World Gas Markets

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Outline

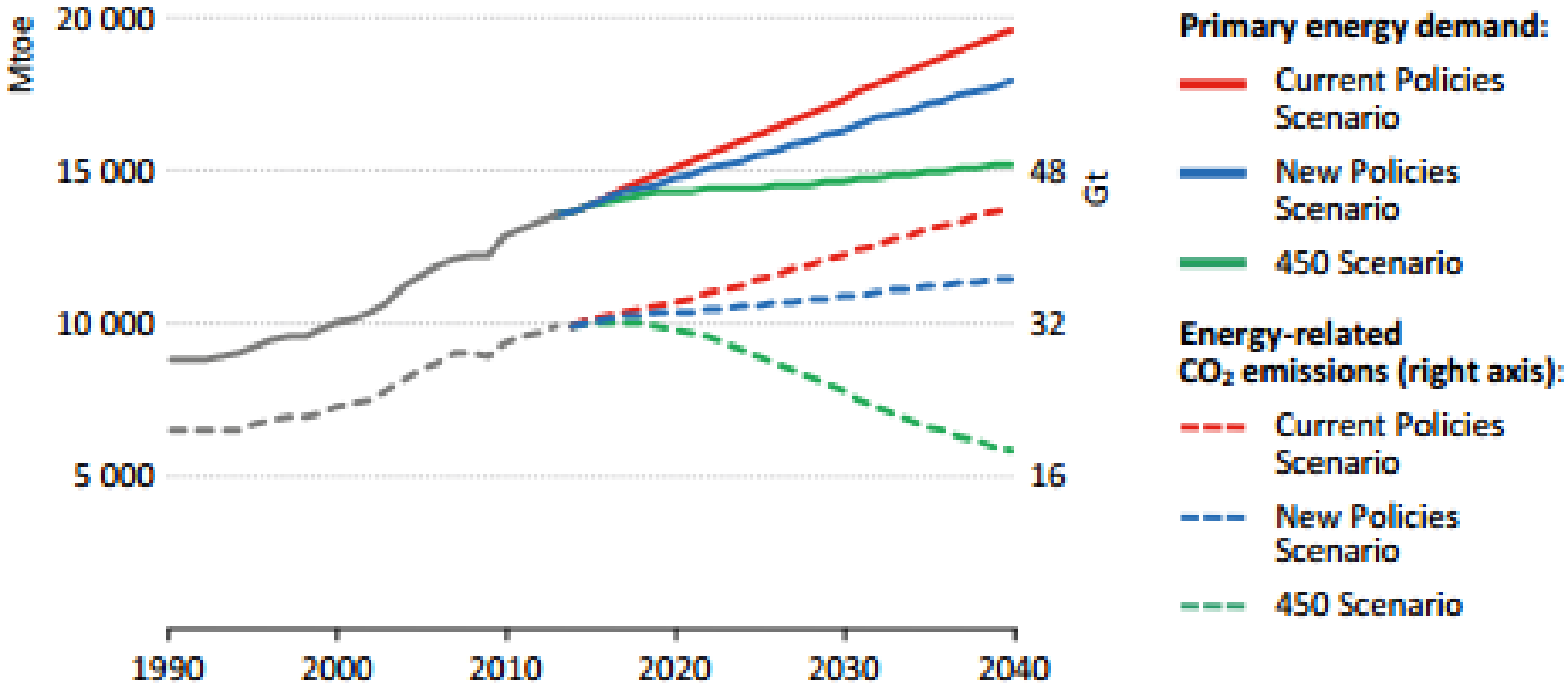
1. Gas some important physical properties
2. World gas markets
3. Game changers

Sources

- International Energy Agency (IEA) – World Energy Outlook (WEO), 2015
- (US) Energy Information Agency (EIA): International Energy Outlook (IEO) 2015
- BP Statistical Review of World Energy June 2015

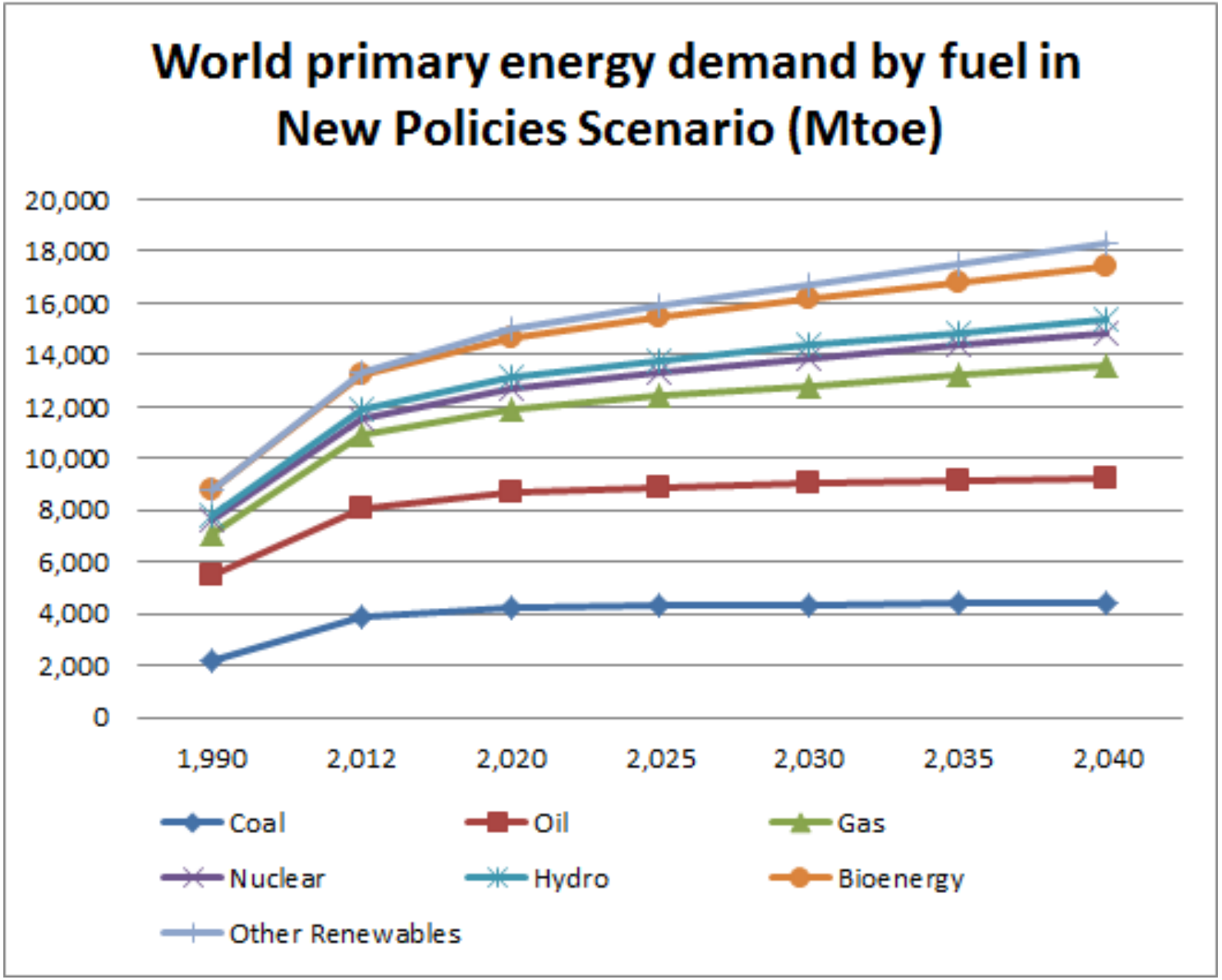
IEA, 2015

Figure 2.1 ▷ World primary energy demand and CO_2 emissions by scenario

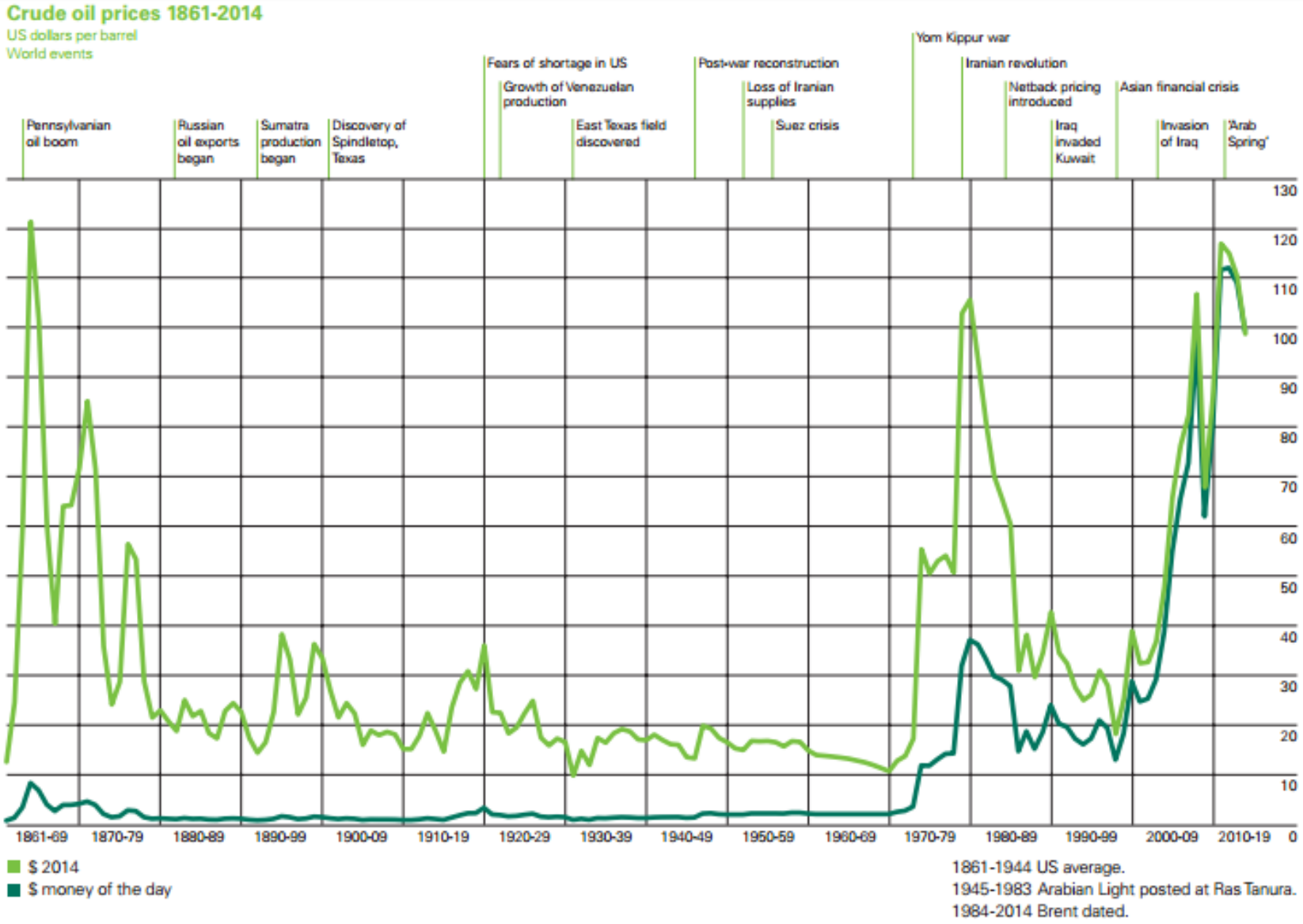


Gas is a major World Energy Input

Especially for electricity generation

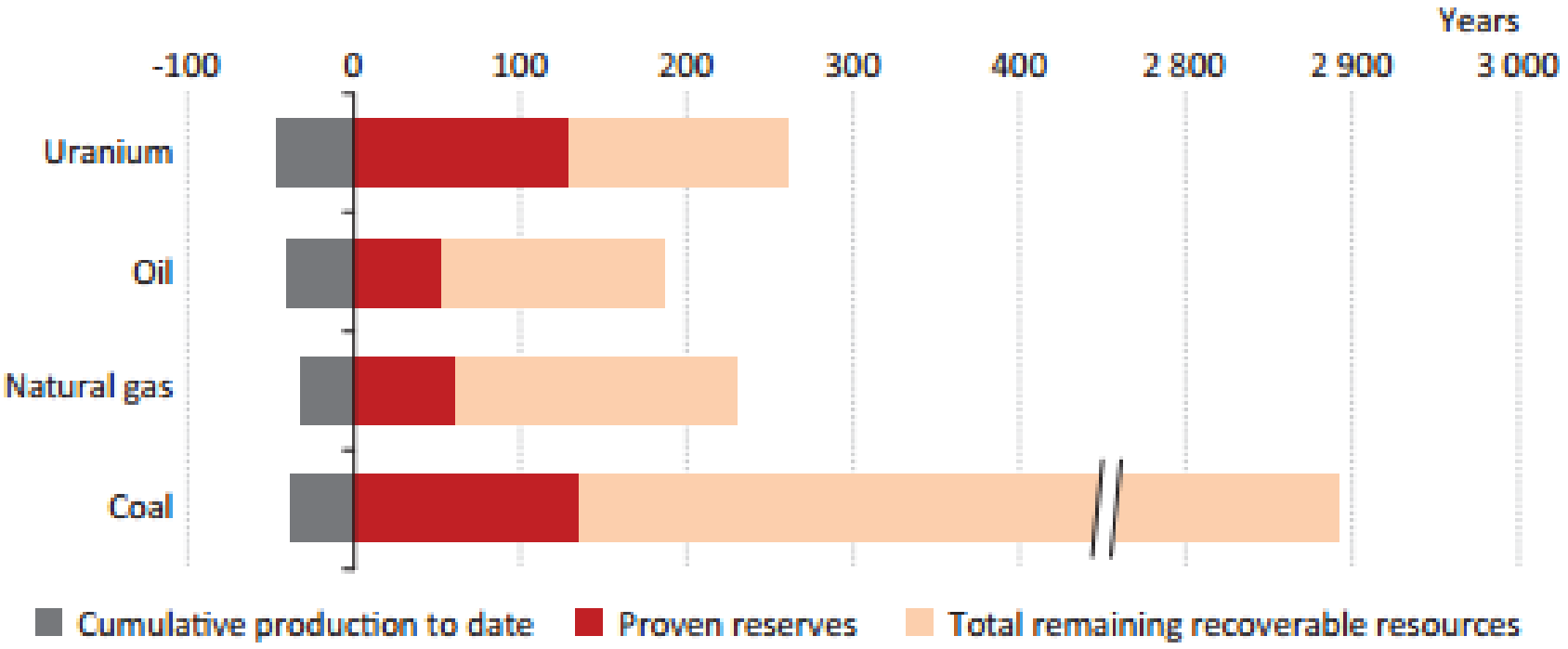


BP, 2015


Crude oil prices 1861-2014
US dollars per barrel
World events
Pennsylvanian oil boom
Russian oil exports began
Sumatra production began
Discovery of Spindletop, Texas
Fears of shortage in US
Growth of Venezuelan production
East Texas field discovered
Post-war reconstruction
Loss of Iranian supplies
Suez crisis
Yom Kippur war
Iranian revolution
Netback pricing introduced
Iraq invaded Kuwait
Asian financial crisis
Invasion of Iraq
'Arab Spring'
130
120
110
100
90
80
70
60
50
40
30
20
10
0
1861-69
1870-79
1880-89
1890-99
1900-09
1910-19
1920-29
1930-39
1940-49
1950-59
1960-69
1970-79
1980-89
1990-99
2000-09
2010-19
$ 2014
$ money of the day
1861-1944 US average.
1945-1983 Arabian Light posted at Ras Tanura.
1984-2014 Brent dated.

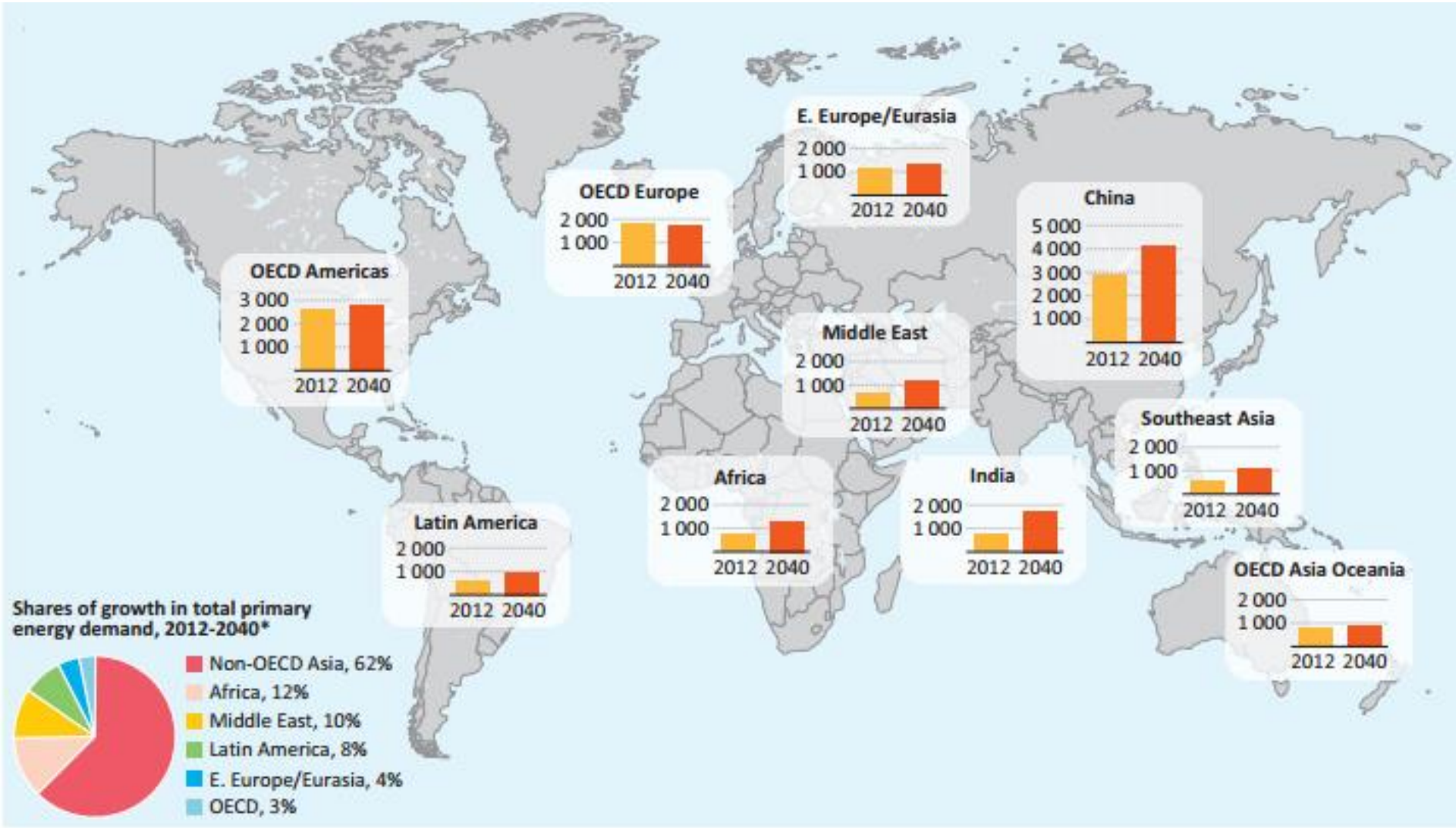
More Gas Reserves than Oil

Figure 2.13 ▻ Lifetimes of fossil-fuel and uranium resources*



Source: IEA, 2014

Primary Energy Use by Region in IEA (2014) New Policies Scenario



IEA – example Impact of policy scenarios

Figure 4.1 ▷ World natural gas demand by scenario

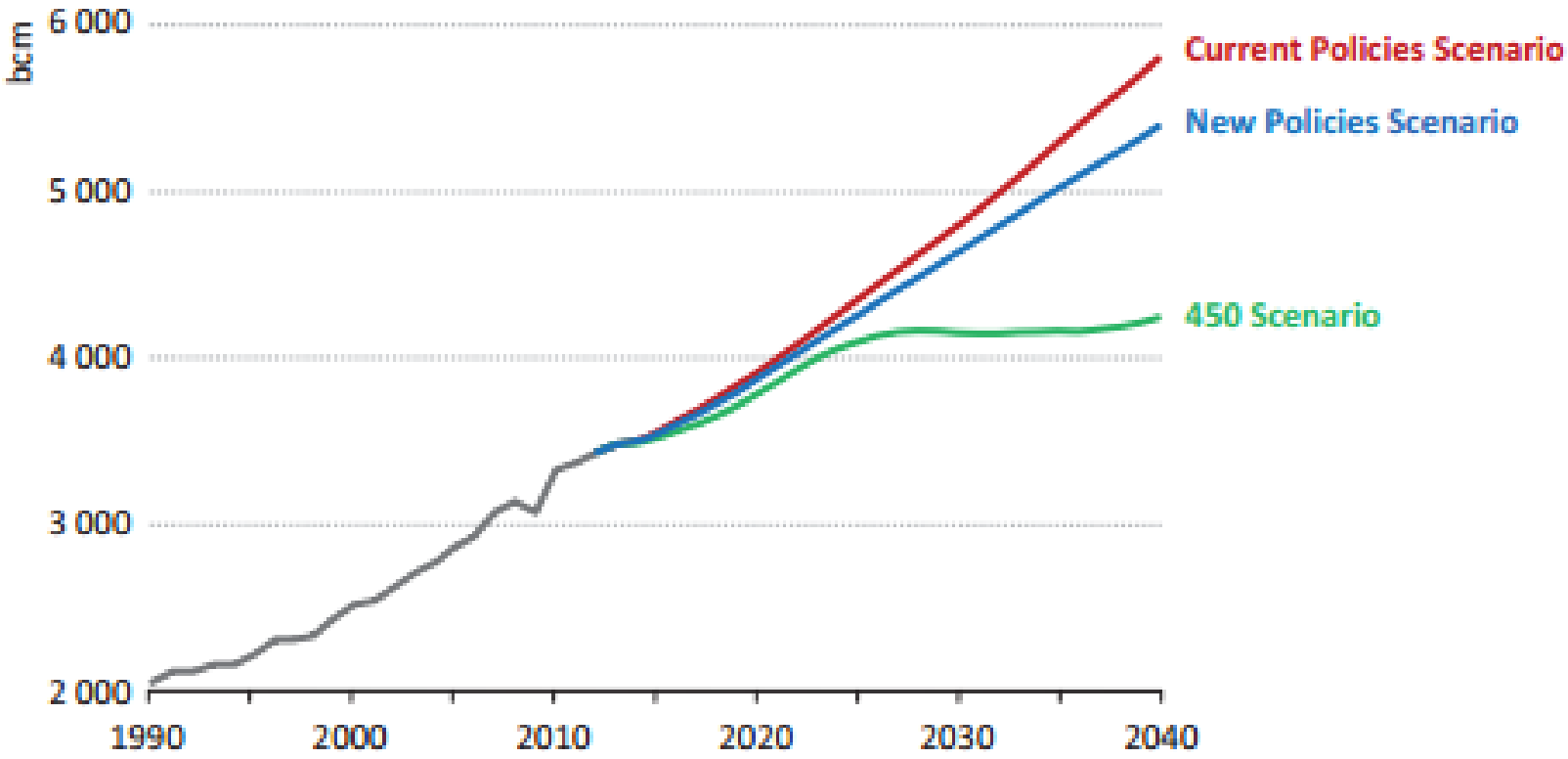
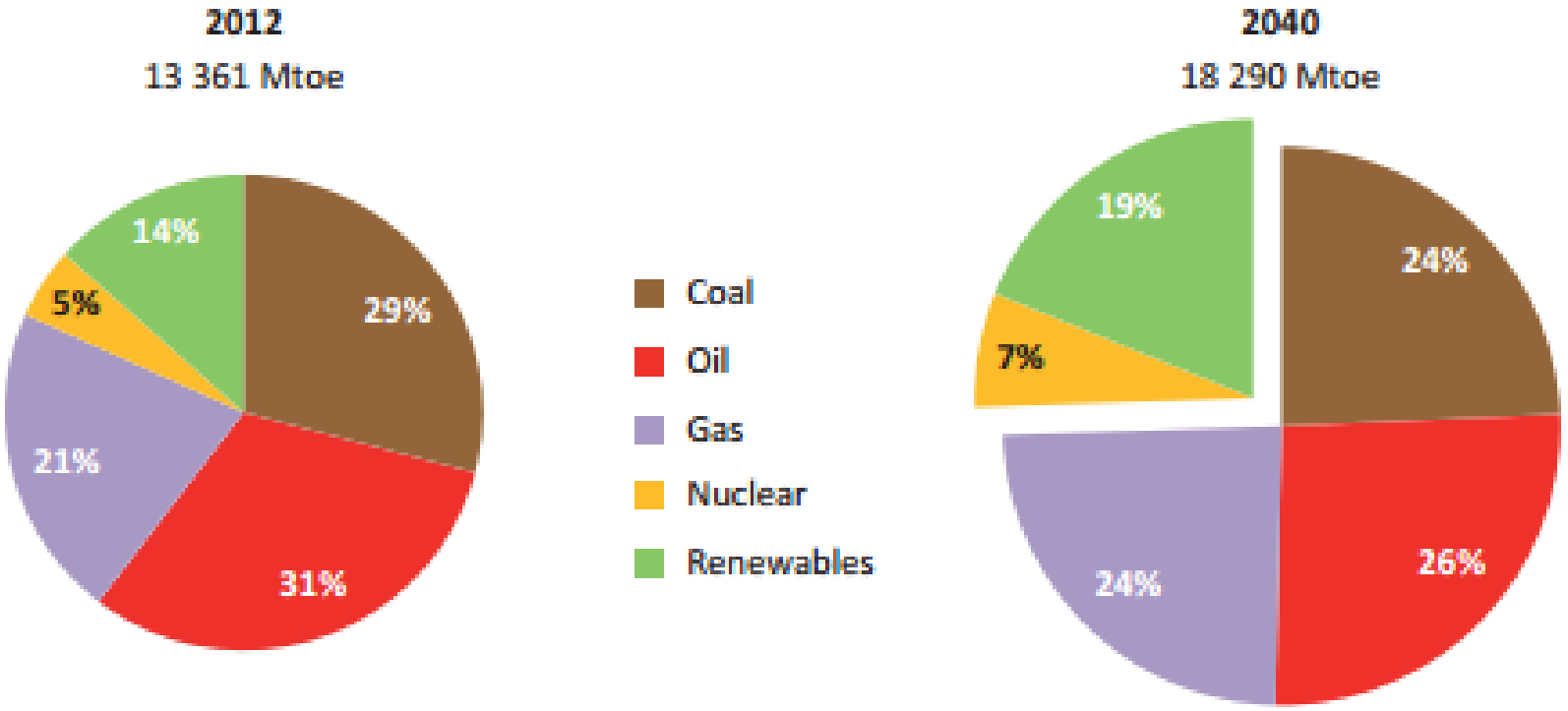


Figure 2.2 ▷ Fuel shares in world primary energy demand in the New Policies Scenario



Gas – some important properties

1. Physical:

- Gas is less easy to transport & has less energy density than oil
- Gas is mainly CH4: a clean fuel (low C, S, NOx, particulates, etc) and easier to clean than oil & coal
- Gas easier to store than electricity, but less so than oil or coal
- Often a by-product off Oil E&P (‘Rats, I found gas’)

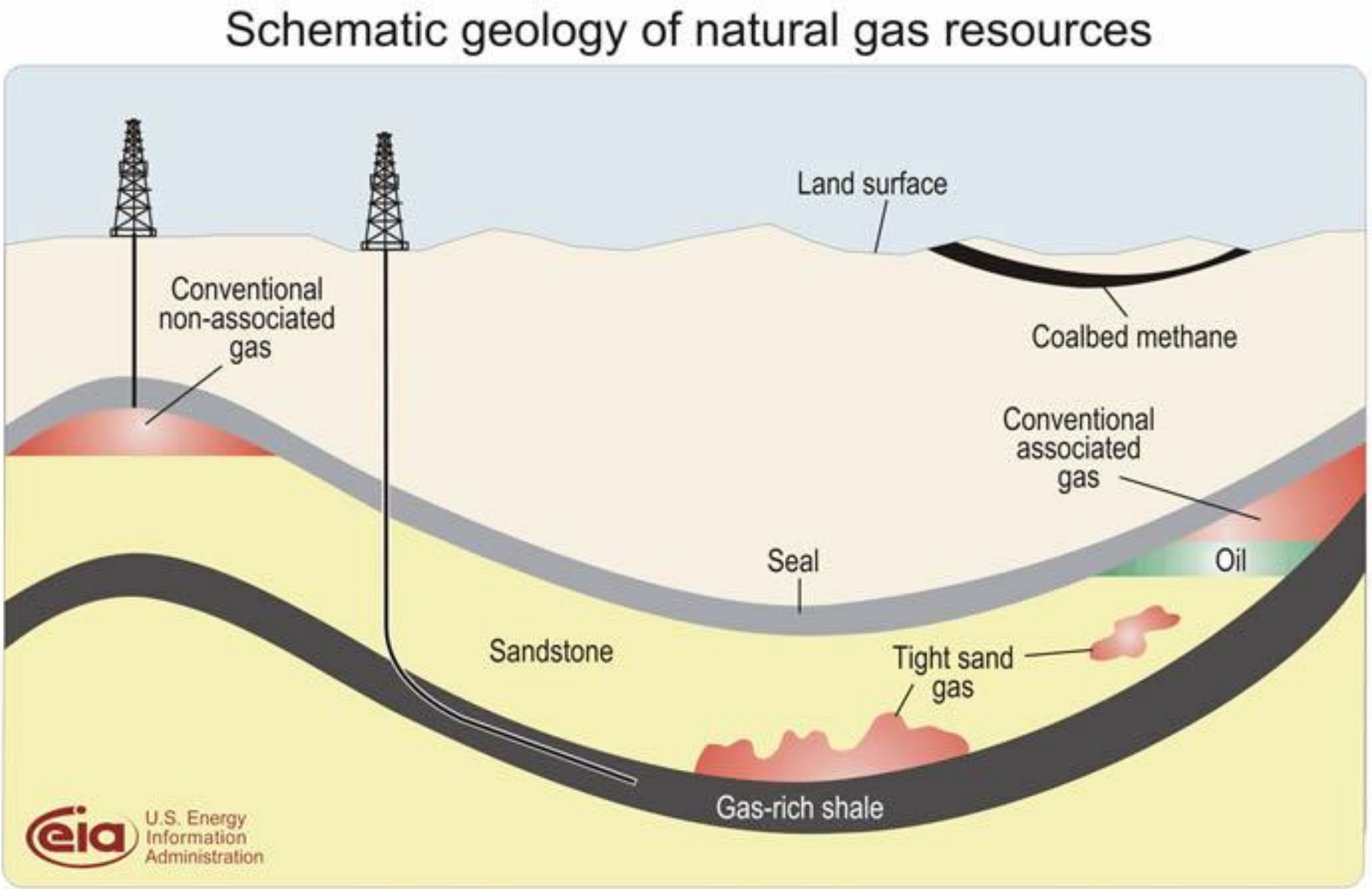
2. Geophysical:

- Gas resources are (were) more concentrated in limited regions than oil
- There are more years of global gas reserves than oil reserves

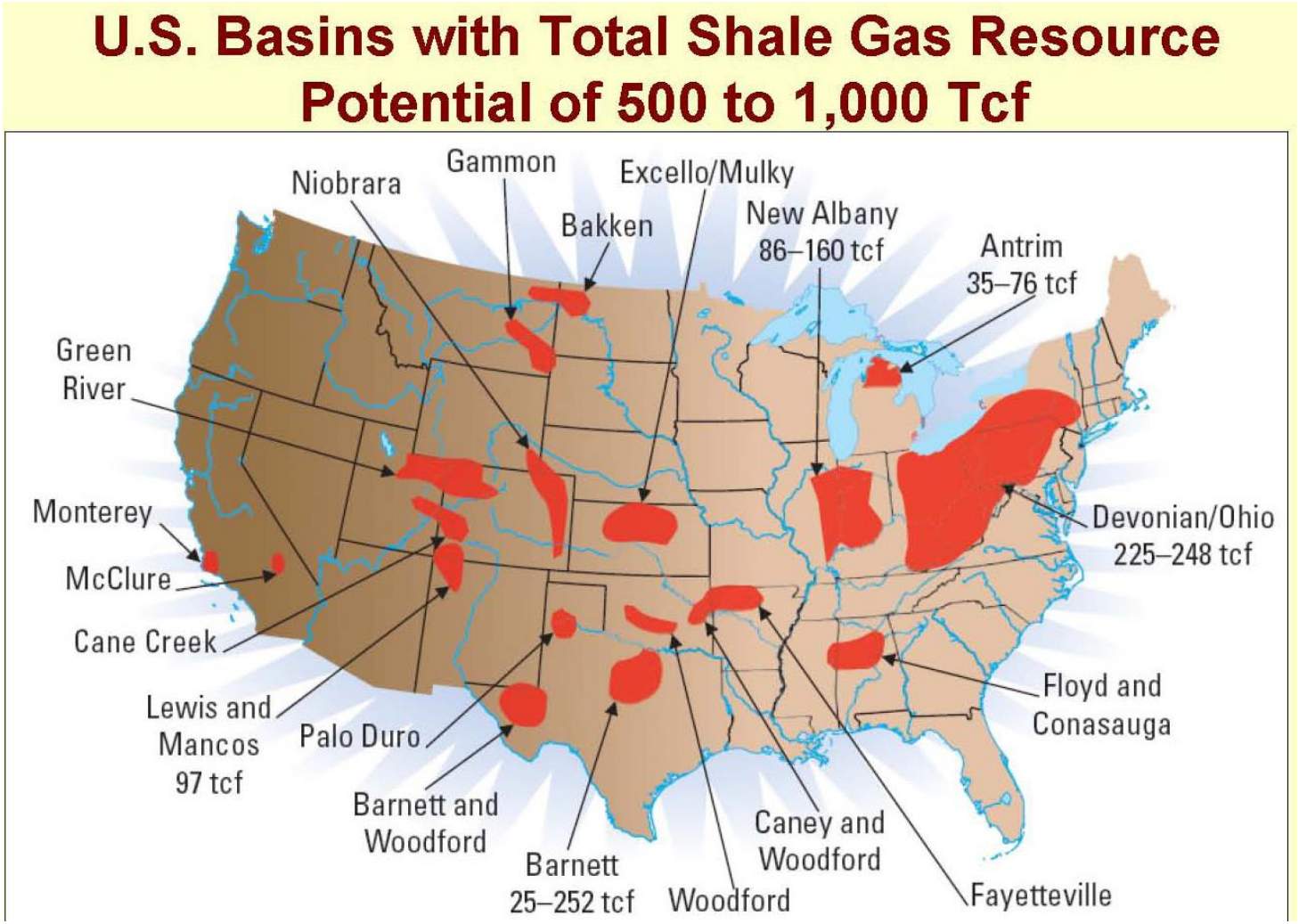
3. Economic:

- Gas markets function both like a network industry (eg electricity) as a ‘natural resource’ industry (eg oil)
- More likelihood of ‘stranded gas’ than ‘stranded oil’
- Some major ‘game changers’ over recent decade & future = role of gas has been coming more important again (‘Golden Age of Gas’?)

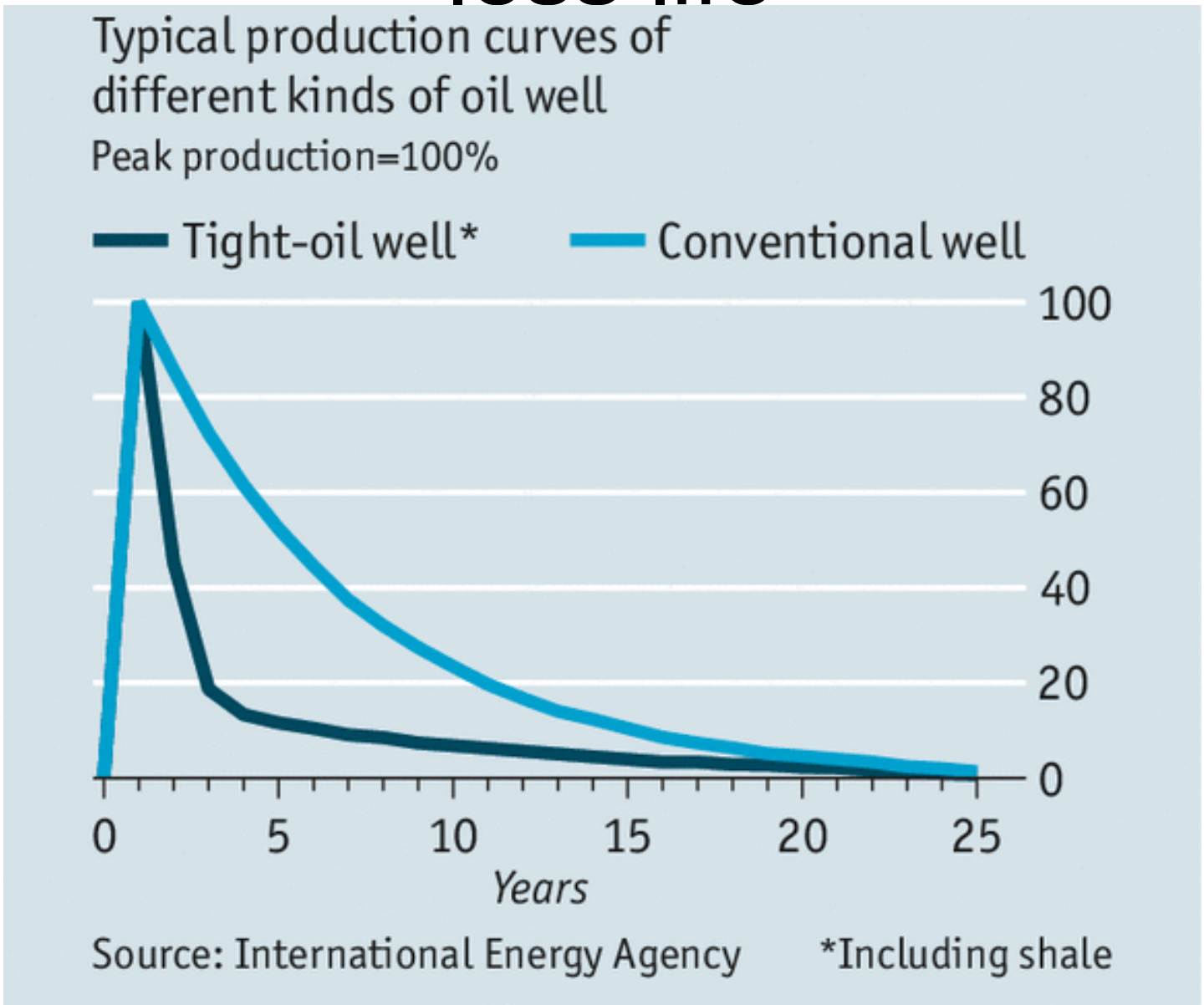
Where/how do we find gas



Shale gas revolution



Shale wells much less flow = less life



Gas Markets

Network industry:

- Essential facility
- Economies of scale
- Monopoly characteristics
- Time & quality component (as in electricity)

Natural Resource Industry

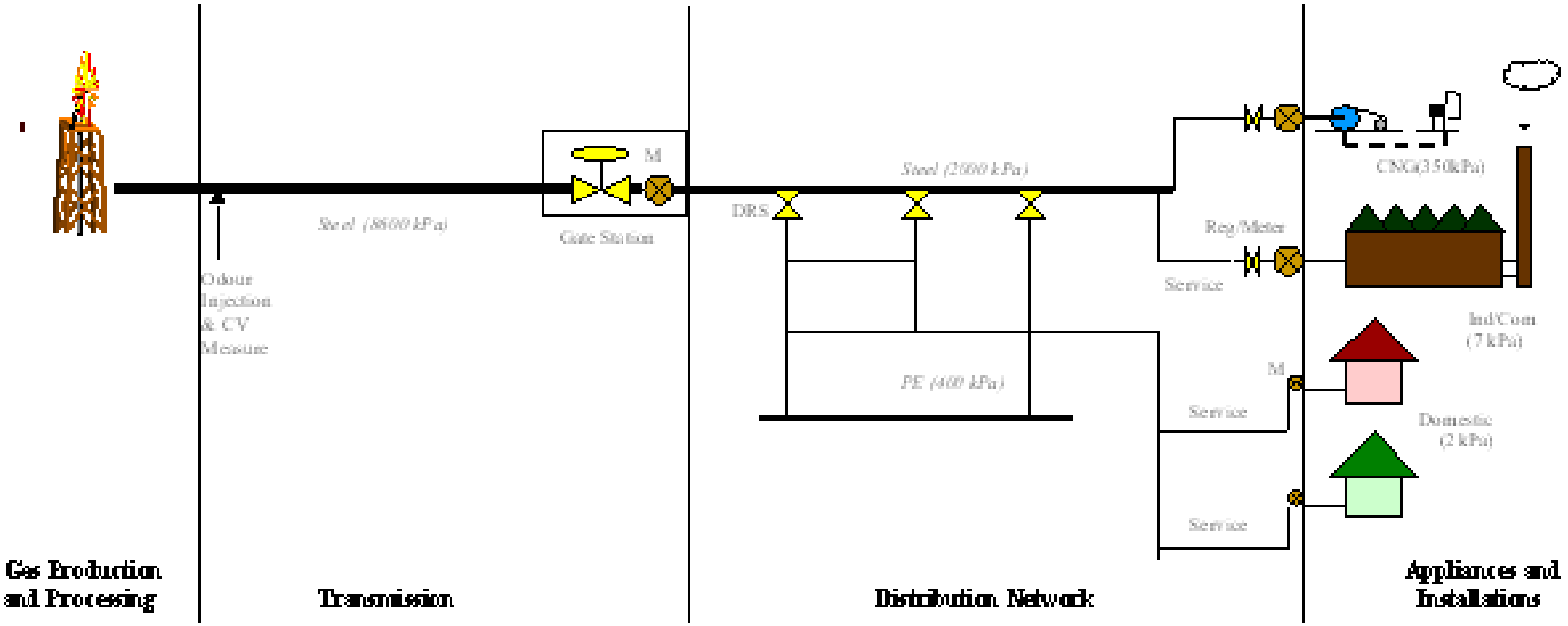
- Scarcity and non-renewability of resource
- Quality & time dimension
- High cost, high risk E&P (prospectivity, cost, price)
- Boom&bust cycles in prices and investment

Traditional gas trade

- Problem: high E&P AND high transport costs
- Physical solution:
  - create ‘demand ‘ on location (factory, power gen, residential infrastructure); or
  - export gas by pipeline to other ‘stable’ market

  Organisational/financial solution:
  - government backing
  - long-term contracts with both volume & price components:
    - Take-or-pay
    - Fixed price (or inflation indexed price)
    - Oil-linked price
    - S-curve (oil linked with floor and cap)

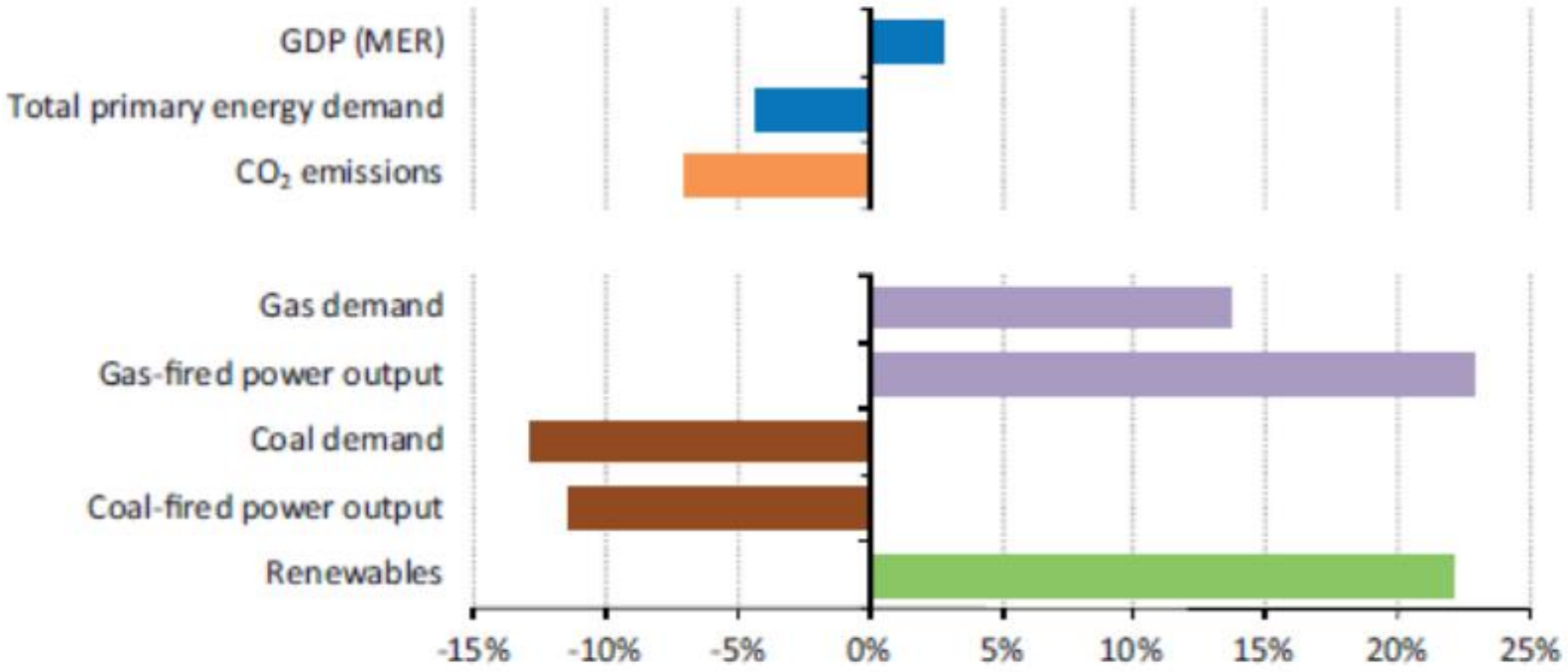
Gas Supply Chain



- Game Changer/Effects Shale Gas Revolution

Major impact on US-Power Generation; transport next?

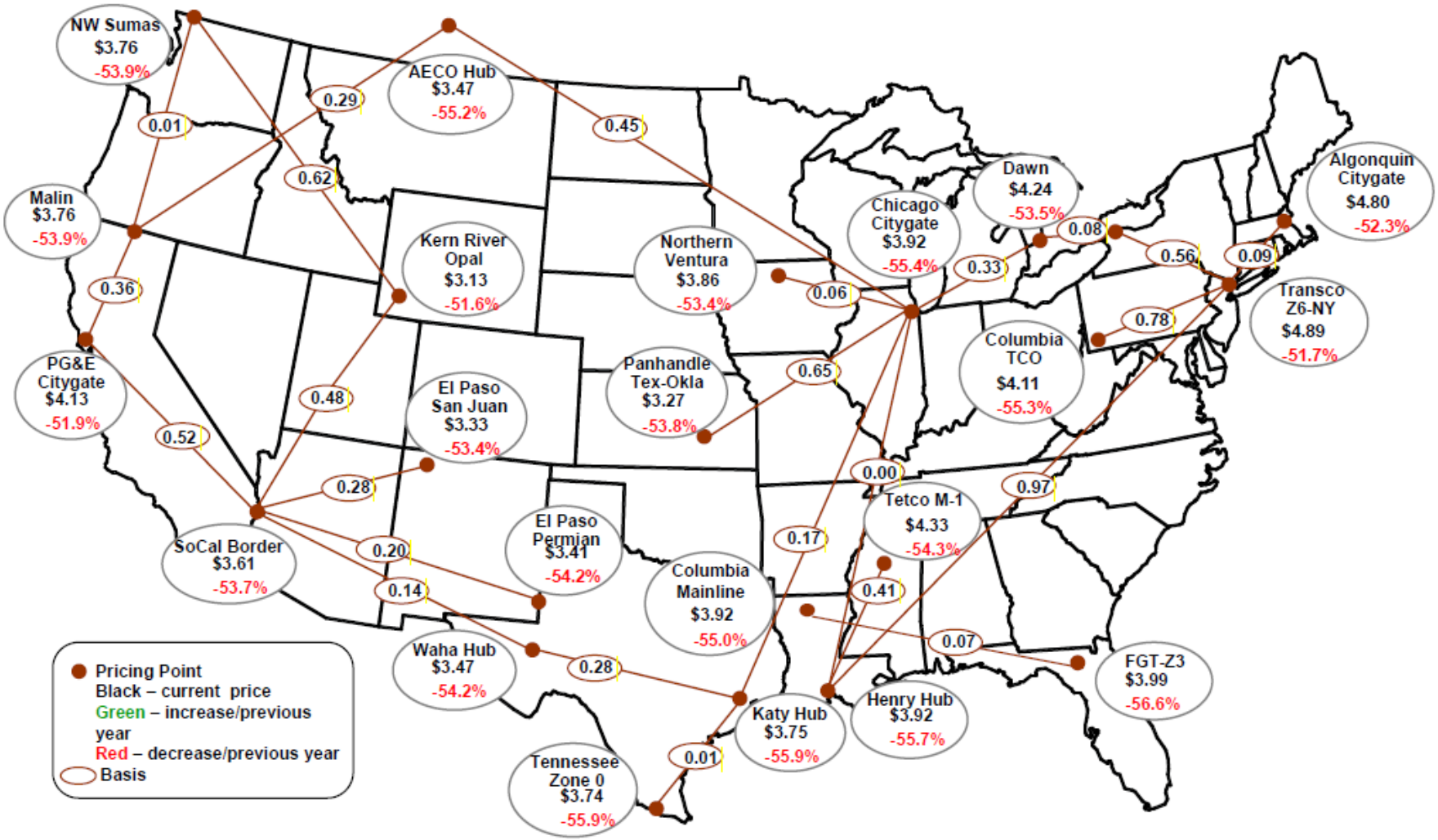
Figure 4.9 ▷ Percentage change in selected economic and energy indicators in the United States, 2006-2011



Note: MER = market exchange rate.

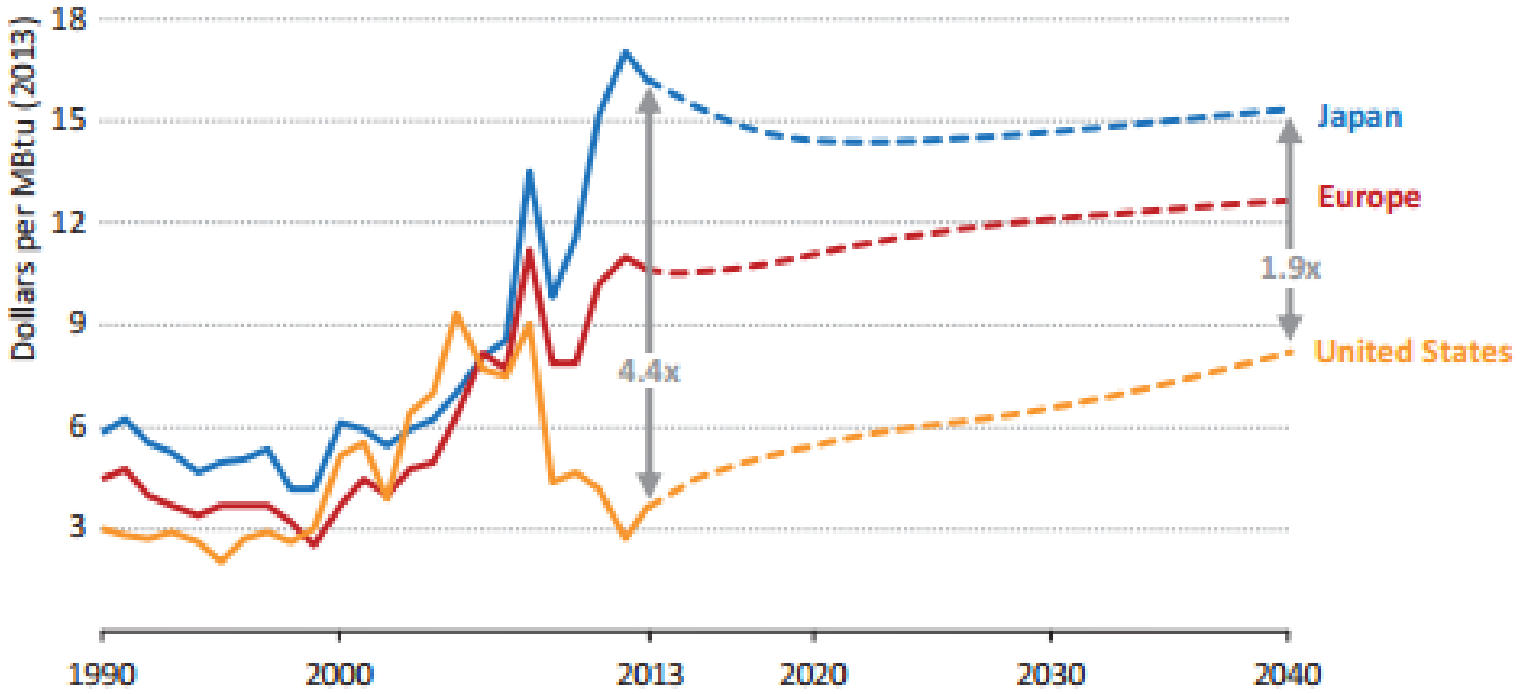
US Gas market well integrated

Average Spot Gas Prices, 2009 ($MMBtu)



IEA, Nov 2014

Figure 1.3 ▷ Natural gas price by region in the New Policies Scenario



Notes: MBtu = million British thermal units. Average import prices are shown for Japan and Europe; the wholesale price is shown for the United States.

EIA, 2015

Figure ES1. North Sea Brent crude oil spot prices in four cases, 2005-40 (2013 dollars per barrel)

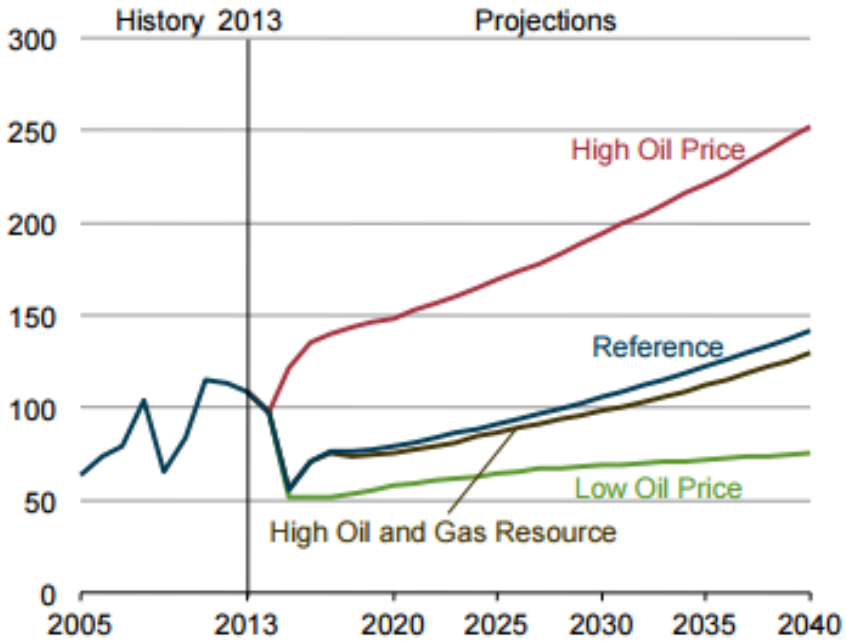
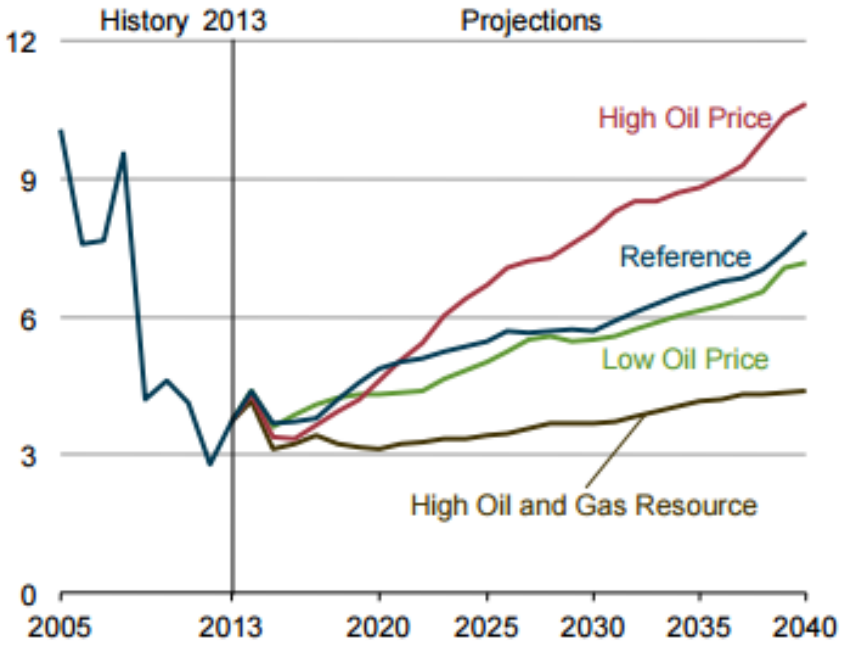


Figure ES2. Average Henry Hub spot prices for natural gas in four cases, 2005-40 (2013 dollars per million Btu)



EIA, 2015

Figure ES4. Net crude oil and petroleum product imports as a percentage of U.S. product supplied in four cases, 2005-40 (percent)

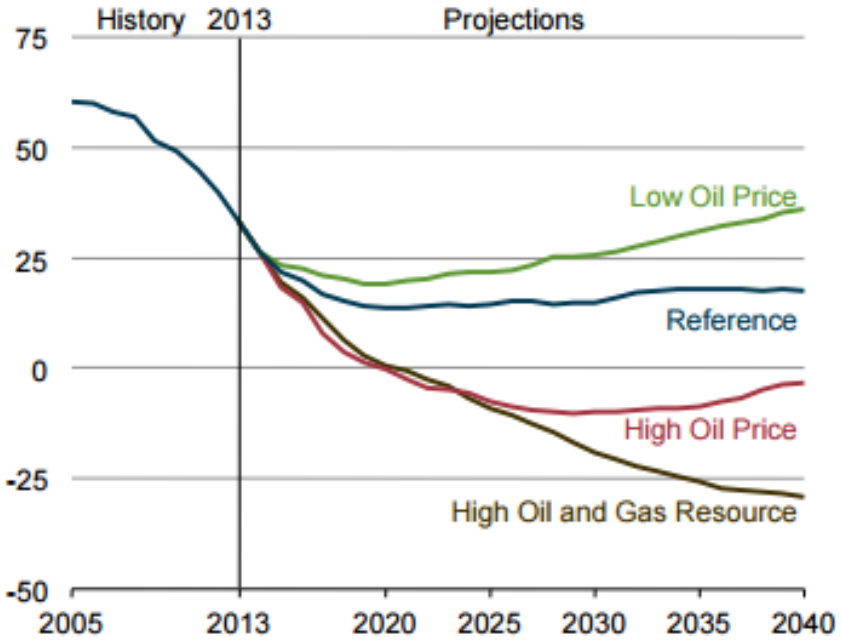
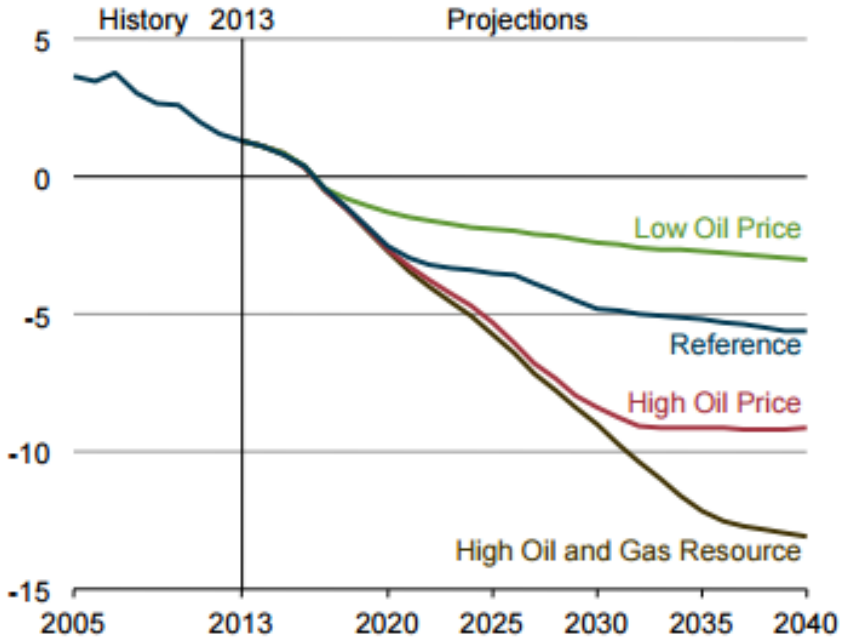
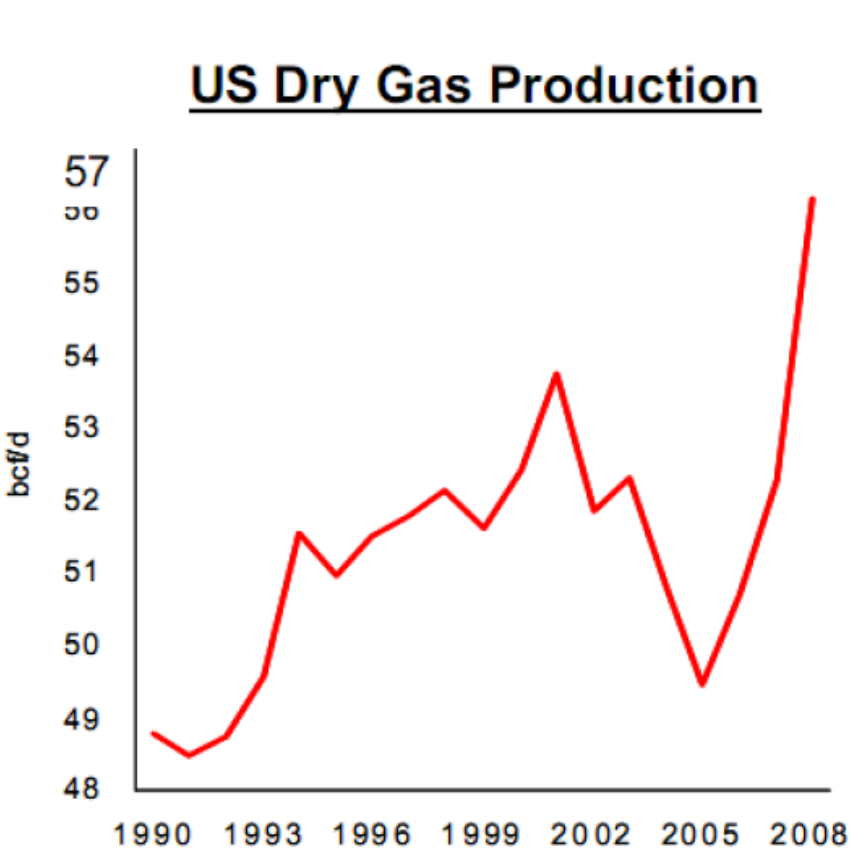
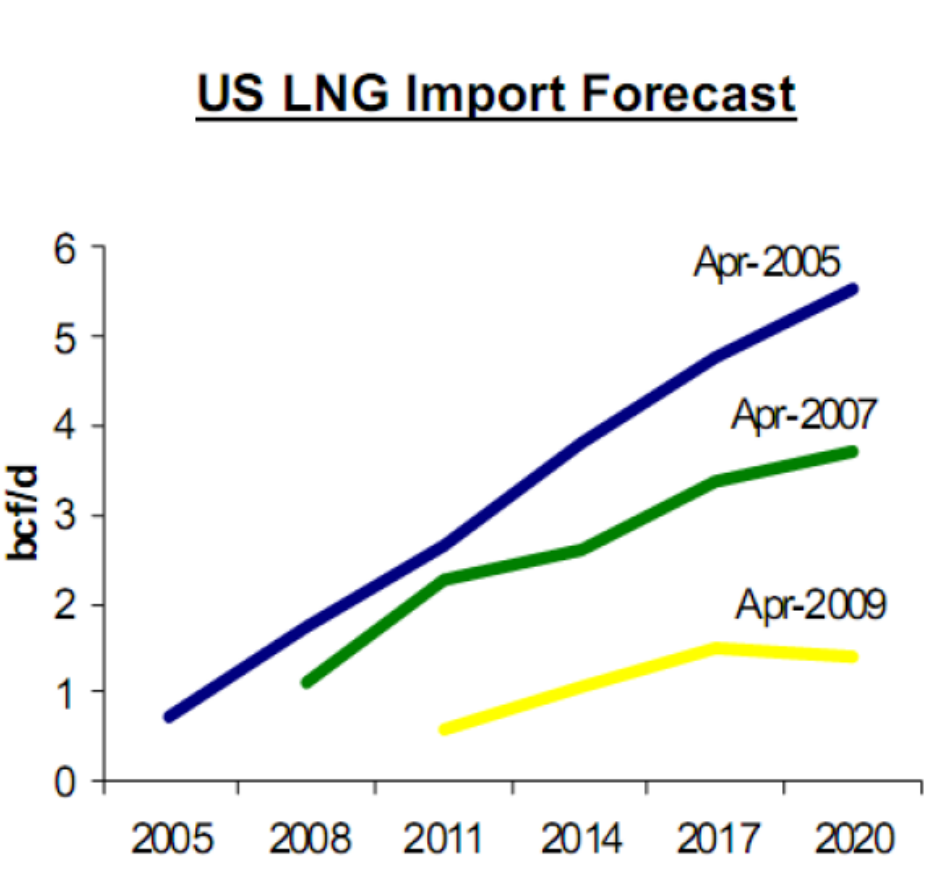


Figure ES5. U.S. total net natural gas imports in four cases, 2005-40 (trillion cubic feet)



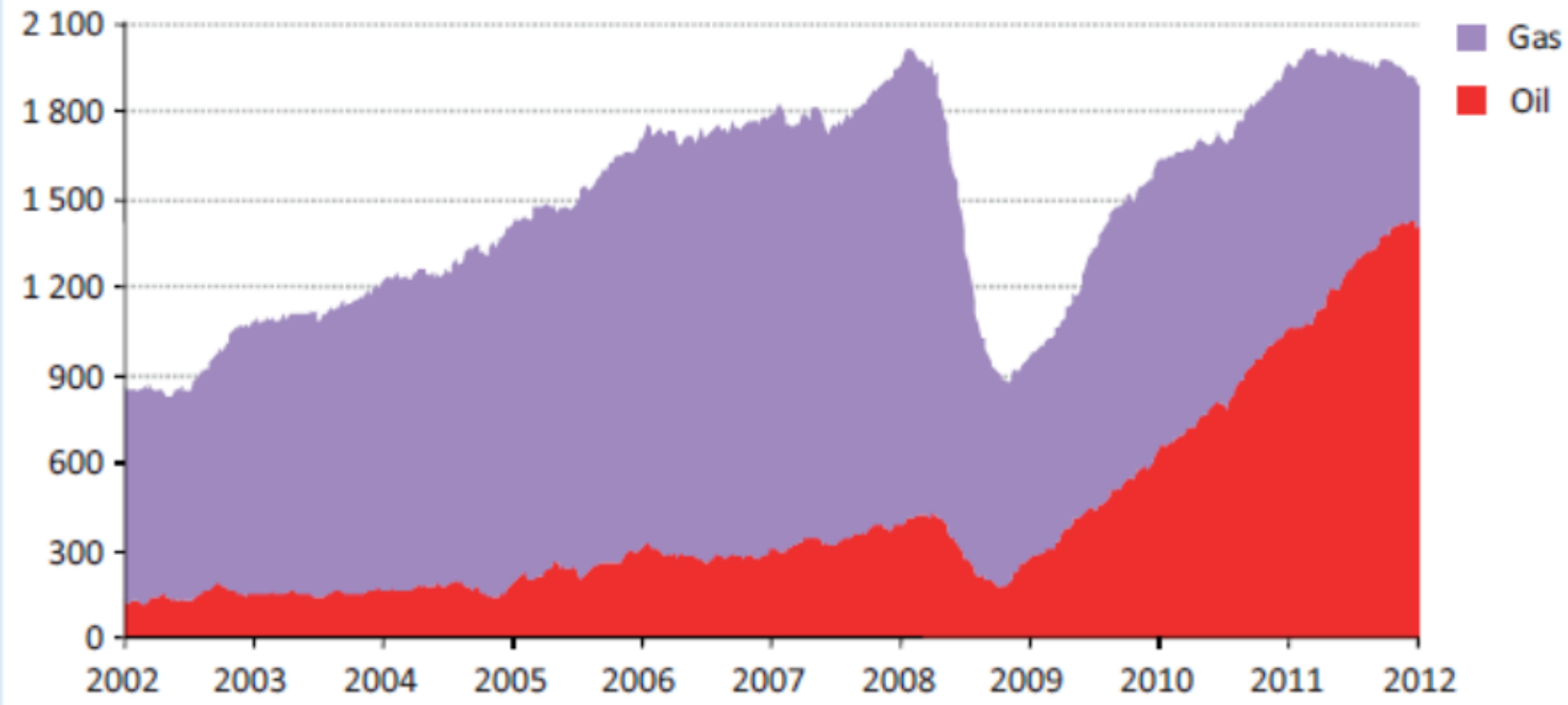
Replacing LNG-imports



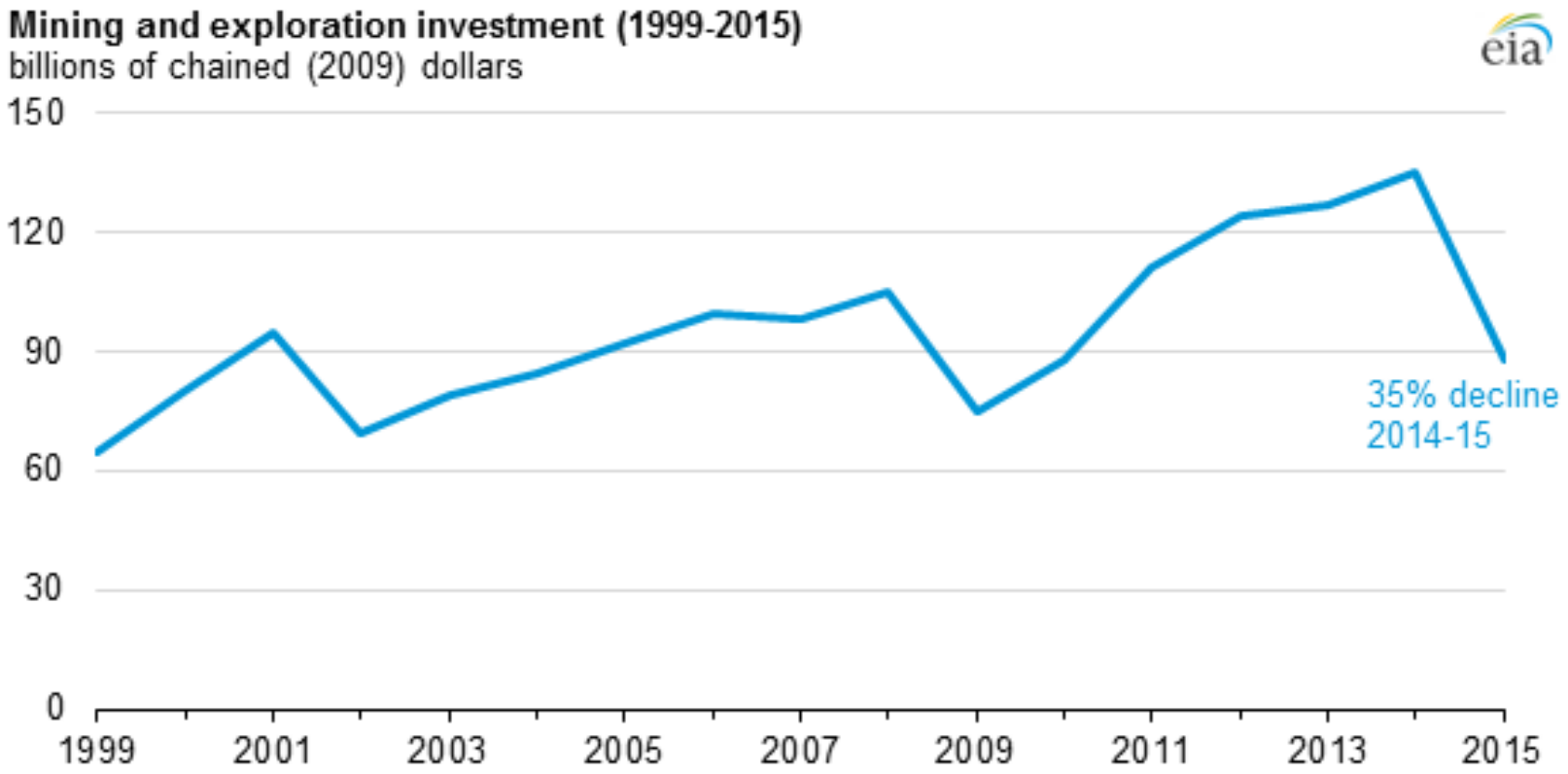


But: Investment & Drilling respond to economics of gas & (tight) Oil in USA

Figure 4.6 ▷ Active drilling rigs in the United States, 2002-2012

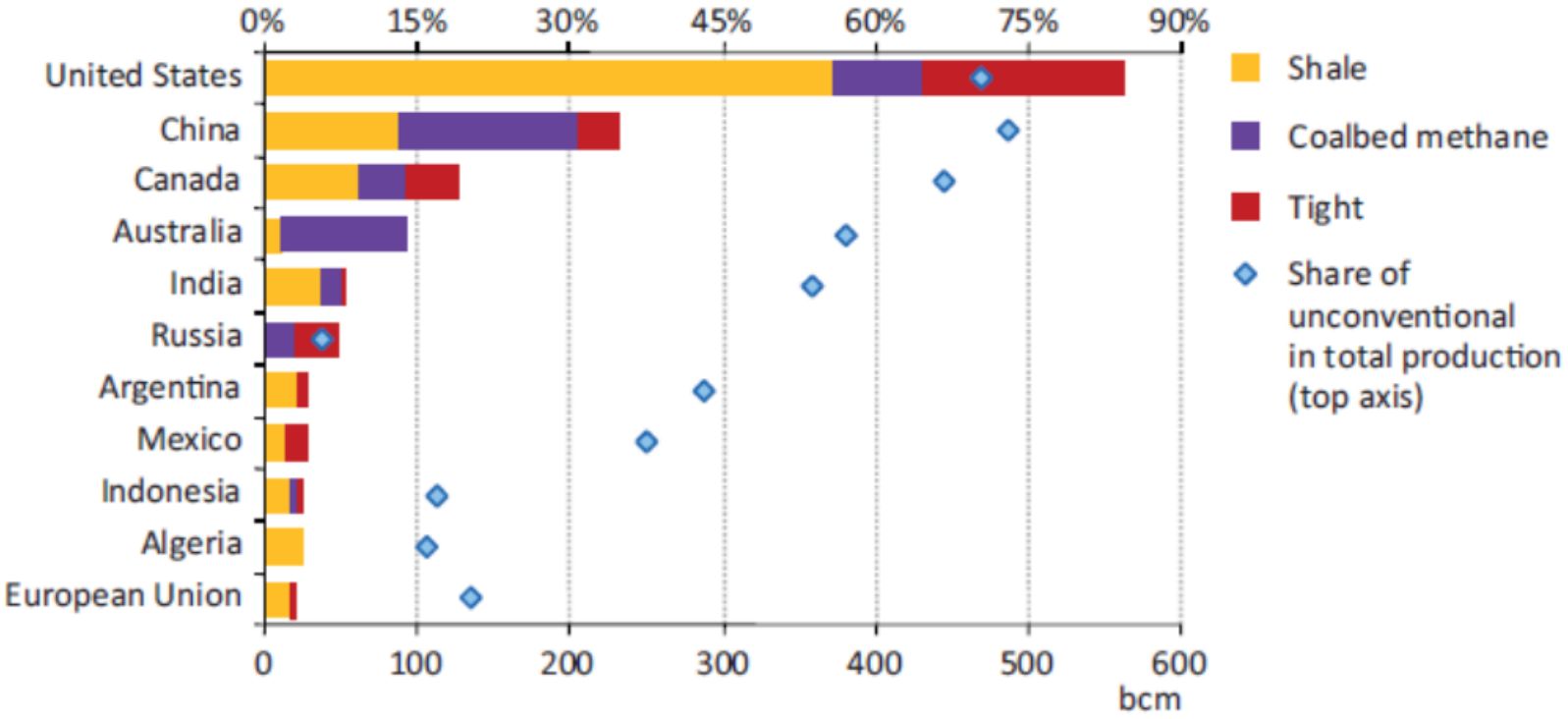


U.S. mining and exploration investment declined 35% in 2015



Also potential in other countries but less

Figure 4.5 ▷ Unconventional gas production in leading countries in the New Policies Scenario, 2035



Game changer 2: LNG

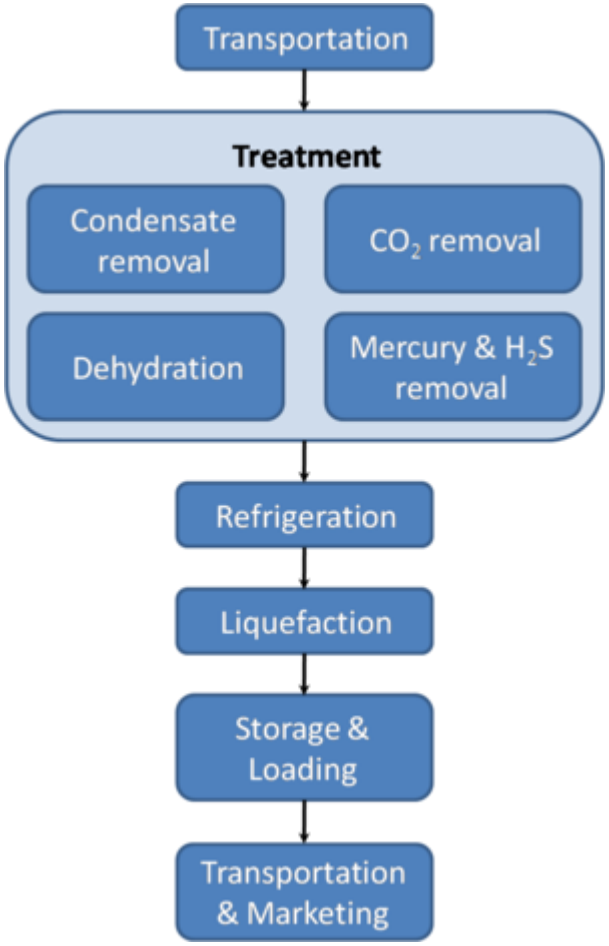
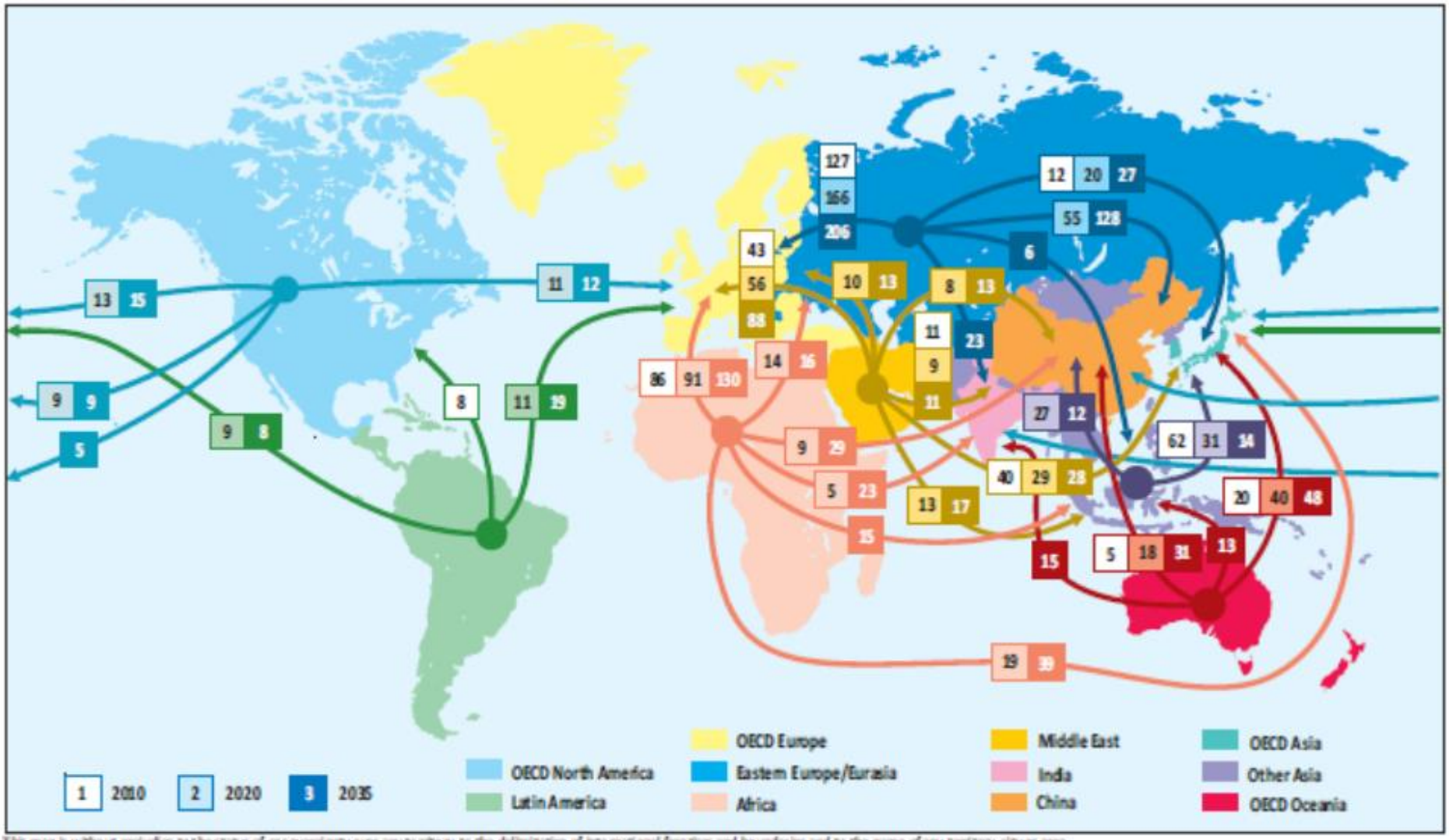
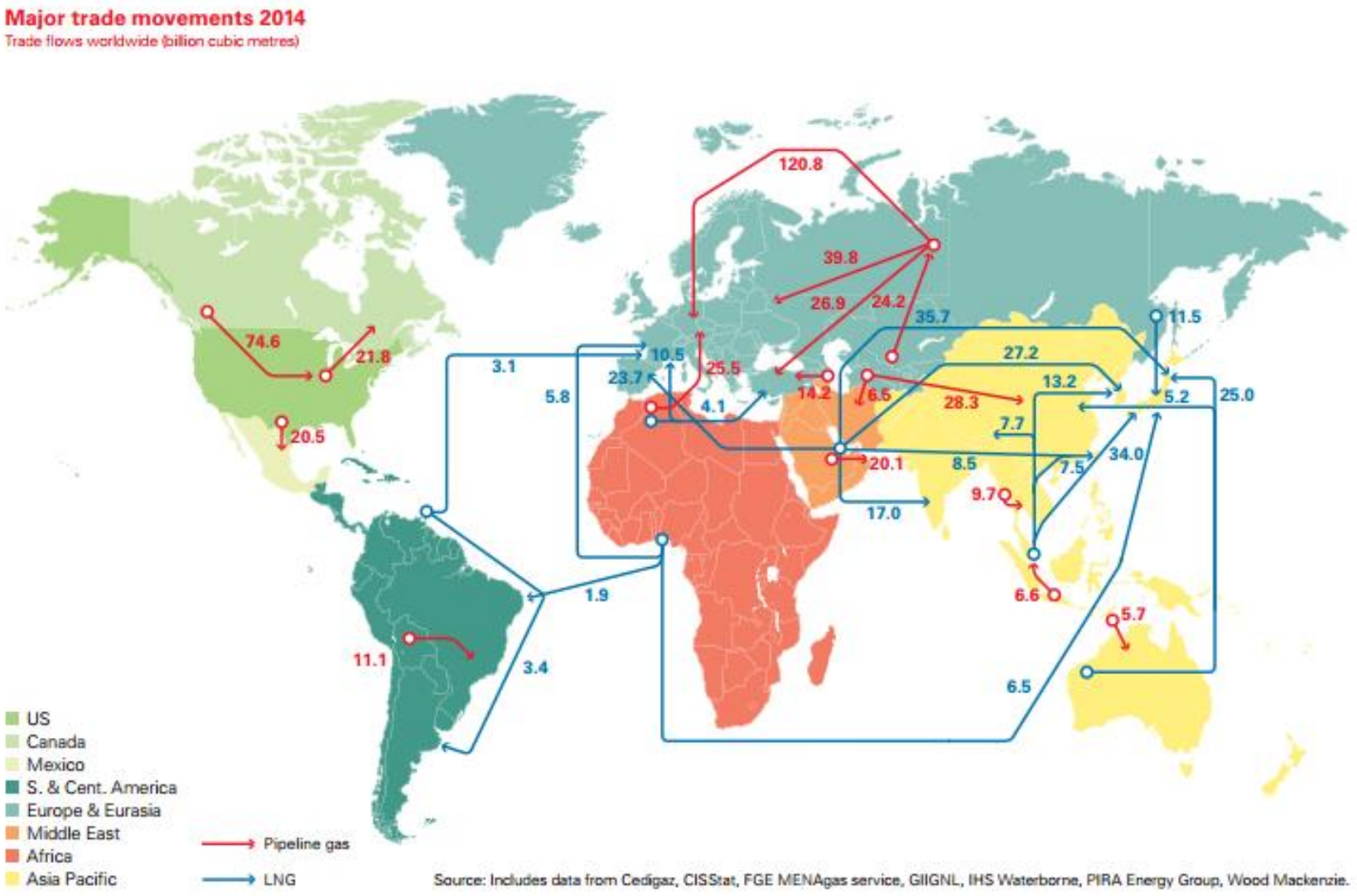


Figure 4.10 ▷ Net inter-regional natural gas trade flows between major regions in the New Policies Scenario (bcm)



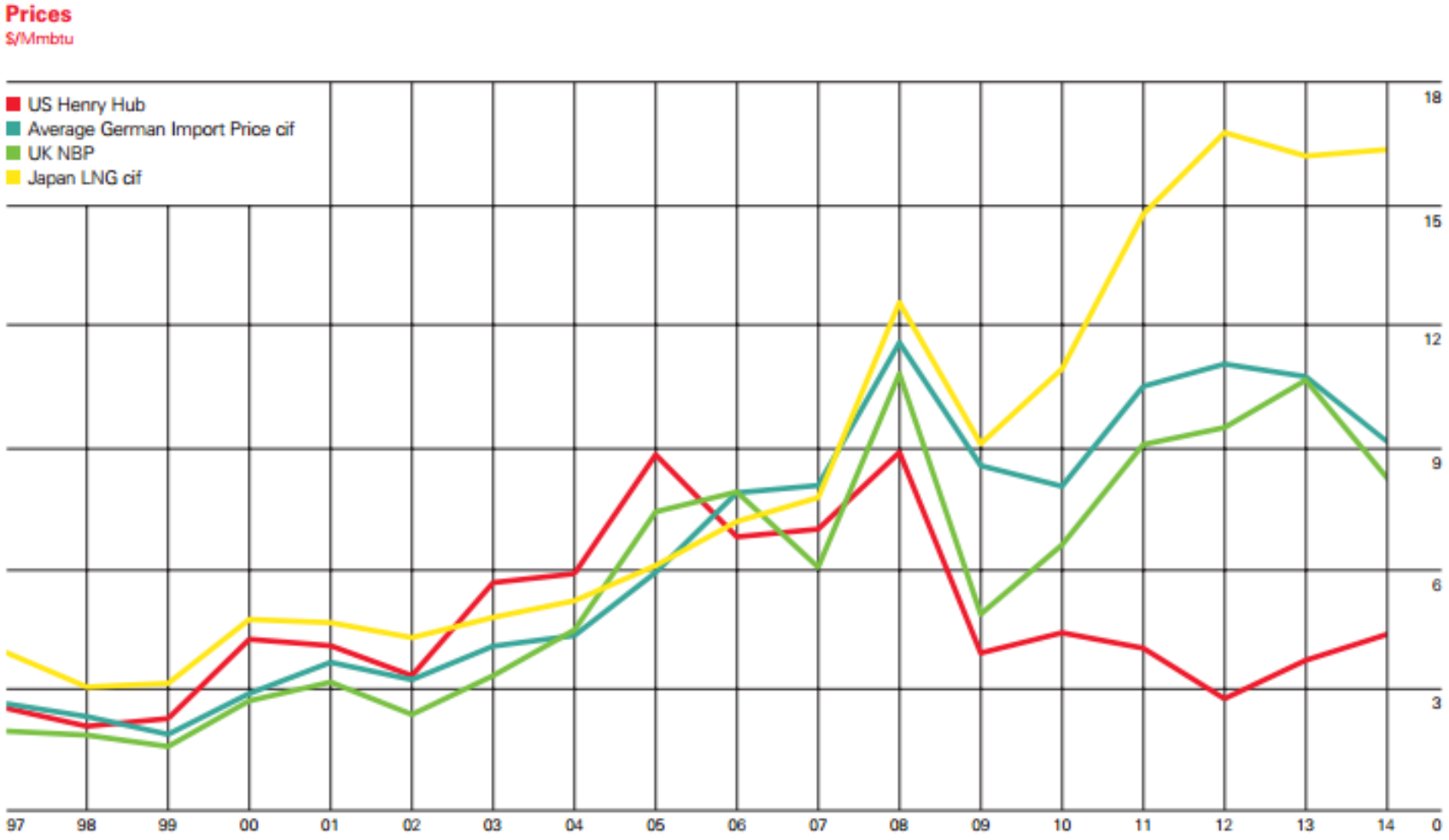
Note: Trade volumes less than 5bcm are not shown.

BP, 2015

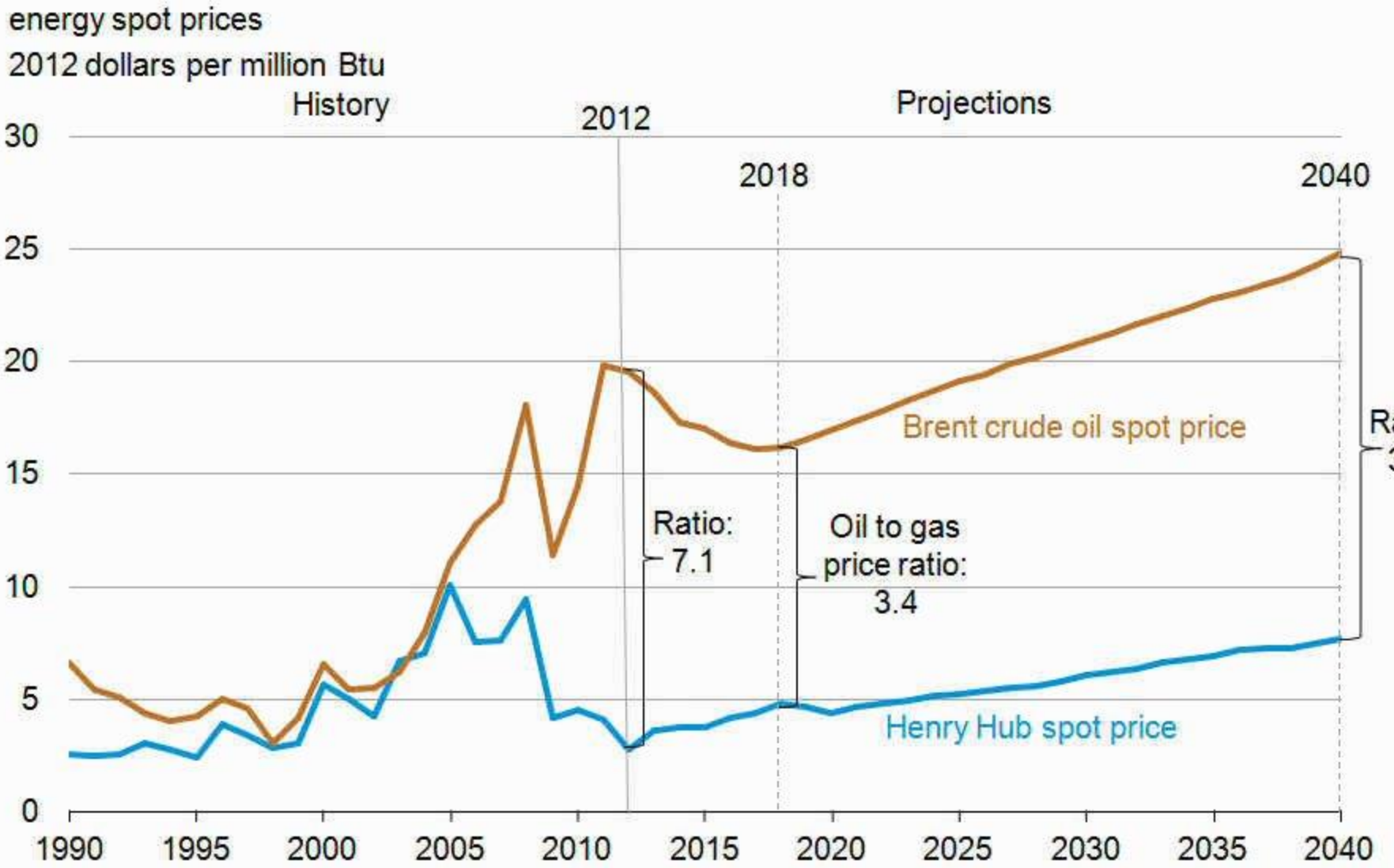

Major trade movements 2014
Trade flows worldwide (billion cubic metres)
120.8
39.8
26.9
24.2
35.7
11.5
74.6
21.8
3.1
10.5
25.5
23.7
27.2
13.2
5.8
4.1
14.2
6.5
28.3
5.2
25.0
7.7
20.5
20.1
8.5
7.5
34.0
9.7
17.0
1.9
6.6
5.7
11.1
3.4
6.5
US
Canada
Mexico
S. & Cent. America
Europe & Eurasia
Middle East
Africa
Asia Pacific
Pipeline gas
LNG
Source: Includes data from Cedigaz, CISStat, FGE MENAgas service, GIIGNL, IHS Waterborne, PIRA Energy Group, Wood Mackenzie.

Many regional gas markets still largely long-term contract, but LNG-sport trading will equalize/integrate markets in due time

BP, 2015

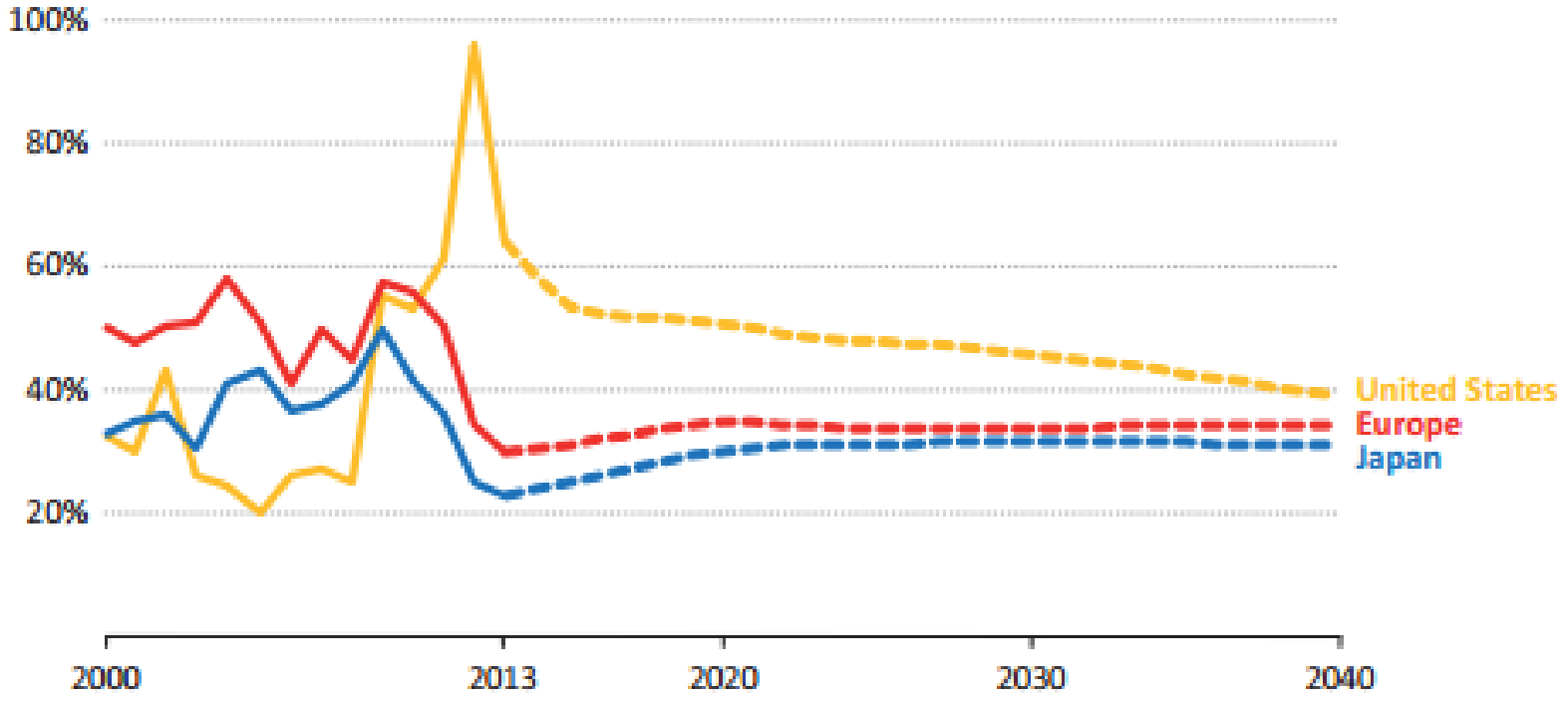

Prices
$/Mmbtu
US Henry Hub
Average German Import Price cif
UK NBP
Japan LNG cif
18
15
12
9
6
3
0
97
98
99
00
01
02
03
04
05
06
07
08
09
10
11
12
13
14

U.S. natural gas prices remain well below crude oil prices



Source: EIA, Annual Energy Outlook 2014 Early Release

Figure 1.4 ▷ Coal price relative to gas price by region in the New Policies Scenario (in energy equivalent terms)



Summary

- Gas has low CO2- & other emissions and could be seen as good ‘transition fuel’
- Physical & economic properties of gas make less easily tradable
- Gas has seen big game changers
- Reserves have been majorly upgraded (esp USA)
- Not without potential environmental impacts (‘fracking debate’)
- Not sure whether repeatable in other countries
- Starting to repeat in Shale& Tight Oil (USA)
- Not sure how this will play out in the future:
  - Integrating of gas prices around the world (as with Oil)
  - More & faster responsiveness of gas (&Oil) supply to demand changes due to drilling requirements shale

Thank you