The geopolitical impact of unconventional oil and natural gas

Mariano Marzo (UB)

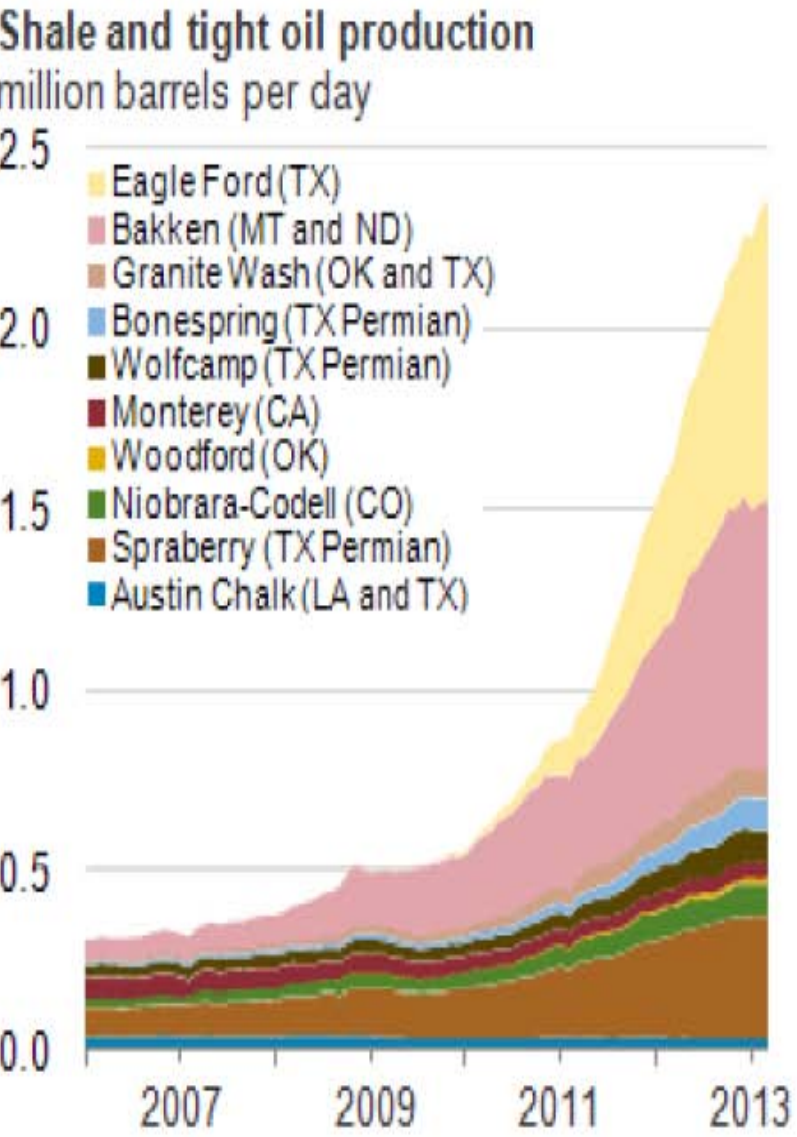
Workshop: Economic Challenges for Energy (Energy Security)

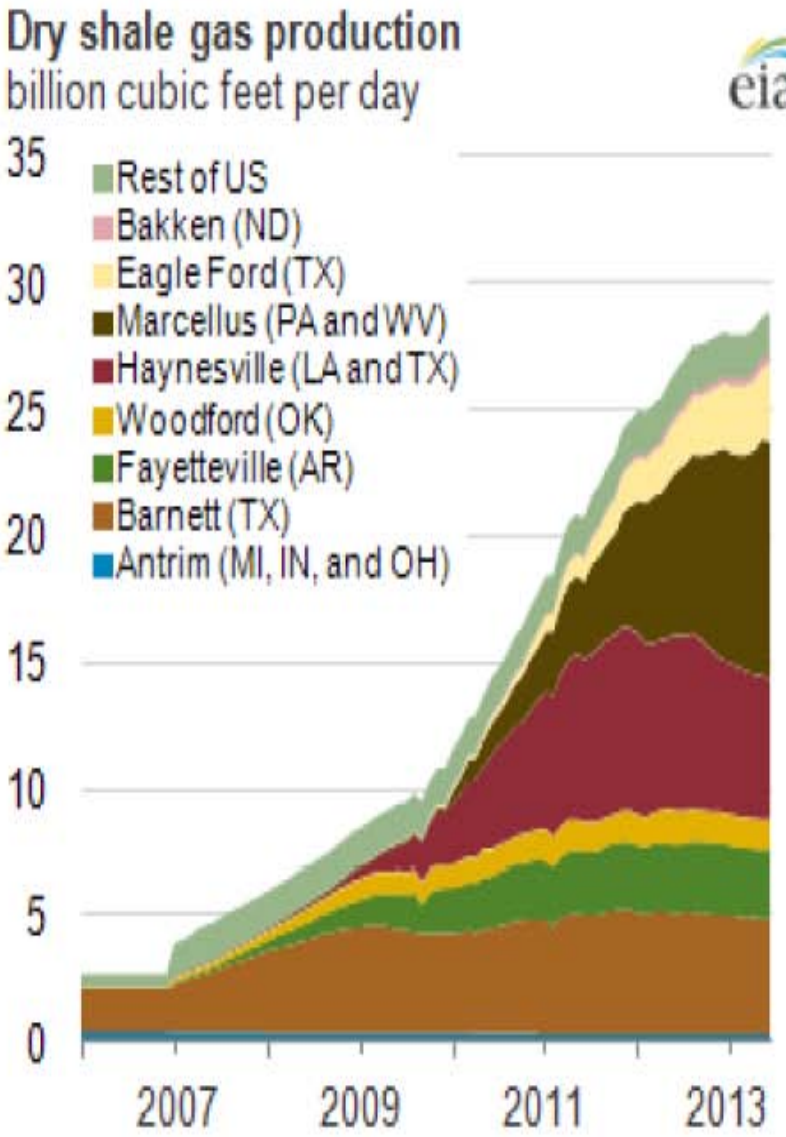
Madrid, 23-1-2014

The Economist, 26-11-2011

Some things have changed dramatically since 2008

The resurgence in oil and gas production in the United States is redrawing the global energy map



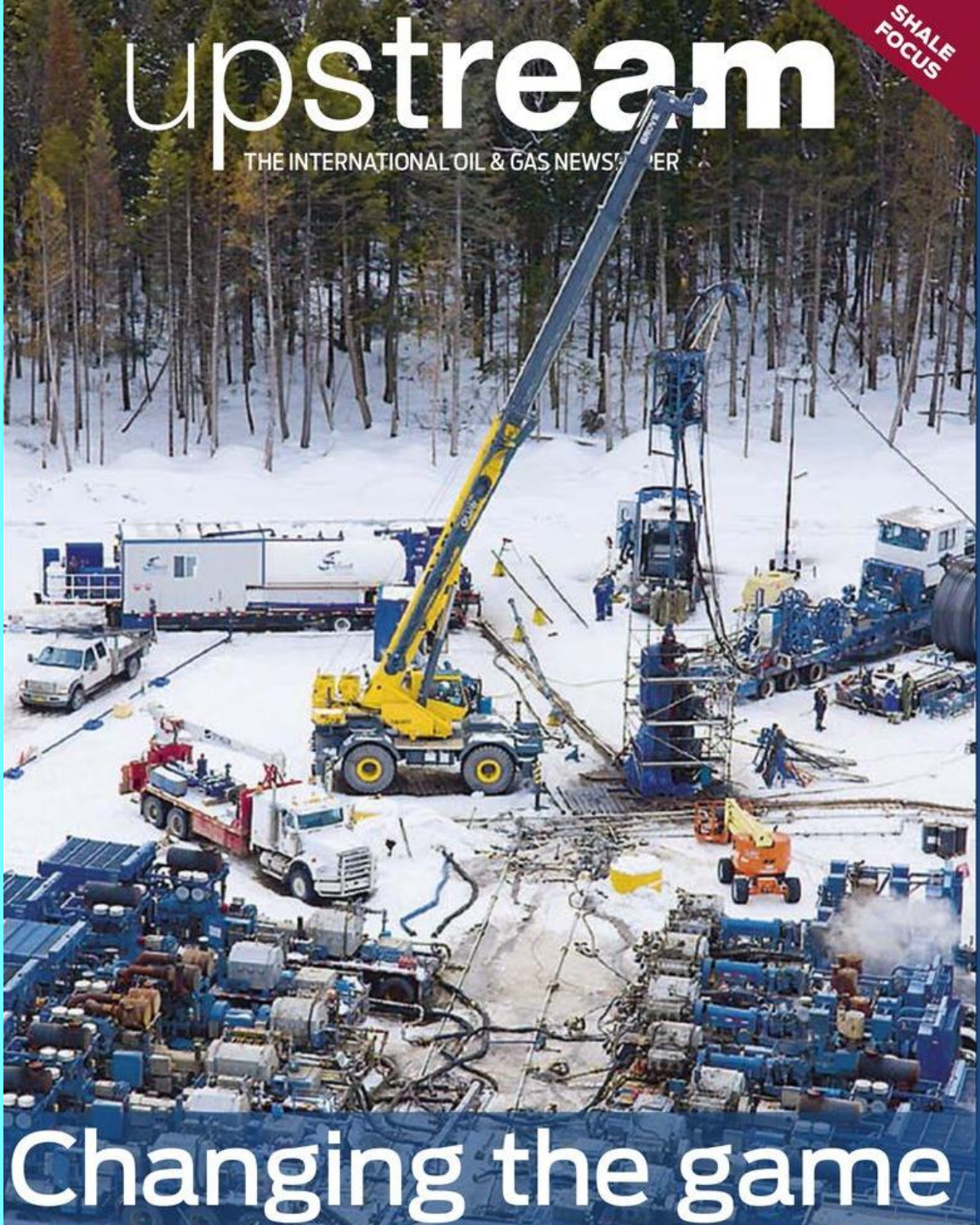


eia

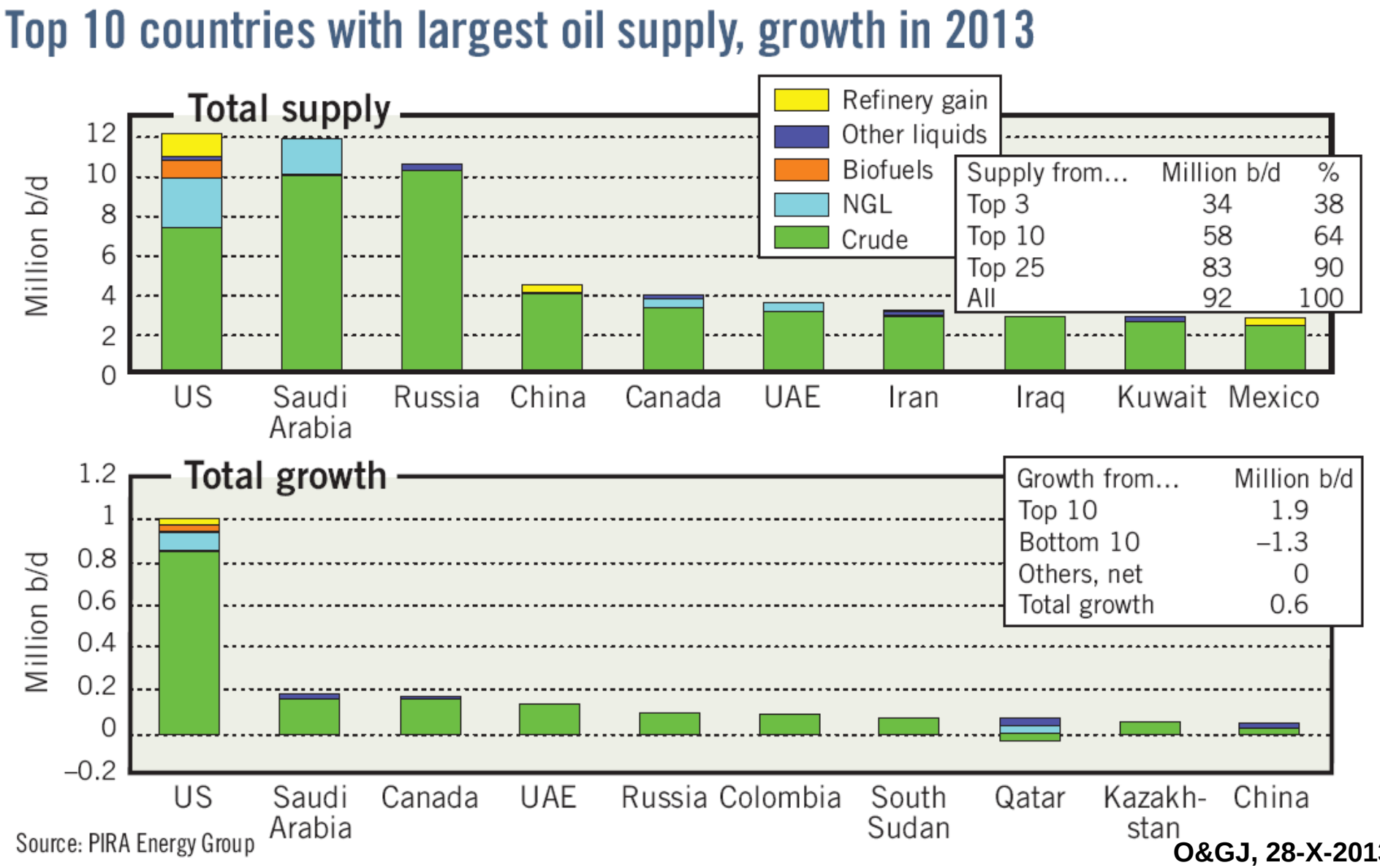
21-10-2013

Fracking, a game changer

The recent rebound in US oil and gas production, driven by upstream technologies that are unlocking light tight oil and shale gas resources, is spurring economic activity – with less expensive gas and electricity prices giving industry a competitive edge – and steadily changing the role of North America in global energy trade.

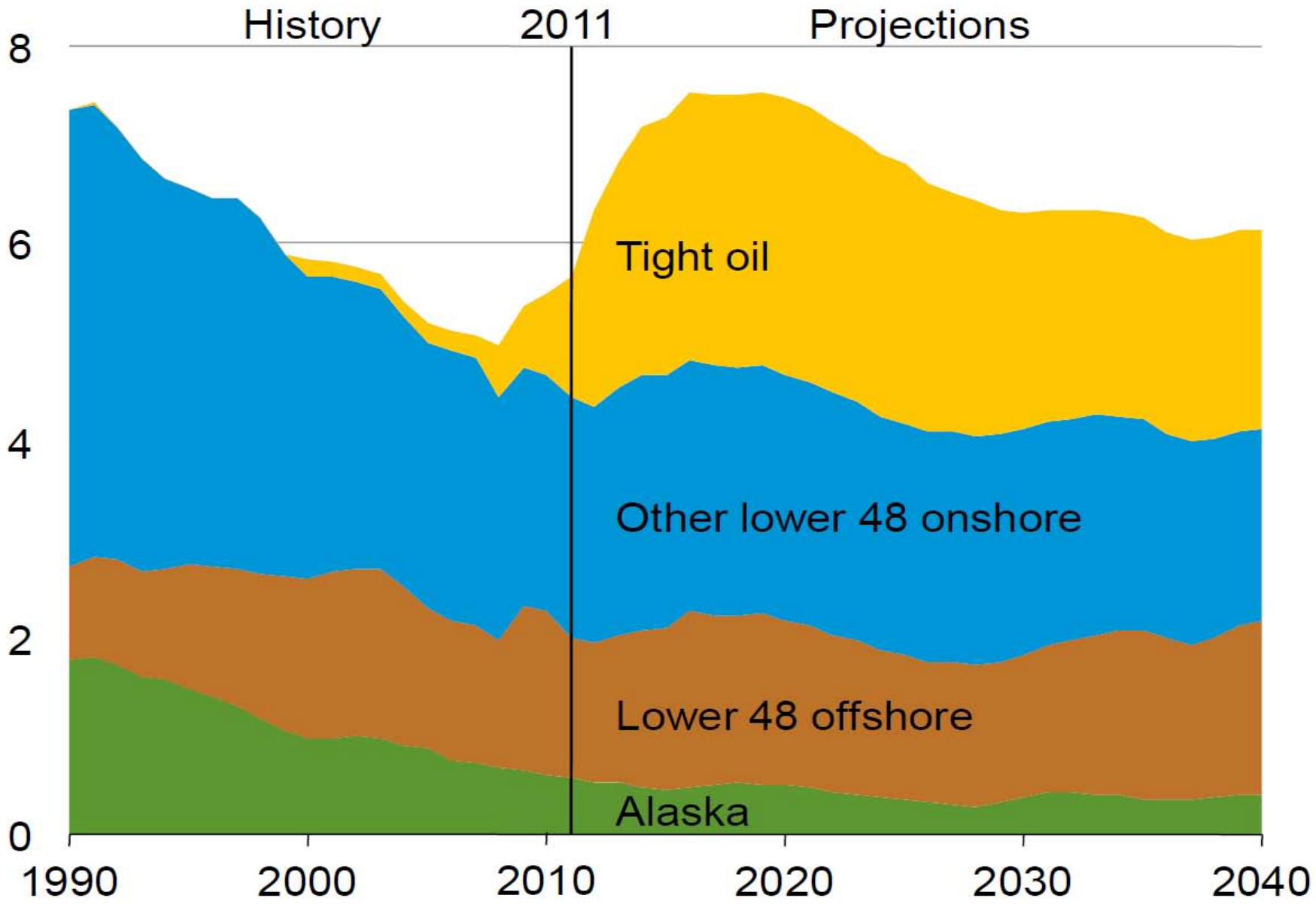


Shale production growth makes US largest liquids producer



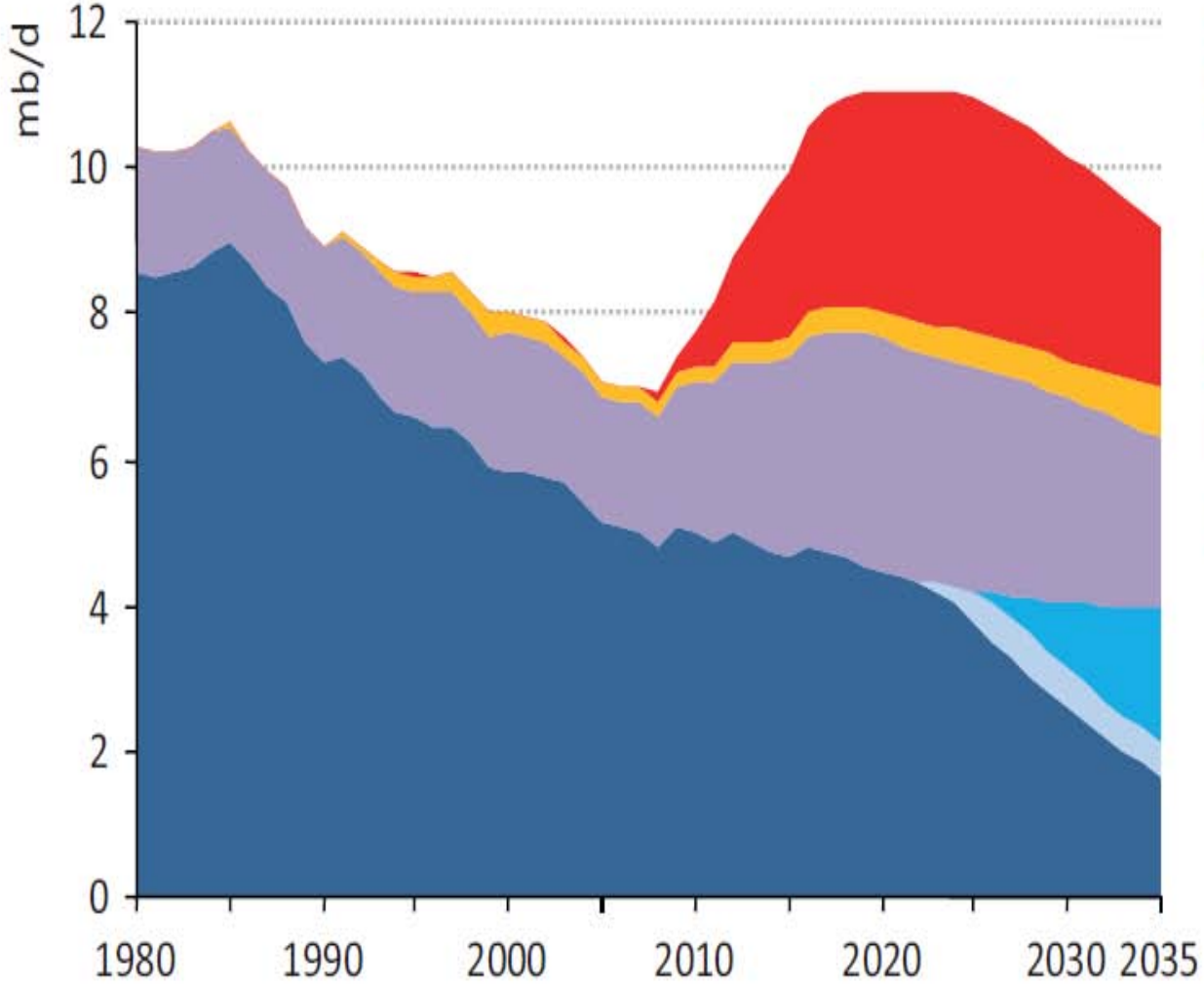
O&GJ, 28-X-2013

U.S. crude oil production (mbd) by source, 1990-2040
The LTO hump



EIA, AEO 2013

United States oil production by type in the New Policies Scenario.

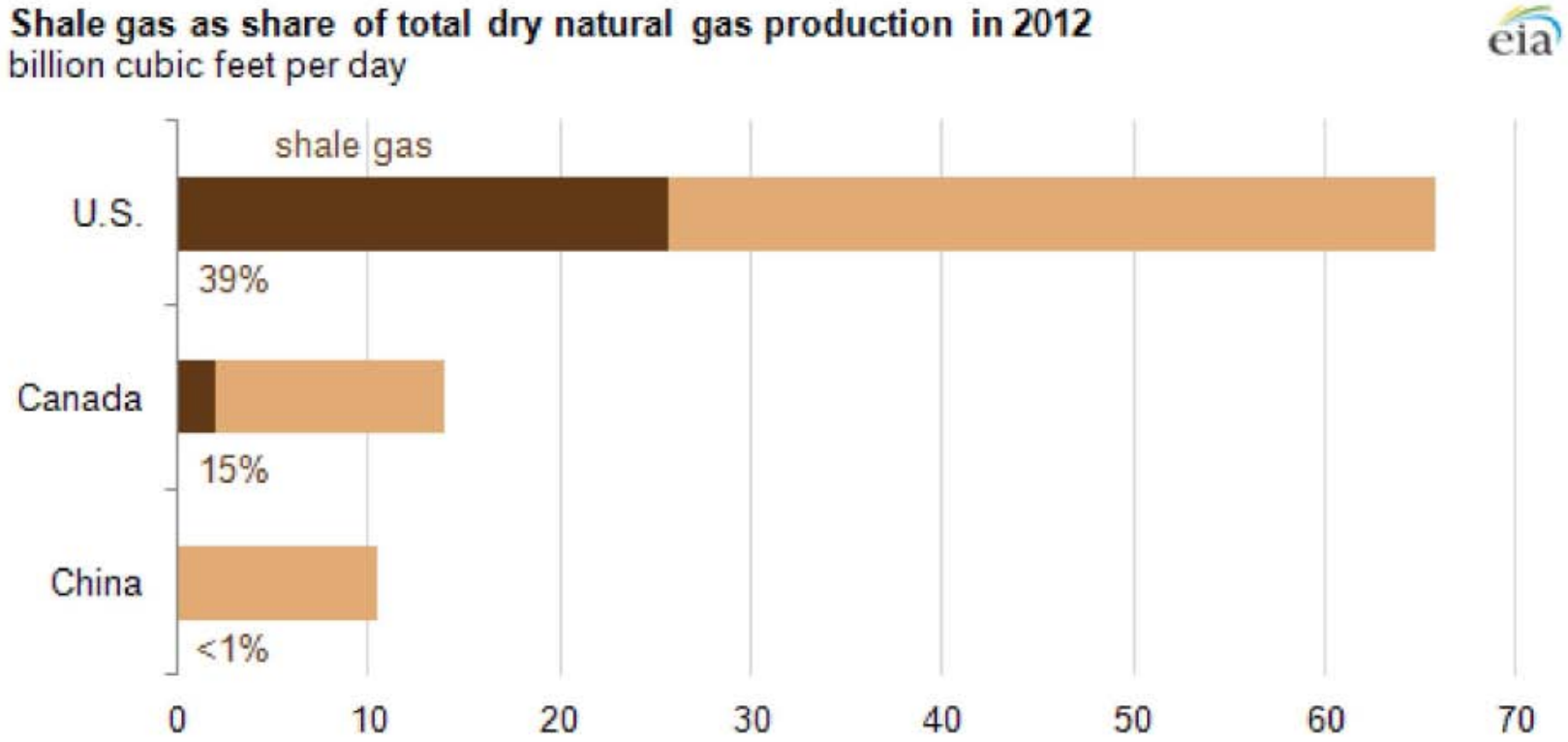


"under the right conditions" The United States overtakes Russia and Saudi Arabia before 2020 to become, until the mid-2020s, the world's largest oil producer...

Note: The World Energy Model supply model starts producing yet-to-find oil after it has put all yet-to-develop fields into production. In reality, some yet-to-find fields would start production earlier than shown in the figure.

IEA, WEO 2012

North America leads the world in production of shale gas



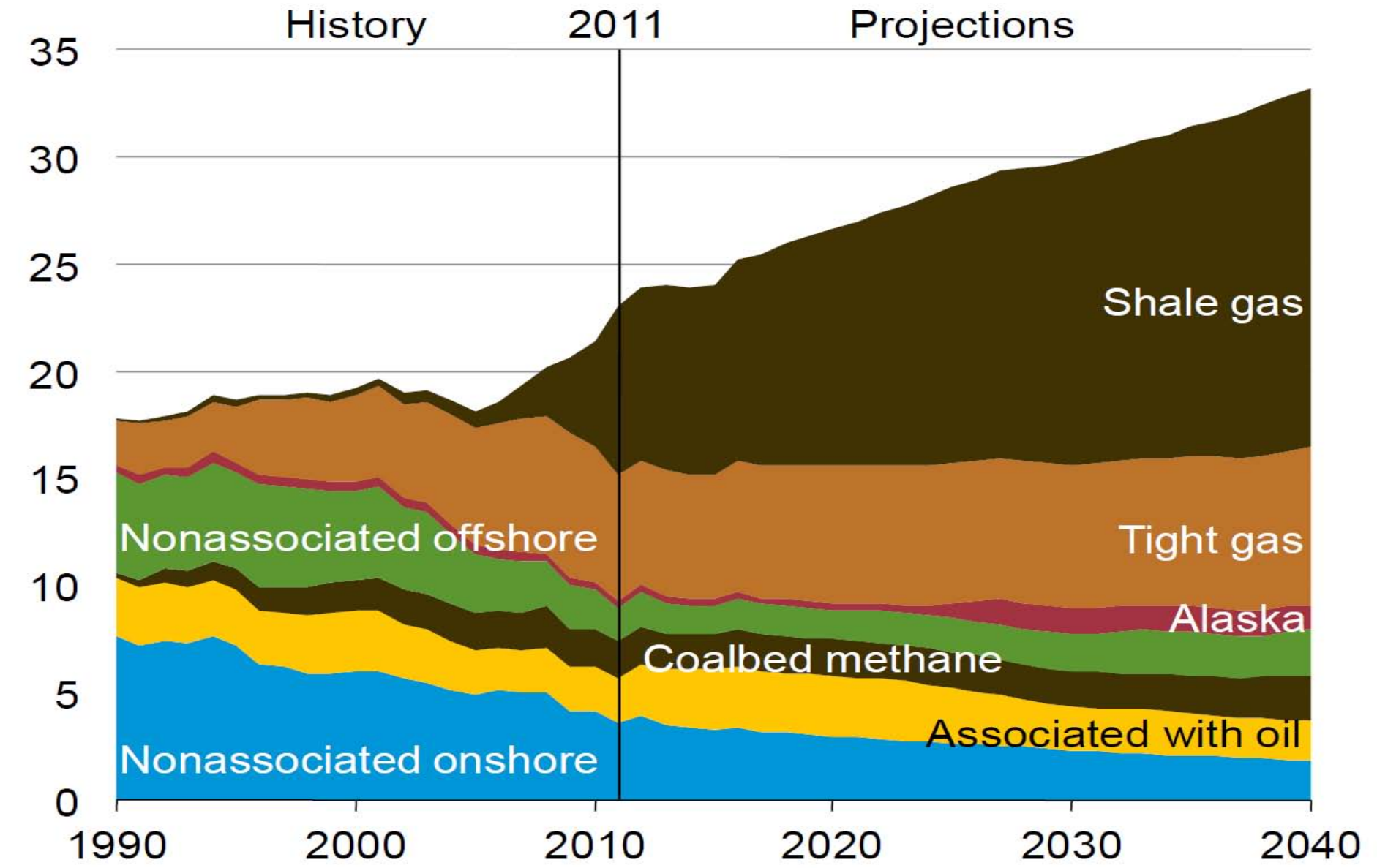
Source: U.S. Energy Information Administration, LCI Energy Insight, Canada National Energy Board, and Facts Global Energy

Note: Canadian data uses "marketable production," which is comparable to dry production.

The United States and Canada are the only major producers of commercially viable natural gas from shale formations in the world, even though about a dozen other countries have conducted exploratory test wells, according to a joint U.S. Energy Information Administration (EIA)/Advanced Resources International (ARI) study released in June. China is the only nation outside of North America that has registered commercially viable production of shale gas, although the volumes contribute less than 1% of the total natural gas production in that country. In comparison, shale gas as a share of total natural gas production in 2012 was 39% in the United States and 15% in Canada.

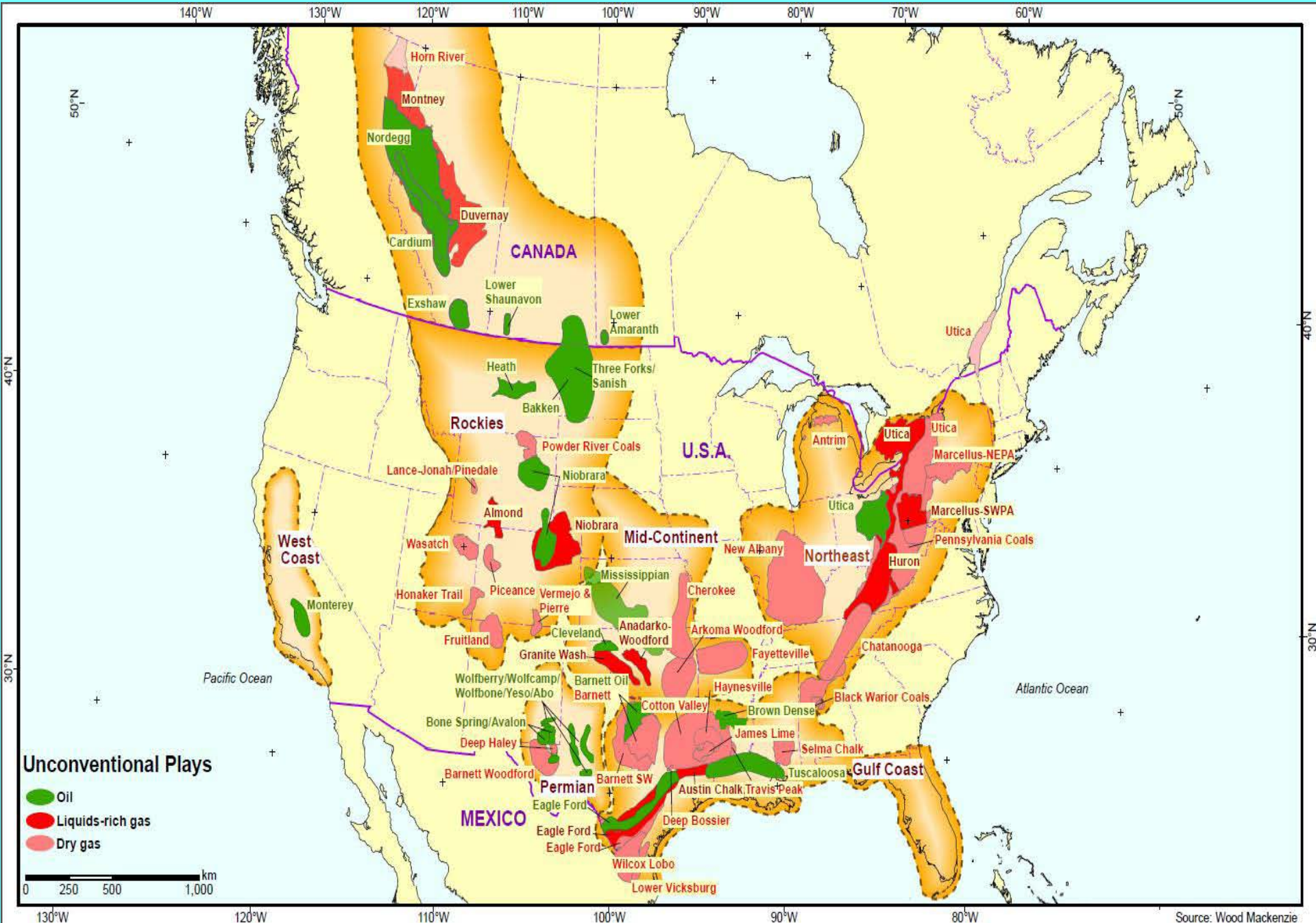
EIA 23-10-2013

U.S. dry natural gas production by source, 1990-2040 (trillion cubic feet)

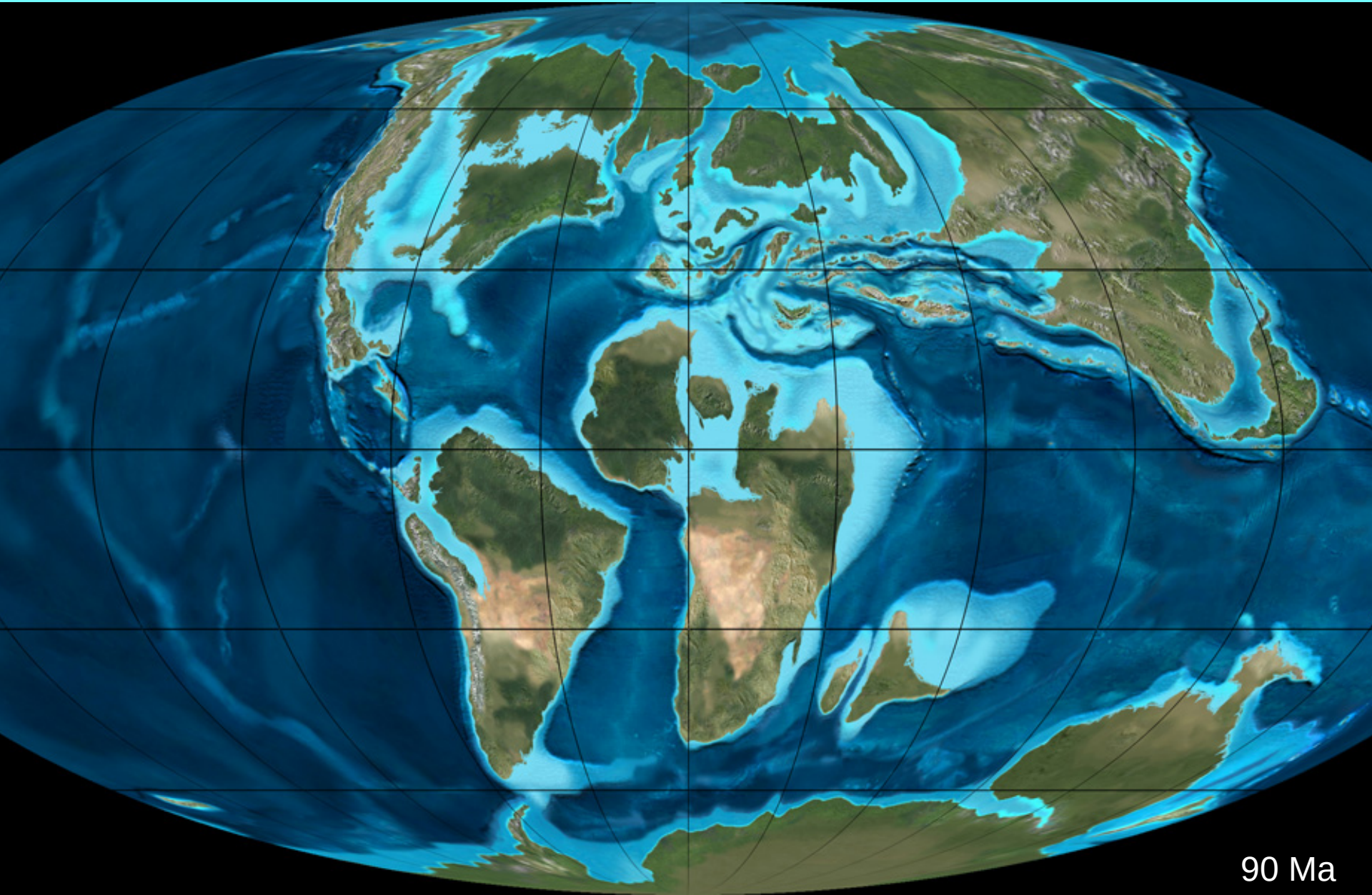


EIA, AEO 2013

Shale gas and LTO: an American success story



The lottery of geology, an entrepreneurial spirit, a long tradition of industrial innovation and something else……



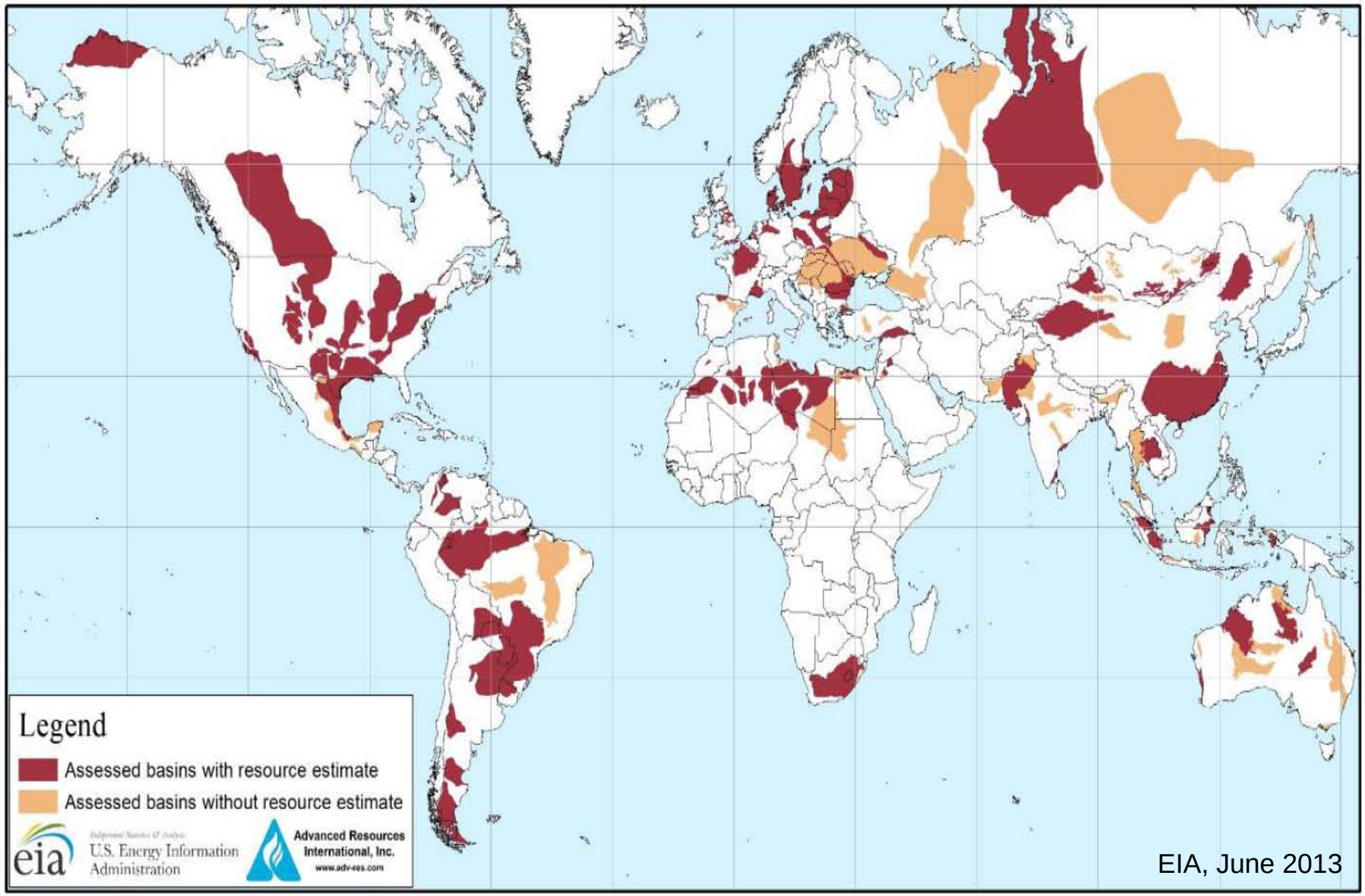
Landowners sue producers over flaring

(Upstream 18-10-2013)

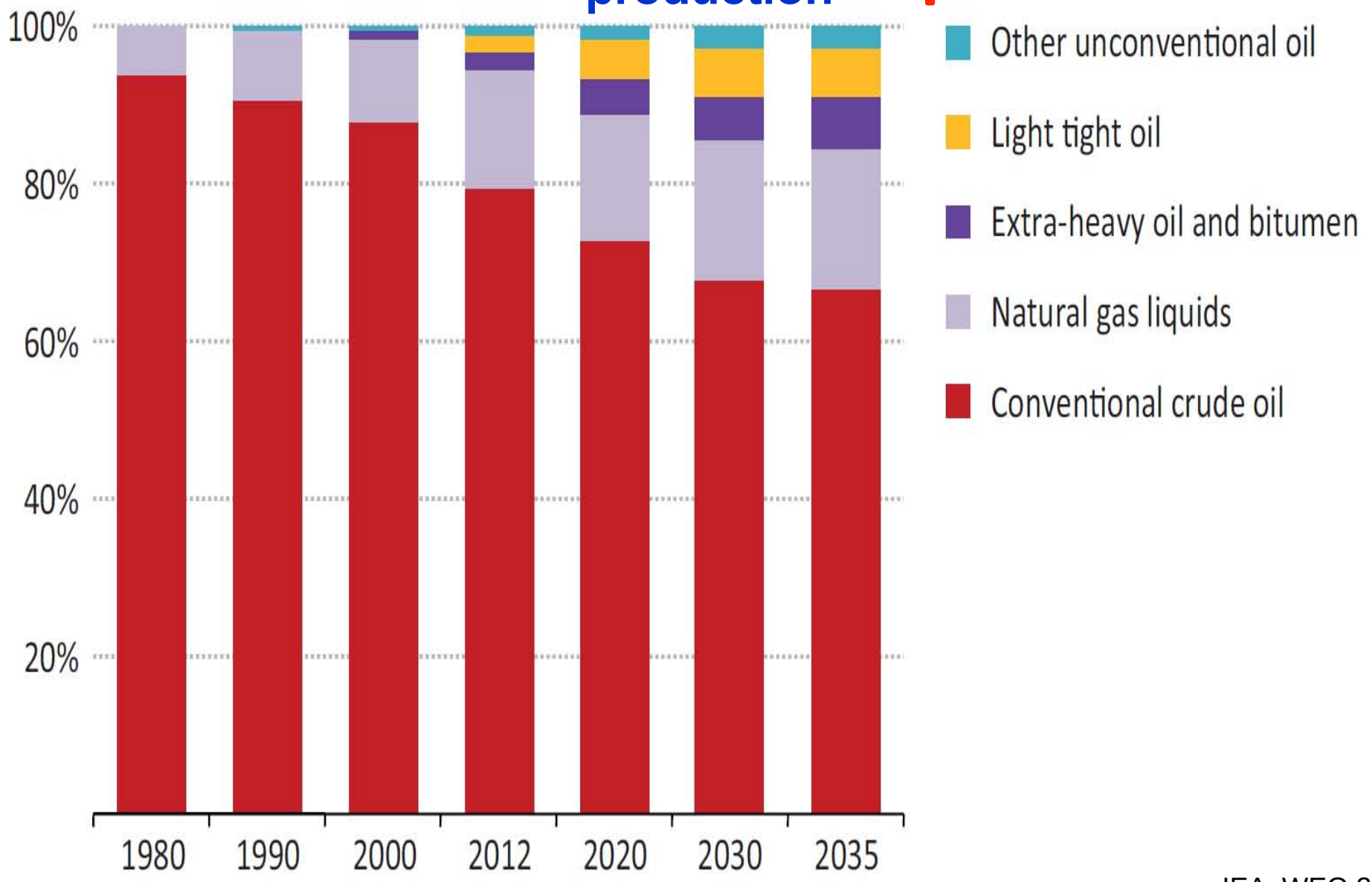
A group of North Dakota mineral-rights owners have filed a lawsuit against Bakken shale producers in the US state, claiming natural gas flaring has deprived them of millions of dollars in potential royalties

A regional industry (EE.UU. & Canada) but a global resource

Map of basins with assessed shale oil and shale gas formations, as of May 2013

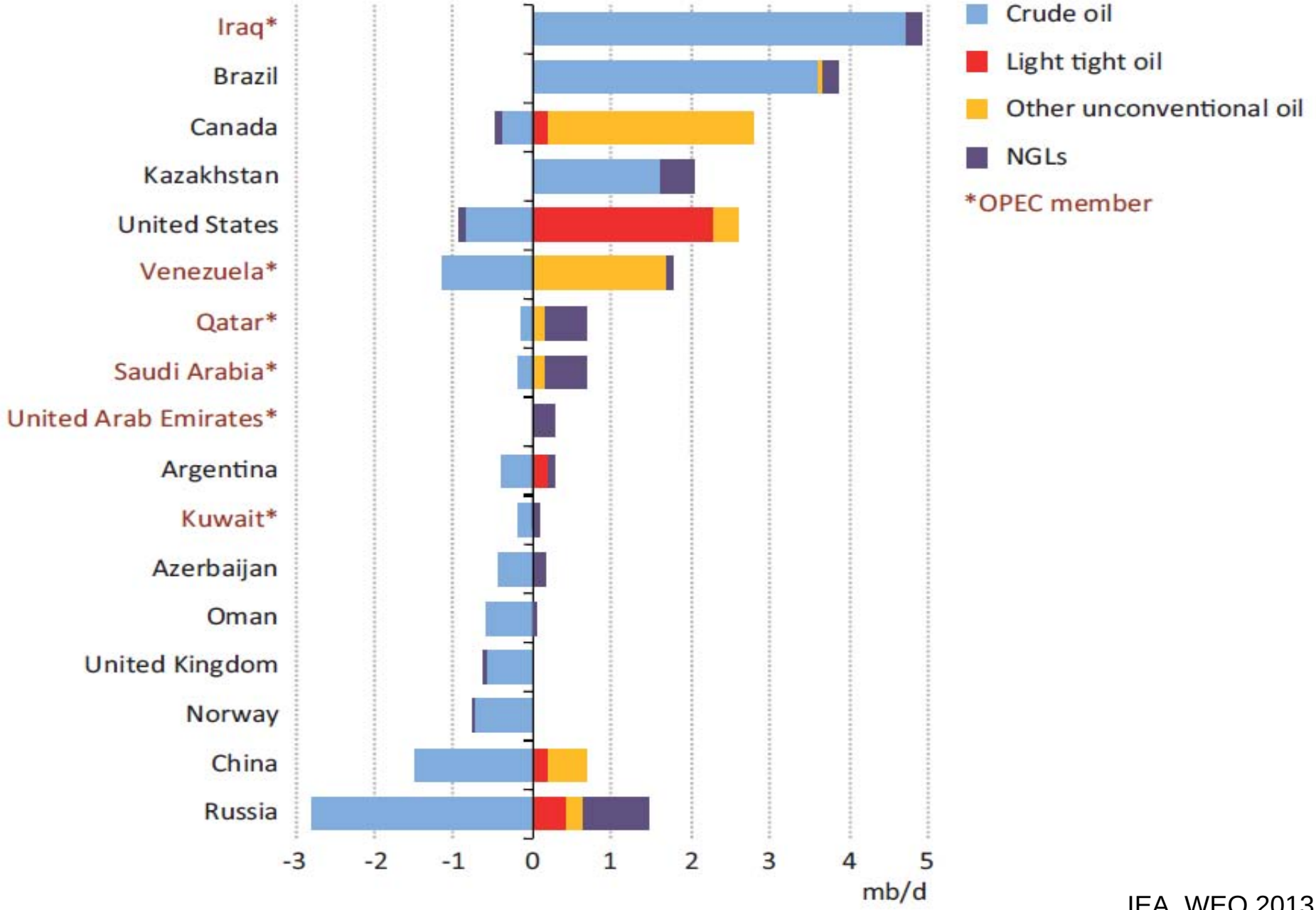


Shares of world oil production by type, 1980-2035, NPS
The world will need more and more unconventional production



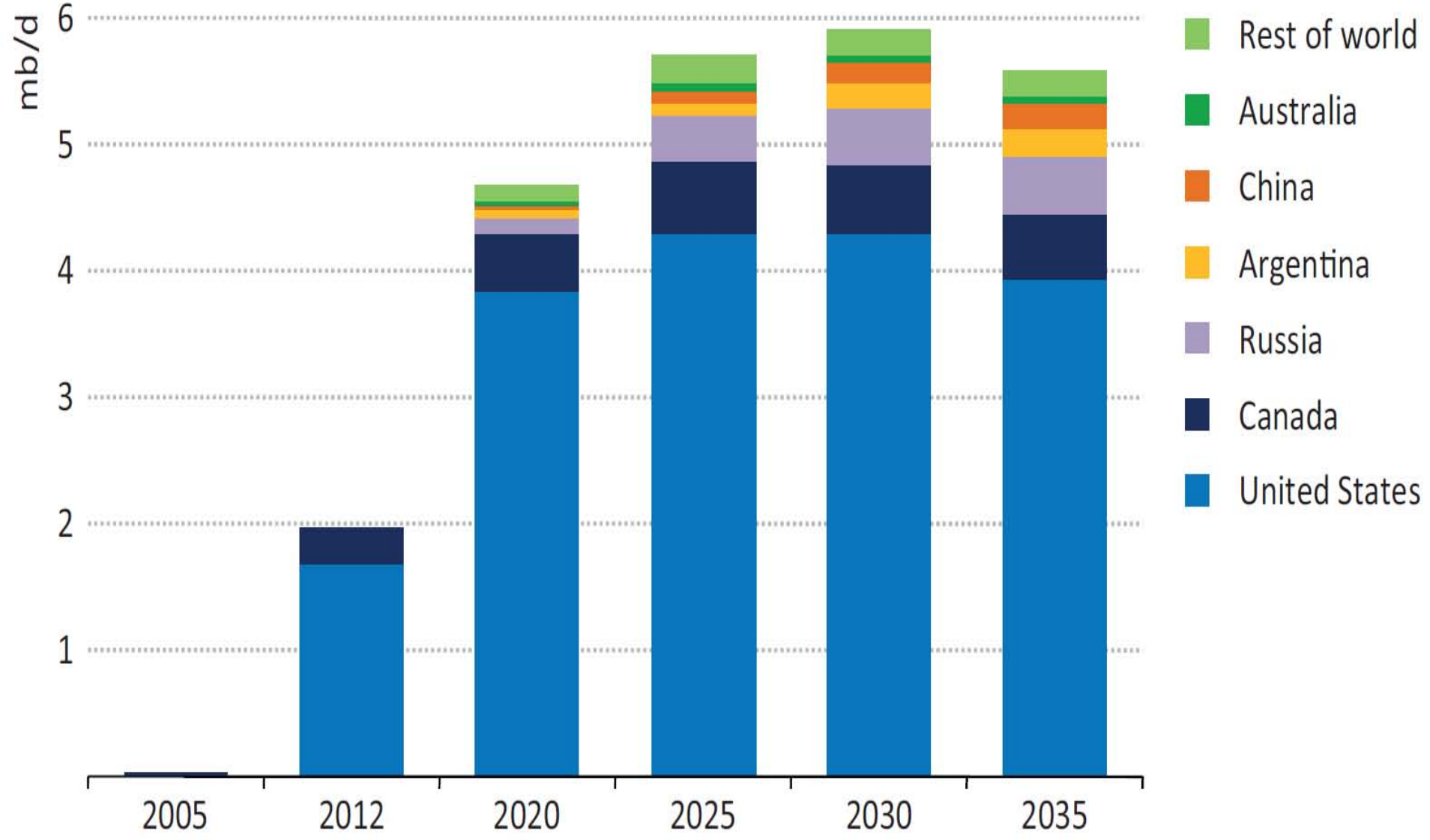
IEA, WEO 2013

Major changes in oil production 2012-2035, NPS



IEA, WEO 2013

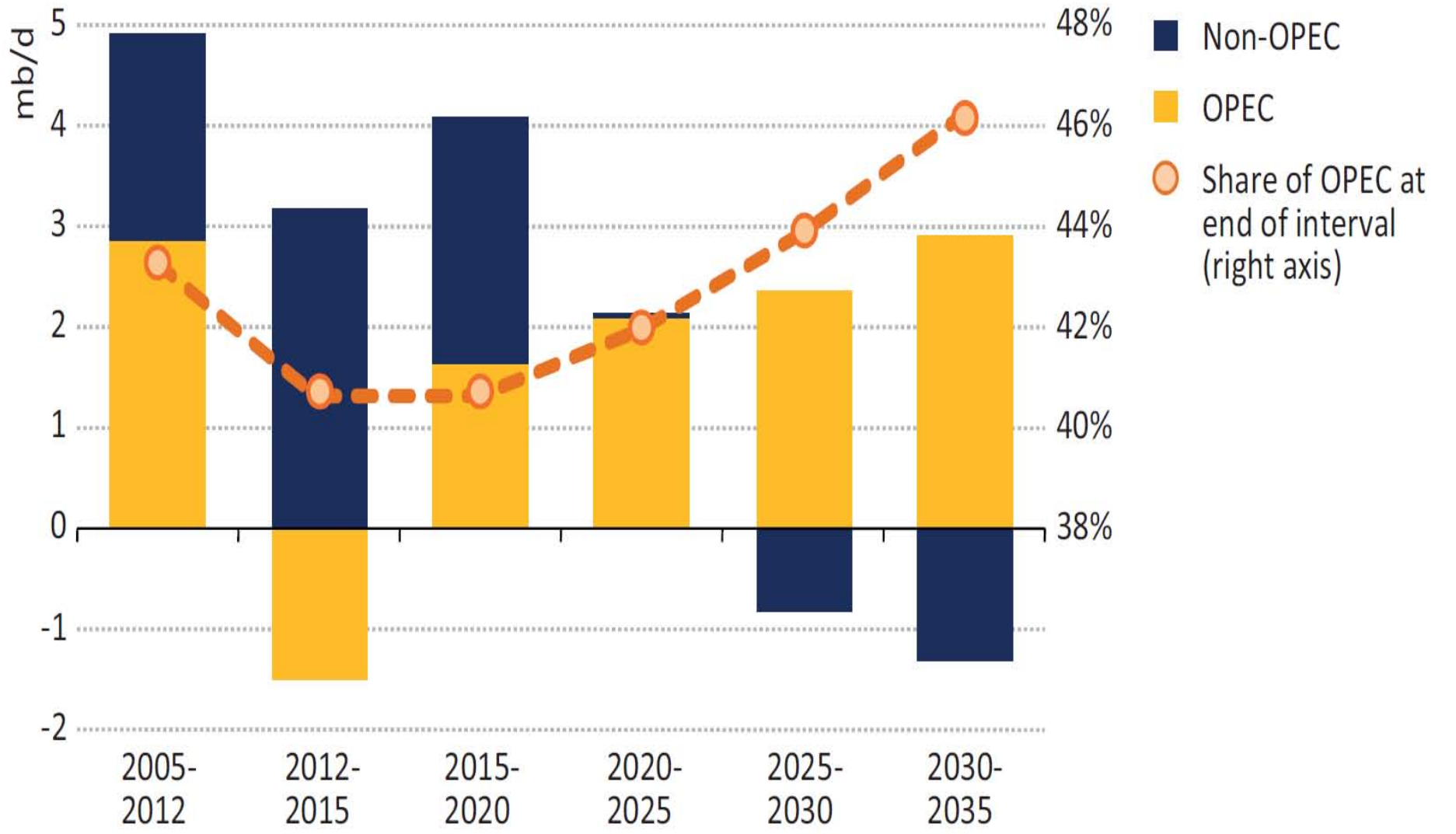
LTO production 2005-2035, NPS



Sources: IEA databases and analysis; Rystad Energy AS.

IEA, WEO 2013

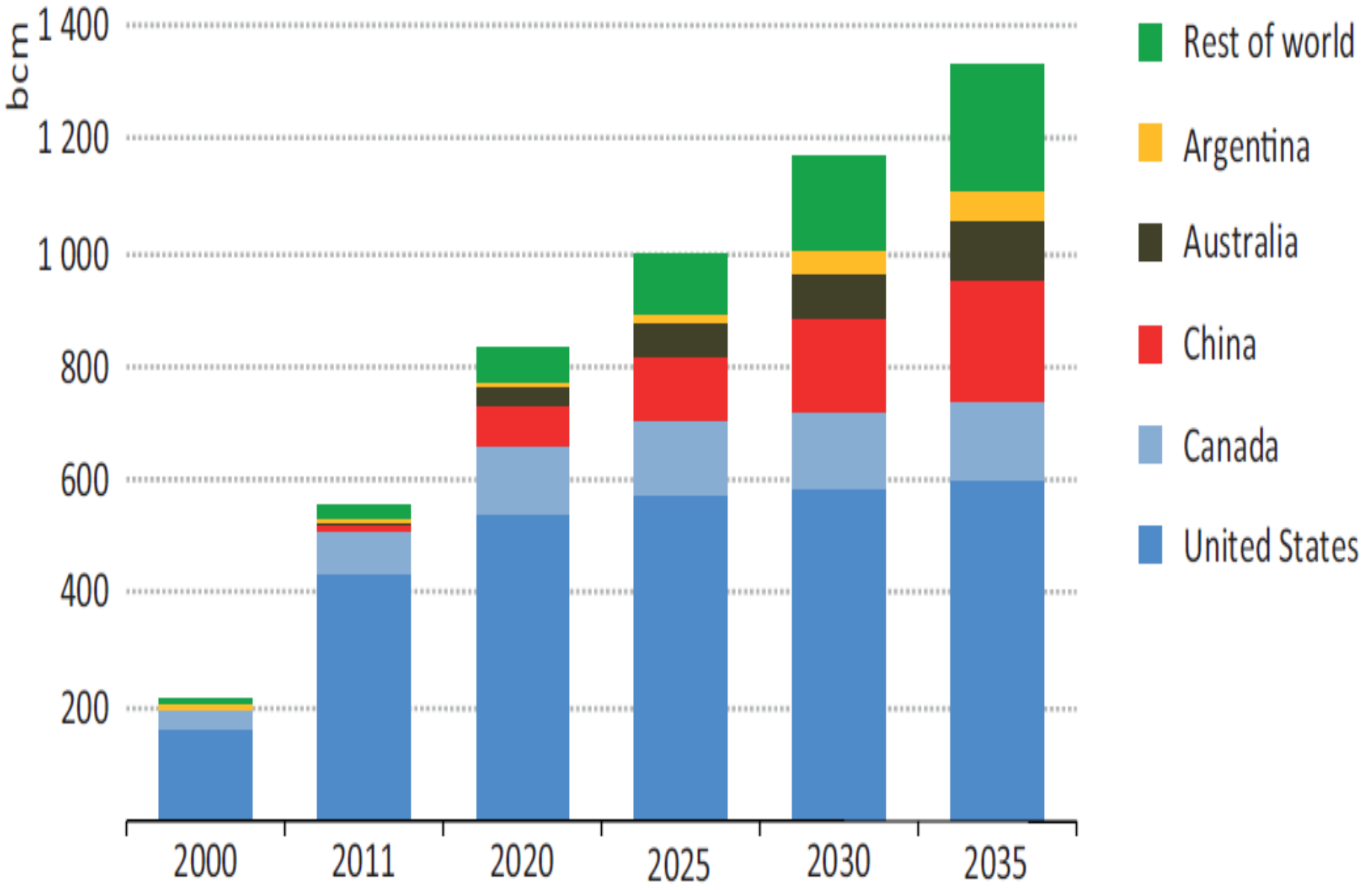
Oil production changes for OPEC/non-OPEC, 2005-2035, NPS



Note: Share of OPEC is for the end of the interval shown, *i.e.* for 2012 in the first column, for 2015 in the second, and so on.

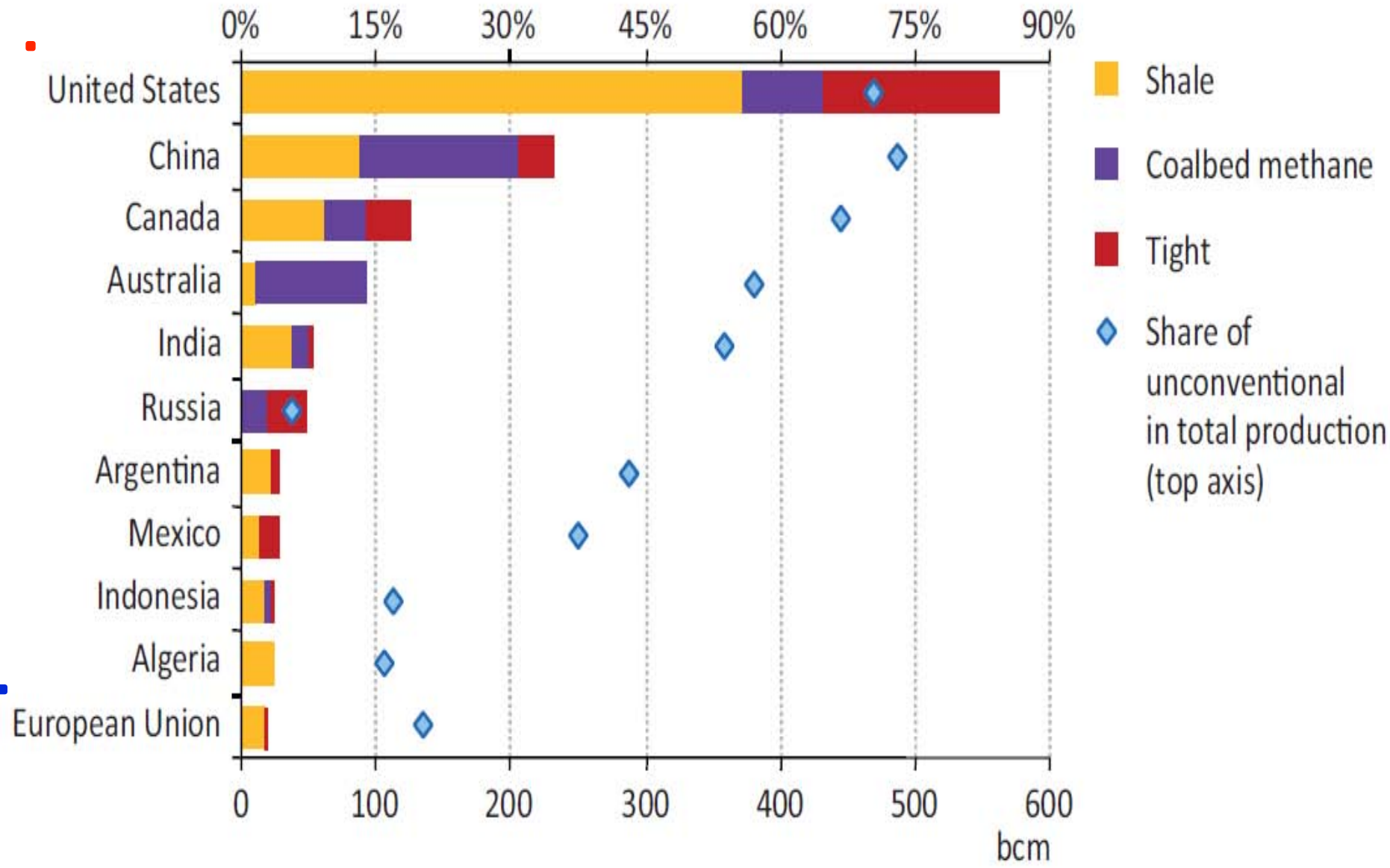
IEA, WEO 2013

Unconventional gas production 2000-2035, NPS



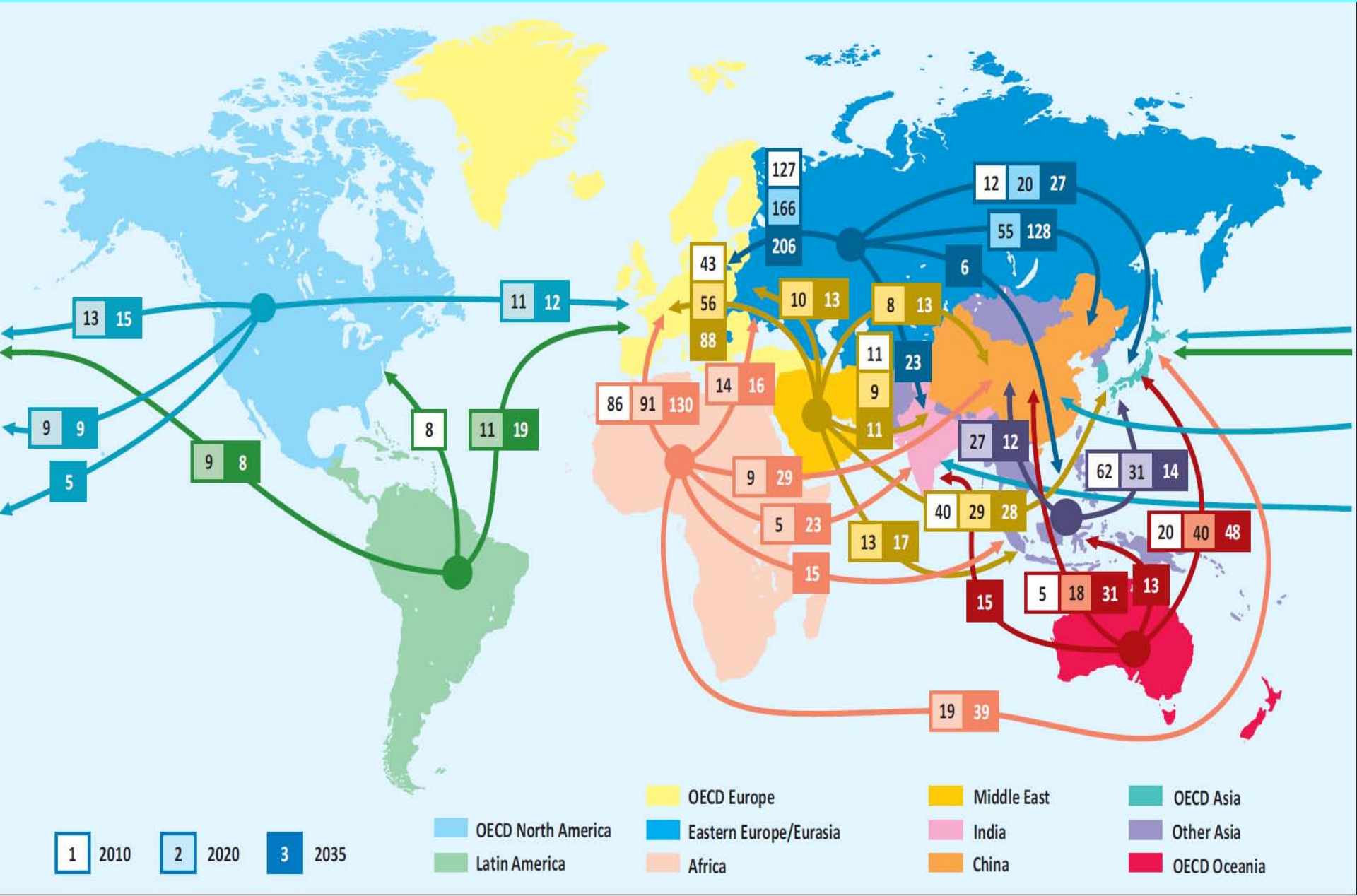
IEA, WEO 2013

Unconventional gas production in leading countries in the New Policies Scenario, 2035



IEA, WEO 2012

Net inter-regional natural gas trade flows between major regions in the New Policies Scenario (bcm)



Major barriers to the development of shale gas in the world

OUTLOOK FOR SHALE DEVELOPMENT WORLDWIDE

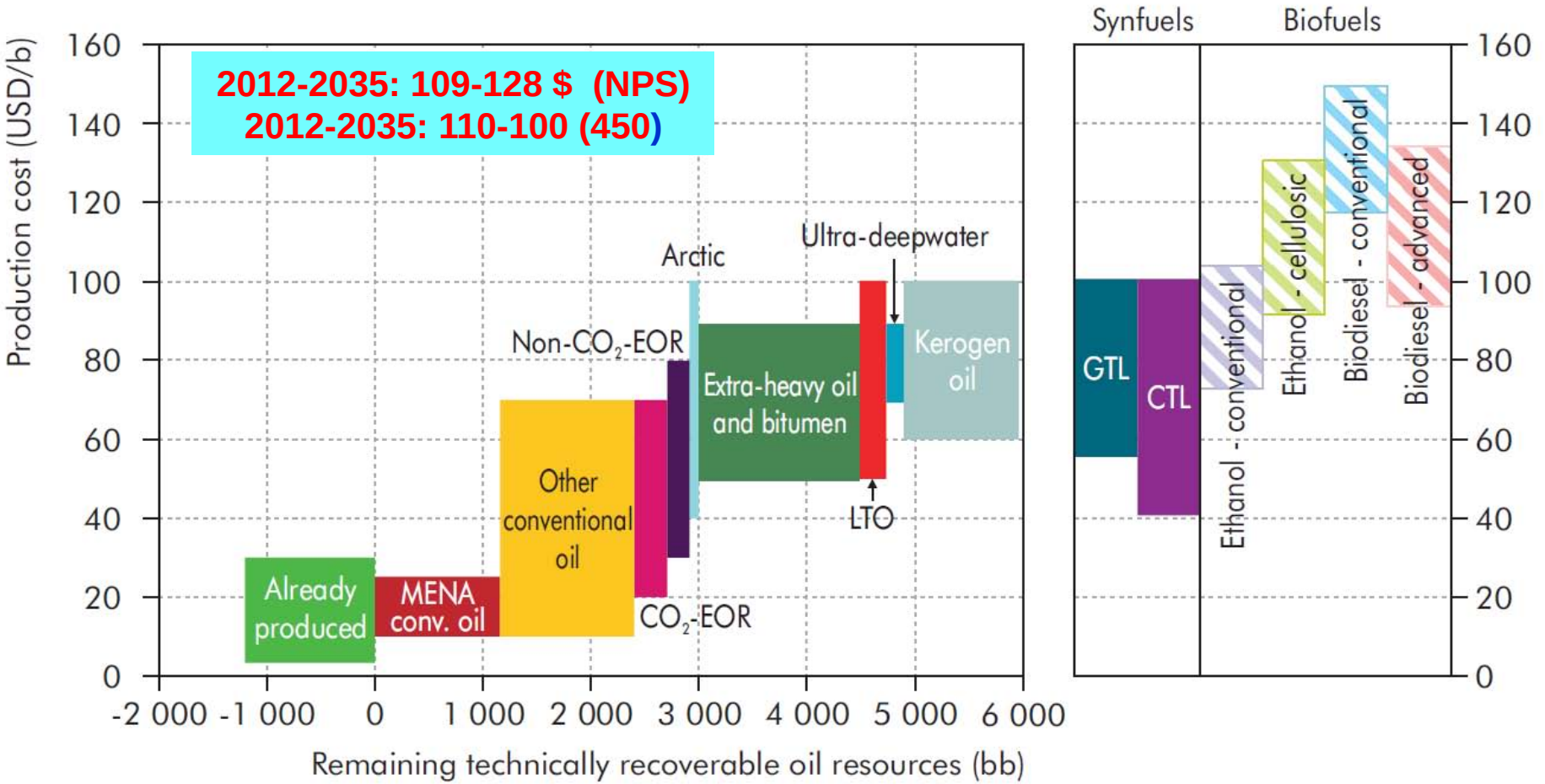
Country	EIA resource estimate (tcf)	Services	Pipelines	Water access	Geological complexity	Gas reserves/ capita (Mcf)	Shale % of natural gas production	Outlook
Argentina	774					318	<5%	• Success during the nascent stage is driving investments needed as an incubator. • Maintaining a favorable investment is for midstream.
China	1,275 [1](886)					80	<3%	• International partnerships needed to overcome geological complexity. • Services sector needs shale experience, and water is a concern. • Unlikely to be a globalizer.
Poland	187 [2](12-27)					88	N/A	• Stable investment climate needed to reinvigorate investments. • Must demonstrate commercial viability of its shale. • Unlikely to be a globalizer.
US	482					966	23%	• Poised to be a globalize with LNG exports. • Government export approvals are determining factor.

[1] China Ministry of Land and Resources estimate.
[2] Polish Geological Institute estimate.

= Low barrier
= Moderate barrier
= High barrier

Source: Deloitte Oil and Gas Reality Check 2013: A look at the top issues facing the oil and gas sector

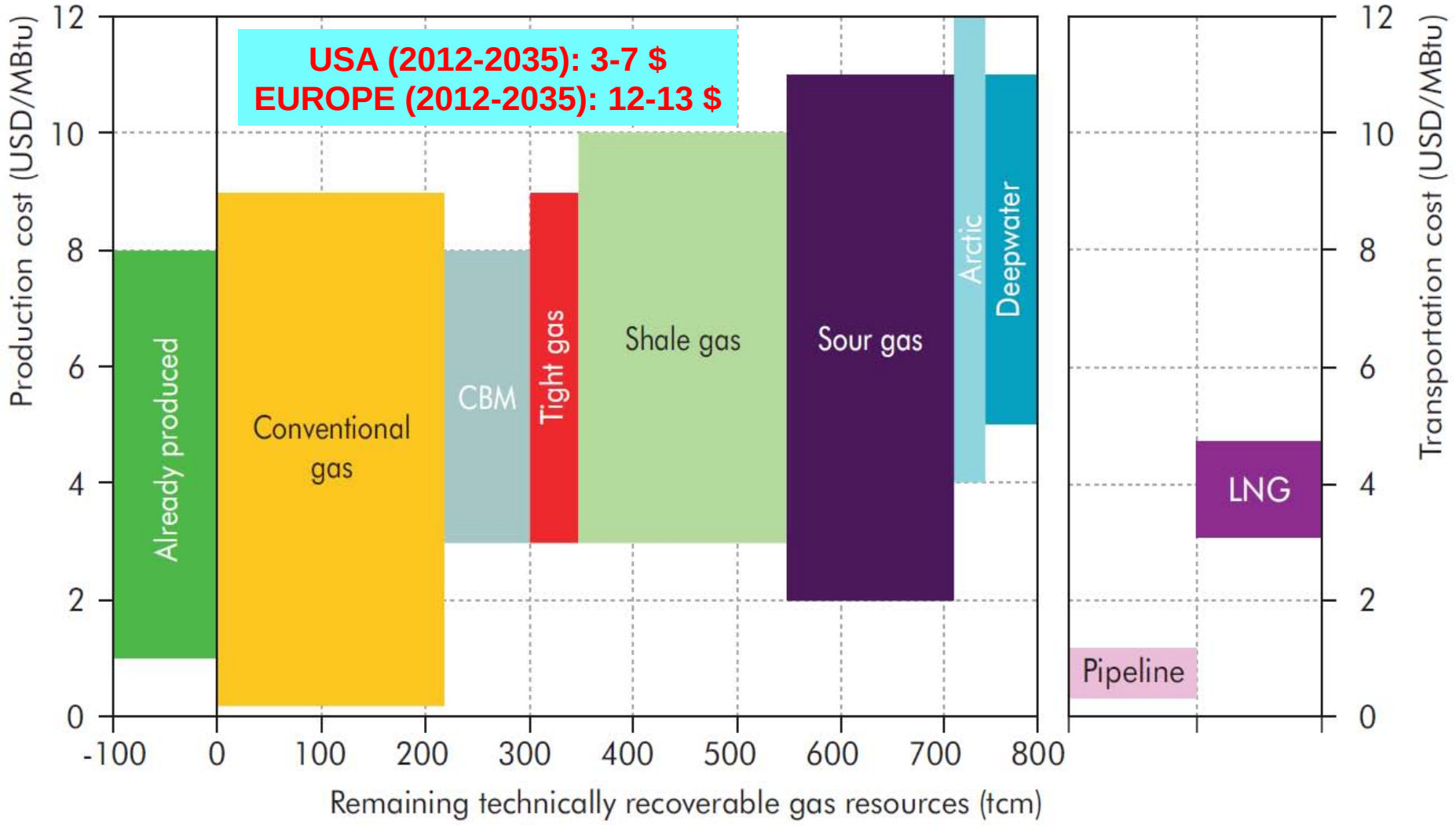
Oil production costs for various resource categories
No carbon pricing included



Notes: unless otherwise indicated, all material in figures and tables derives from IEA data and analysis. CO_2 = carbon dioxide; MENA = Middle East and North Africa. "Other conventional oil" includes deepwater. No carbon pricing included. Synfuel resources are difficult to assess due to competition with other natural gas and coal uses. Biofuels are renewable and, in theory, not resource constrained. Biofuels production costs have been credited with a "refiner's margin", using the ratio of gasoline and diesel spot prices in the United States compared to the West Texas Intermediate crude oil price. The ratio was, on average, 1.3 for gasoline and 1.35 for diesel between 2007 and 2012.

IEA, RtoR, 2013

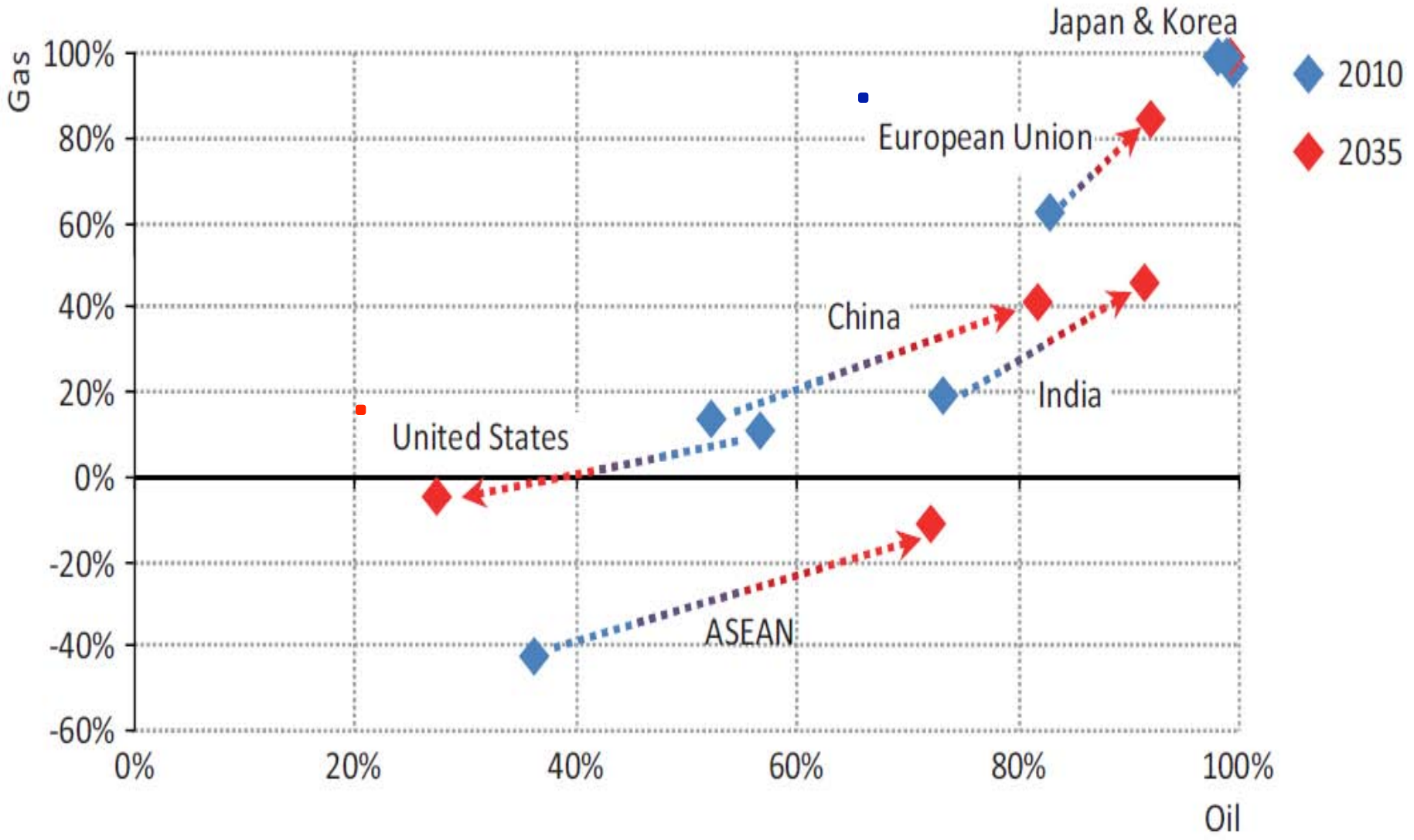
Long-term gas production costs for various resource categories. No carbon pricing included



Notes: CBM = coal-bed methane; LNG = liquefied natural gas; Pipeline costs refer to costs per 1 000 km; MBtu = million British thermal units; tcm = trillion cubic metres.

IEA, RtoR, 2013

Net oil and gas import dependency in selected countries in the New Policies Scenario

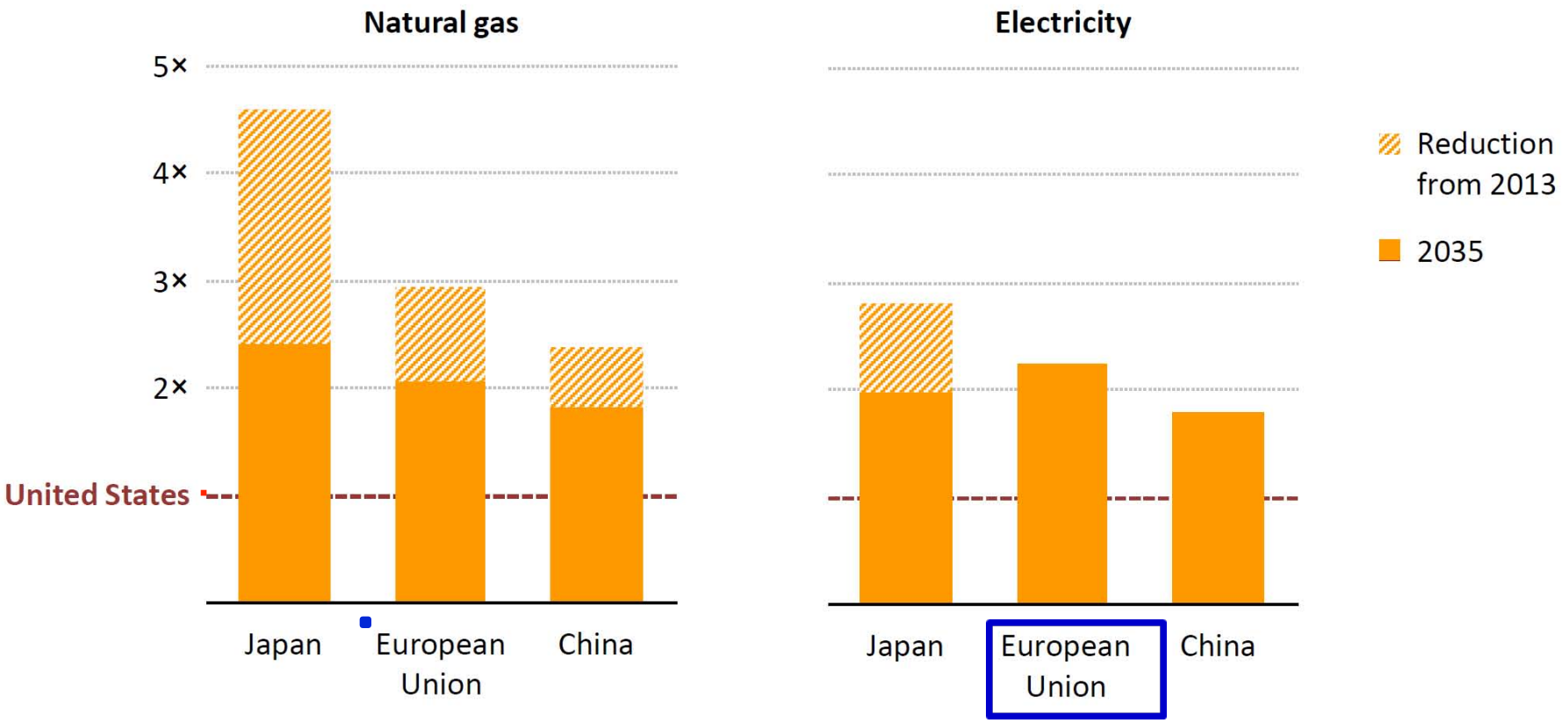


Note: Import dependency is calculated as net imports divided by primary demand for each fuel.

Who has the energy to compete?

WORLD ENERGY OUTLOOK 2013

Ratio of industrial energy prices relative to the United States

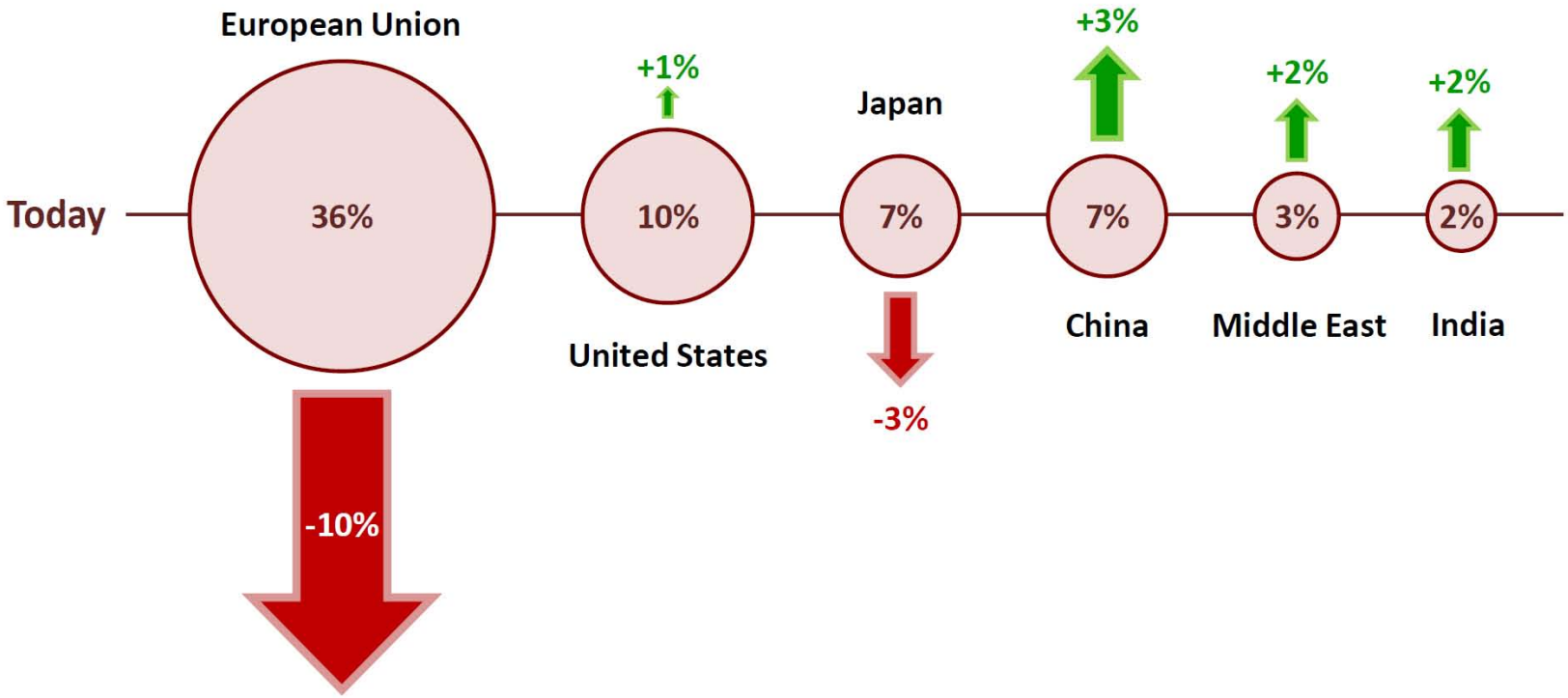


Regional differences in natural gas prices narrow from today's very high levels but remain large through to 2035; electricity price differentials also persist

An energy boost to the economy?

WORLD ENERGY OUTLOOK 2013

Share of global export market for energy-intensive goods



The US, together with key emerging economies, increases its export market share for energy-intensive goods, while the EU and Japan see a sharp decline

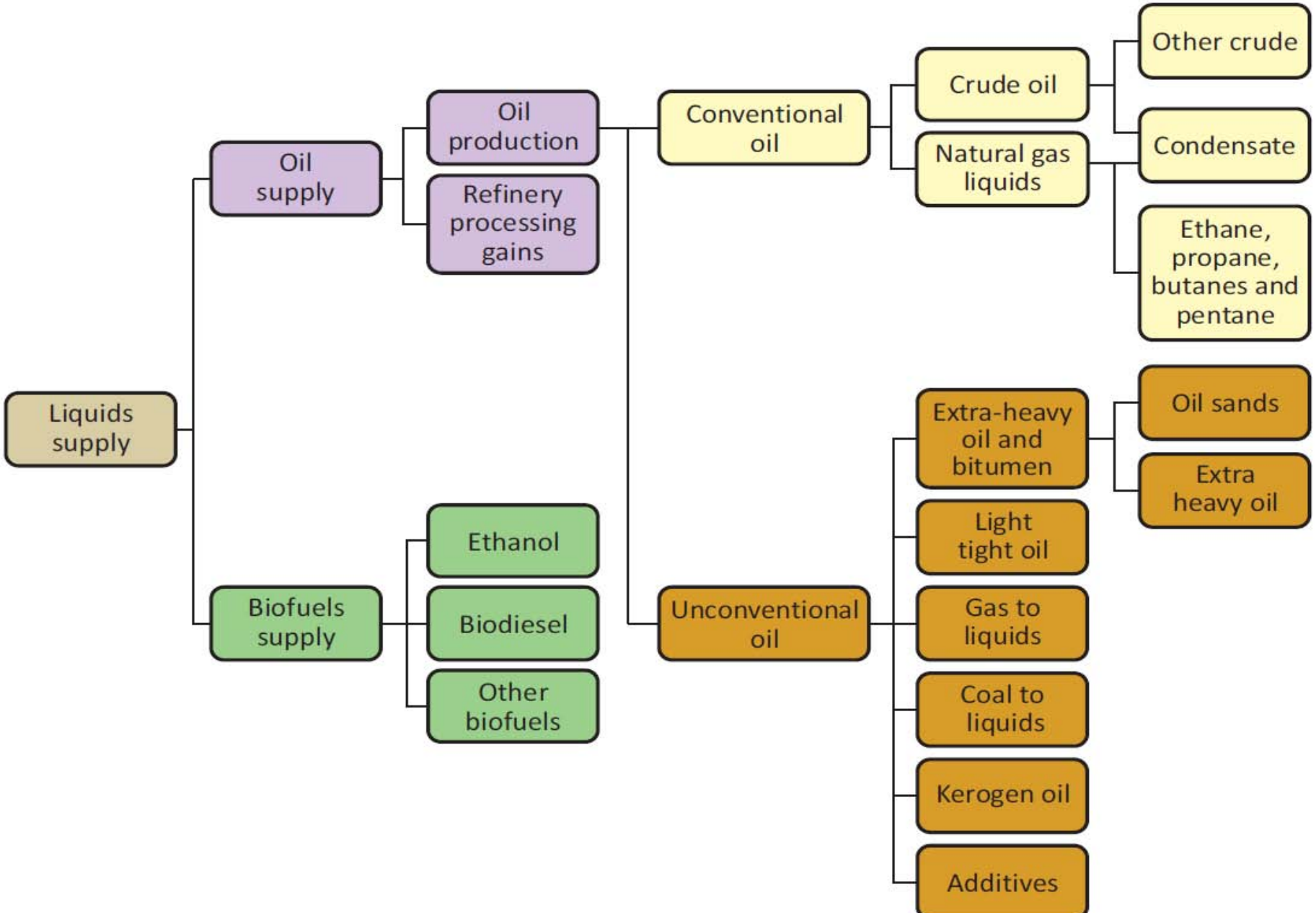
The capacity of technologies to unlock new types of resources, such as light tight oil -LTO- and ultra-deepwater fields, and to improve recovery rates in existing fields is pushing up estimates of the amount of oil that remains to be produced.

But this does not mean that the world is on the cusp of a new era of oil abundance.

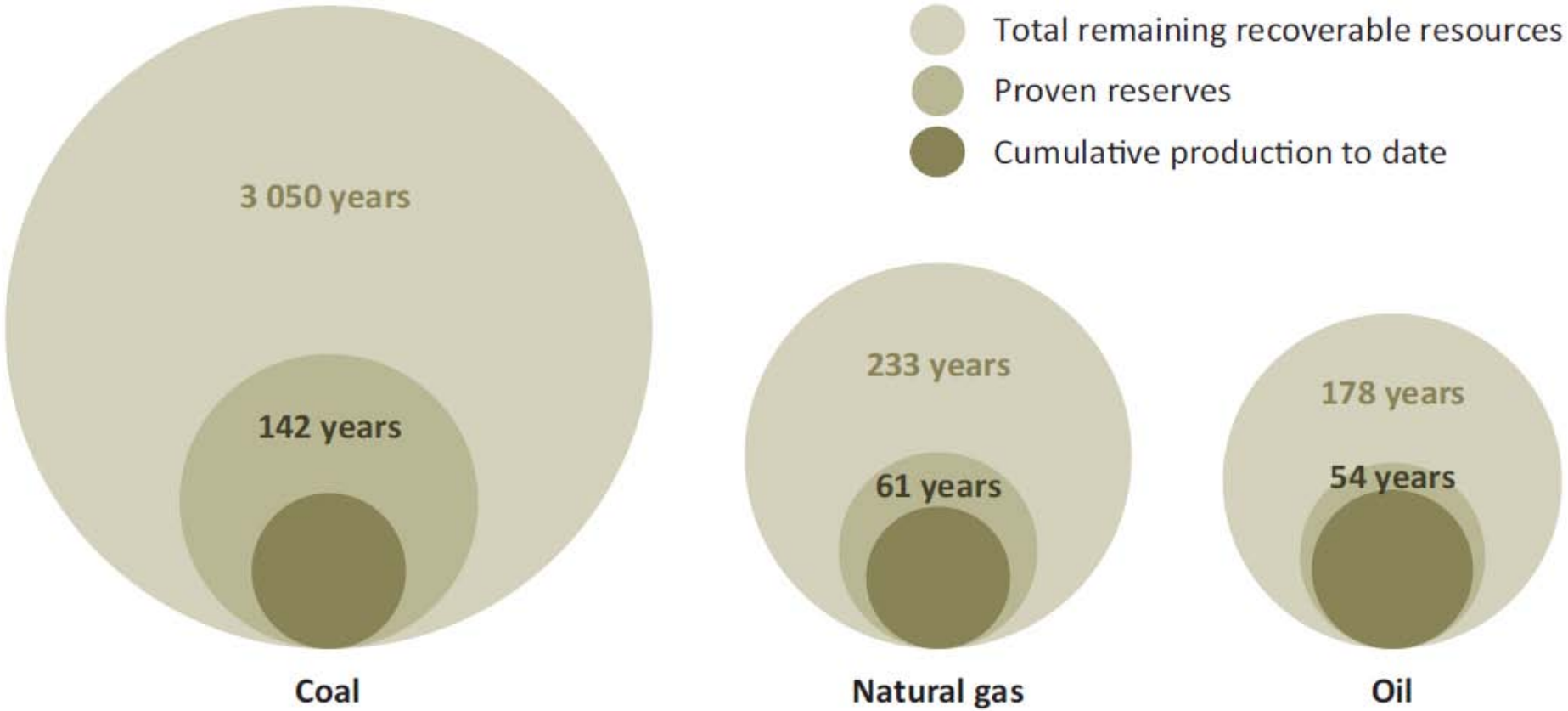
An oil price that rises steadily to $128 per barrel (in year-2012 dollars) in 2035 supports the development of these new resources, though no country replicates the level of success with LTO that is making the United States the largest global oil producer.

The rise of unconventional oil (including LTO) and natural gas liquids meets the growing gap between global oil demand, which rises by 14 mb/d to reach 101mb/d in 2035, and production of conventional crude oil, which falls back slightly to 65 mb/d

Classification of liquids fuels

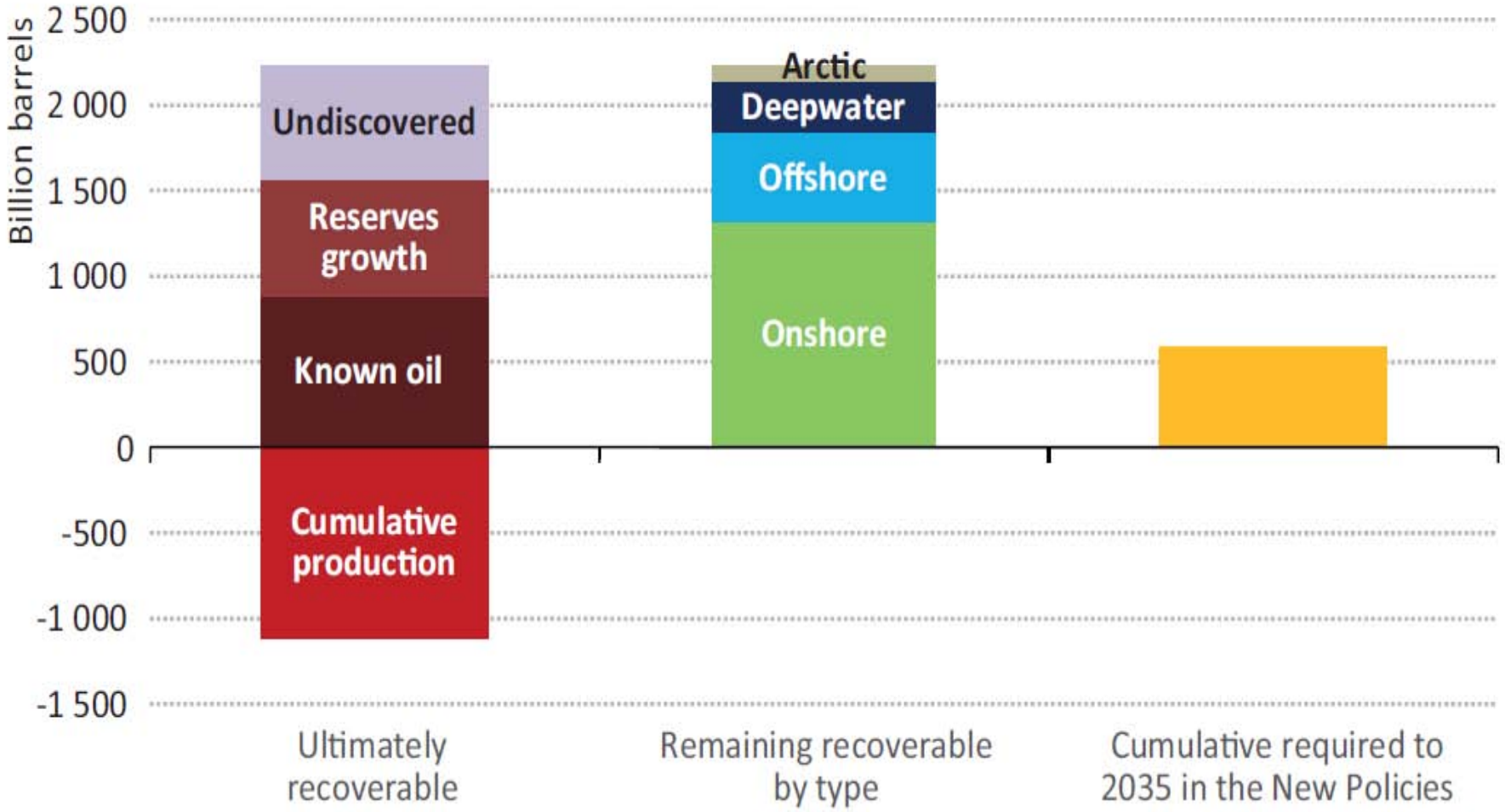


Fossil energy resources by type



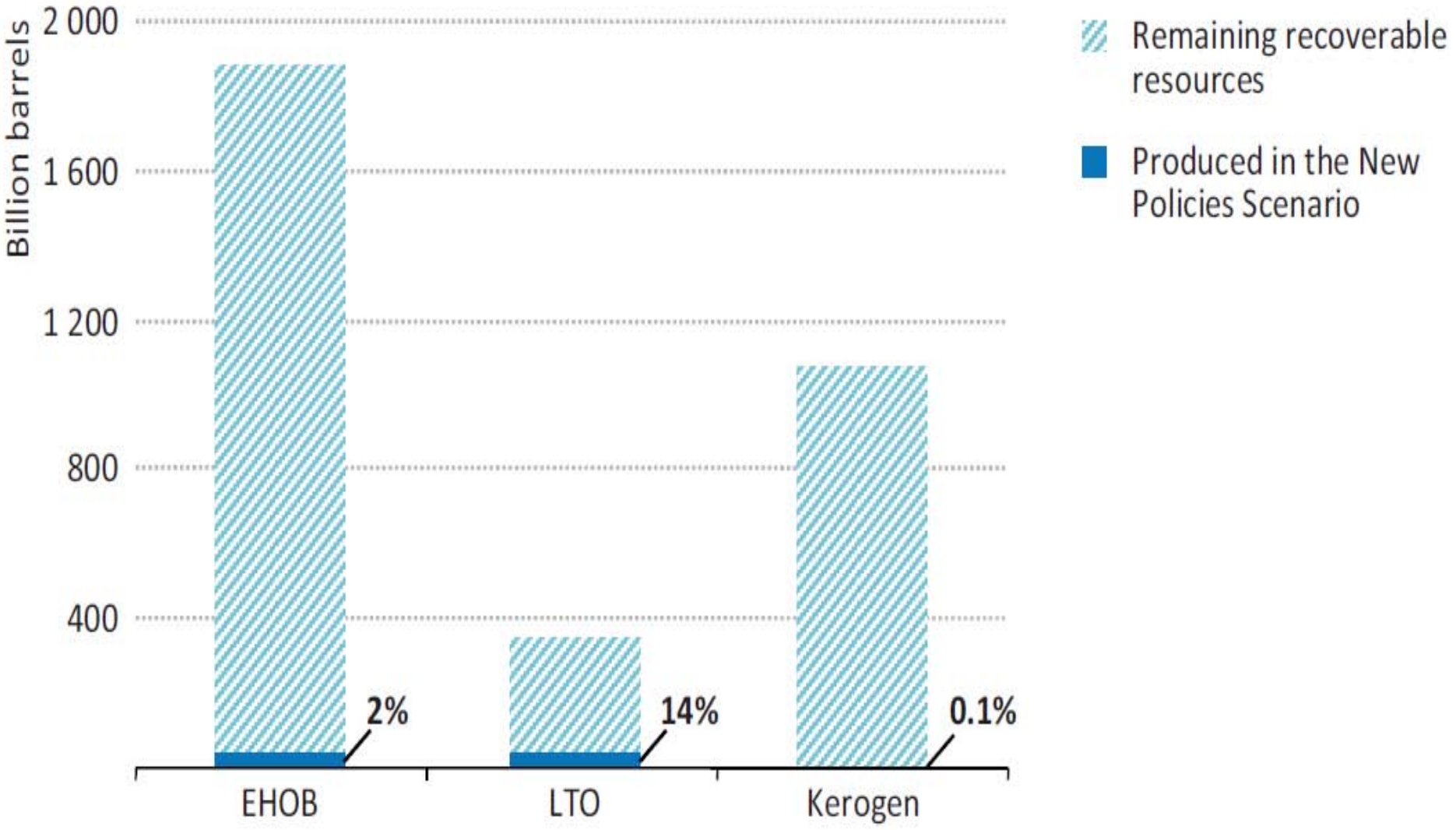
Notes: All bubbles are expressed as a number of years of production based on estimated production in 2013. The size of the bubble for total remaining recoverable resources of coal is illustrative and is not proportional to the others. The figure specifies the status of reserves for coal as of end-2011, and gas and oil as of end-2012. Sources: BGR (2012); O&GJ (2012); USGS (2000, 2012a and 2012b); IEA estimates and analysis.

Ultimately recoverable conventional oil resources and cumulative production required in the New Policies Scenario



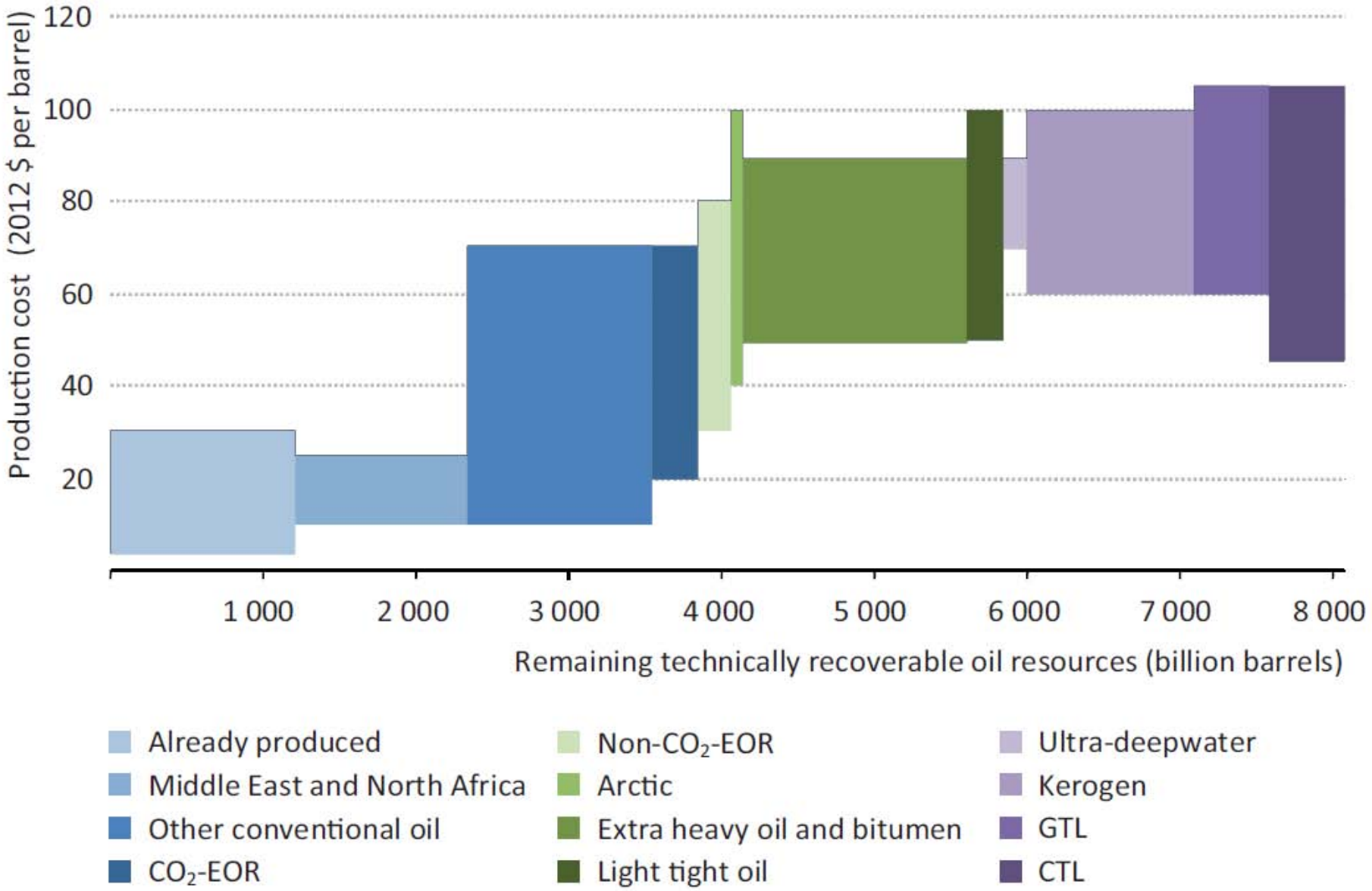
Notes: The ultimately recoverable conventional crude oil resources are as of January 2012, so the cumulative production required for the New Policies Scenario (for conventional crude only) covers the period 2012-2035. Known oil (in the USGS use of the term) includes also cumulative production.

Cumulative production versus remaining recoverable resources by type on unconventional oil in the NPS



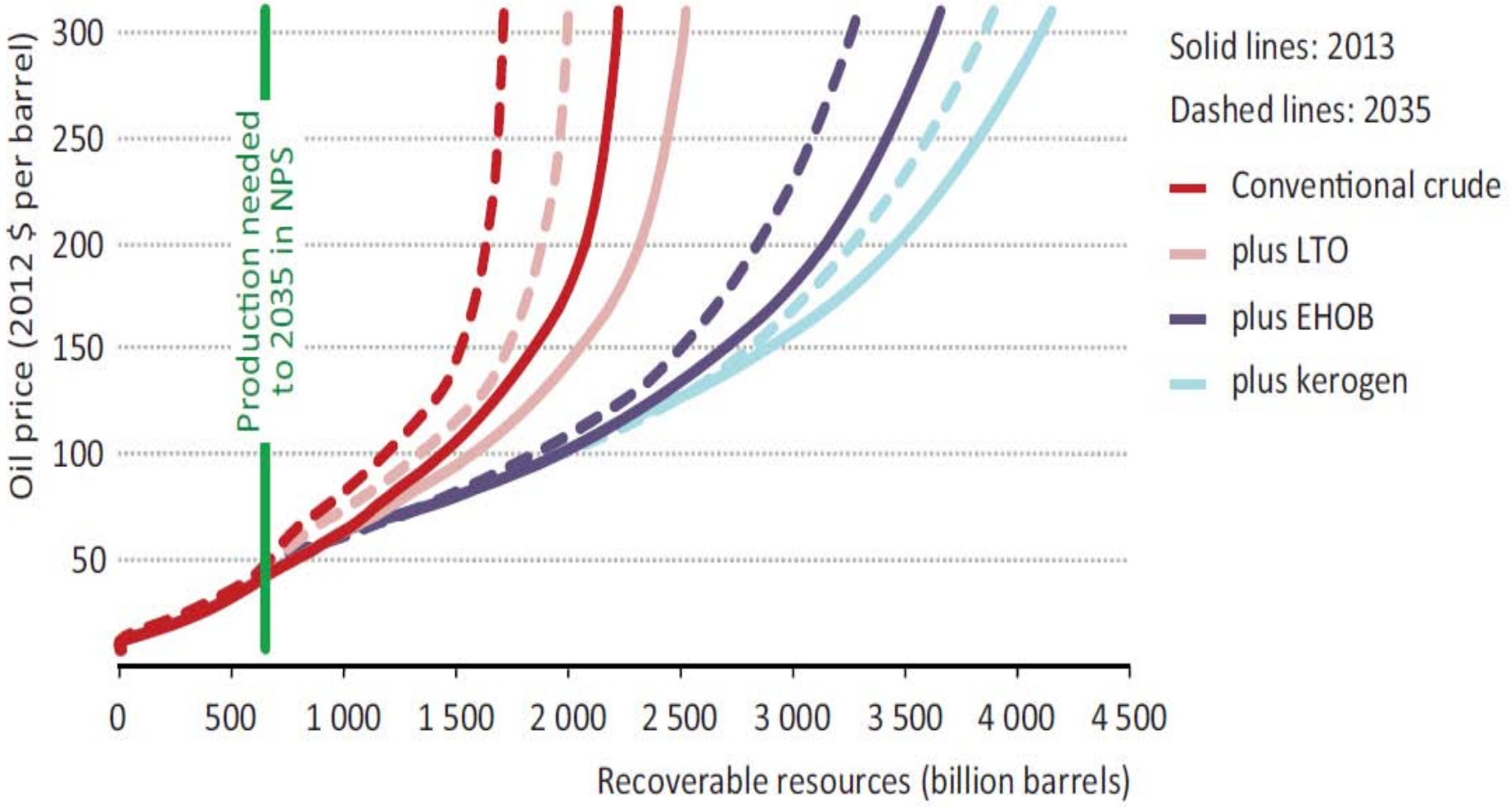
Note: Cumulative production is for the years 2013-2035.

Supply costs of liquids fuels



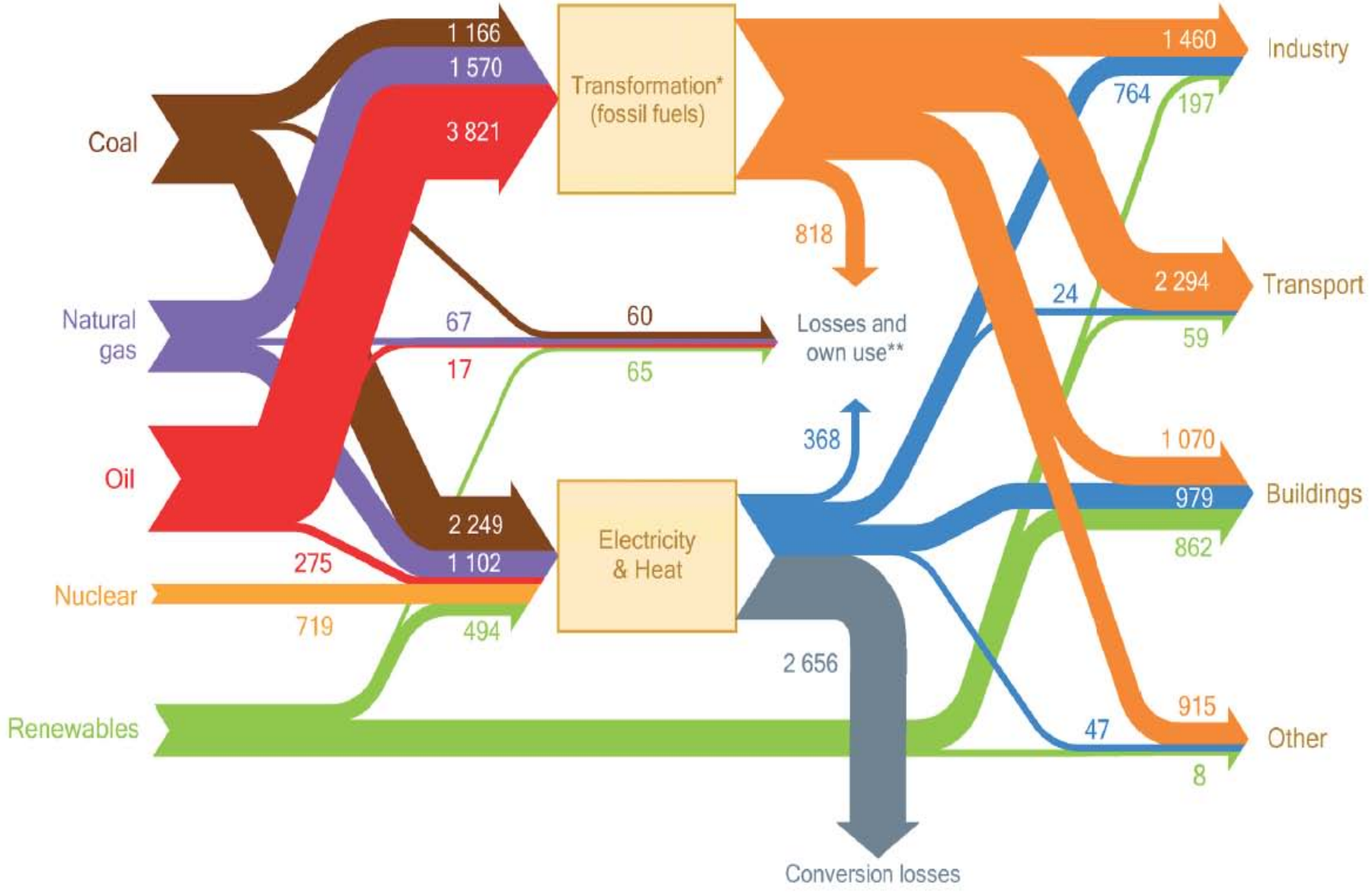
Source: *Resources to Reserves* (IEA, 2013).

World supply costs curves for 2013 and 2035 in the NPS



Notes: The supply curves are cumulative, *i.e.* the "plus LTO" line includes conventional crude and LTO; the "plus EHOB" includes conventional crude, LTO and EHOB, and so on. The vertical green line indicates the amount of production required between 2013 and 2035 in the New Policies Scenario (NPS).

The global energy system 2010, (Mtoe)



* Transformation of fossil fuels from primary energy into a form that can be used in the final consuming sectors. ** Includes losses and fuel consumed in oil and gas production, transformation losses and own use, generation lost or consumed in the process of electricity production, and transmission and distribution losses.

Facing “triple trilemma” in the future of energy

Peter Voser, Royal Dutch Shell CEO (Southern Weekend,June 23, 2011)

“**Trilemma” - a triangle of interrelated concerns.**
We can’t just address one part of the triangle, and ignore the others, without some serious consequences.

The first trilemma is the **3Es: economy, energy and environment**

The second trilemma relates to the **3As: availability, accessibility, and acceptability**
As energy demand rises, not only will we have to find new sources of energy, we will have to develop the technology to harness them. We will also have to ensure that we do so in ways that are acceptable to consumers and communities.

The third trilemma relates to the growing nexus between the world’s **energy, water and food** needs, all of which will rise dramatically by mid century.

While the EU struggles to solve the “3Es trilemma” (economy, energy

While the EU struggles to solve the "3Es trilemma"….

Sostenibilidad
El Roto, 2-12-2012

Linking the 3 “es”

Integrate energy policy into trade, economic, environmental, security, and foreign policies.
Strengthen global energy trade and investment.
Broaden dialogue with both producing and consuming nations.

Clean f. f.
Renewables
Nuclear

Energy security

Conservation
Efficiency
Education

R+D

“No silver bullet”

Incentives
Dissuasion
Full costs

Environment

Economy

…the US has focused on the "energy security-economy" axis

It’s all about priorities!

Acceptability

Resource efficiency

Cost efficiency

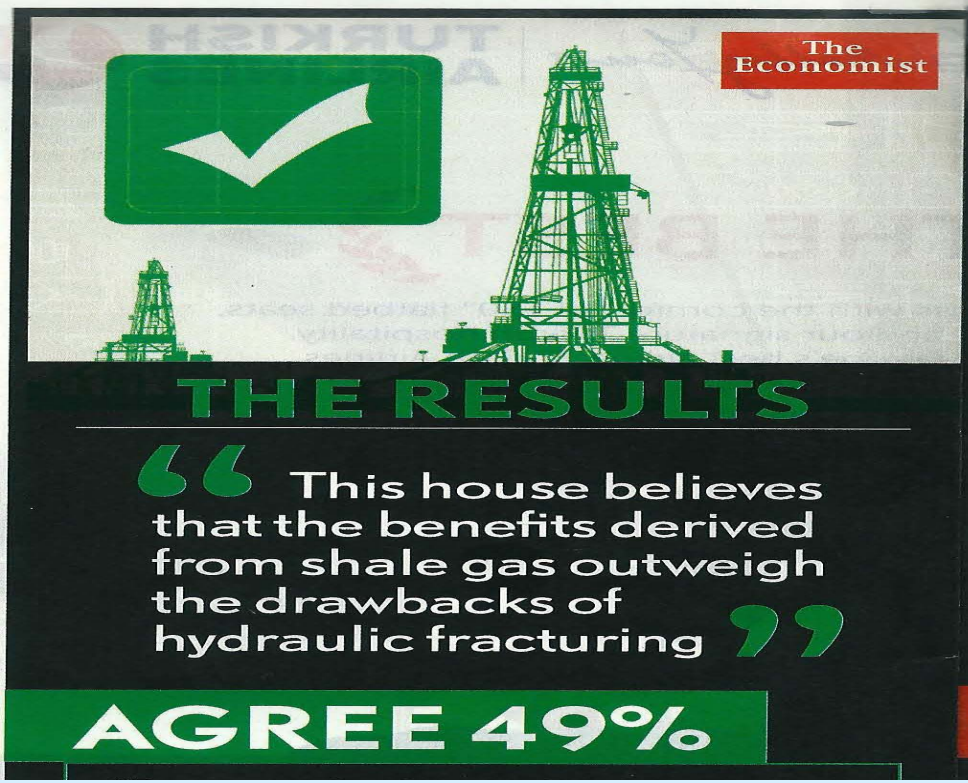
Supply security and reliability

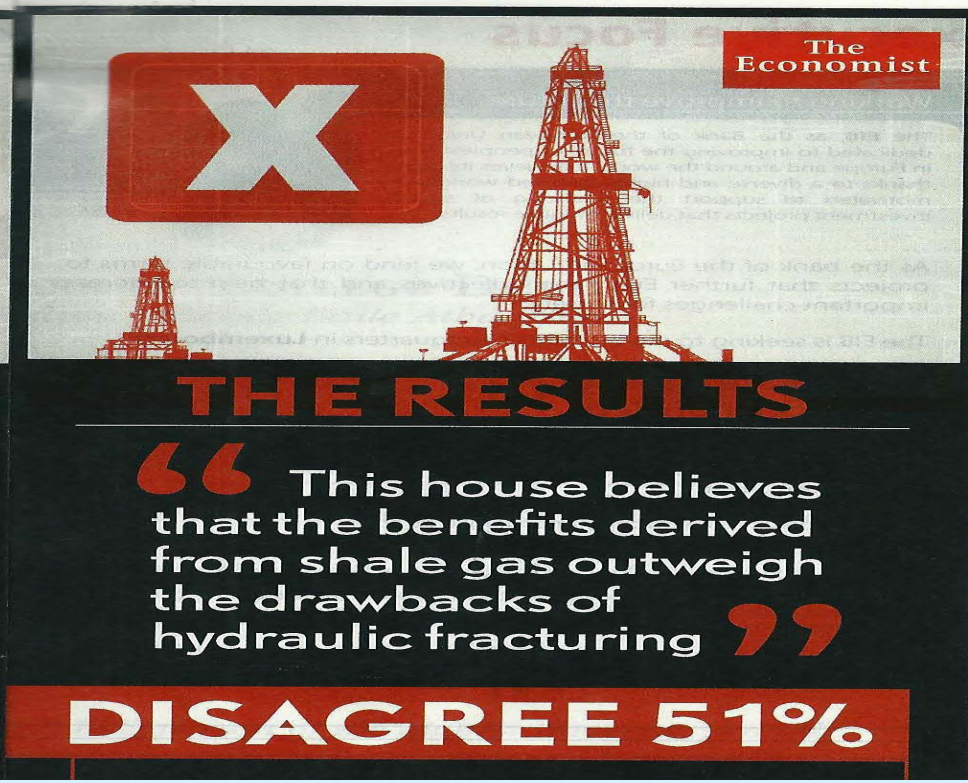
Energy access

Maslow’s pyramid for energy

How resilient is your country?

NATURE, 22-11-2012





Market, market, market... "Greed is good

Precautionary principle? Learning while working!

The science behind the industry

Confidentiality

"Drill baby drill": more than one million wells, 30,000 per/yr

Insufficient funding for research

Fossil fuel import prices by scenario (dollars per unit)

	Unit	2012	New Policies Scenario				Current Policies Scenario				450 Scenario			
			2020	2025	2030	2035	2020	2025	2030	2035	2020	2025	2030	2035
Real terms (2012 prices)														
IEA crude oil imports	barrel	109	113	116	121	128	120	127	136	145	110	107	104	100
Natural gas														
United States	MBtu	2.7	5.1	5.6	6.0	6.8	5.2	5.8	6.2	6.9	4.8	5.4	5.7	5.9
Europe imports	MBtu	11.7	11.9	12.0	12.3	12.7	12.4	12.9	13.4	14.0	11.5	11.0	10.2	9.5
Japan imports	MBtu	16.9	14.2	14.2	14.4	14.9	14.7	15.2	15.9	16.7	13.4	12.8	12.2	11.7
OECD steam coal imports	tonne	99	106	109	110	110	112	116	118	120	101	95	86	75
Nominal terms														
IEA crude oil imports	barrel	109	136	156	183	216	144	171	205	245	132	144	157	169
Natural gas														
United States	MBtu	2.7	6.1	7.5	9.1	11.6	6.2	7.7	9.3	11.7	5.8	7.2	8.6	10.0
Europe imports	MBtu	11.7	14.2	16.1	18.5	21.5	14.9	17.3	20.2	23.6	13.8	14.7	15.4	16.0
Japan imports	MBtu	16.9	17.1	19.1	21.7	25.1	17.7	20.4	24.0	28.2	16.1	17.2	18.4	19.7
OECD steam coal imports	tonne	99	127	146	165	186	134	155	178	202	121	128	129	127

Notes: Gas prices are weighted averages expressed on a gross calorific-value basis. All prices are for bulk supplies exclusive of tax. The US price reflects the wholesale price prevailing on the domestic market. Nominal prices assume inflation of 2.3% per year from 2012.

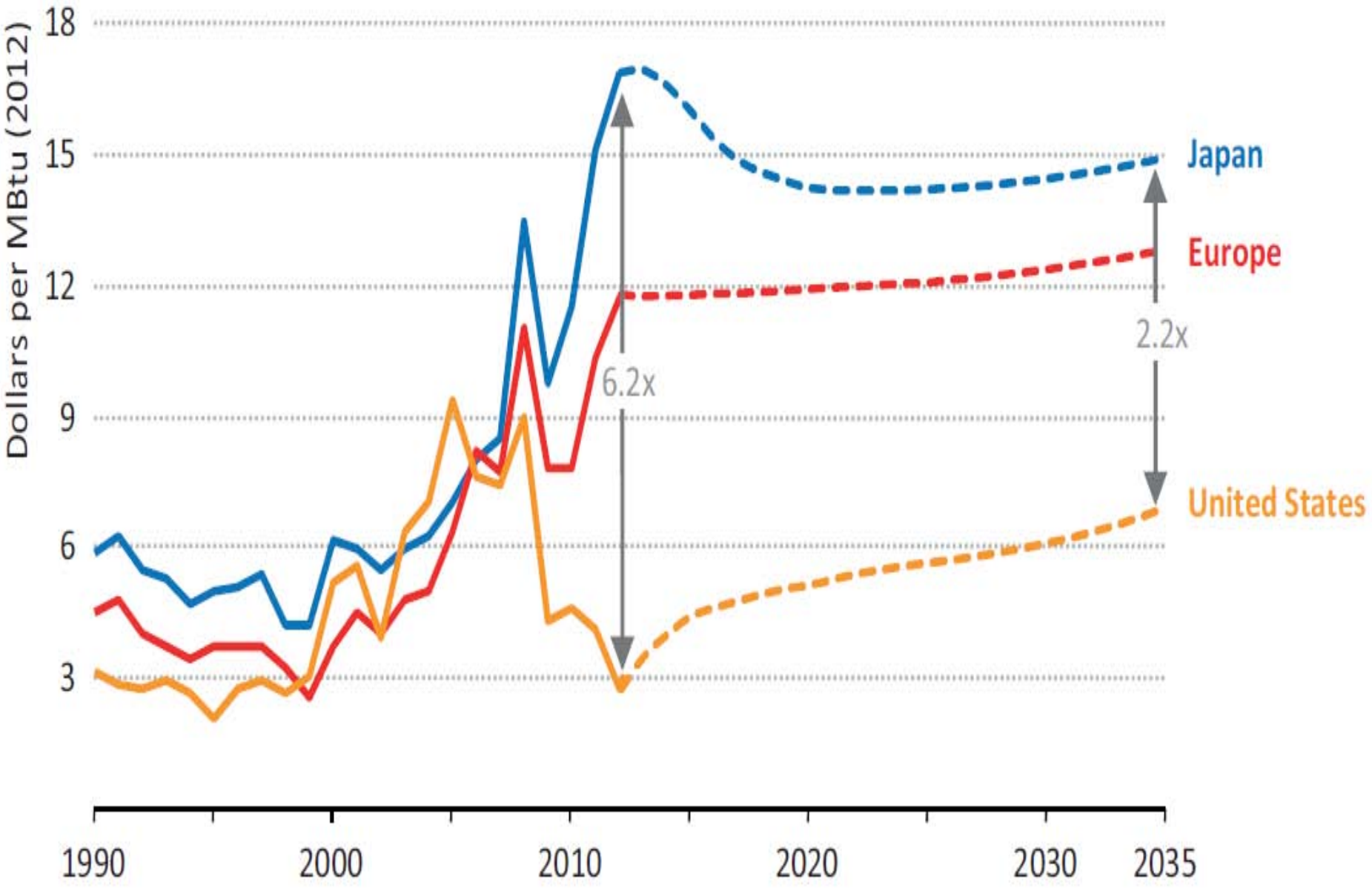
SOUTH AFRICA

Suspicions: Middelburg, a small town in the Karoo, will be worried about water resources if shale gas drilling is given the go ahead Photo: IAIN ESAU

Trust also a rare commodity

The company's **main detractor** accuses **Shell** of being **economical with the truth** but the supermajor says it is **committed to transparency**

Natural gas price by region, NPS



IEA, WEO 2013