater gas field; can immediately refine, liquefy, store and transport natural gas on site

Innovation:

- Enables gas production on offshore field, thus expanding gas producing coverage
- Movable facility reducing small/mid- size field CAPEX burden, hence ensuring economic viability



- Storage and gasification facility installed on LNG ship to serve as offshore LNG terminal

- Helps to lower geographical and cost entry barrier for countries not using gas to adopt LNG
 - No need to secure site for terminal
 - 20-50% lower investment spend vs. onshore terminal
 - CAPEX becomes OPEX

Source: Lit. Search; Expert Interview

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Conclusions

- 1 This is a great moment for every country to pause and think strategically about the future of its energy matrix
 - Renewables and natural gas should be given special consideration
 - Energy-starved countries shouldn't miss this window of opportunity
- 2 Fossil fuels will remain competitive in the energy matrix in the foreseeable future
 - oil, oil derivatives and natural gas
- 3 Taking advantage of this situation requires a combination of strategic insight, project finance expertise and impeccable project management / project portfolio management

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