Oil Markets

Basil Sharp

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Support by Energy Education Trust of NZ

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Life before oil

- Prior to 1800s

- Light: torches, candles made from tallow, and lamps which burned oils rendered from animal fat.
- First candles were made in China in 200 BC from whale fat & tallow with rice paper wick.
- Discovery of paraffin wax which made production of candles cheap and candles affordable to everyone. Wick was also improved over time.

Whale oil

- Whale oil was popular because less odour and smoke. Sperm whale oil popular for lamps but very expensive ~US$200/gallon current dollars; also used as lubricant in trains
- US whaling fleet grew from 392 ships in 1833 to 735 by 1846 – massive toll on whale population

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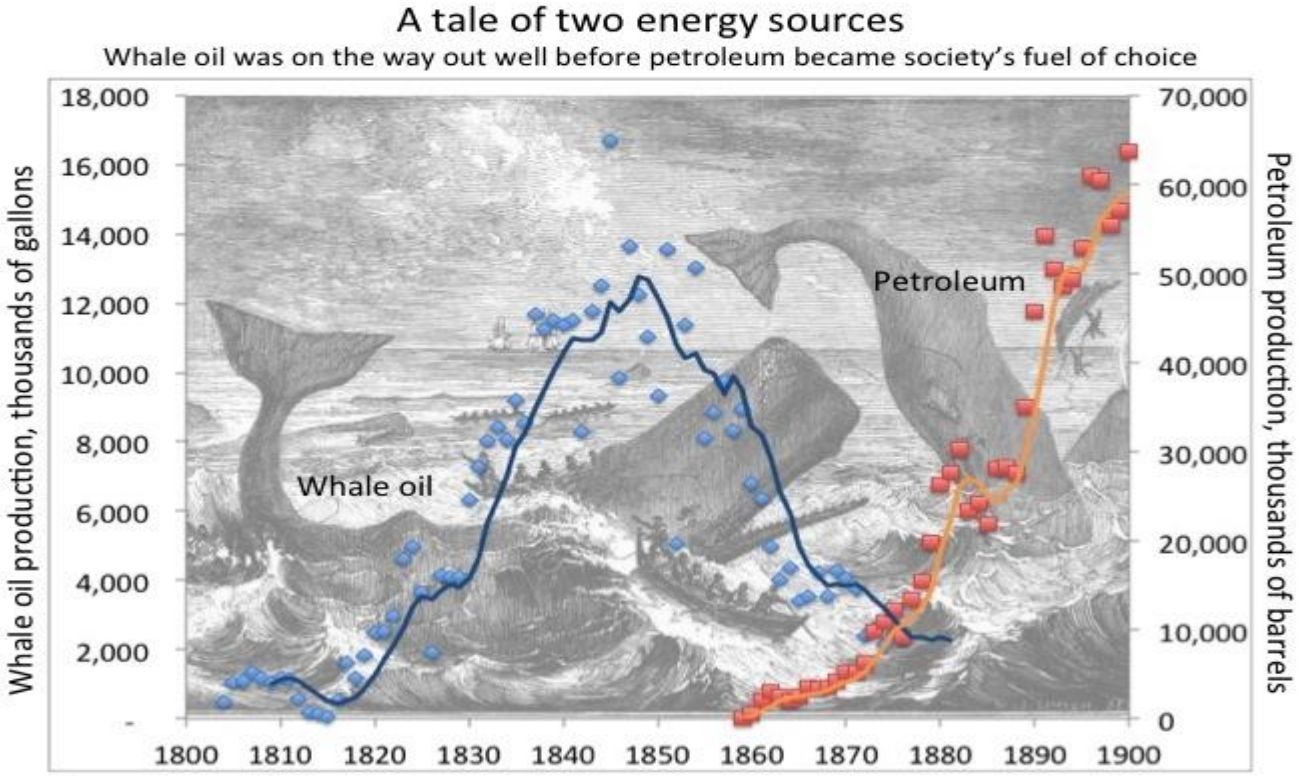
Whale population



Kerosene

- 1849 , kerosene lamp, invented by Michael Dietz appeared on the market in 1857, immediate effect on the whaling industry was immediate.
- Ignacy Lukasiewicz, Polish pharmacist , 1856 built the world's first oil refinery refining kerosene from crude oil.

- By 1860, at least 30 kerosene plants were in production in the United States, and whale oil was ultimately driven off the market. Price sperm oil > refined petroleum, whale oil driven off market

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Electric lighting

- In 1807, London got a first street illuminated with gas lanterns. After that other cities of the world followed.
- Incandescent light bulb - Swann and Edison 1878

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Early days of oil

- 347 A.D.Oil wells are drilled in China up to 800 feet deep using bits attached to bamboo poles.
- 1858 first oil well in North America is drilled in Ontario, Canada.
- 1859 first oil well in United States is drilled 69 feet deep at Titusville, Pennsylvania by Edwin Drake.
- Gasoline-powered automobiles, Karl Benz and Wilhelm Daimler created additional markets for US oil.

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Conventional oil field California

National Geographic; May 27, 2013

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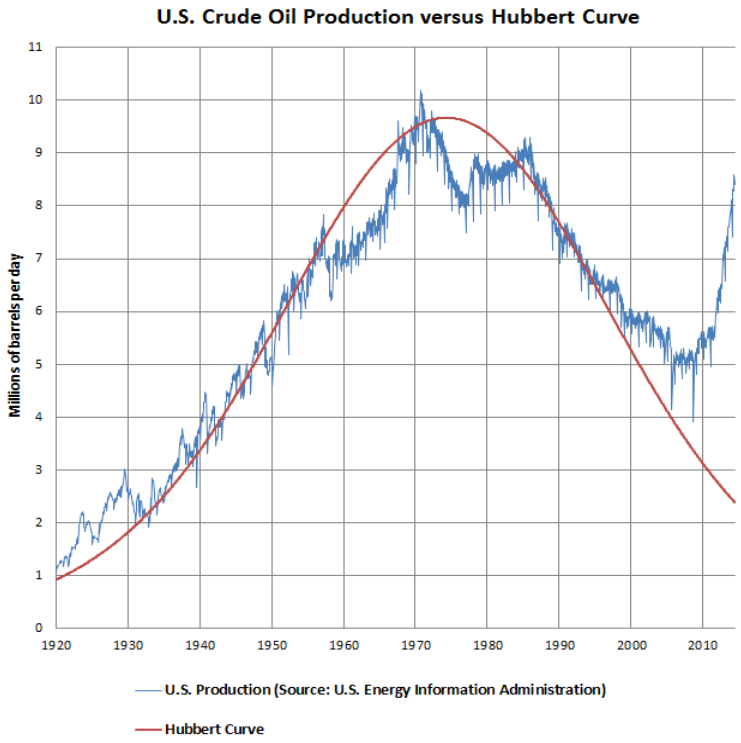
Hubbert's Peak Oil



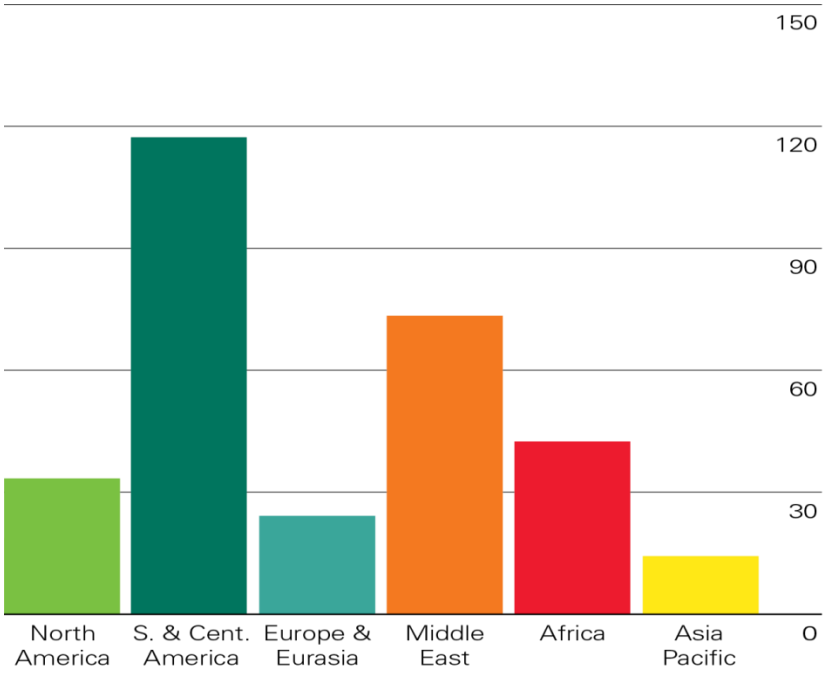
- Peak oil: point of maximum production
  - Coined by King Hubbert in 1956, predicted that oil production in US would peak between 1966 and 1972; peaked in 1970
  - production rate predicted to follow symmetric logistic curve
- Peak oil not an economic model
  - No prices guiding investment & consumption decisions
  - Economists not particularly successful in predicting time paths of prices & production

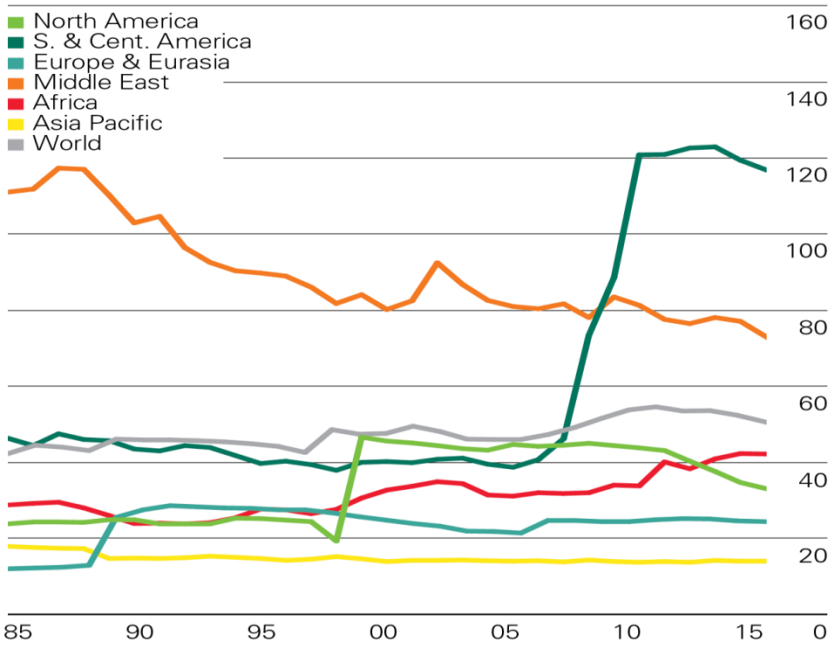
Oil reserves-to-production (R/P) ratios
Years

Ratio of reserves (R) to production (P)

R/P

Accurate data?





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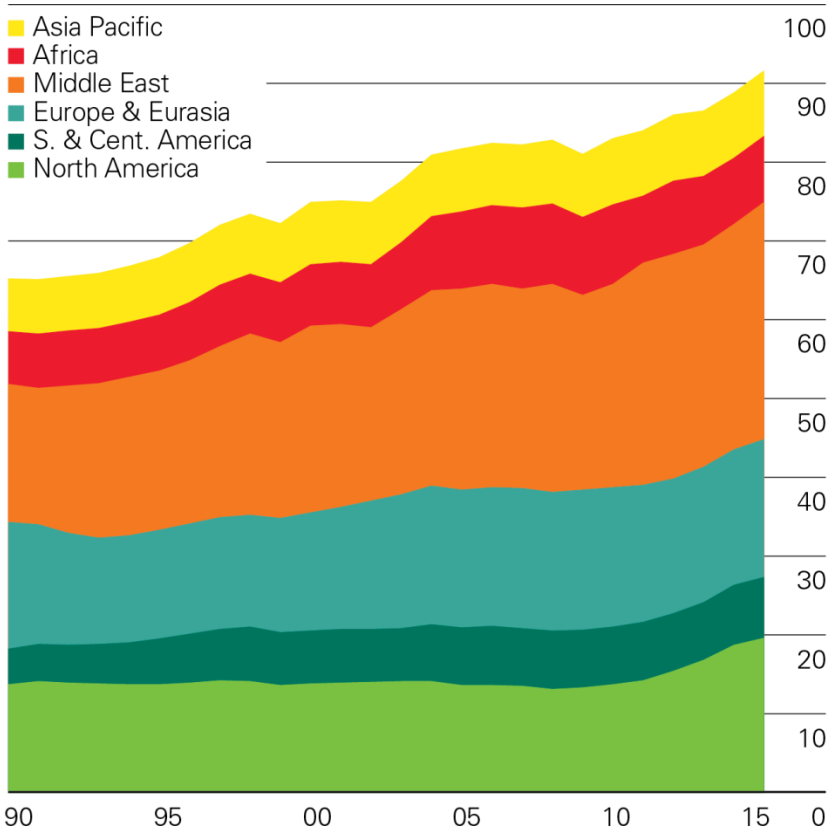
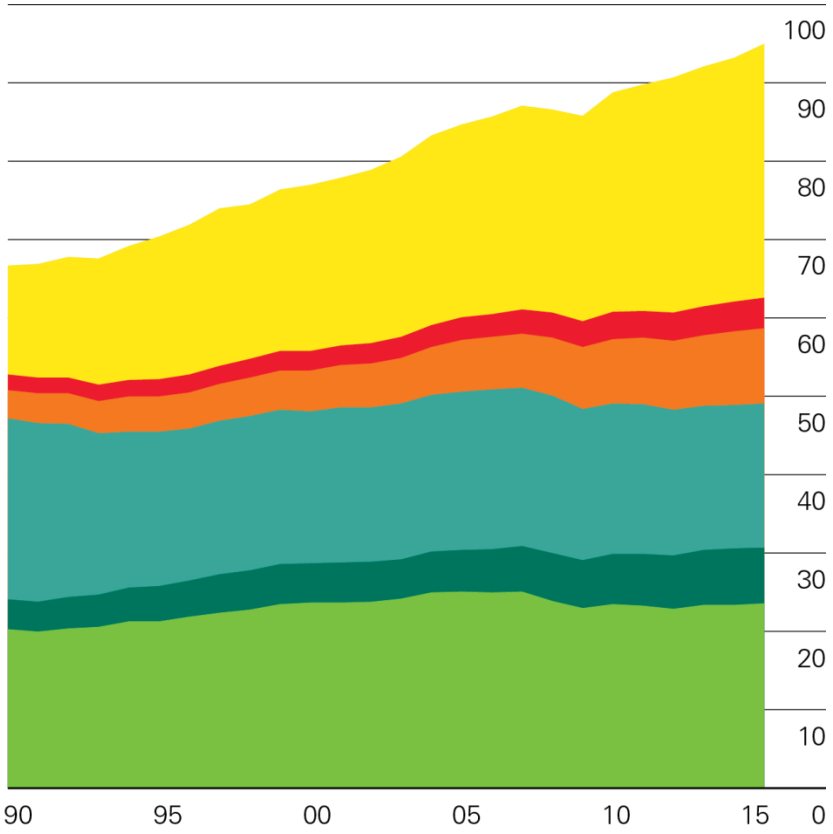
Production & Consumption

Production by region



Consumption by region



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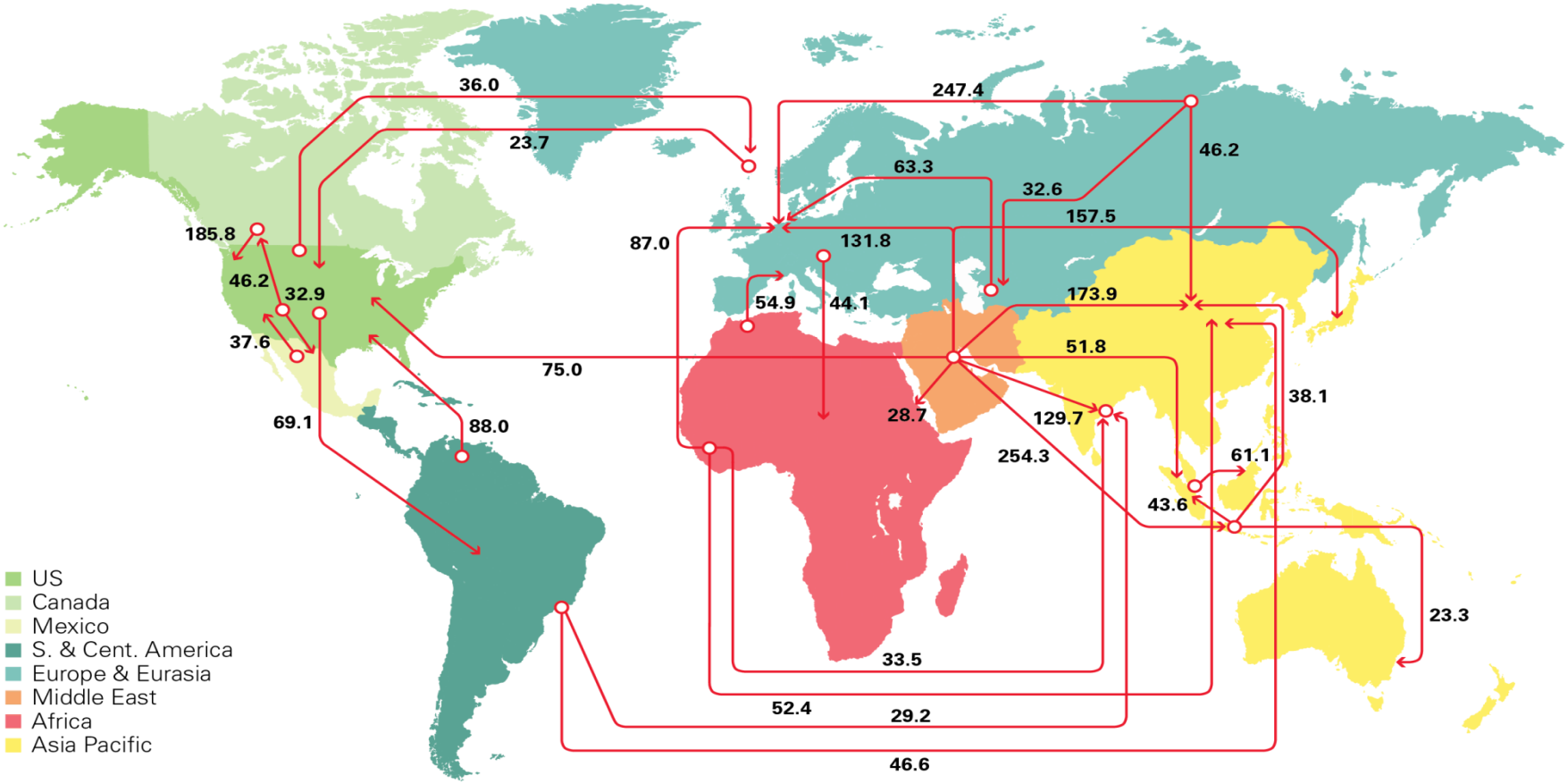
Major oil trade movements 2015

Trade flows worldwide (million tonnes)



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Trading benchmarks

- Commodity, just like copper, coffee, …
- Of little use unless refine it
- Financial markets, investors hedge bets on what they think prices will do
- Benchmarks:
  - West Texas Int (WTI) – underlying NY commodity futures, traded delivery at Cushing OK
  - Brent – traded for delivery at Sullom Voe
  - OPEC basket

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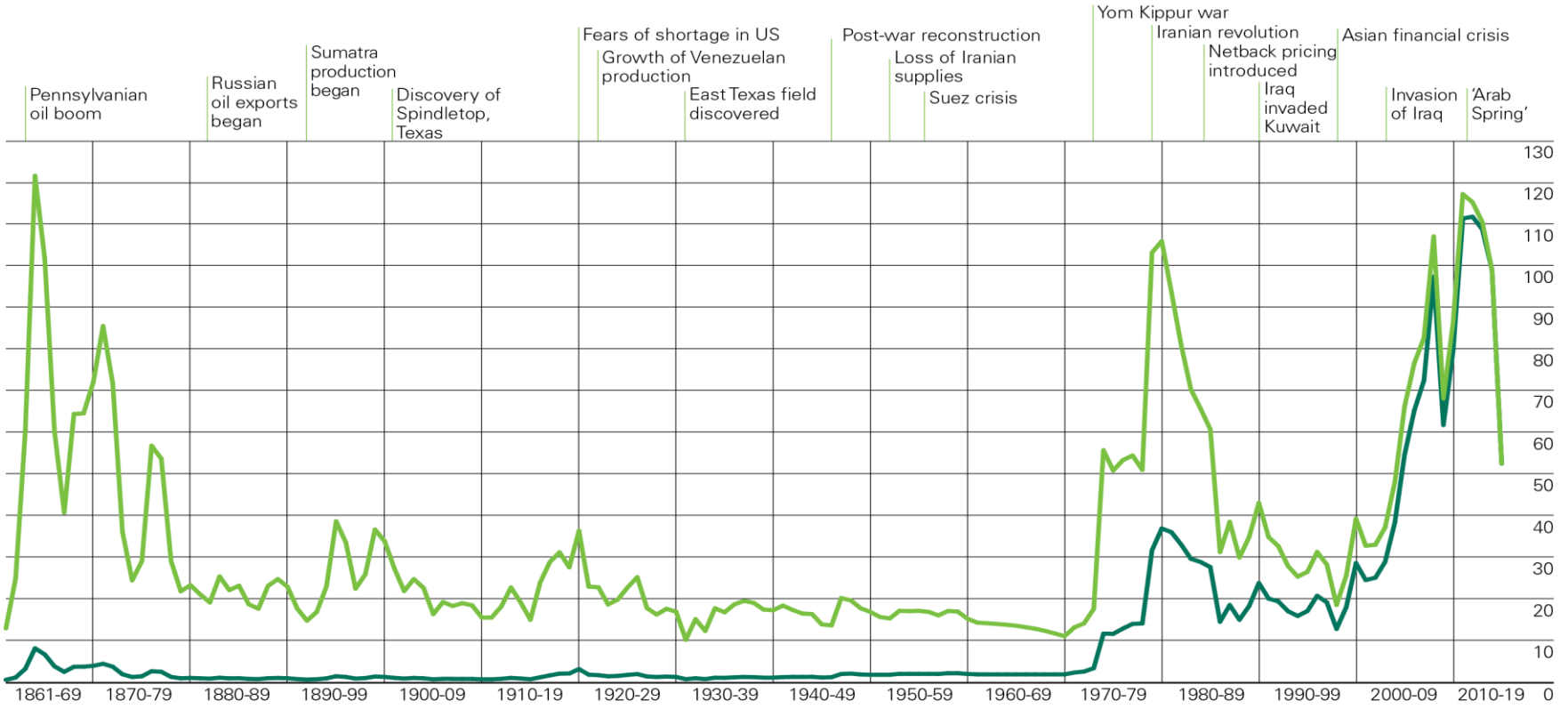
Crude oil prices 1861-2015, US $/barrel



$ 2015 (deflated using the Consumer Price Index for the US)
$ money of the day

1861-1944 US average.
1945-1983 Arabian Light posted at Ras Tanura.
1984-2015 Brent dated.

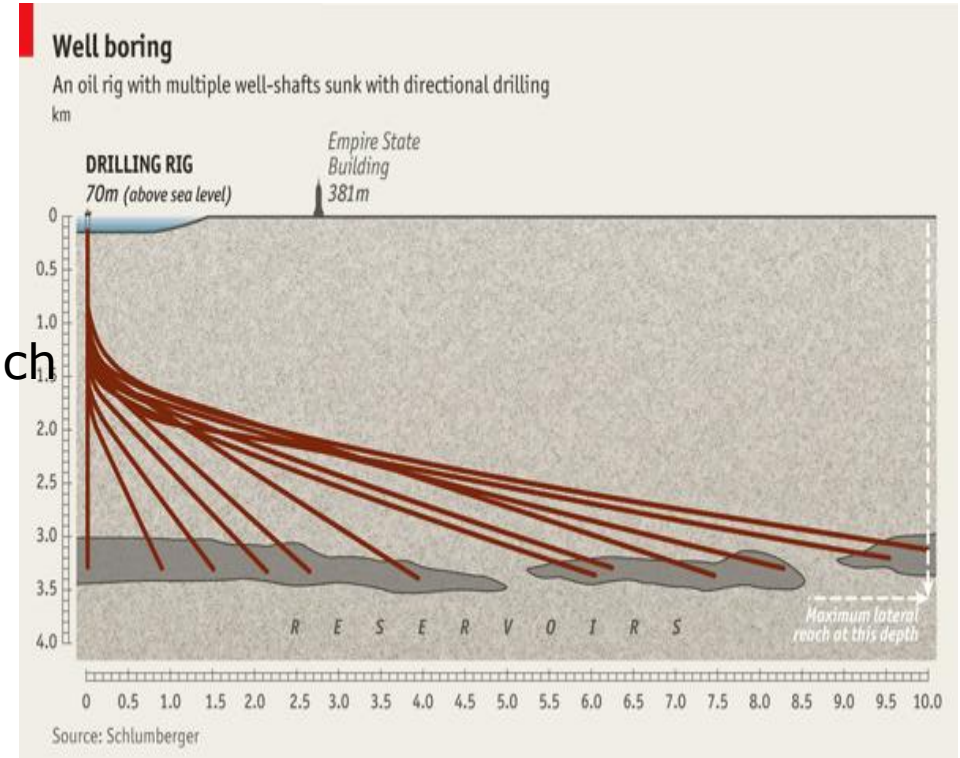
BP Statistical Review of World Energy 2016

Supply – solution #1

- Drill deeper:
  - Onshore & offshore
  - Oil window in the range 2,000-4,500 m; beyond 4,500 m more likely to find natural gas
- Drill elsewhere:
  - Other provinces e.g. South China Sea, Artic
- Speed up exploration:
  - It can take up to 10 years from a cold start to deliver oil

Supply - Solution #2

Jack Well (Gulf of Mexico)
- 6,000 m beneath the sea floor
- 2,000 m of water
- Test well cost US$100 m
- Production facility ~ US$500m
- Production wells ~ US$120 m each



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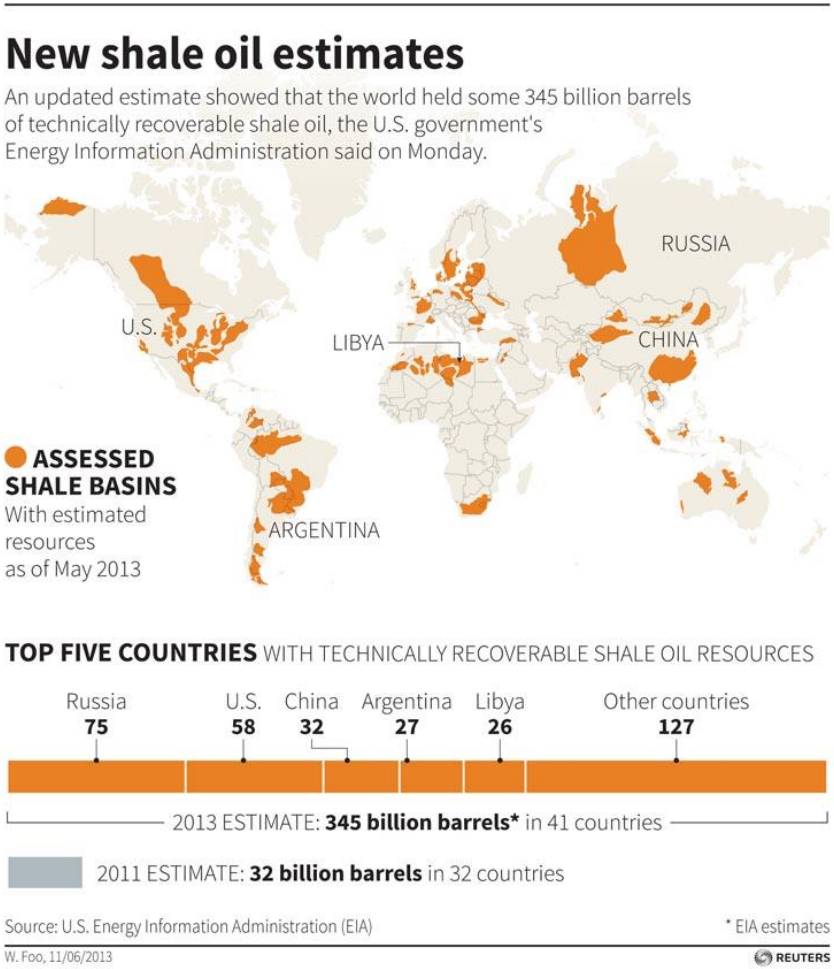
Along Comes Shale



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Canada's oil sands

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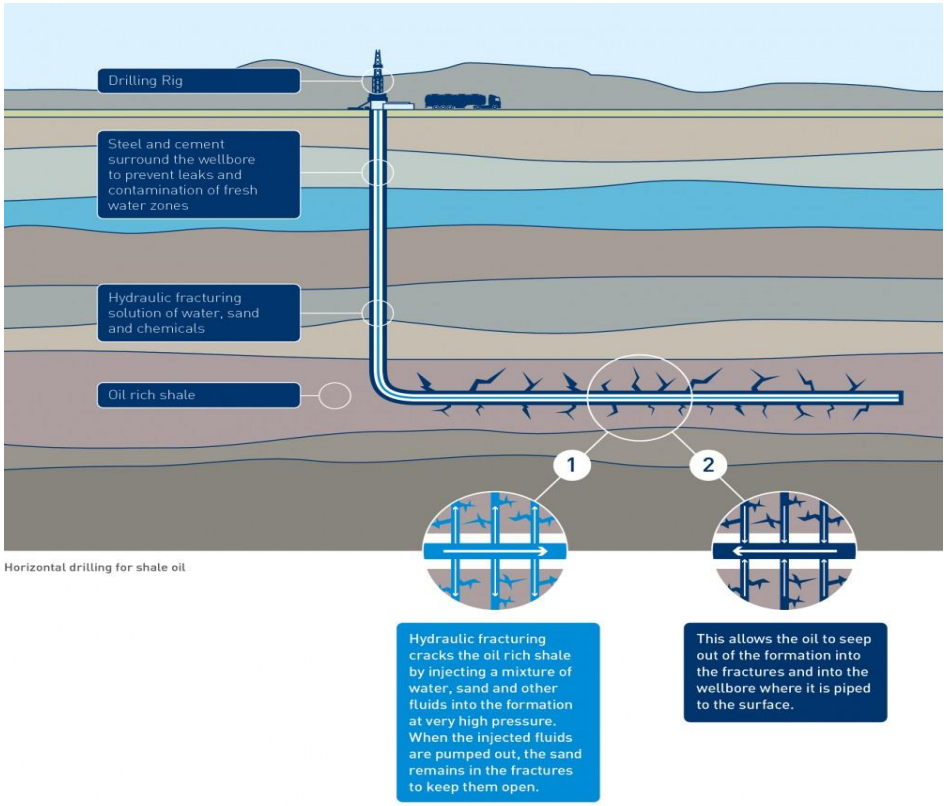
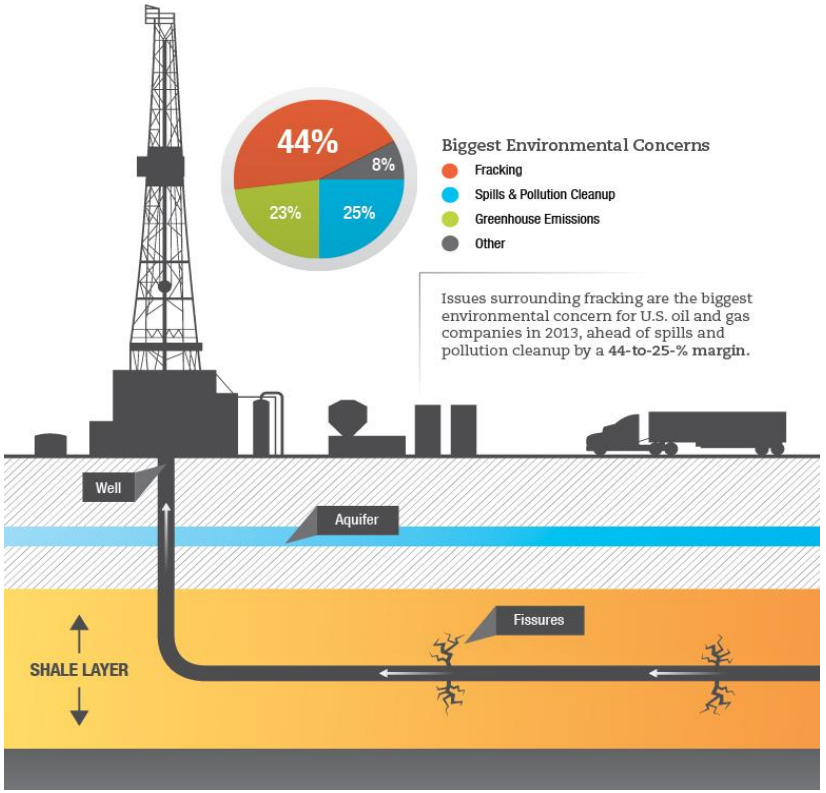
Fracking



Horizontal drilling for shale oil



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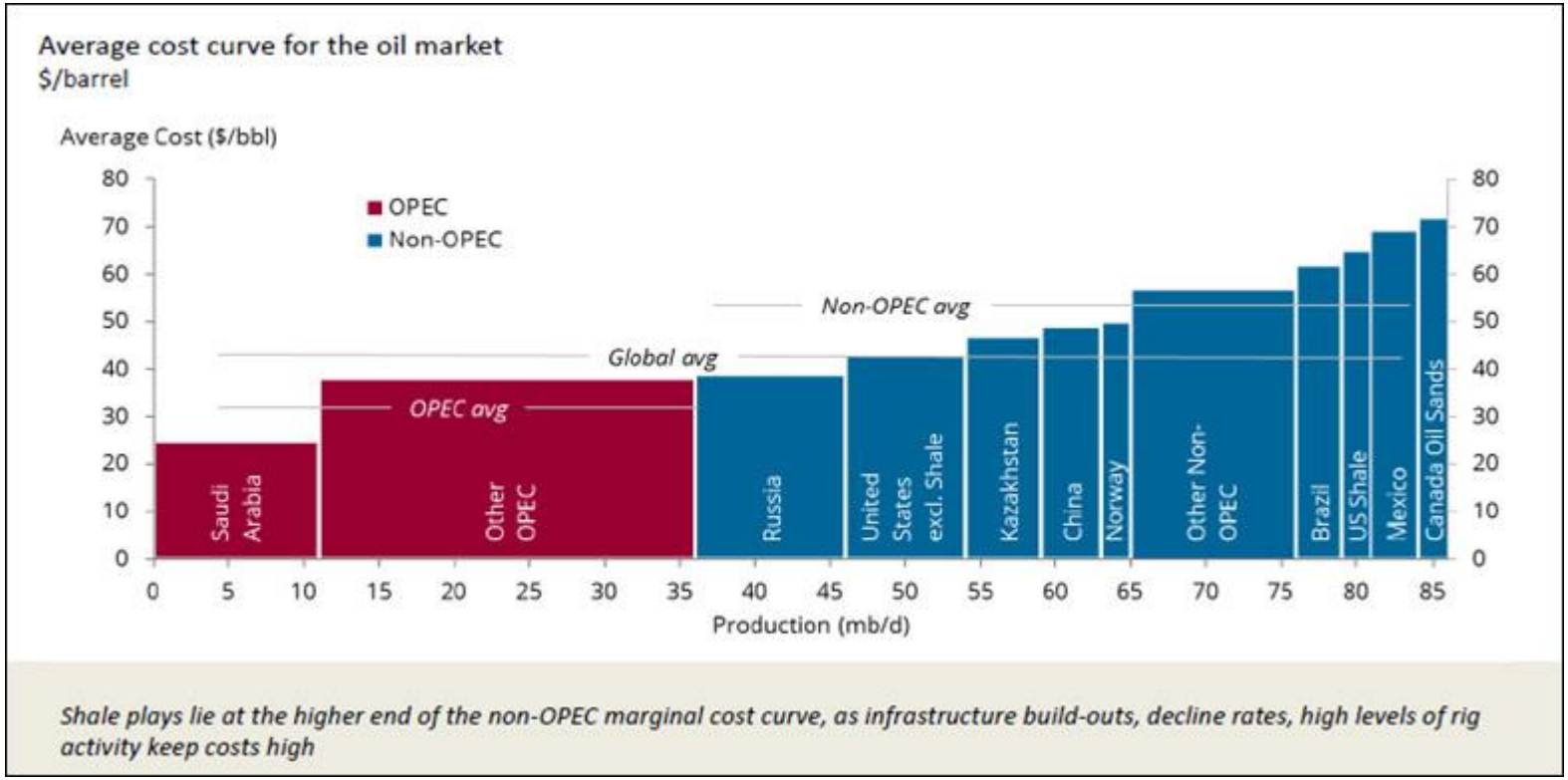
Recovery Costs



Shale plays lie at the higher end of the non-OPEC marginal cost curve, as infrastructure build-outs, decline rates, high levels of rig activity keep costs high

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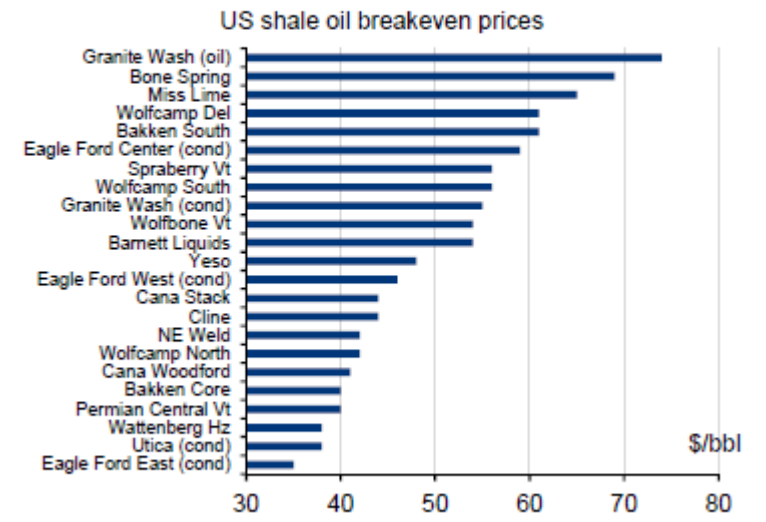
Breakeven prices for shale

Chart 15: The highest cost producers in the Permian start to feel the pain by not being able to cover their costs



Source: BofA Merrill Lynch Global Commodities Research

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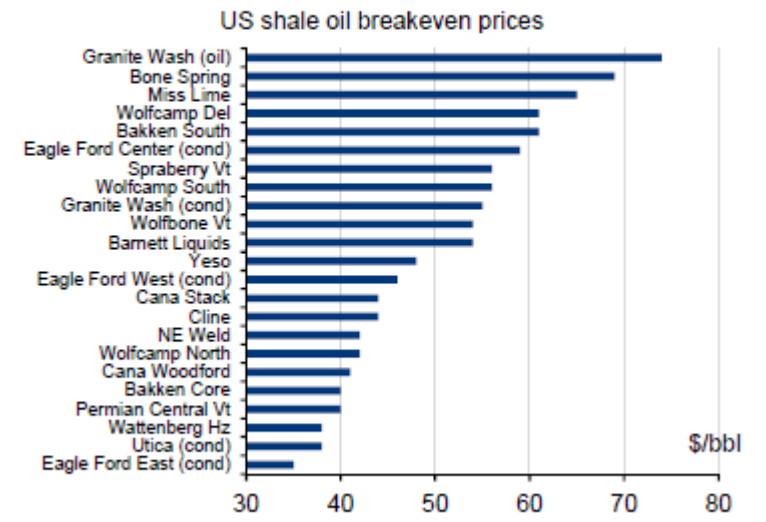

Source: BofA Merrill Lynch Global Commodities Research

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Global Oil Outlook

- Most promising sites are located in some of the world's most challenging operating environments
  - deep water, freezing temperatures, extreme weather
  - political instability
- Cost – massive investments, time lags
- Environmental concerns are a major issue
  - Untouched wilderness
  - Oil spills
    - Exxon Validez – clean up US$2 b
    - Deep Water Horizon – clean up US$38 b

Great Deal of Uncertainty

- Weather, environmental disasters (Exxon, Deep Horizon)
- Substitutability of oil and other factors of production
  - How substitutable is oil in long run?
- Will prices will increase as global economy recovers?
- Geopolitical risks
  - Government actions

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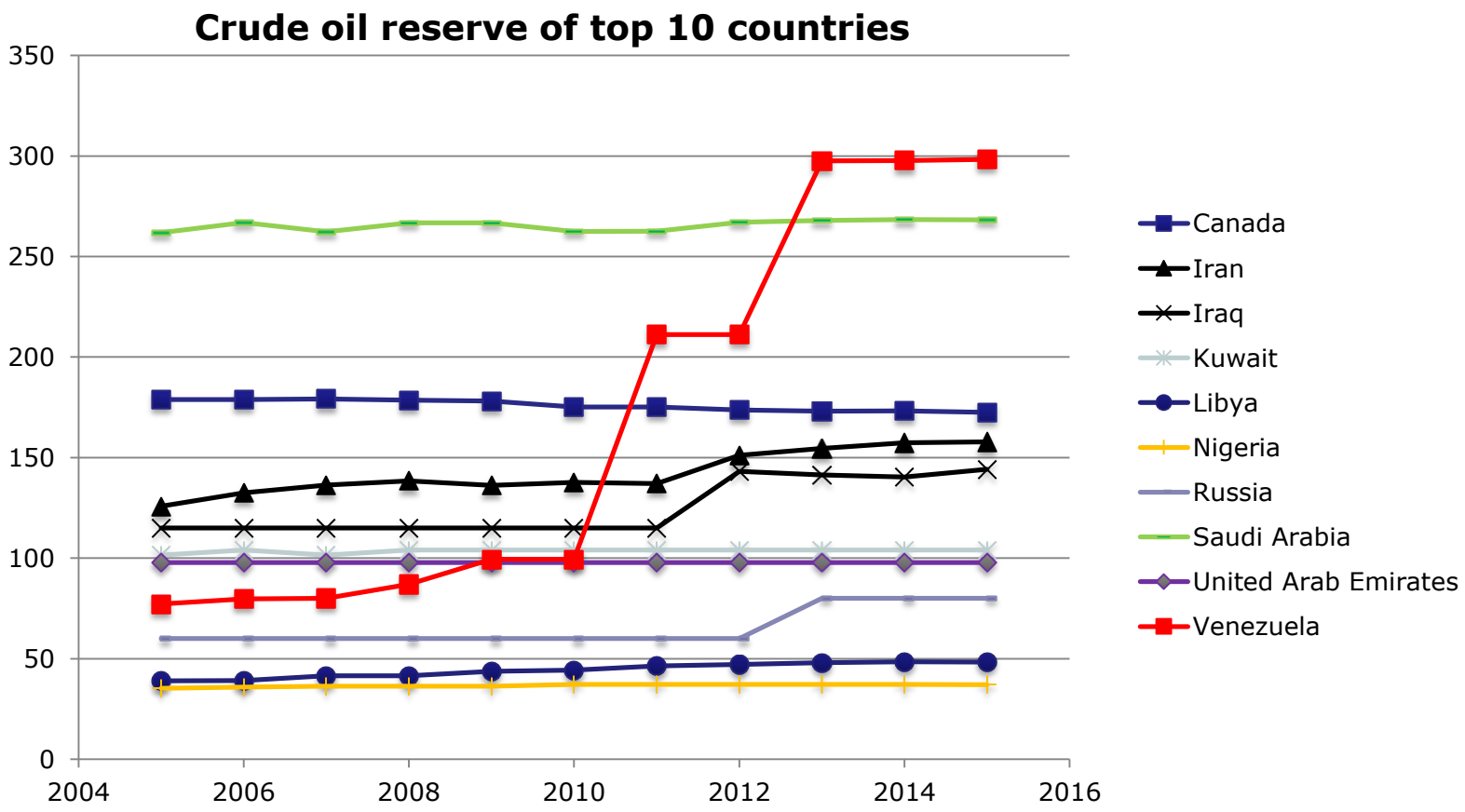
Crude oil reserves



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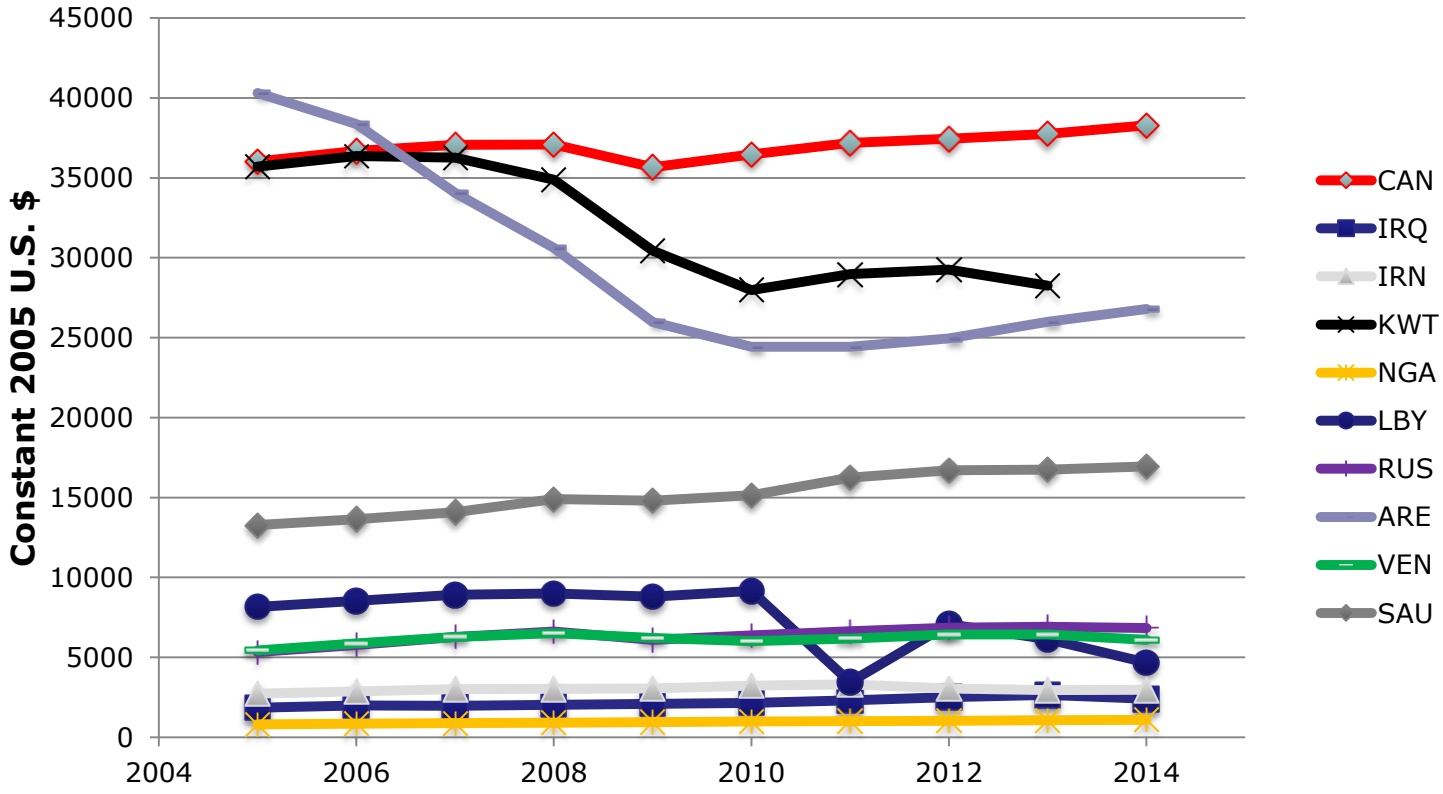
GDP per capita oil producers



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Demand

- Demand sensitive to economic conditions, efficiency mandates, government policy
  - GDP – recovery of 3% => growth in demand of ~ 1%
  - Policy – sulphur, climate, car efficiency, reserves, …
  - Subsidies: US$557b a year, chronic under pricing – removal could reduce demand by 6 mmbd (~1/3 of US demand)
- Economic evidence
  - Demand Price (volatility) S_R elasticity ~ 0.2; L_R ~ 0.08
  - Income 0.5 (developed countries) 1 in emerging
  - Supply price elasticity 0.02, lags 2-4 years

Demand – price of substitutes

- Renewables sound great in theory
  - Palm oil – felling forests to plant palm oil for the European biodiesel market added to carbon emissions
  - Deforestation accounts for 20% of the world's emissions.
- If the US switched its entire grain crop to ethanol it would replace 1/5th of gasoline consumption
  - Impact on food prices

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EVs

- Electric vehicles
  - Battery : cost, charging, range
  - Supply of lithium
  - May not be entirely emission free, depends on electricity source
  - Development of smart grid technology
  - Race to find the transportation game-changer
    - Nissan predicts worldwide sales at 10% of the market by 2020, Peugeot 5% and Volkswagen 1.5% - IEA estimates 7% by 2030.

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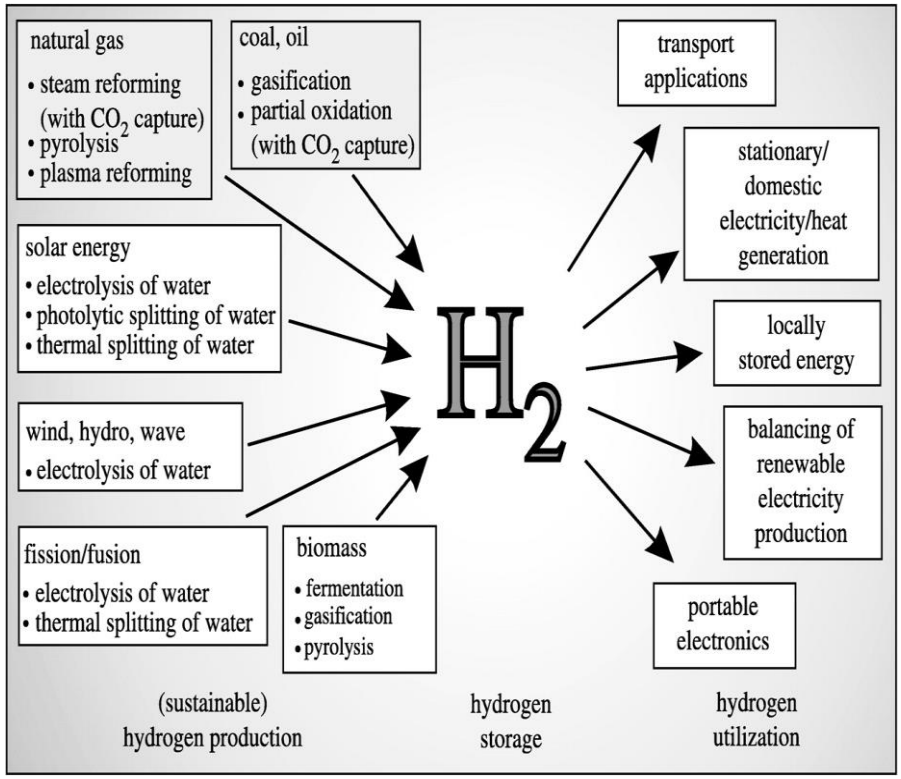
Hydrogen



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Energy policy

- Access
  - Property right arrangements
  - Allocation
- Resource curse
  - Poor institutional design
- Taxation
  - Severance tax
  - Depletion allowances
- Subsidies
  - Production & consumption

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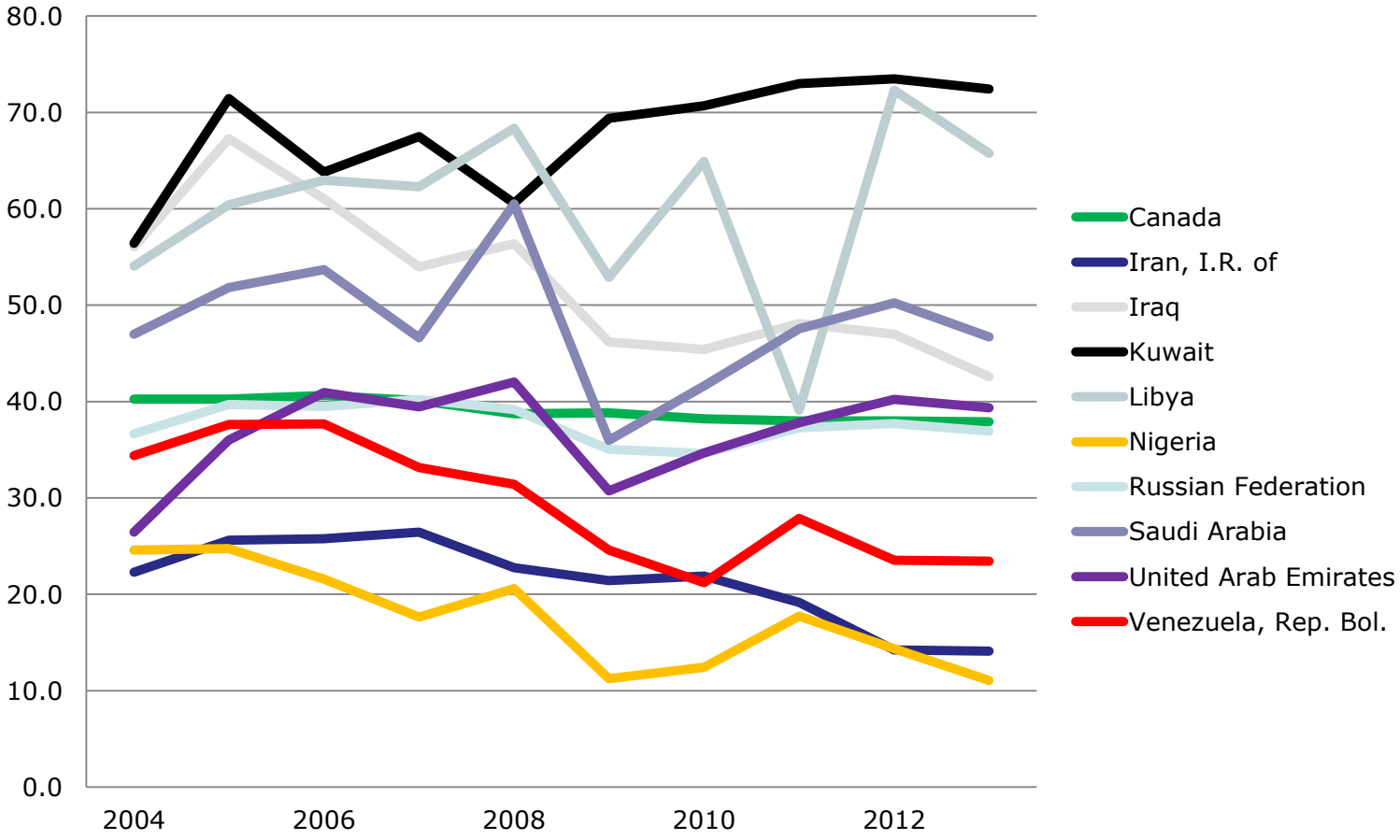
Govt revenue as % GDP



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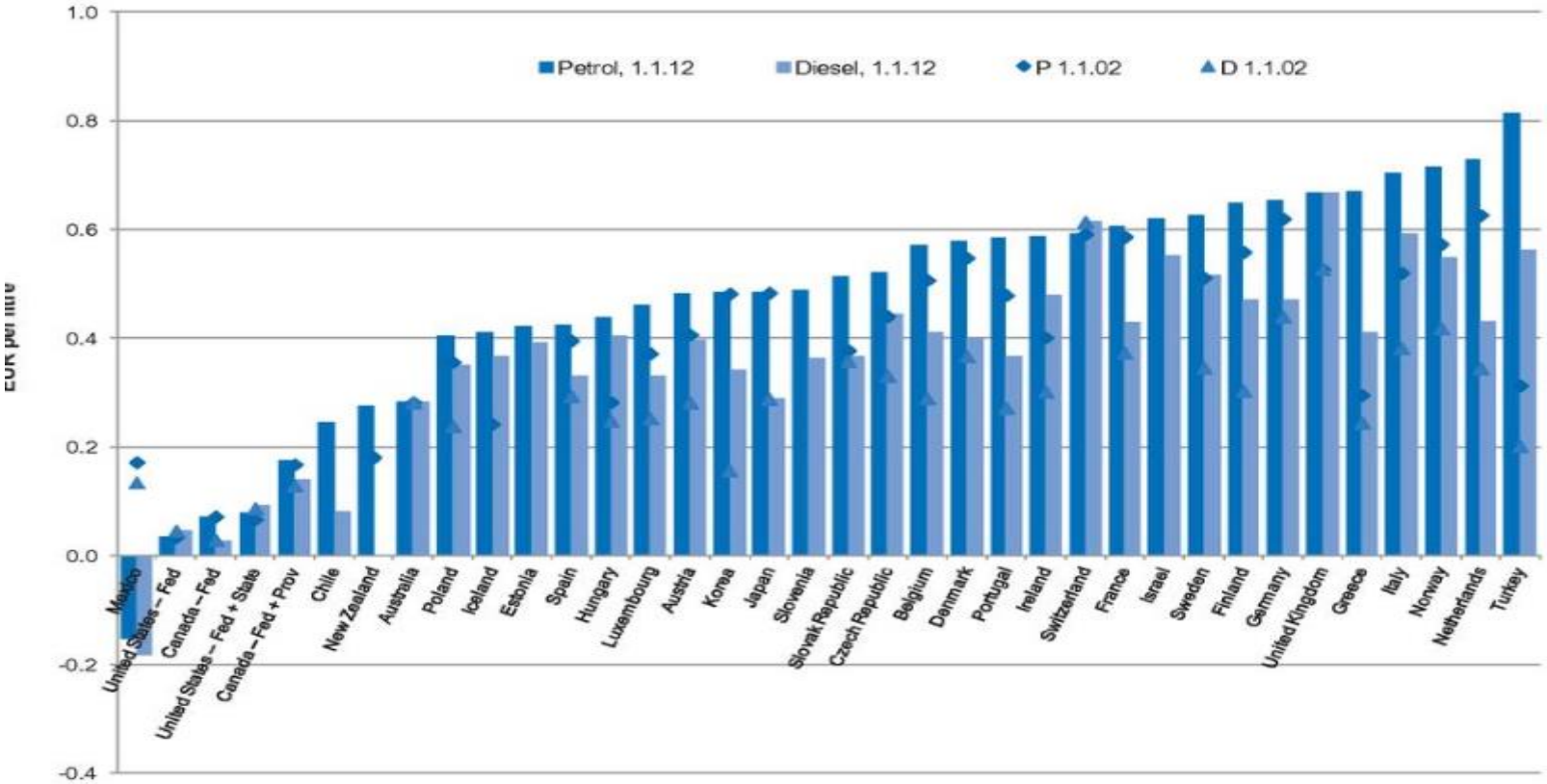
Tax Rates in OECD Economies

Figure 1.1. Tax rates on petrol (P) and diesel (D) in OECD countries (excluding VAT), as of 1 January 2002 (excluding VAT) and as of 1 January 2012



Notes: Average 2011 exchange rates are applied for all years.

Source: http://www.oecd.org/site/tadffss/

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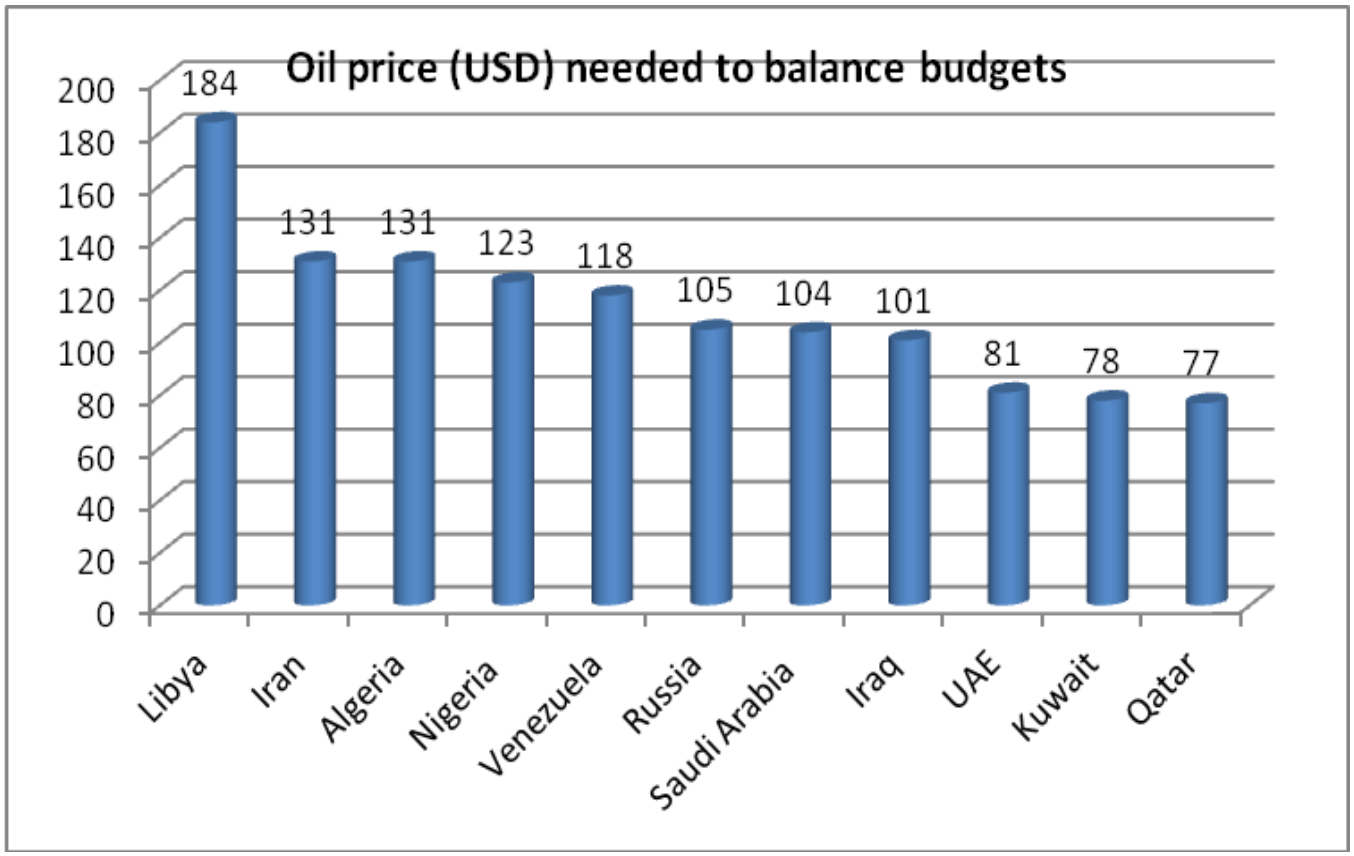
Oil price and government budget



GDP per capita:
Saudi US$25,000
Nigeria US$3,000
Venezuela US$12,000
(95% imports depend)

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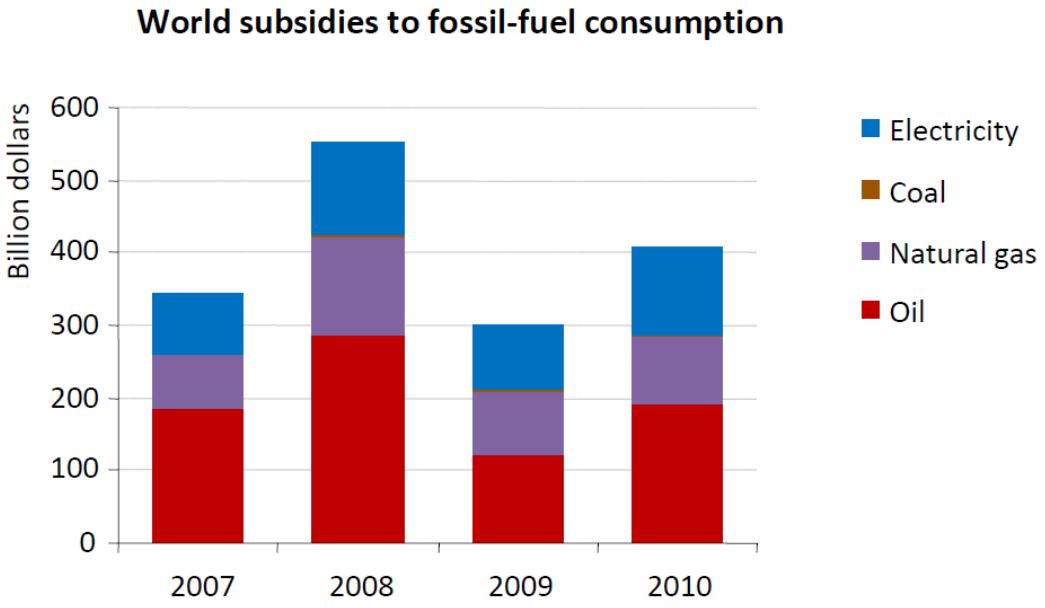
World subsidies



Fossil fuel subsidies have been driven higher by the rebound in international energy prices they totalled $409 billion in 2010 – about $110 billion up on 2009

http://www.iea.org/publications/worldenergyoutlook/resources/energysubsidies/

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Support to fossil fuels in US 2011

- OECD definition: budgetary expenditure and tax expenditure that provide a benefit or preference for fossil fuel production or consumption relative to alternatives
- Fossil fuels make up 84% of primary energy supply in US; oil 36%, gas 25% & coal 23%
- OECD estimate for 2011:
  - Producer support in US: US$ m 2445
  - Consumer support US$ m 2666

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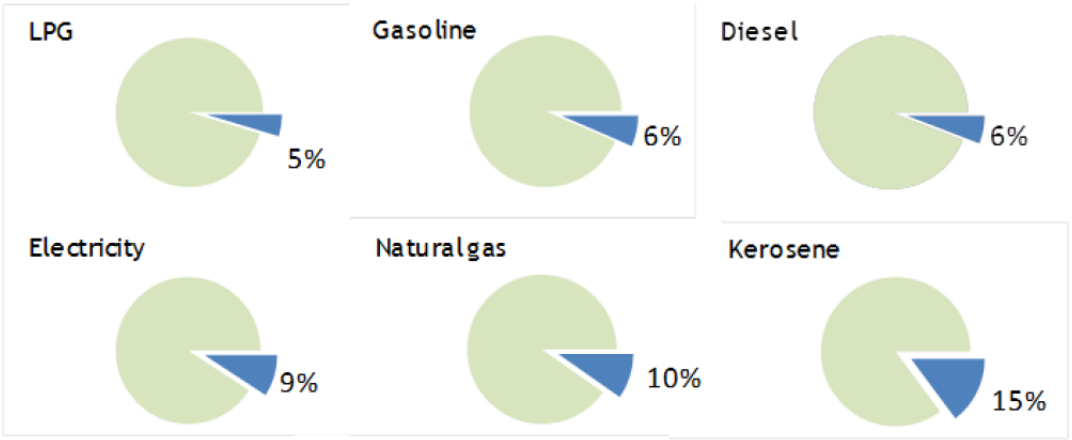
Do low income groups benefit?

Share of fossil-fuel subsidies received by the lowest 20% income group, 2010



Subsidies are an extremely inefficient means of assisting the poor: only 8% of the $409 billion spent on fossil-fuel subsidies in 2010 went to the poorest 20% of the population

http://www.iea.org/publications/worldenergyoutlook/resources/energysubsidies/

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What if subsidies were removed?

- Without further reform, spending on fossil-fuel consumption subsidies is set to reach $660 billion in 2020, or 0.7% of global GDP
- Phasing-out fossil-fuel consumptions subsidies by 2020 would:
  - *slash growth in energy demand by 4.1%*
  - *reduce growth in oil demand by 3.7 mb/d*
  - *cut growth in CO_2 emissions by 1.7 Gt*
- Many countries have started or planned reforms since early-2010
  - *key driver has been fiscal pressure on government budgets*
  - *G20 & APEC commitments have also underpinned many reform efforts*
  - *much more remains to be done to realise full extent of benefits*

http://www.iea.org/publications/worldenergyoutlook/resources/energysubsidies/

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Concluding comments

- Fundamentals of supply & demand in determining price
- Impact of
  - Global economy
  - Technology
  - Geopolitical
  - Government policies; taxation, subsidies, regulations
- Increasingly interdependent linkages with world events