

In the name of God



Peak Oil: Trends and Implications

Ramin Forouzandeh | 16 November 2019 | Khatam University

Agenda

Main discussions

- Energy cake
- Major trends in energy
- Strategies for energy companies

Other topics

- References
- Companies

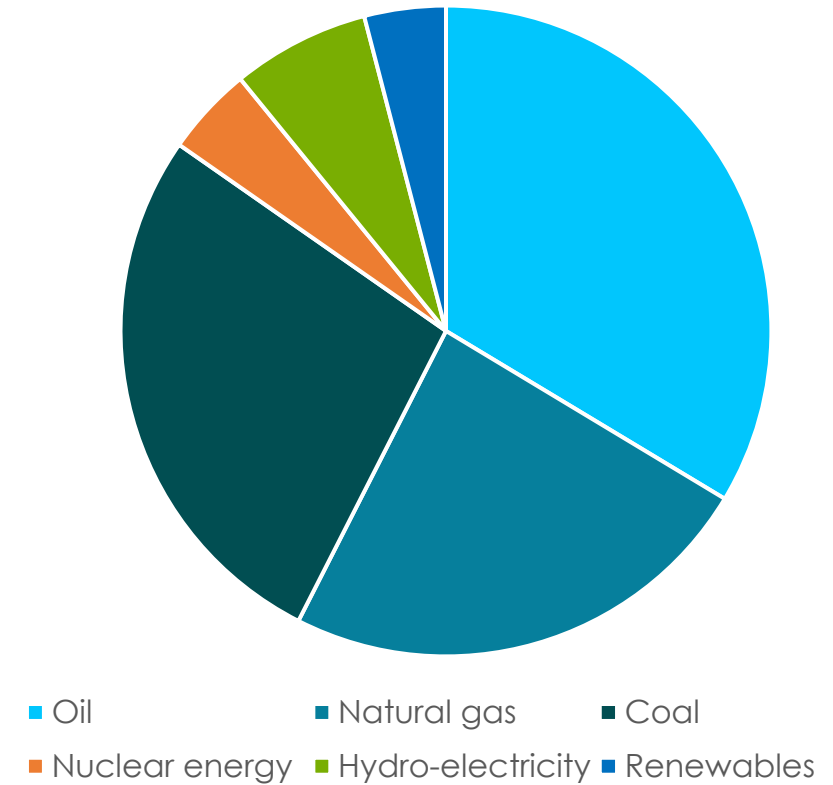


Energy cake

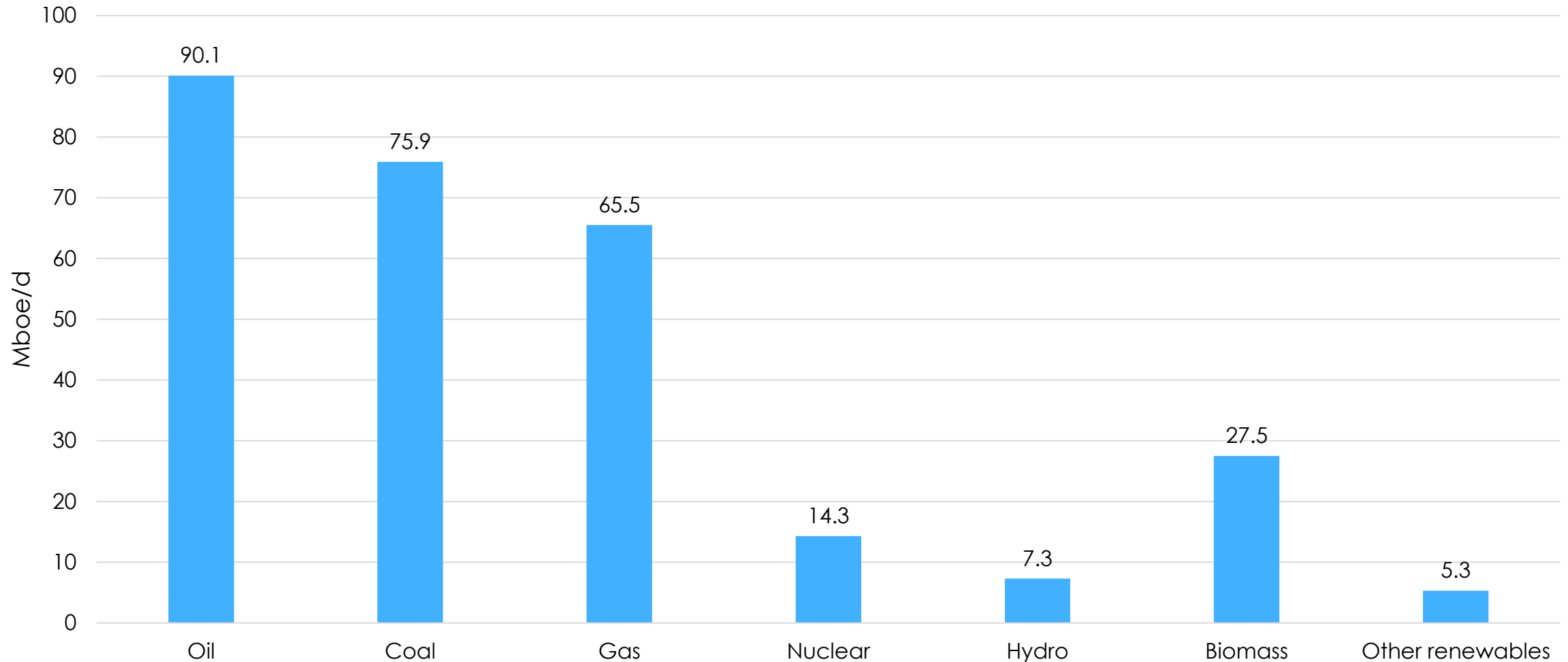
The energy cake



Primary energy consumption (MTOE)

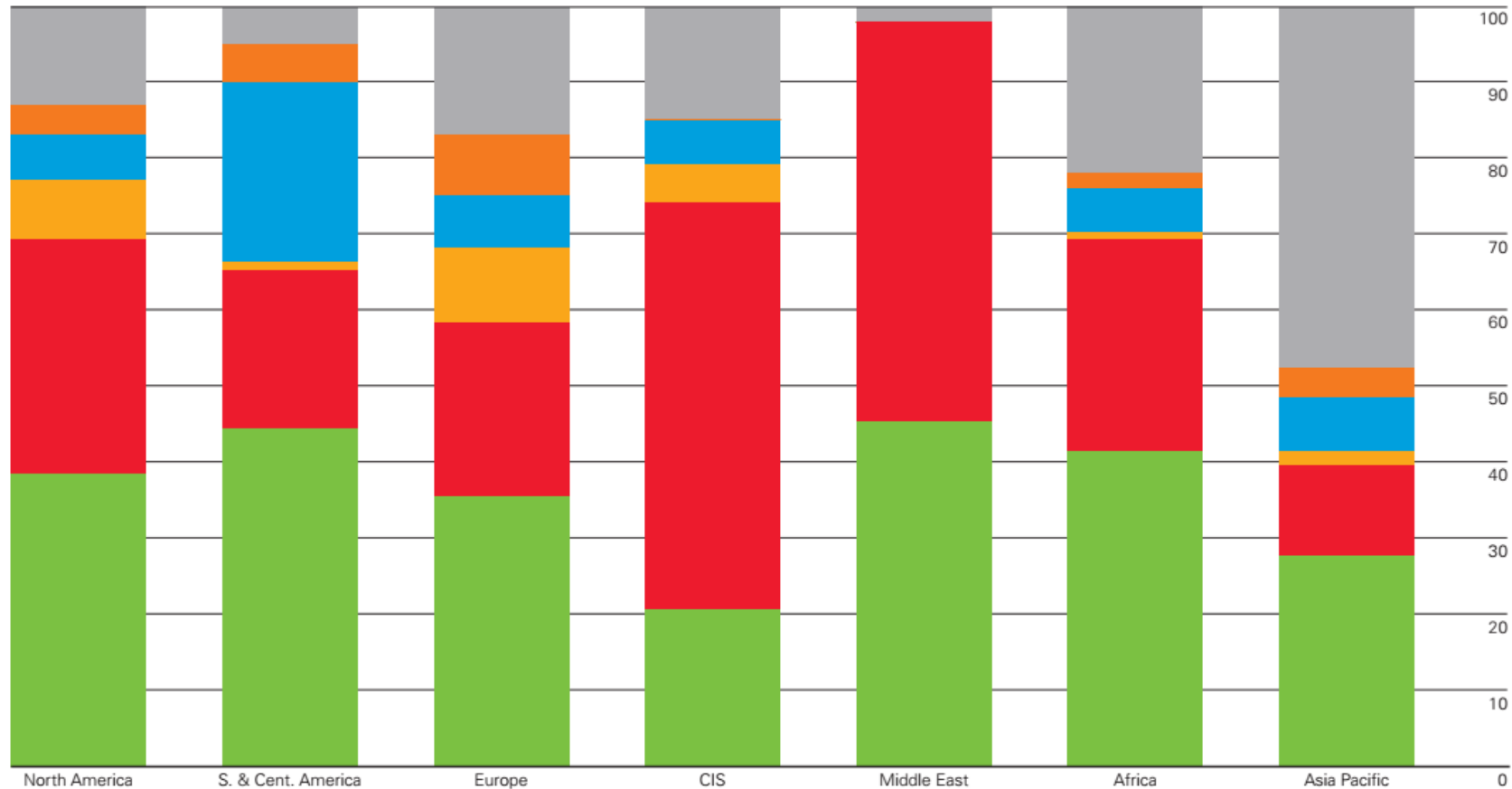


World primary energy demand by fuel type (2018)



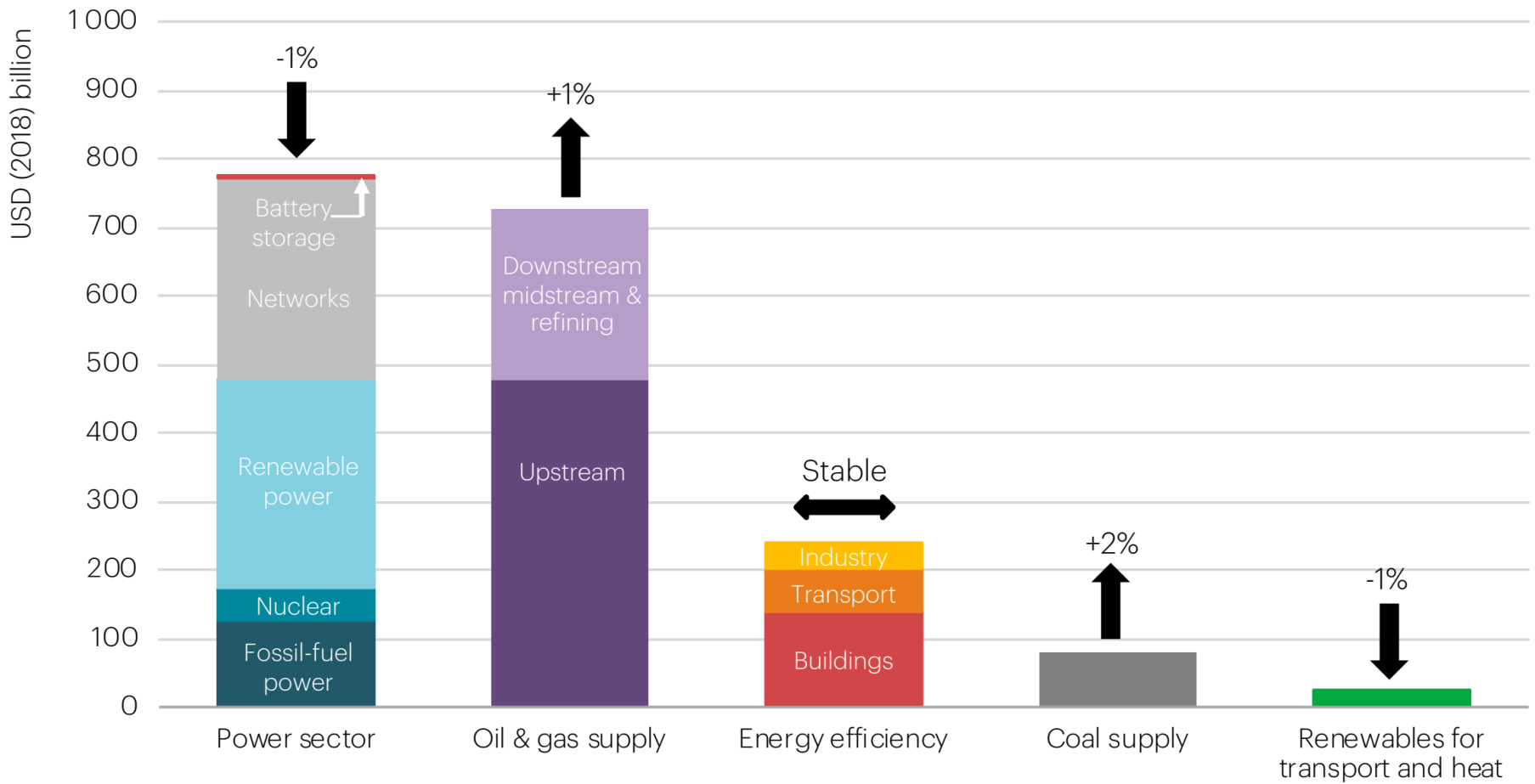
Regional consumption by fuel (2018)

- Coal
- Renewables
- Hydroelectricity
- Nuclear energy
- Natural gas
- Oil



Oil remains the dominant fuel in Africa, Europe and the Americas, while natural gas dominates in CIS and the Middle East, accounting for more than half of the energy mix in both regions. Coal is the dominant fuel in the Asia Pacific region. In 2018 coal's share of primary energy fell to its lowest level in our data series in North America and Europe.

Global energy investment in 2018 and change compared to 2017



Two views of energy cake-1

How much

Size of cake

Energy efficiency

GDP growth, population

From where

Ingredients of cake

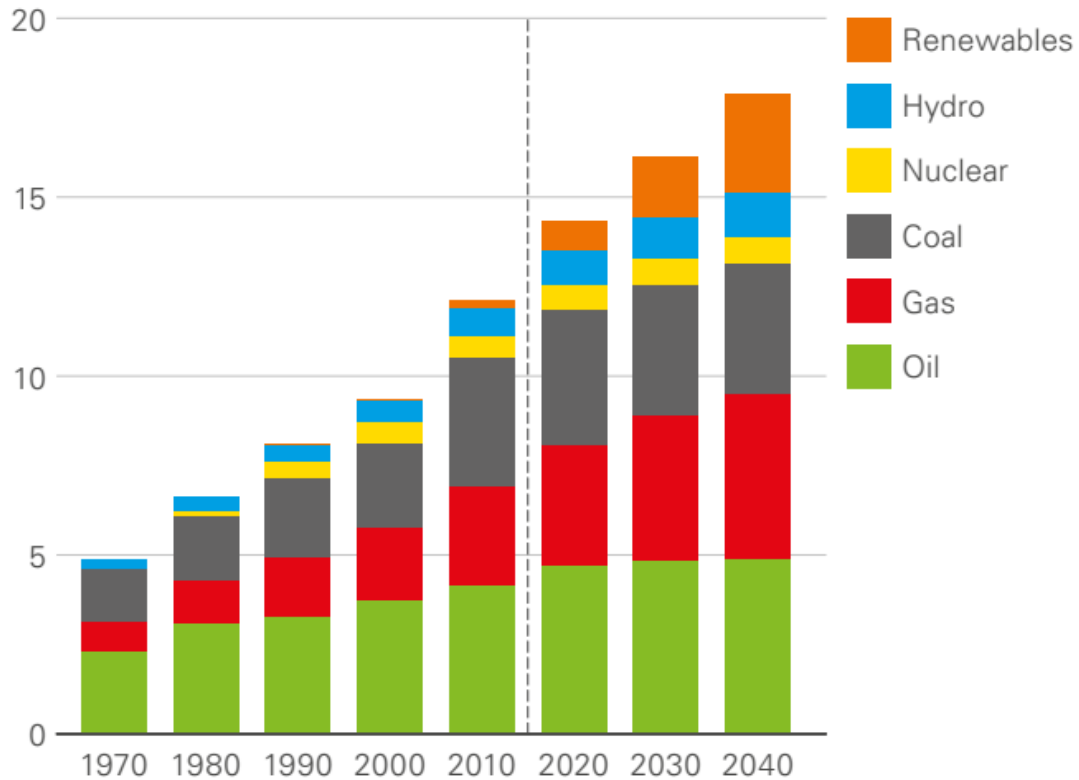
Renewable sources

Environmental policies

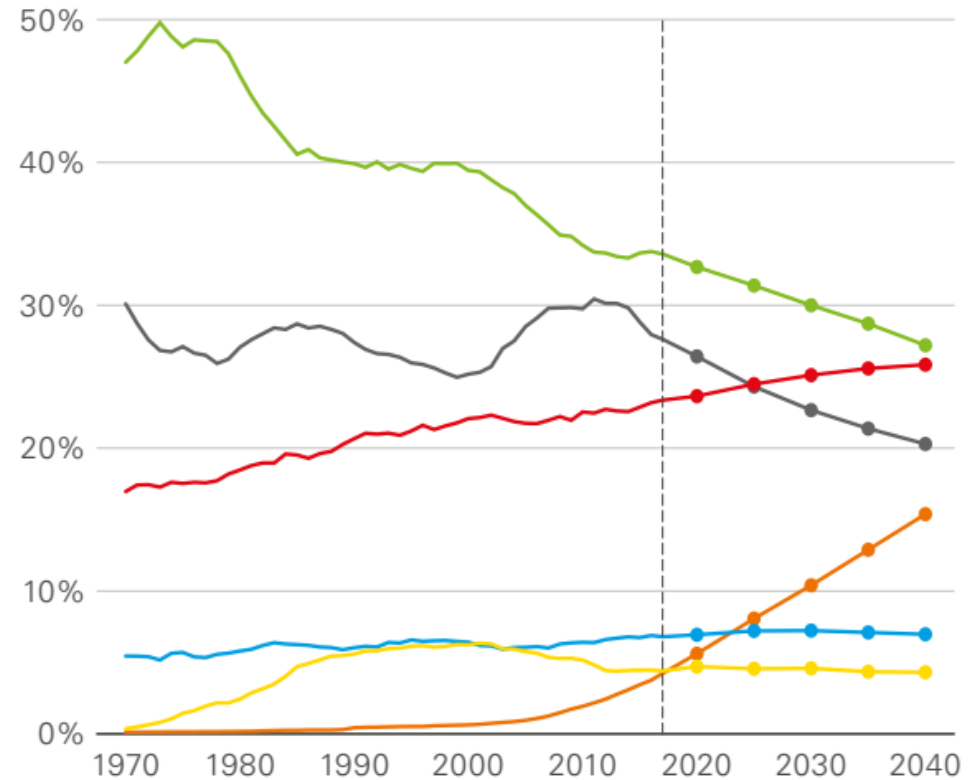
Two views of energy cake-2

Primary energy consumption by fuel

Billion toe



Shares of primary energy



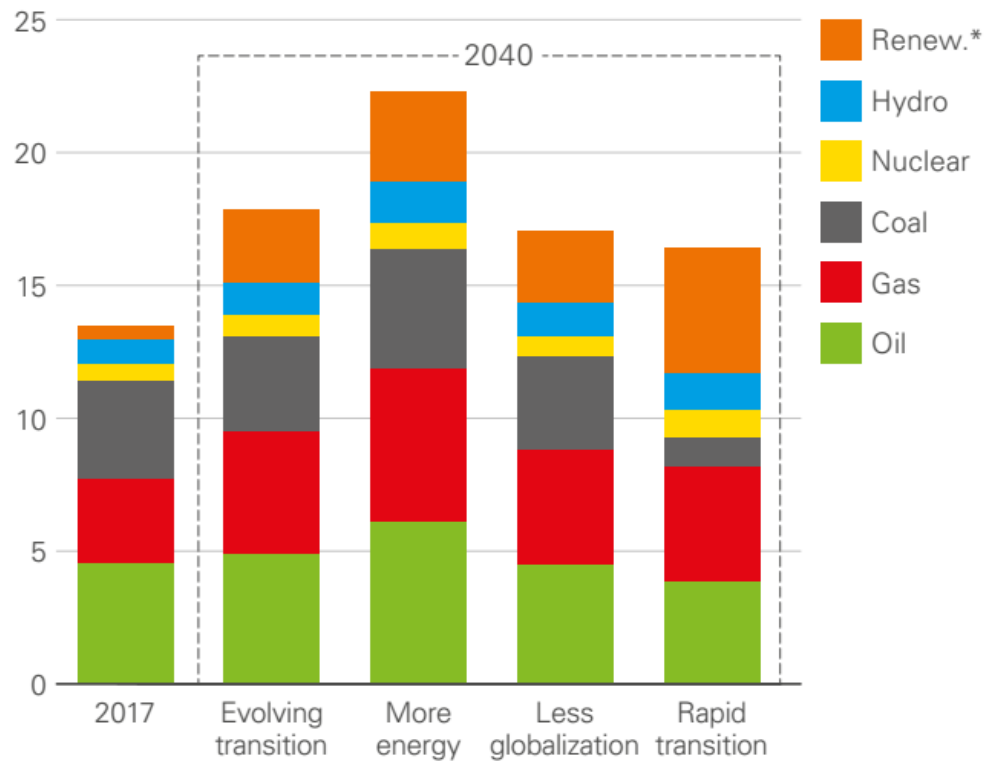
3 drivers of energy shift

- Drivers behind the energy shift:
 1. **Change in shape of GDP:** increase in share of the services sector
 2. **Efficiency:** less energy for the same GDP level (lower energy intensity)
 3. **Electrification:** high growth of electricity, especially from renewable sources

Scenario-based analysis

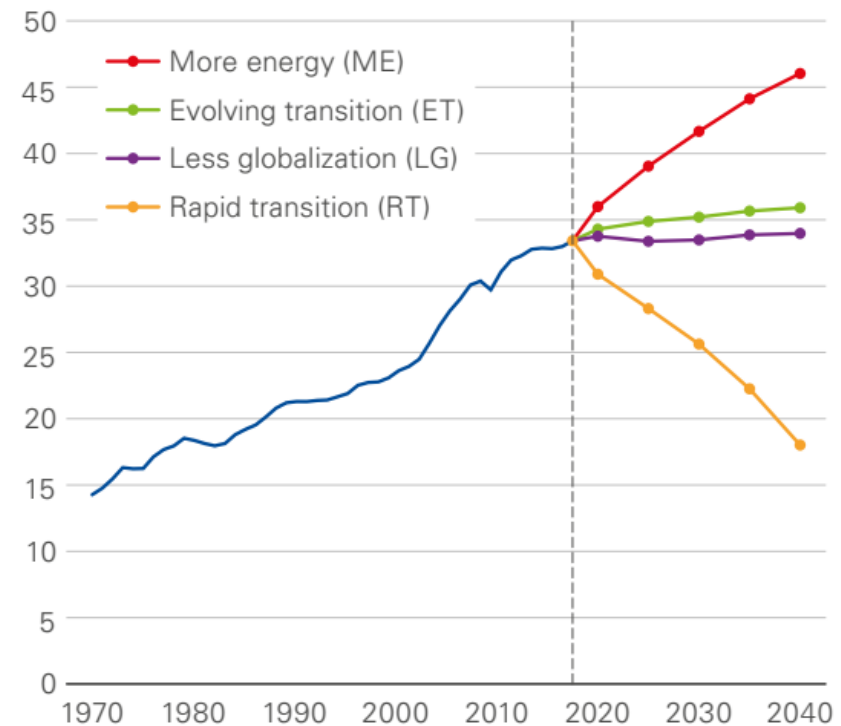
Primary energy consumption by fuel

Billion toe



CO₂ emissions

Gt of CO₂



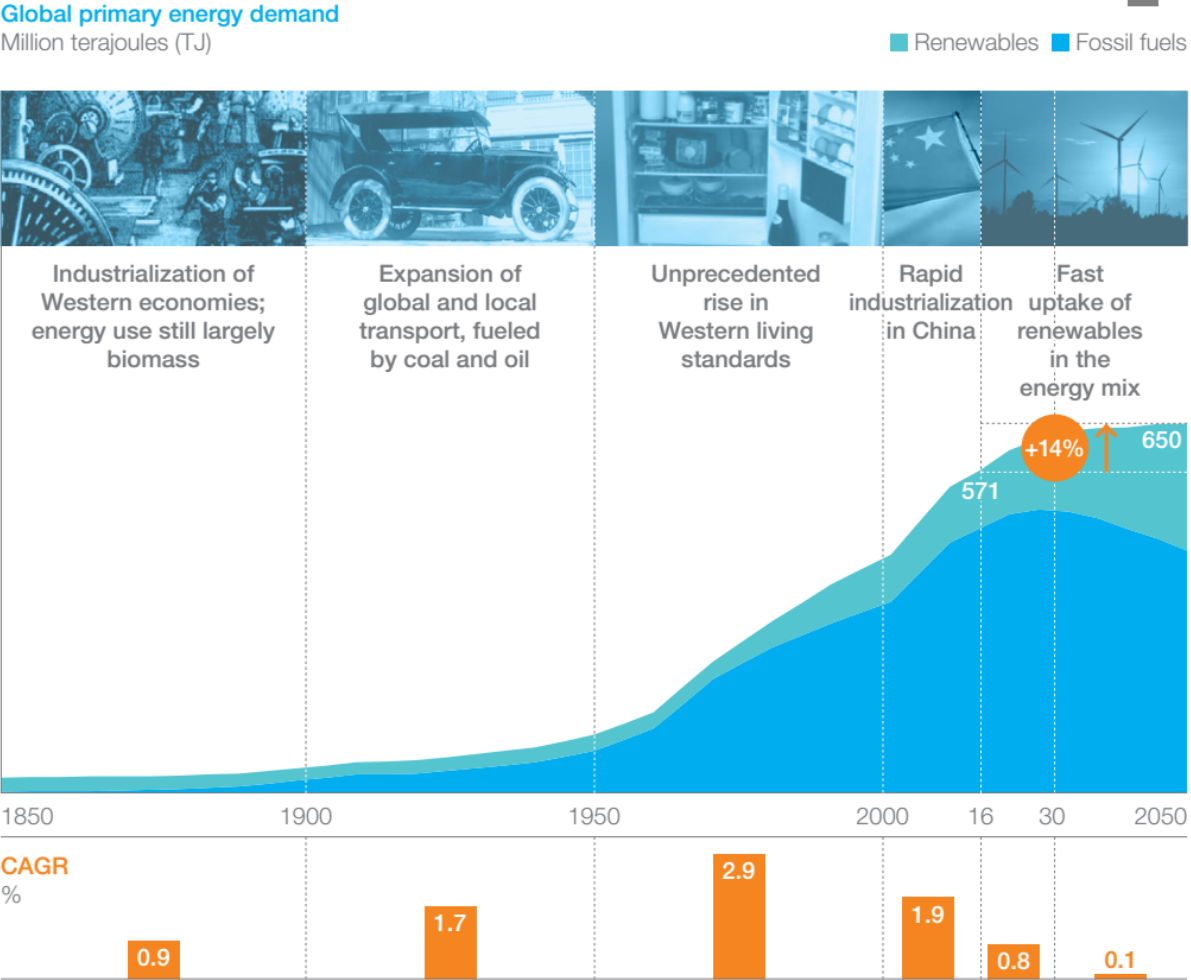
*Renewables includes wind, solar, geothermal, biomass, and biofuels. For full list of data definitions see p138





Major trends in energy

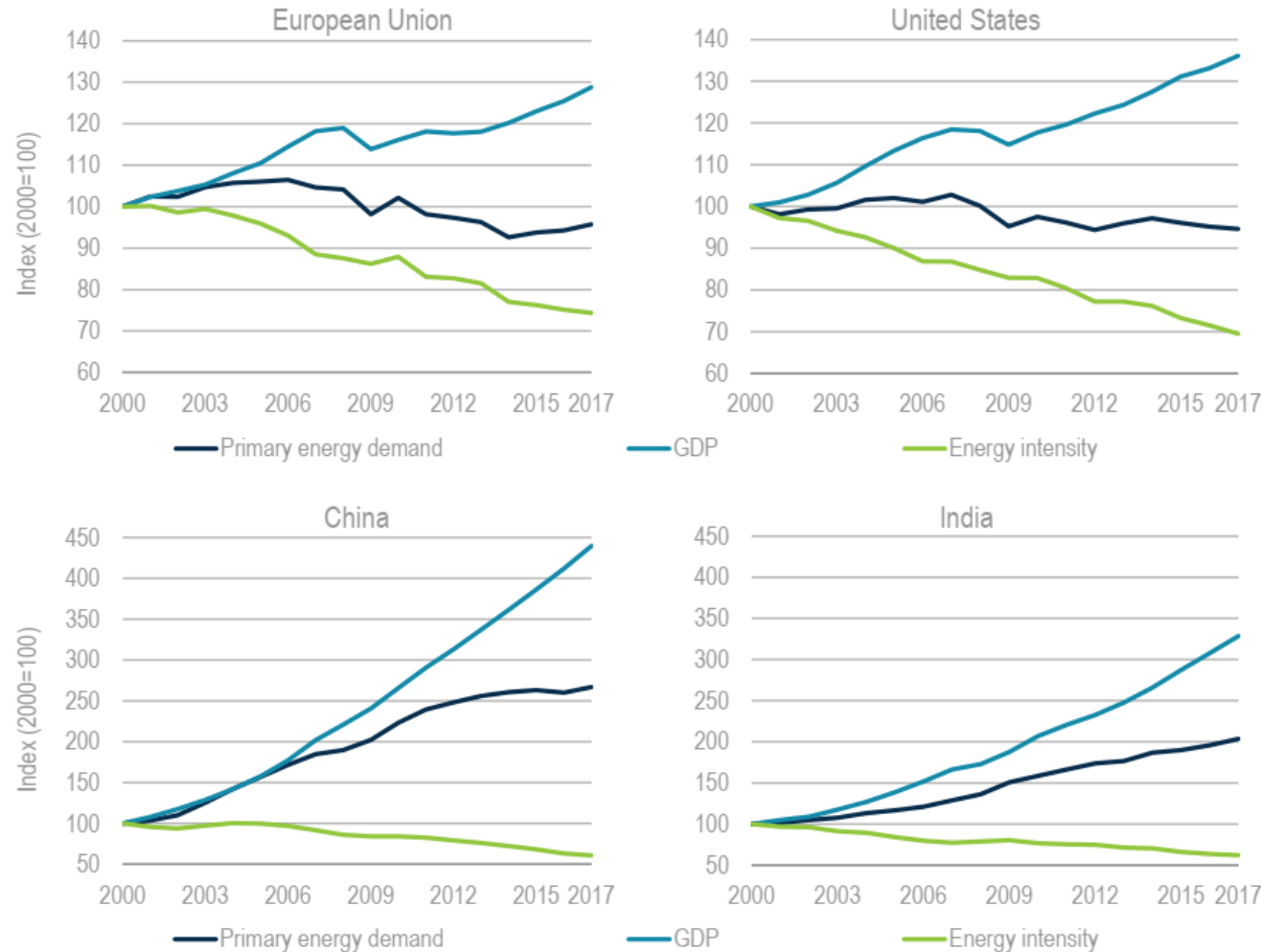
Long-term energy consumption growth



Energy intensity metrics (2017)

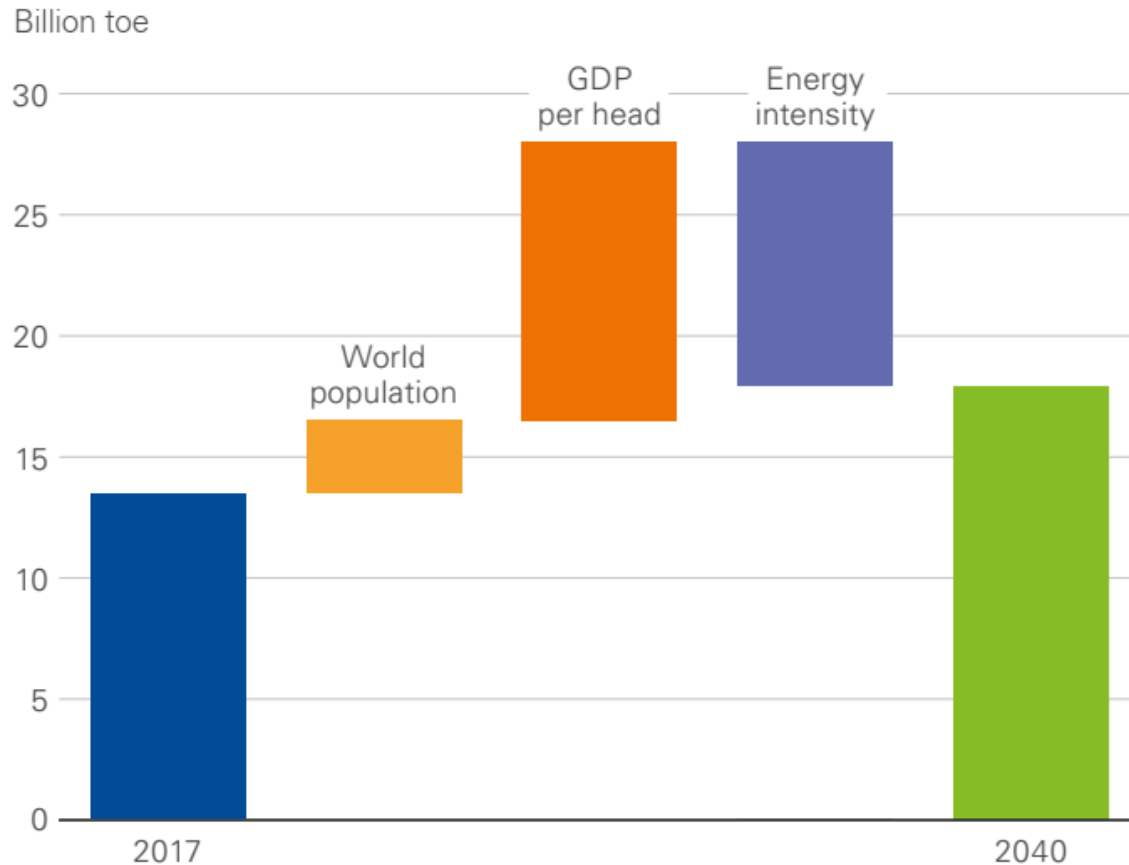
Country	(TPES/GDP) toe/'000 2010 USD	(TPES/GDP PPP) toe/'000 2010 USD	TPES/pop toe/capita
World	0.17	0.12	1.86
Iran	0.47	0.17	3.22
Trinidad and Tobago	0.8	0.43	12.22
Turkey	0.12	0.07	1.79
Middle East	0.32	0.14	3.17
OECD	0.1	0.11	4.1
Africa	0.33	0.14	0.65

Primary energy demand, GDP and energy intensity

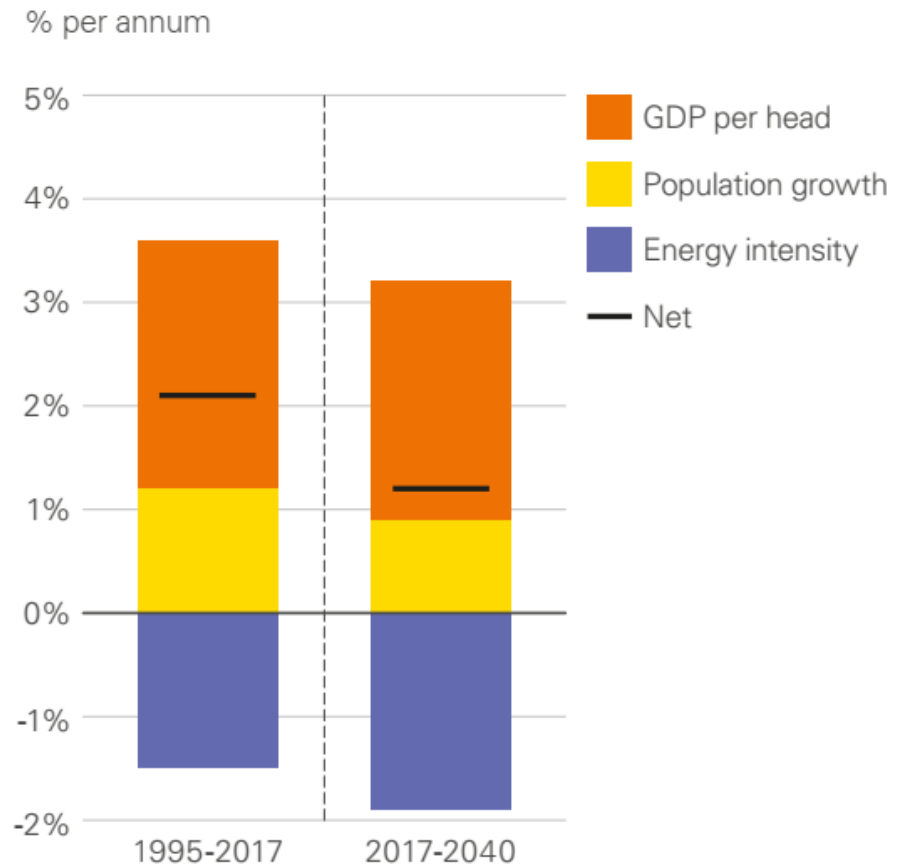


Efficiency & energy intensity

Increase in primary energy demand, 2017-2040

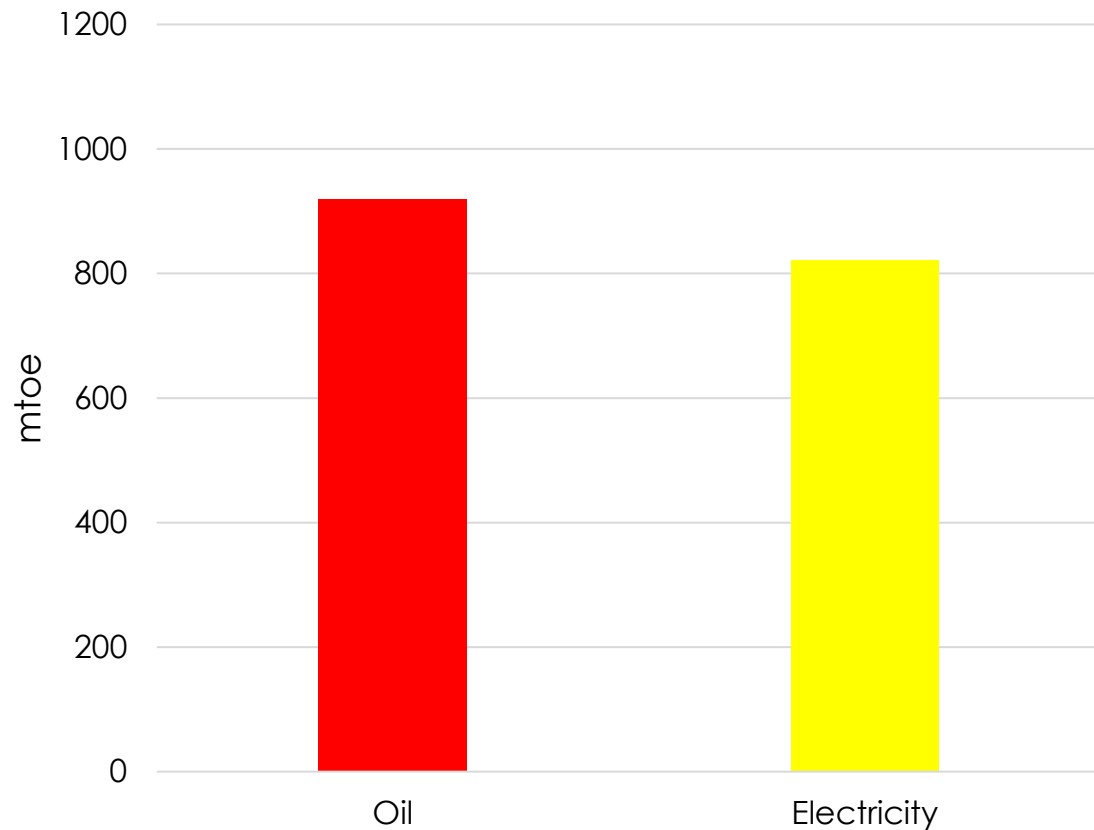


Contributions to primary energy demand growth

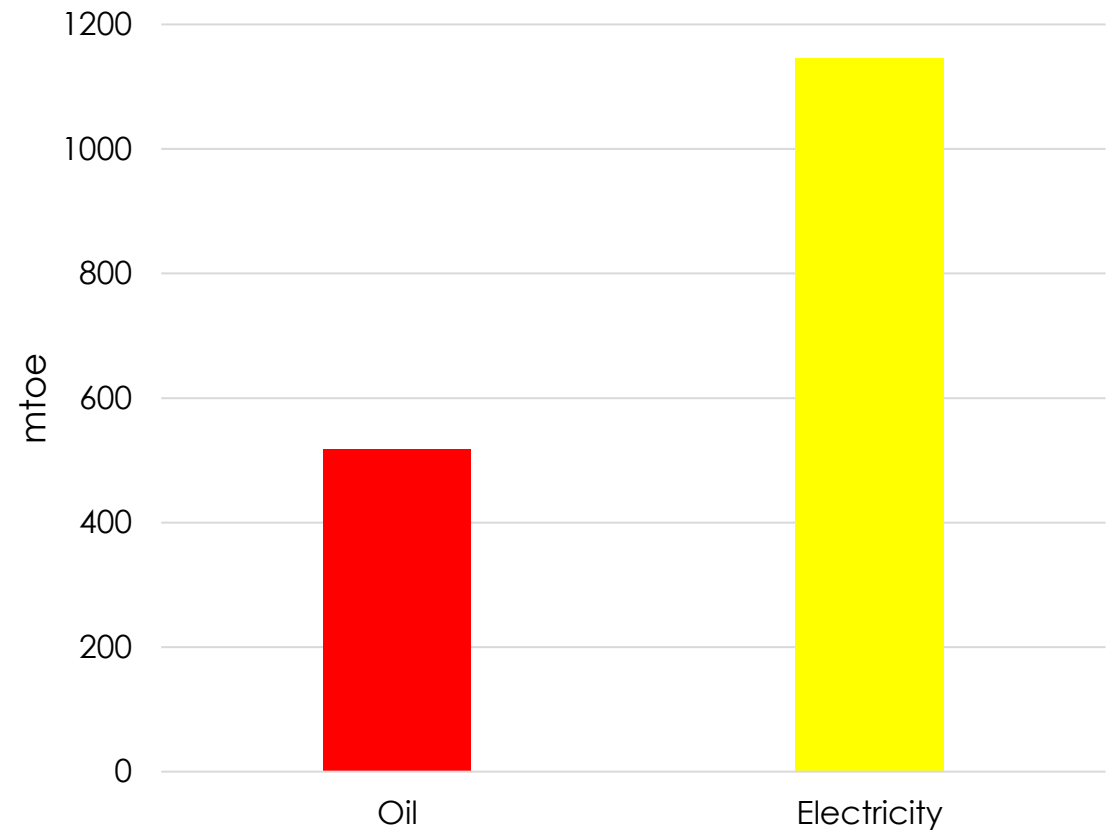


Electrification

Change in global oil and electricity consumption, 2000 - 2018

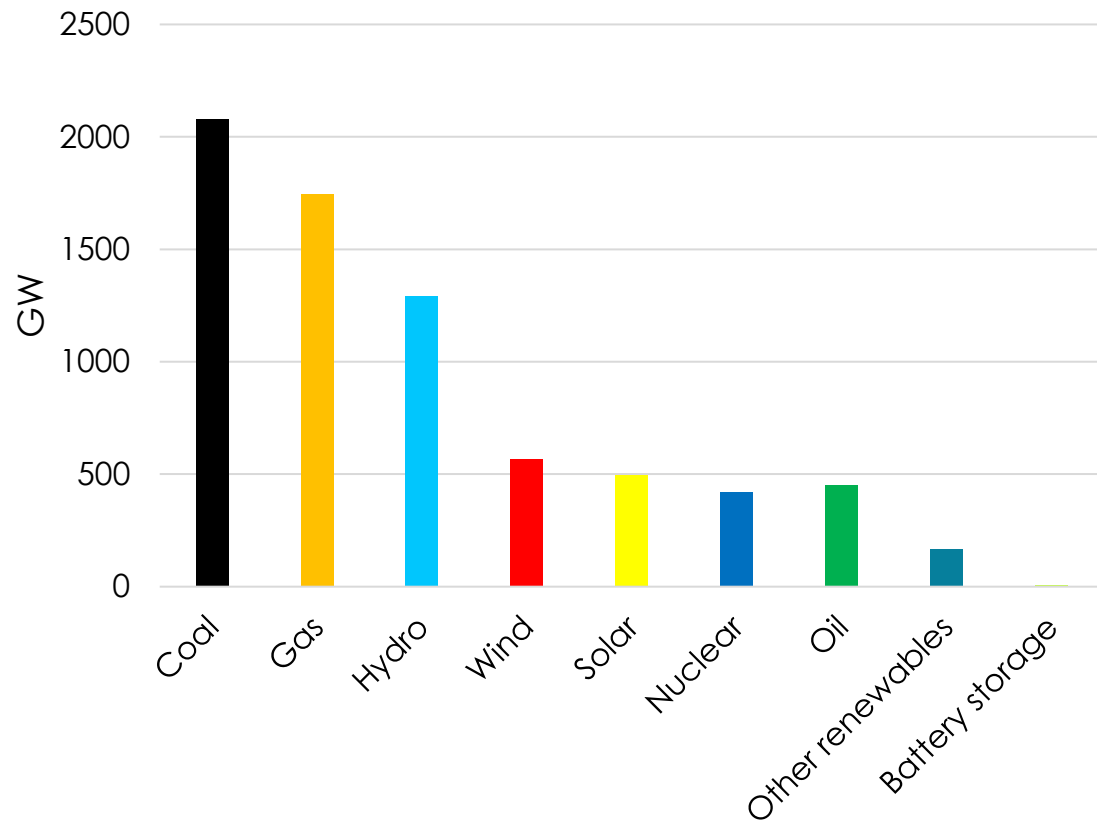


Change in global oil and electricity consumption in the SPS, 2018 - 2040

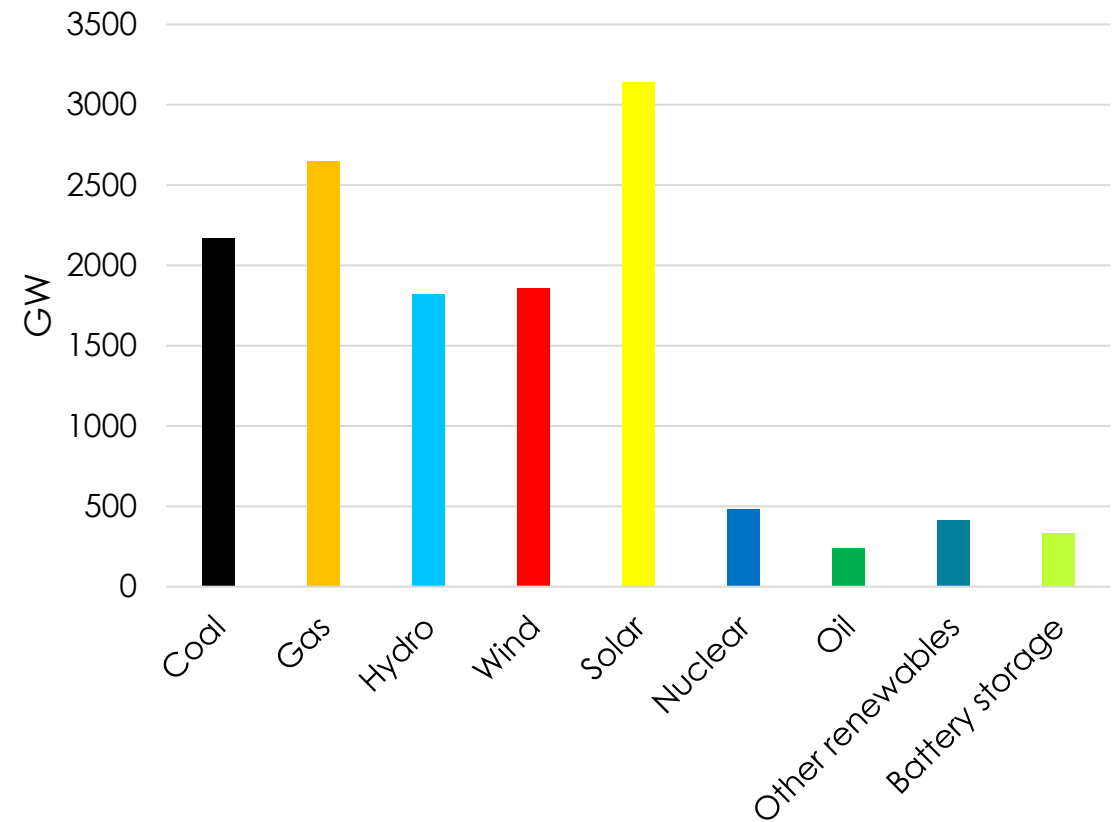


Electrification by renewables

Global power capacity by source in the Stated Policies Scenario (2018)



Global power capacity by source in the Stated Policies Scenario (2040)



Gasification-1

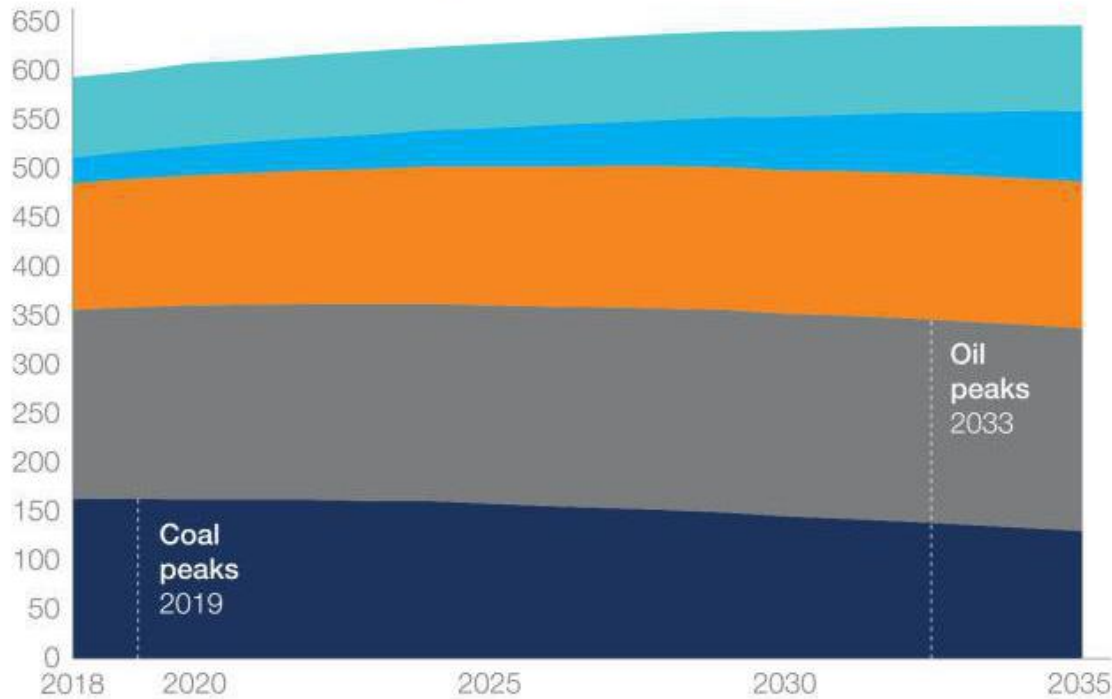
- Regional markets
- Still increasing, for now
- LNG vs. pipeline
- Zero emission implication

Gasification-2

Global primary energy demand per fuel

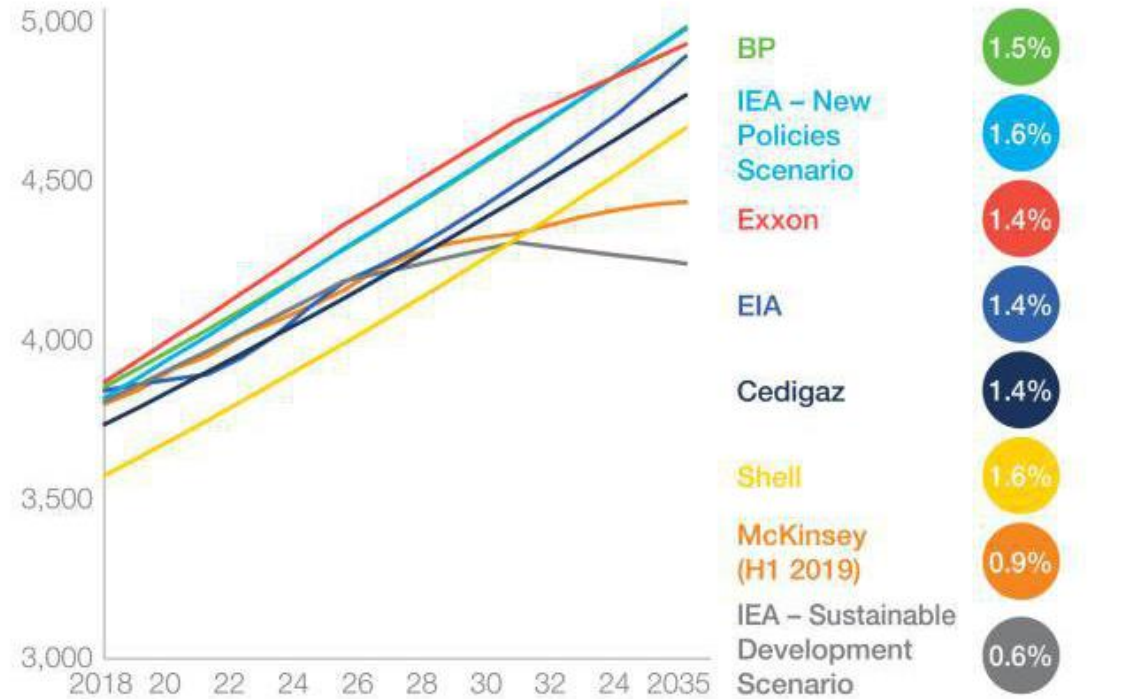
Million terajoules

Other¹ Renewables Natural gas Oil Coal



Projected gas demand

bcm



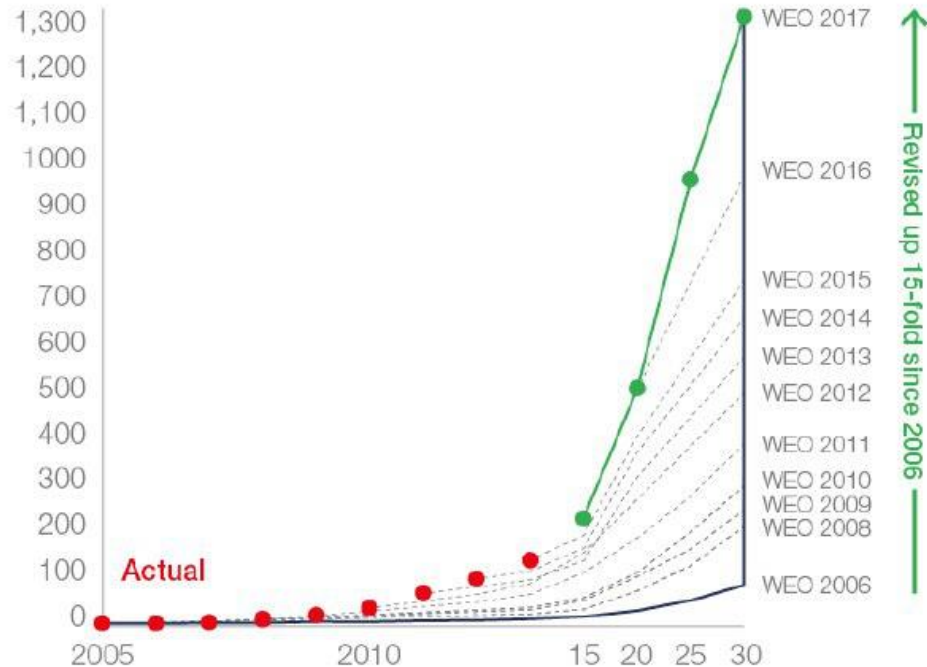
¹ Includes nuclear and biomass

Source: BP Energy Outlook 2019, EIA International Energy Outlook 2018, IEA World Energy Outlook 2018, Energy Insights by McKinsey 2019; Shell LNG Outlook 2019; Exxon Outlook for Energy 2018

Underestimating renewables-1

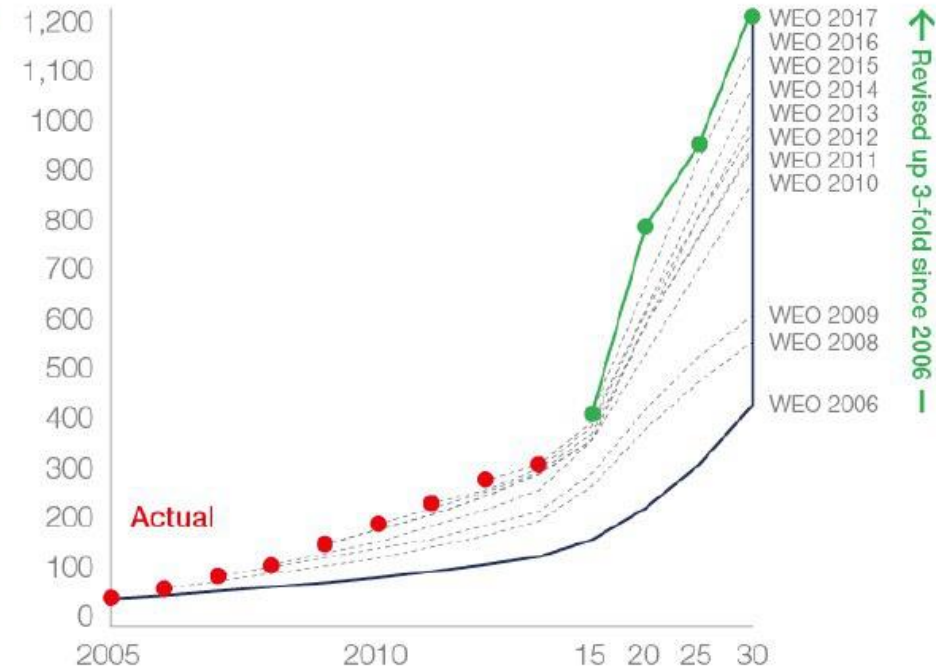
Solar: global forecast of cumulative installed capacity

GW



Wind: global forecast of cumulative installed capacity

GW

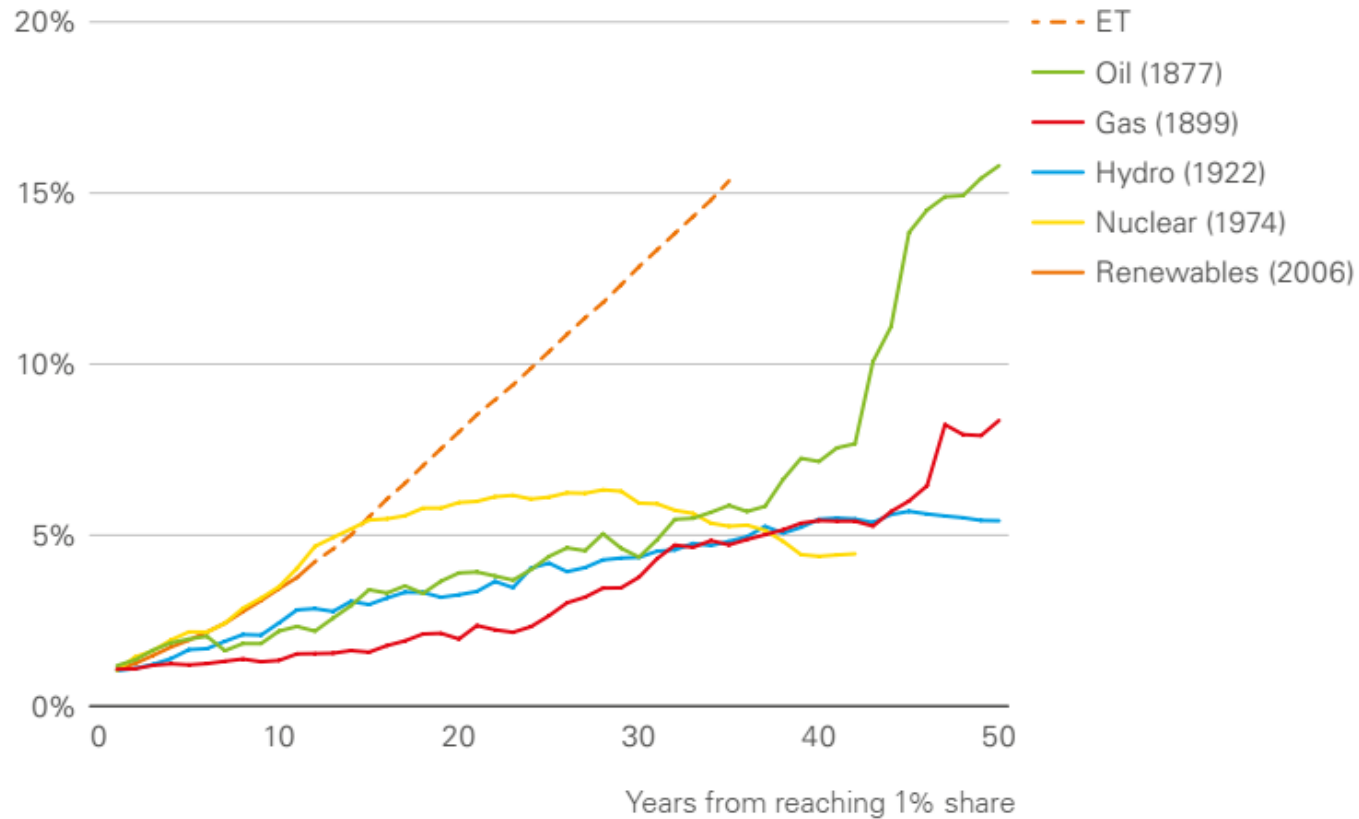


Source: IEA World Energy Outlook – New Policy Scenario

Underestimating renewables-2

Speed of penetration of new fuels in global energy system

Share of world energy



Hubbert peak

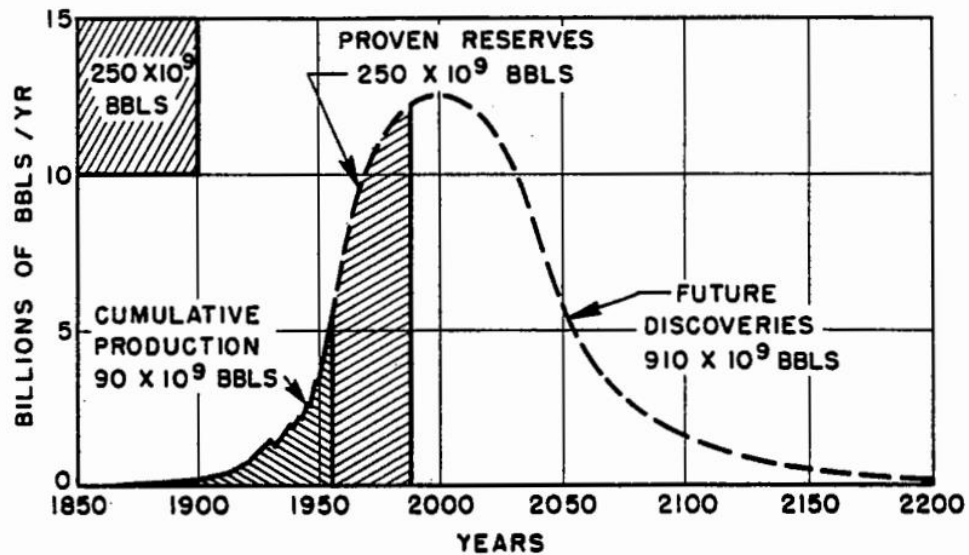


Figure 20 - Ultimate world crude-oil production based upon initial reserves of 1250 billion barrels.

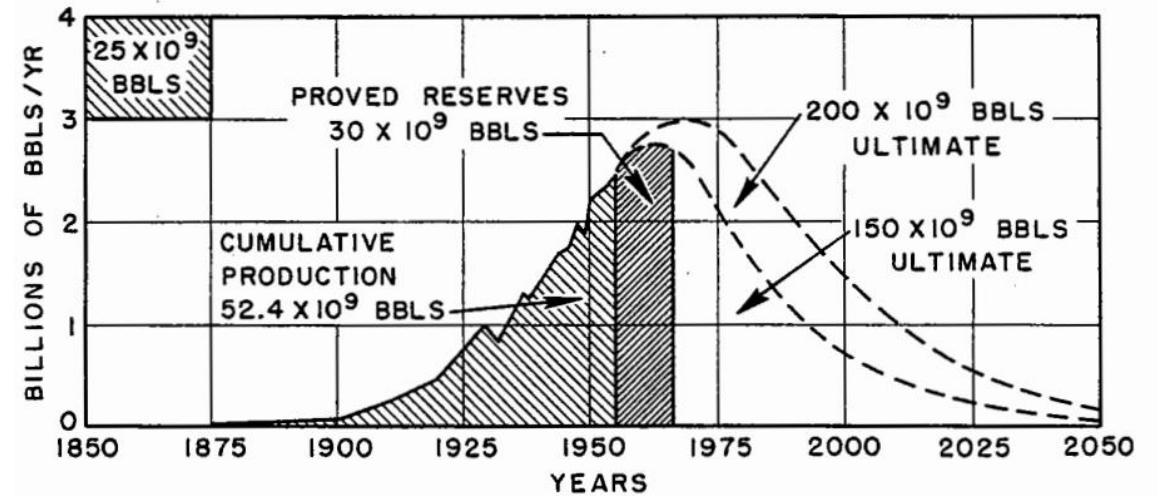
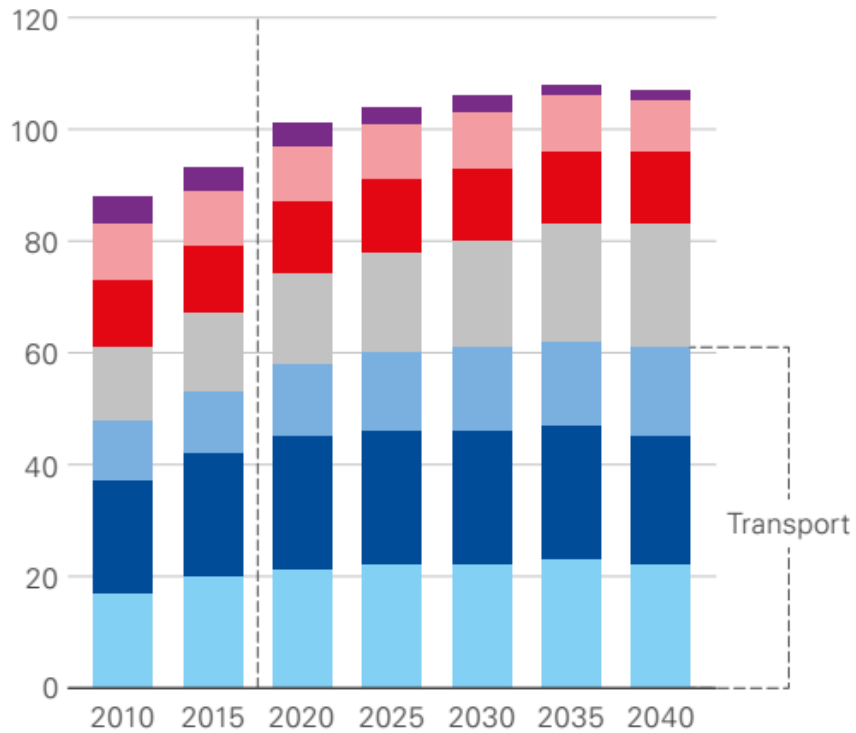


Figure 21 - Ultimate United States crude-oil production based on assumed initial reserves of 150 and 200 billion barrels.

Peak oil demand-1

Liquids demand

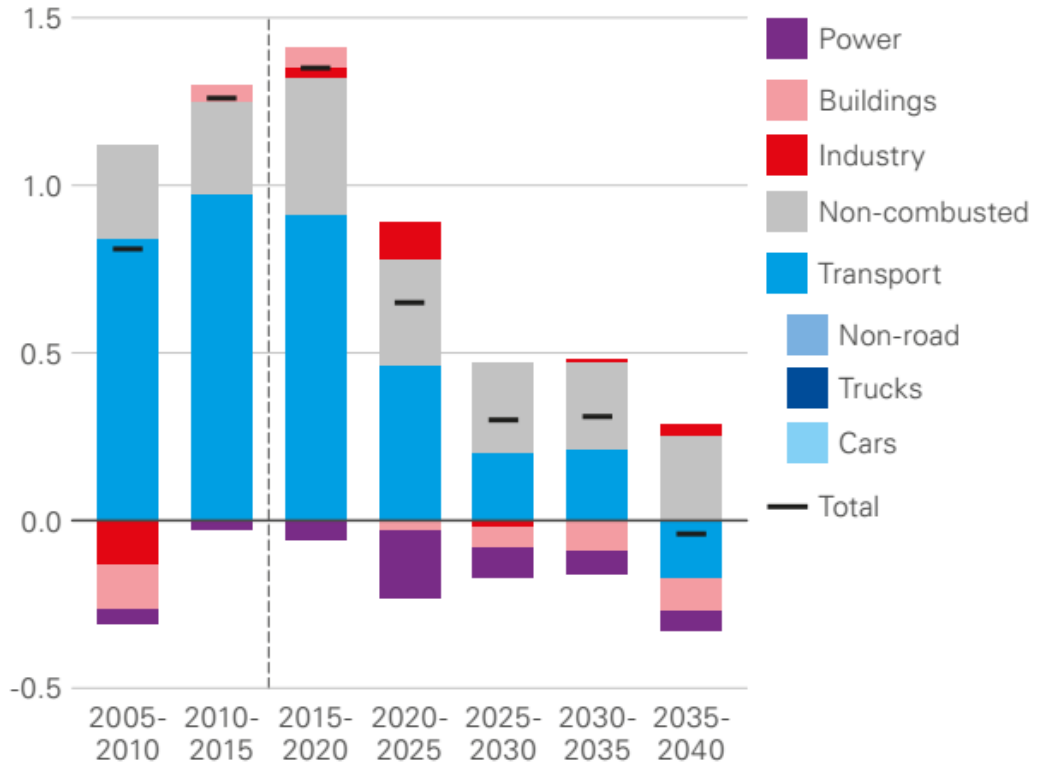
Mb/d



Cars include 2- and 3-wheelers. Trucks includes most SUVs in North America. Non-road includes aviation, marine and rail

Liquids demand growth

Mb/d, average annual growth

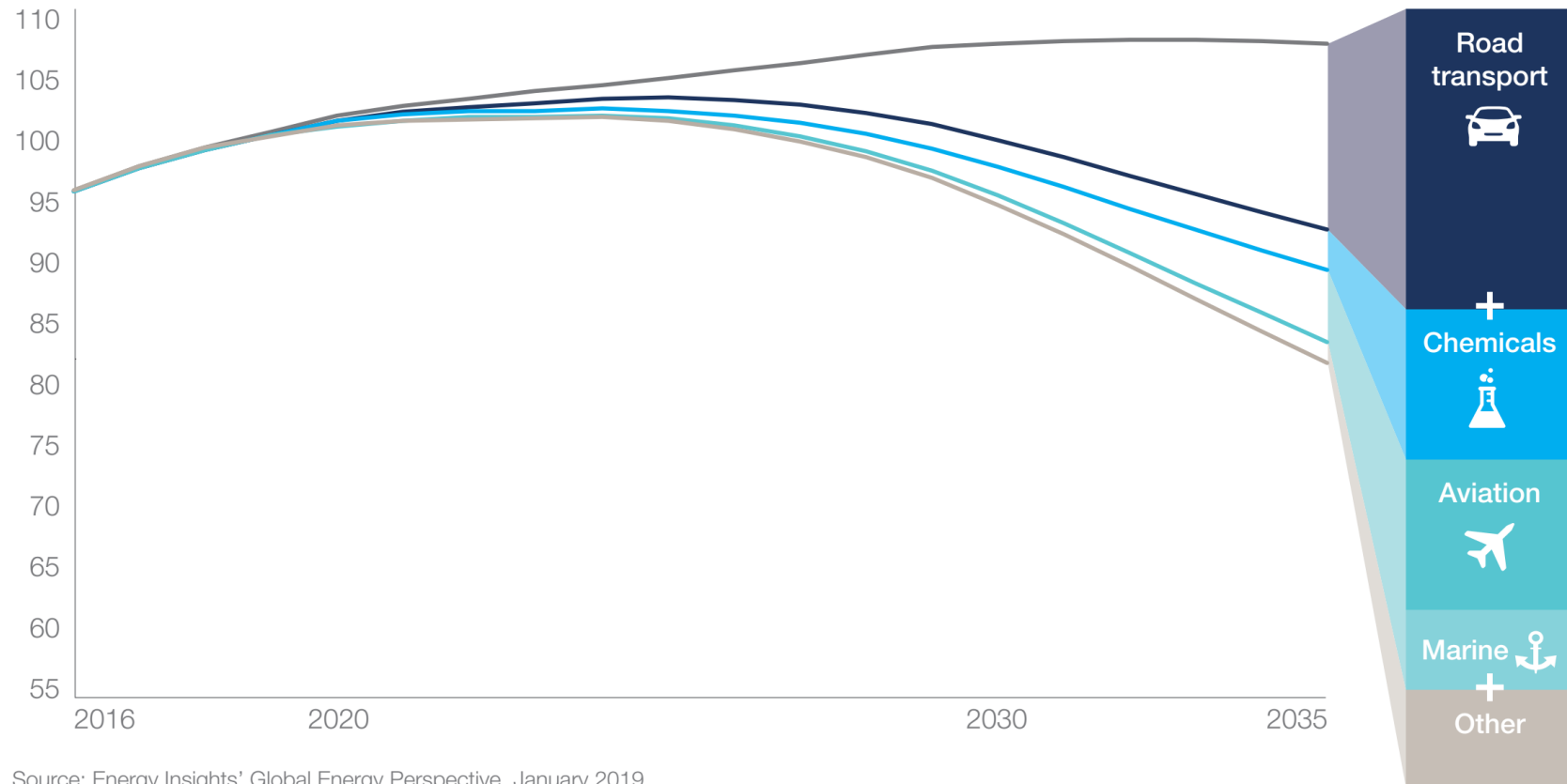


Peak oil demand-2

Global liquids demand

MMb/d

— Reference — Road disruption — Chemicals disruption
— Aviation and marine disruption — Accelerated Energy Transition



Source: Energy Insights' Global Energy Perspective, January 2019

■ Reference Case ■ Additional in Accelerated Energy Transition case

EV passenger car penetration

EVs as % of global new passenger car sales



EV commercial vehicle penetration

EVs as % of global new truck car sales



Plastics recycling

% polyethylene from recycled feedstock



Alternative fuels uptake

% biofuels, natural gas, and electricity in the fuel mix



Other

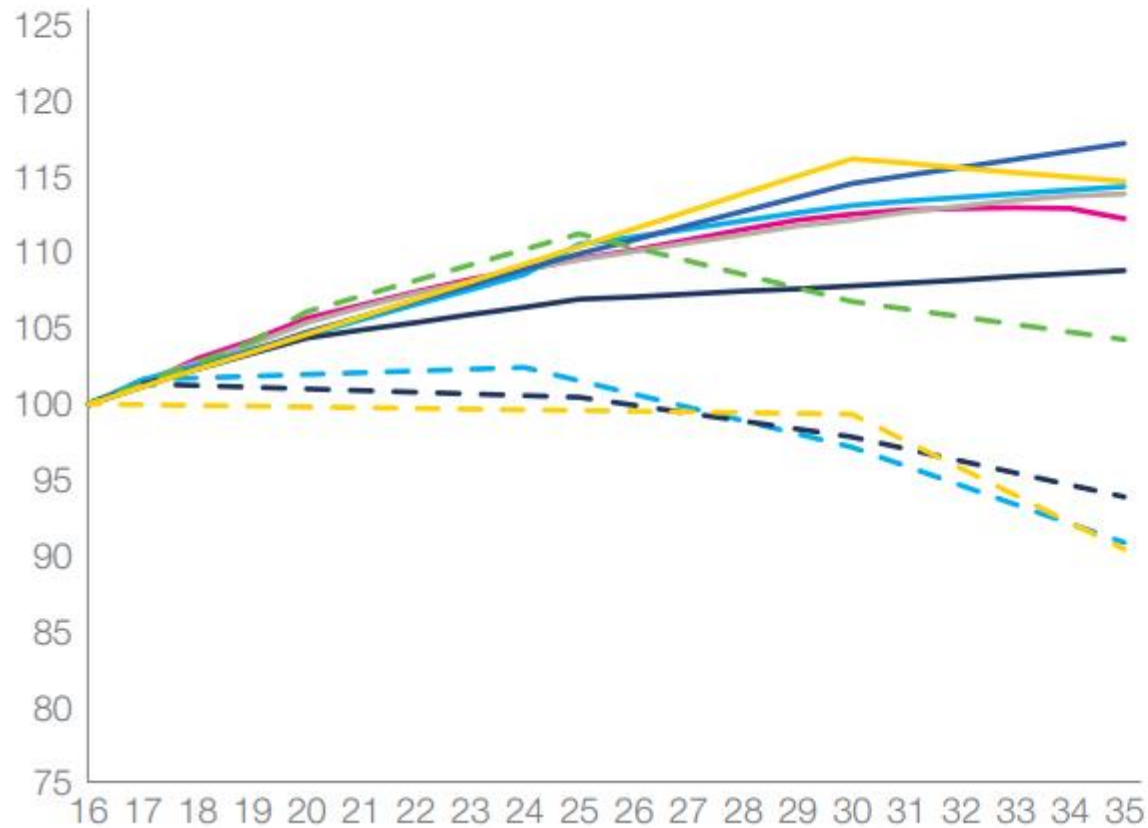
Heat and cooking electrification; industry electrification; and other transport and other energy sectors

Peak oil demand-3

Global oil demand¹

Indexed to 100

— Reference case forecasts -- Sustainability cases



CAGR

2018-35

ExxonMobil 0.8%

Equinor Reform 0.7%

IEA New Policies 0.6%

Global Downstream Model 2018¹ 0.6%

Global Downstream Model 2019¹ 0.5%

BP Evolving Transition 0.4%

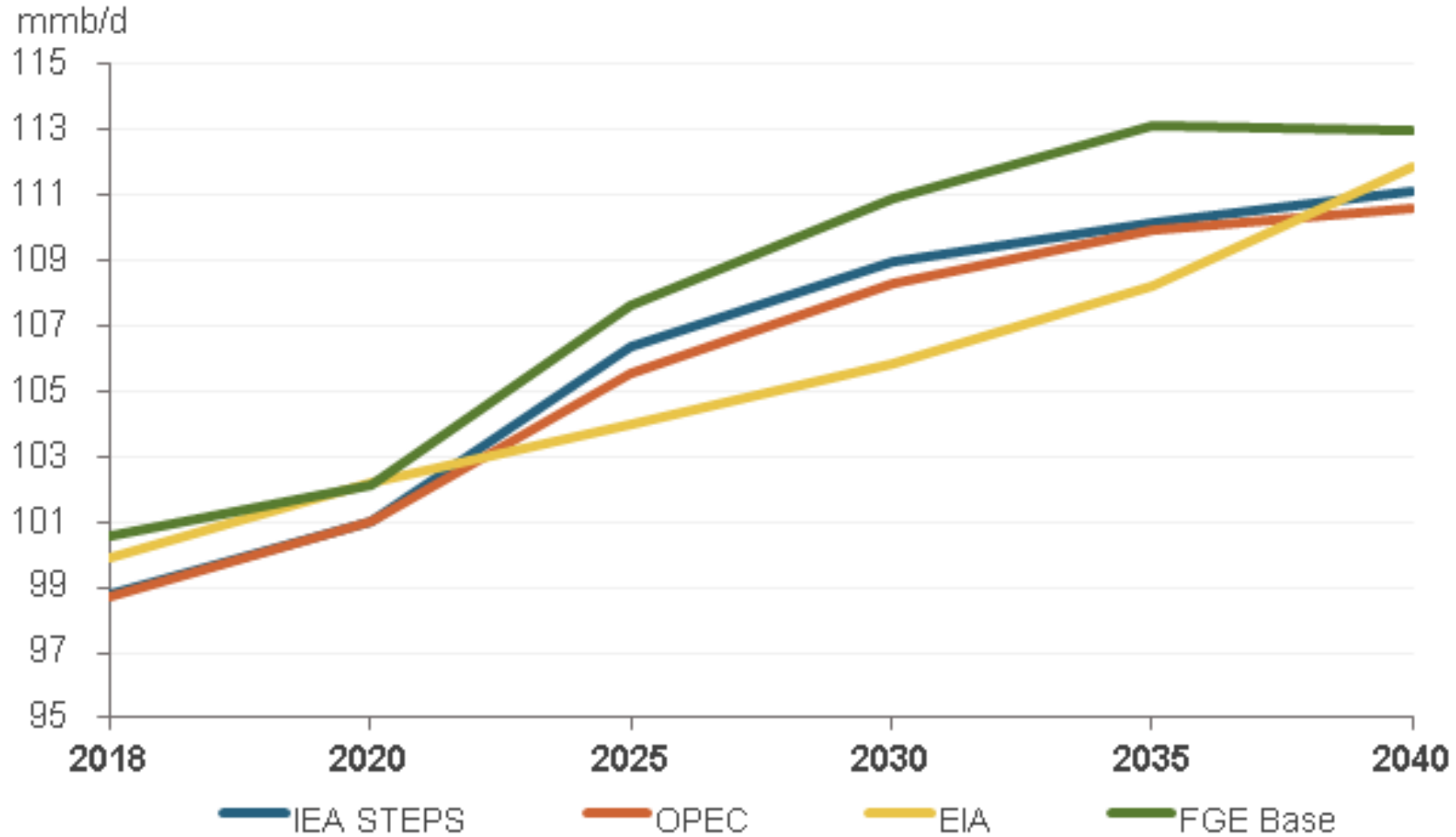
Shell – Sky 0.1%

BP Rapid Transition -0.4%

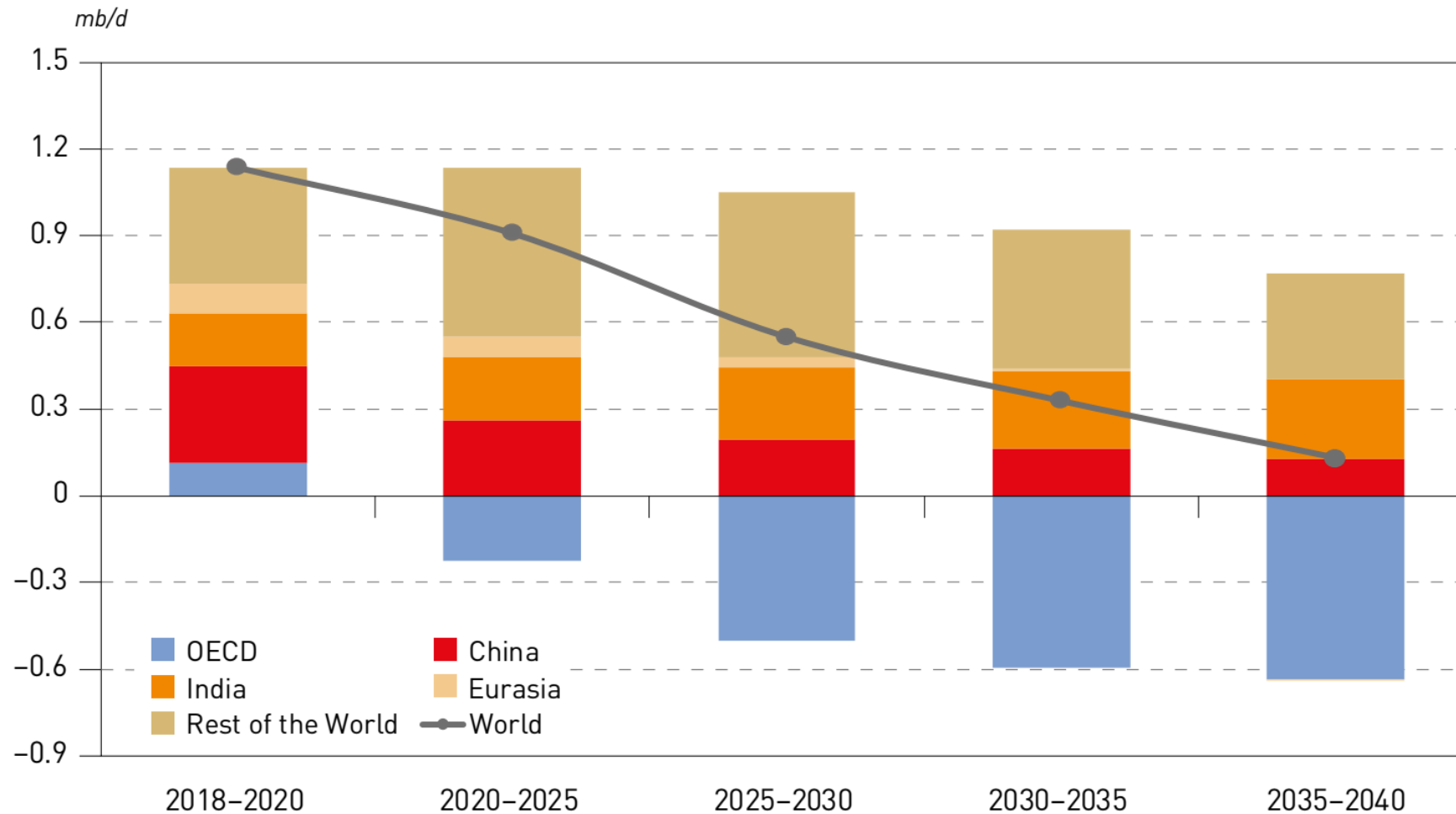
IEA Sustainable Development -0.7%

Equinor Renewal -0.6%

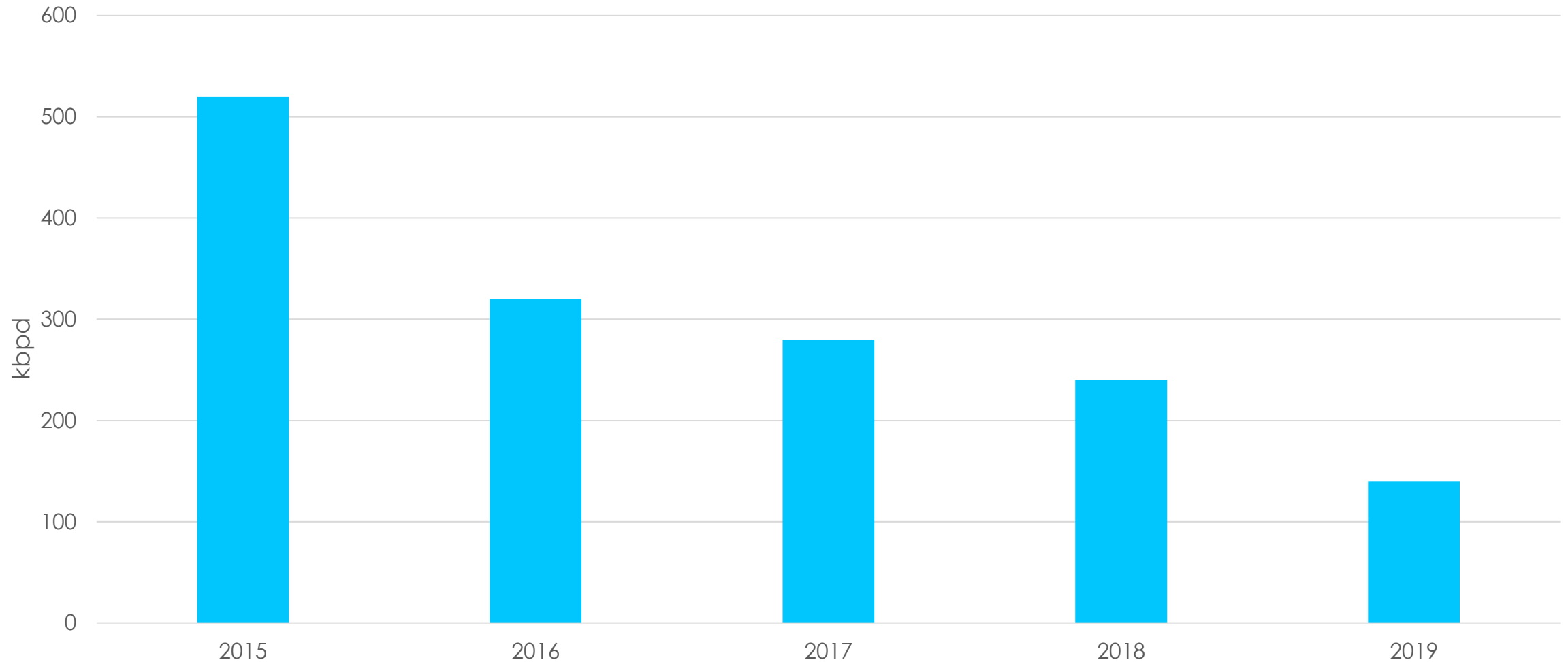
Peak oil demand-4



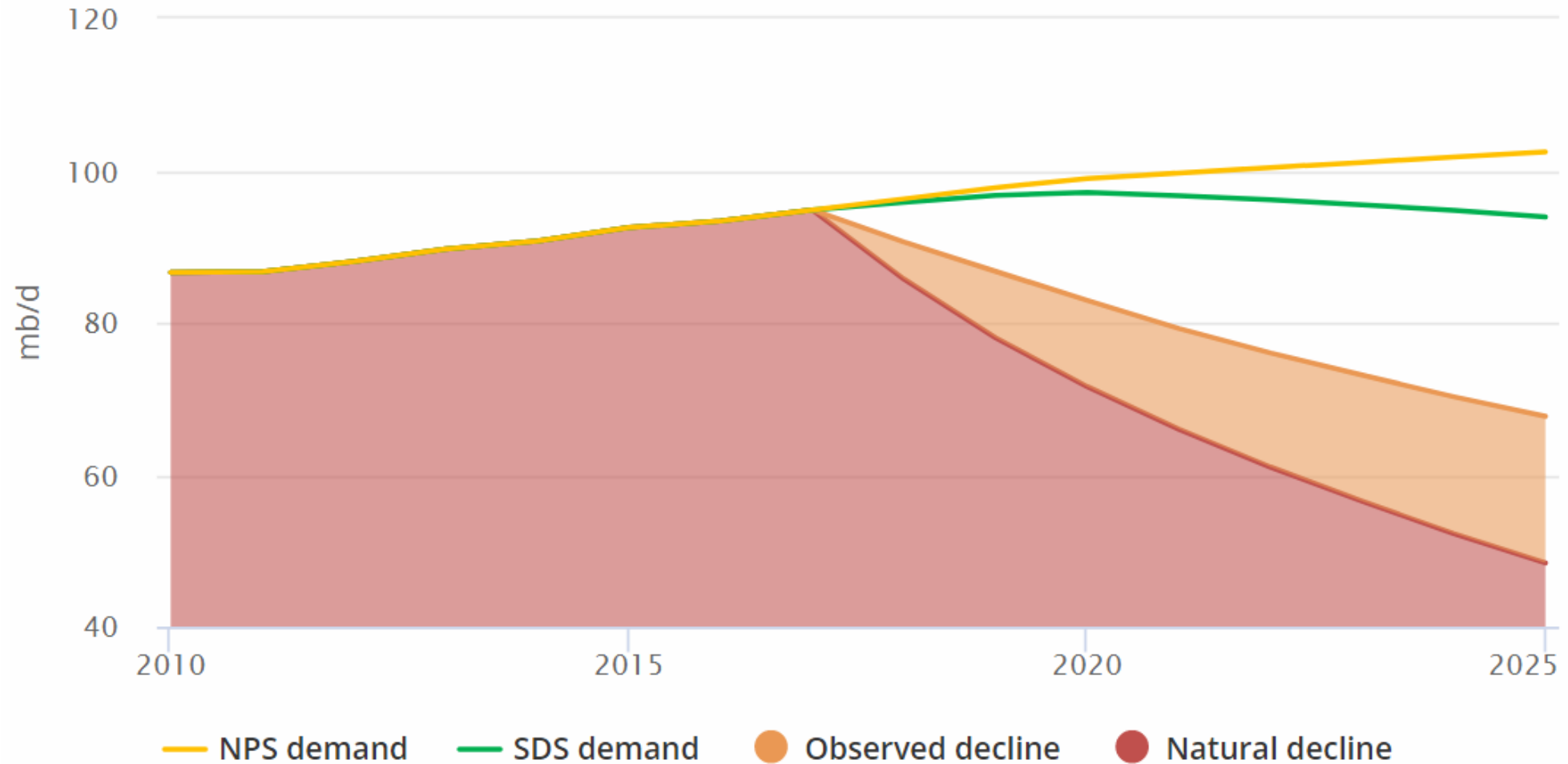
Average annual oil demand growth, 2018–2040



Average annual oil demand growth, 2035–2040



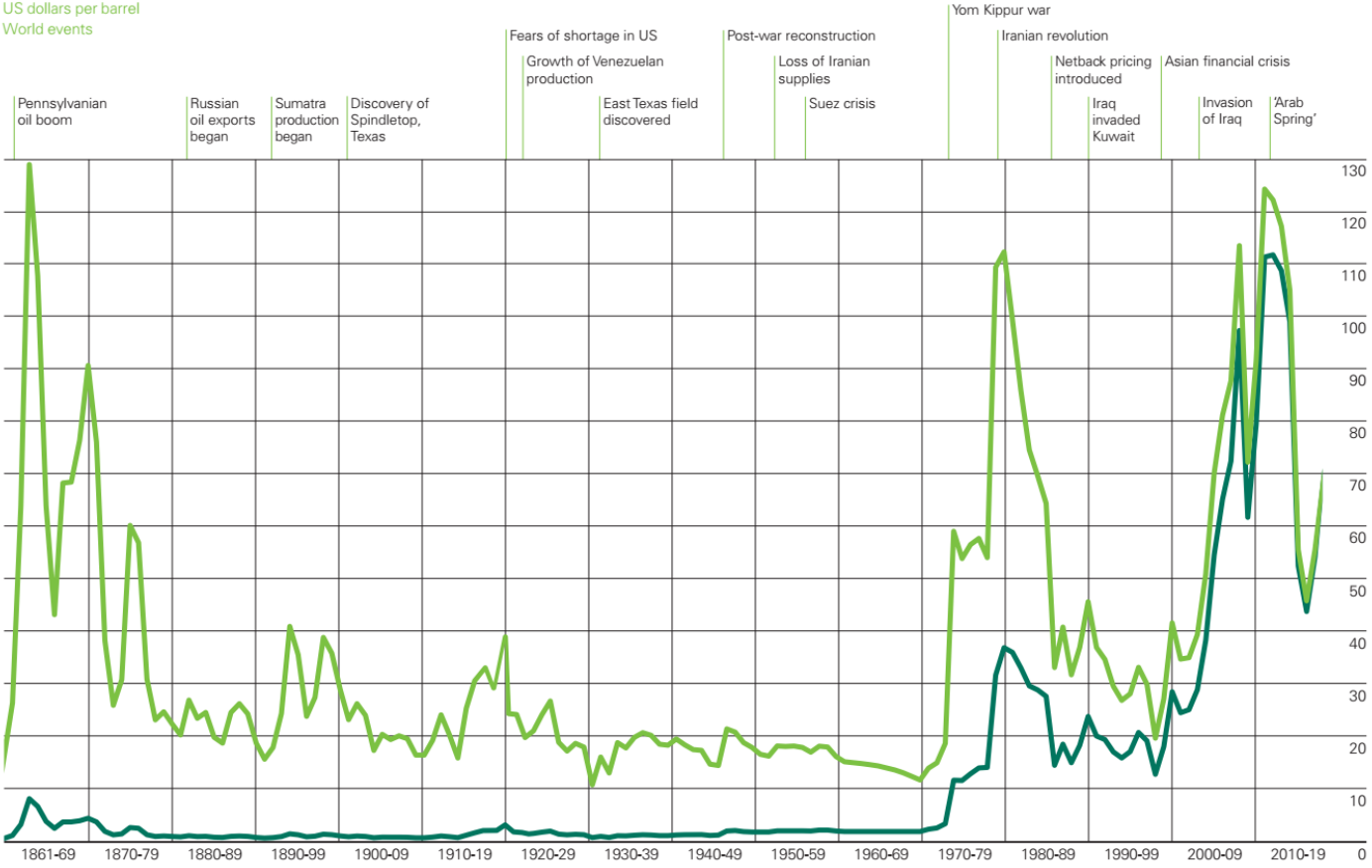
Necessary investment for the industry



Crude oil prices 1861-2018

Crude oil prices 1861-2018

US dollars per barrel
World events



■ \$ 2018 (deflated using the Consumer Price Index for the US)
■ \$ money of the day

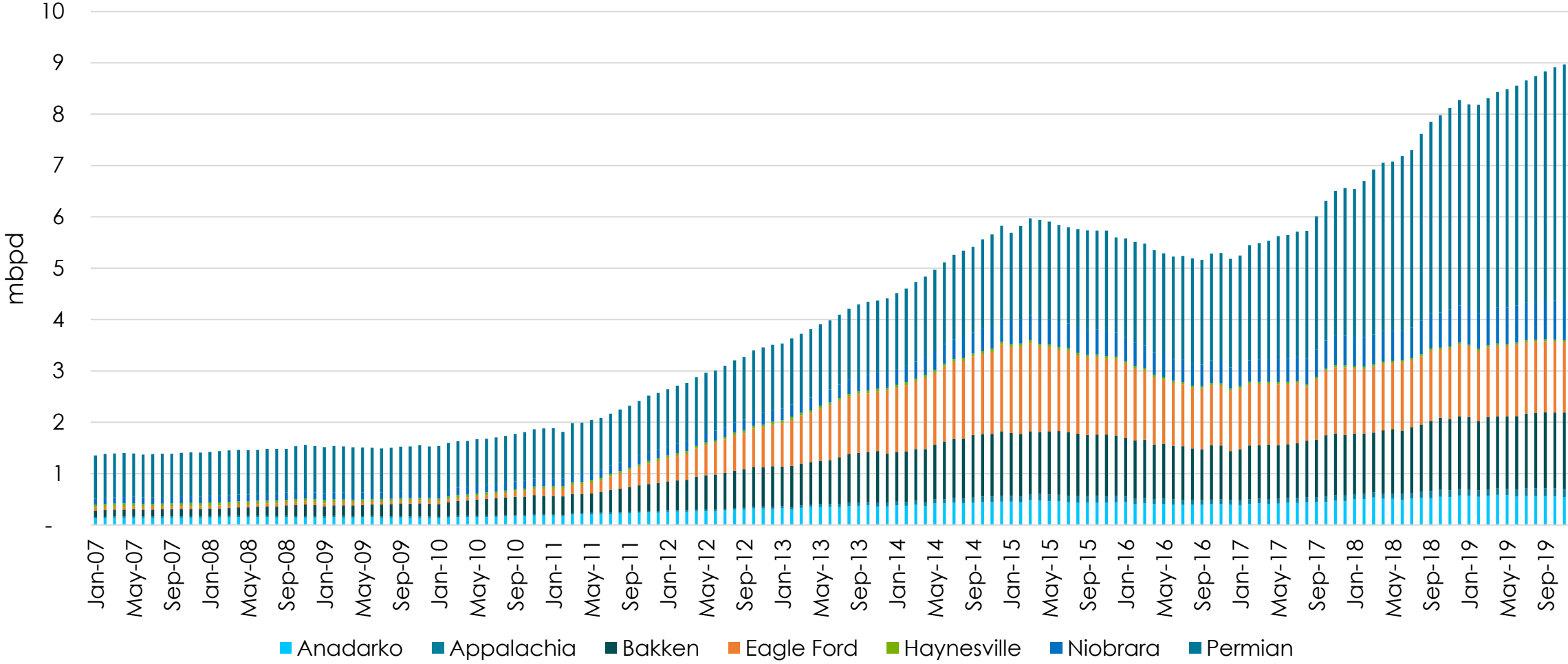
1861-1944 US average.
1945-1983 Arabian Light posted at Ras Tanura.
1984-2018 Brent dated.



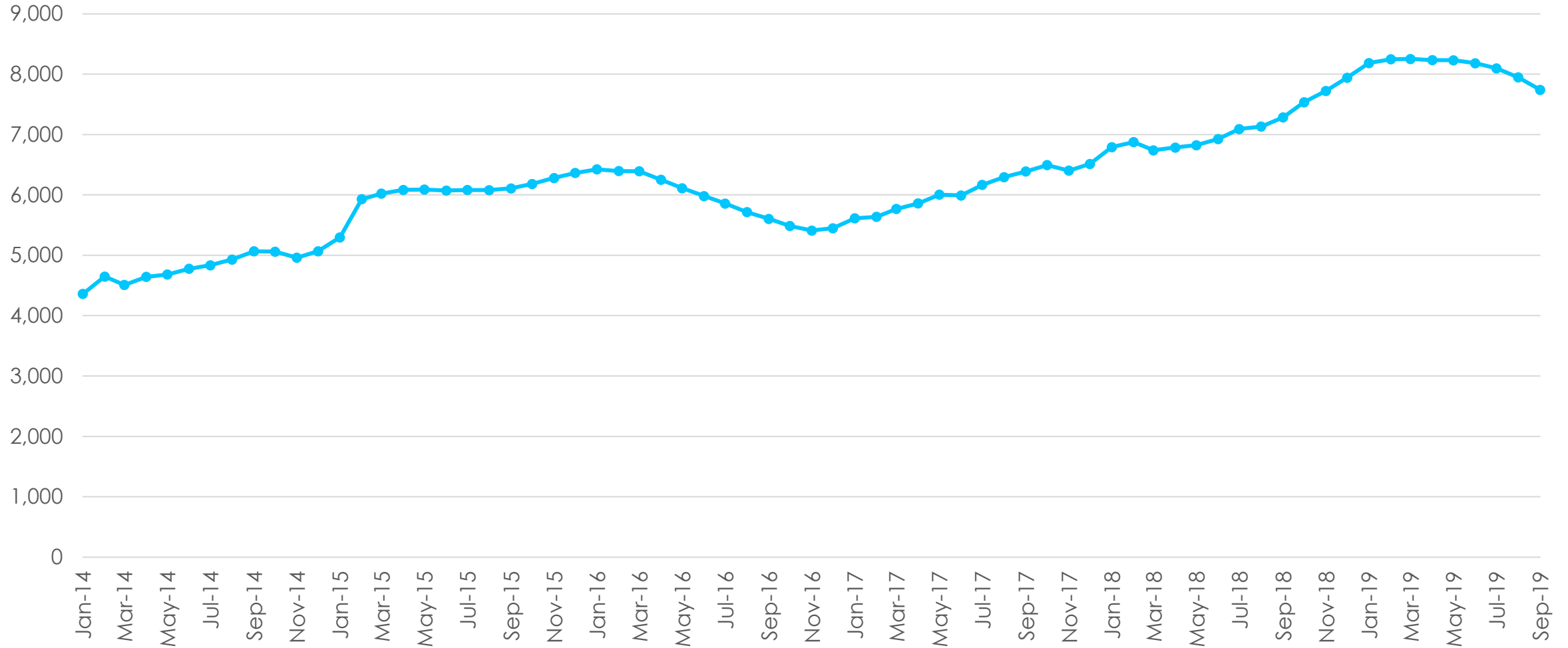
The shale revolution

- Definition
- Shale gas and shale oil revolution (LPG, ethylene, PE, methanol)
- Cost reduction (structural vs. cyclical)
- DUC wells
- Rule of capture
- Export ban
- Pipelines

US shale oil production

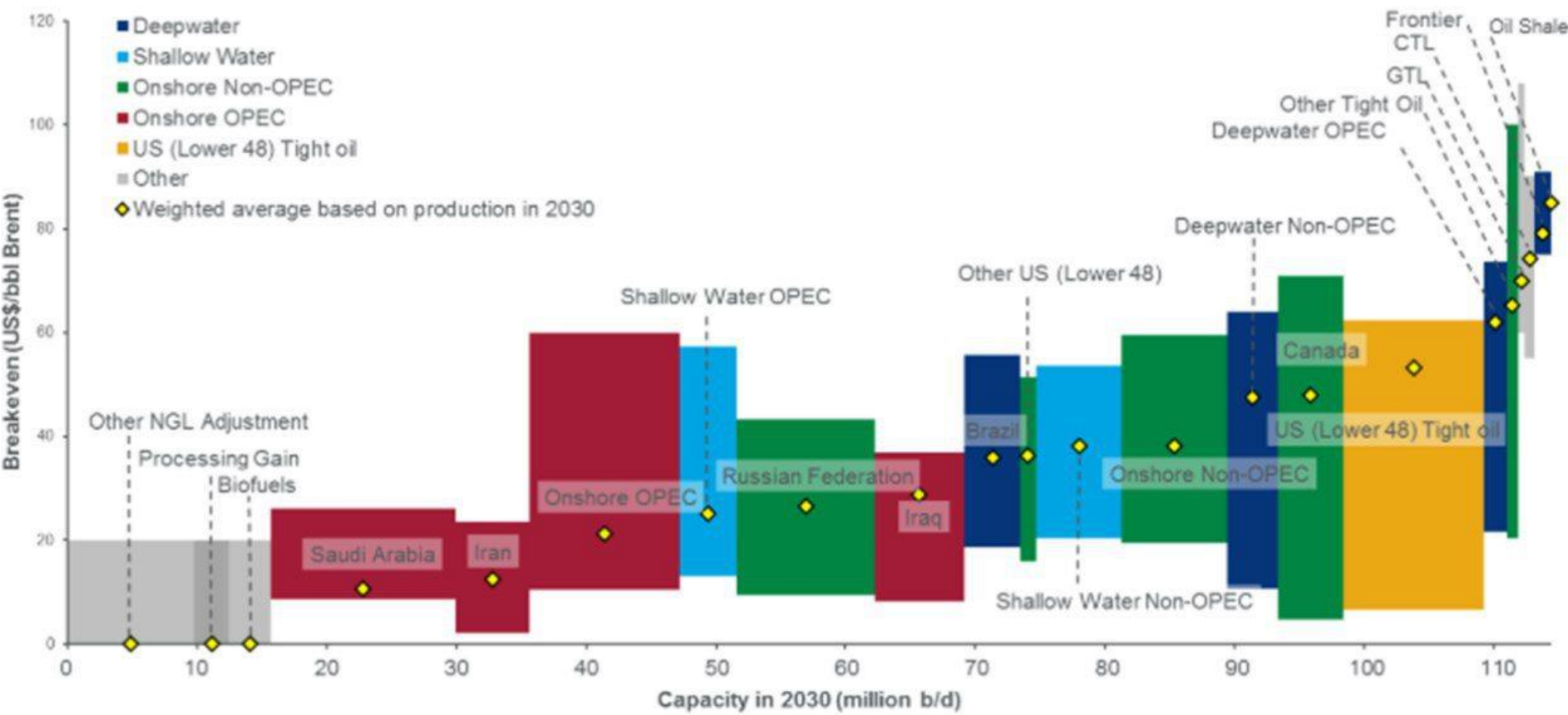


DUC wells



Cost curve

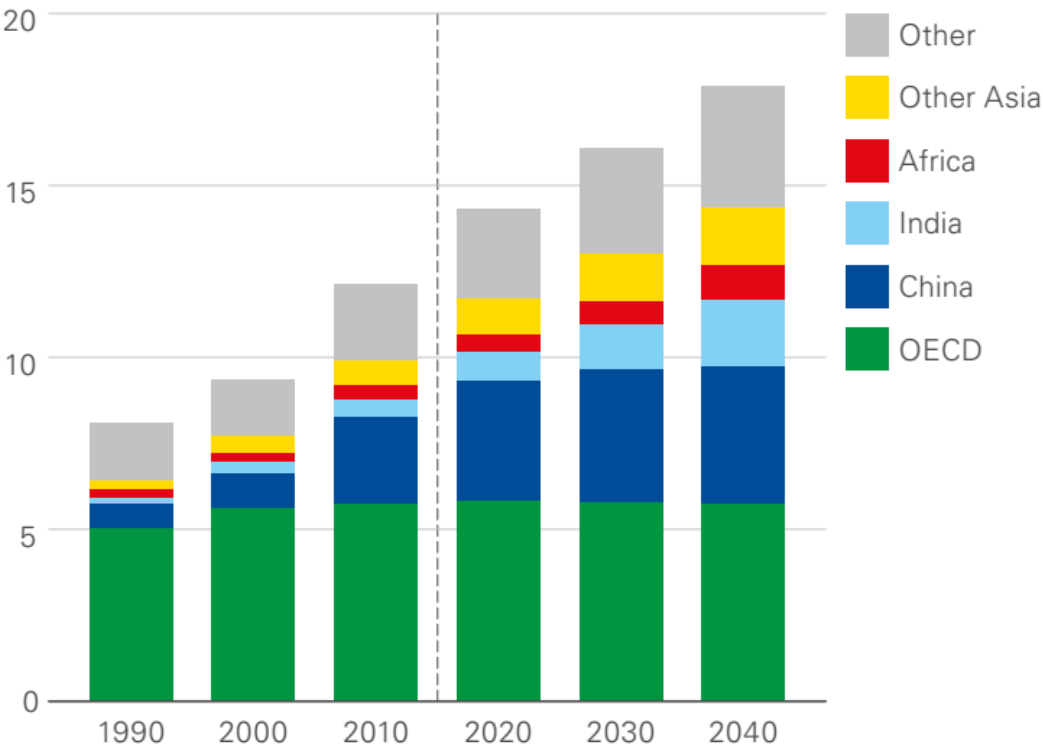
Global liquids capacity in 2030 by breakeven



Shift in energy demand centers

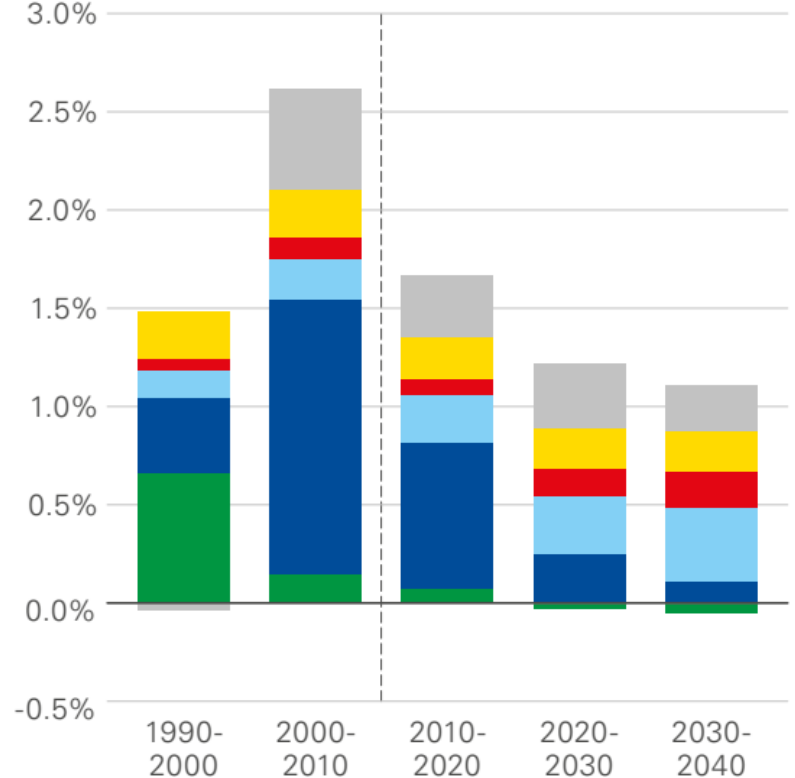
Primary energy consumption by region

Billion toe



Primary energy growth and regional contributions

% per annum



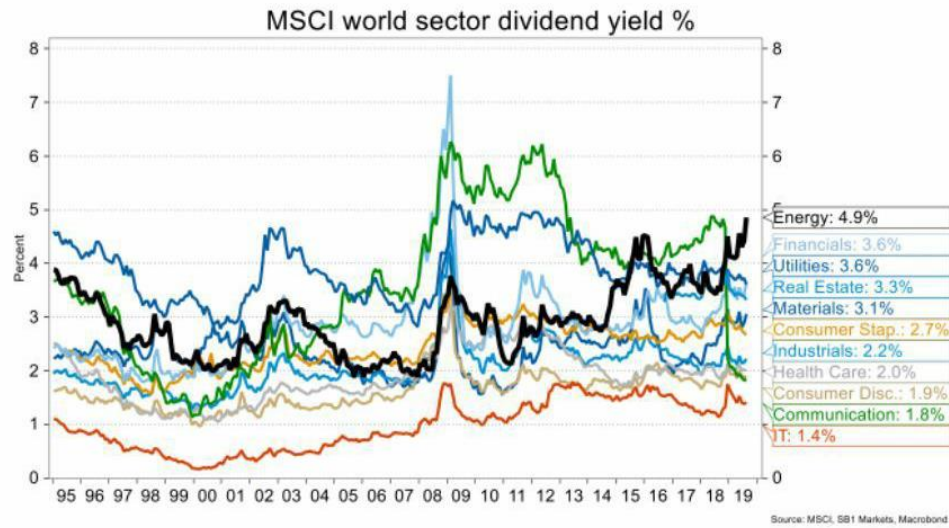


Implications for energy companies

Lower valuation

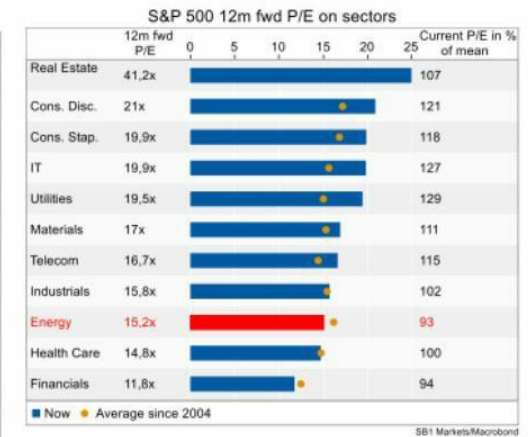
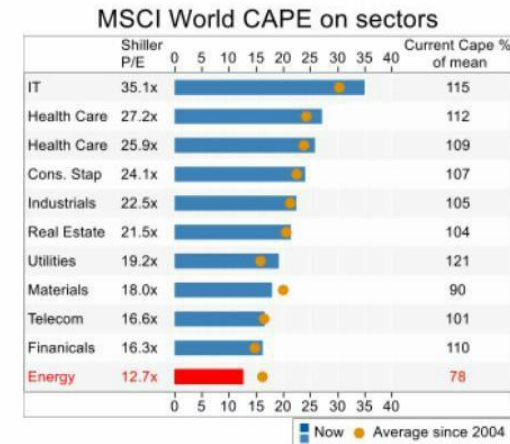
At 4.9%, the dividend yield is unprecedented

Dividend yield is at a 25-year high, and highest of all sectors



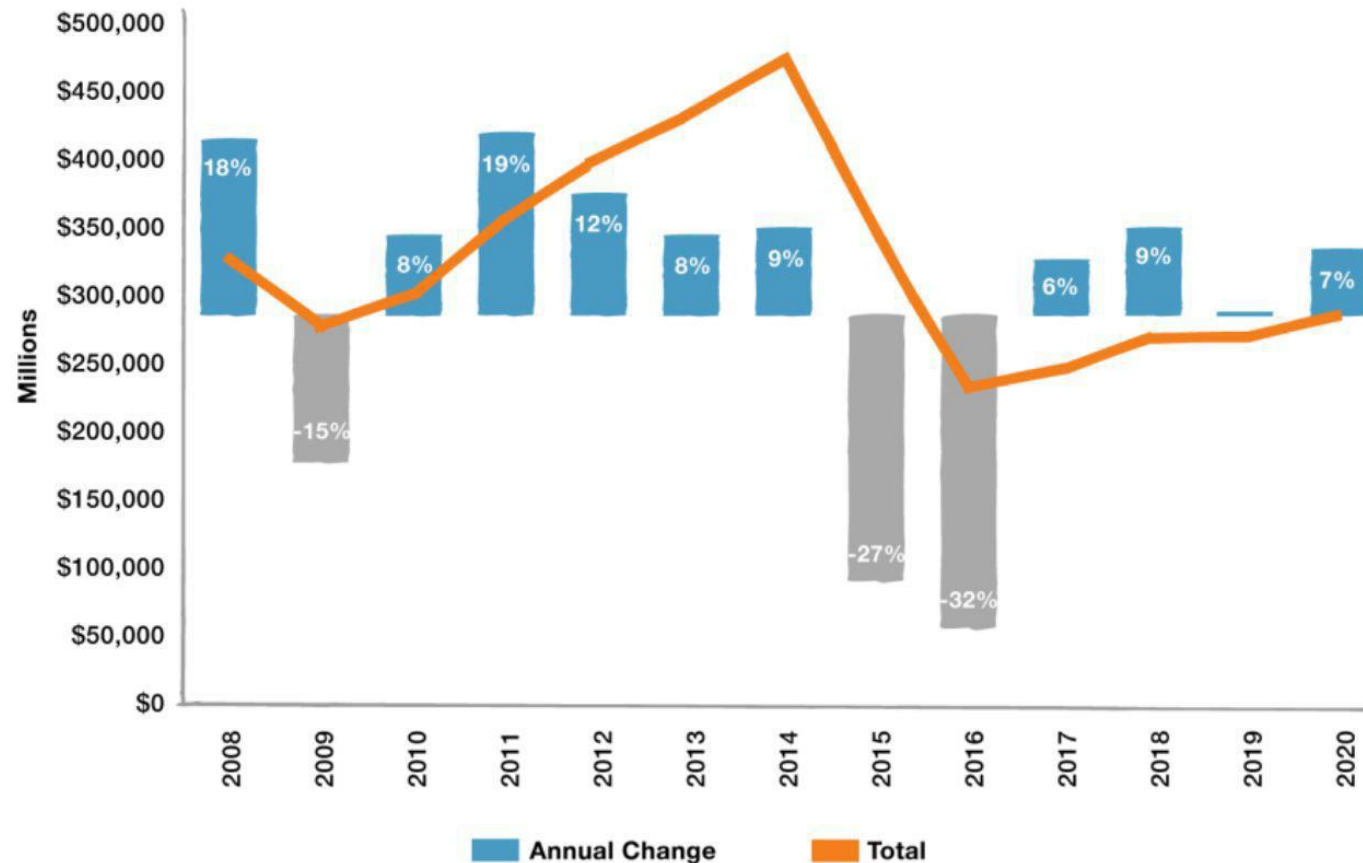
Energy is by far the cheapest sector now...

Lowest vs historical average, both on CAPE forward P/E. Lowest CAPE overall



Status of OFS companies

Global Oilfield Services

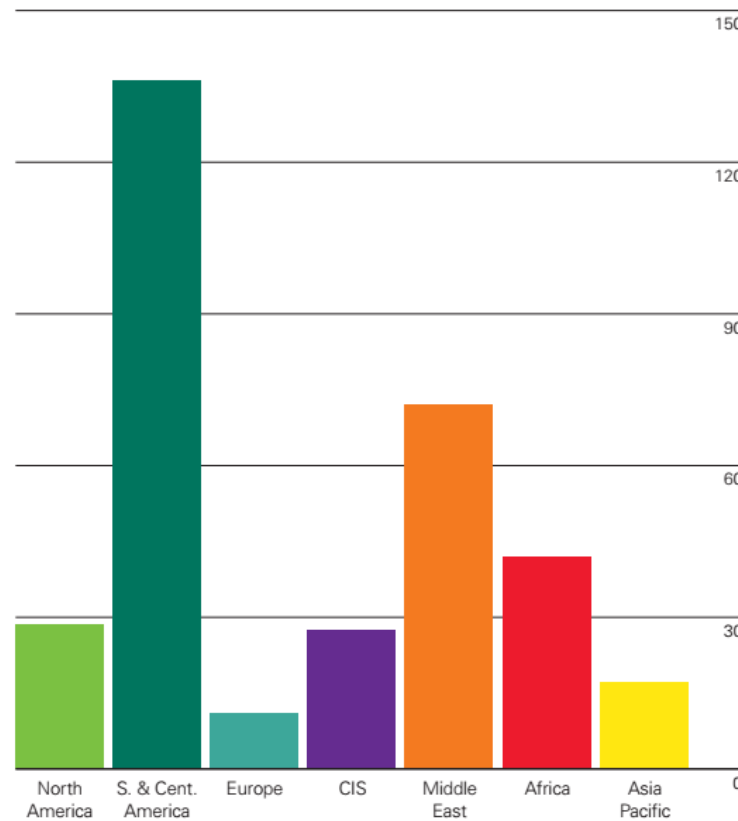


Maximum production

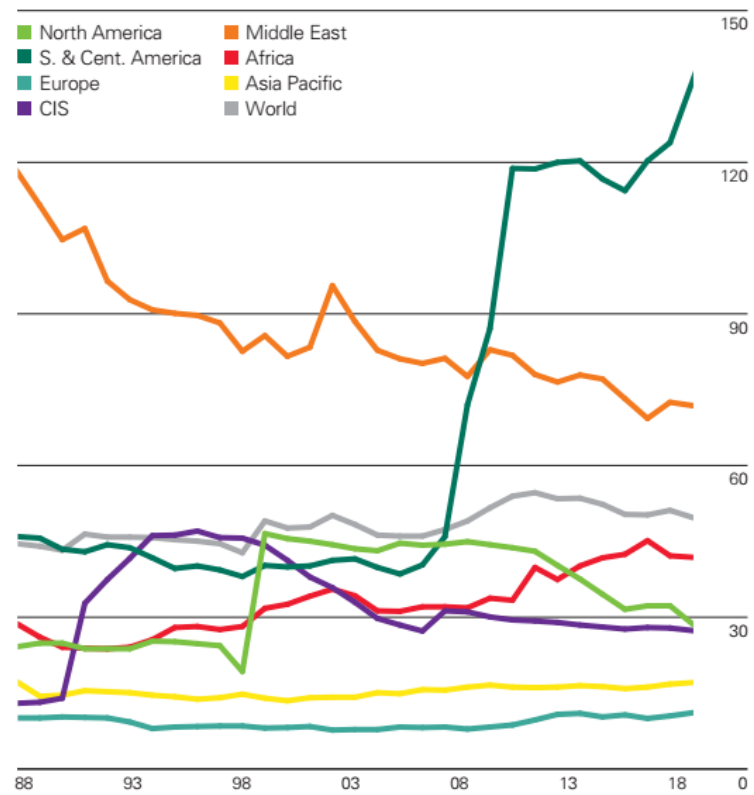
- Stranded resources and unburnable carbon
- Preservative production
- Upstream fiscal regimes
- Long-term prices

Reserve to production ratio-1

2018 by region

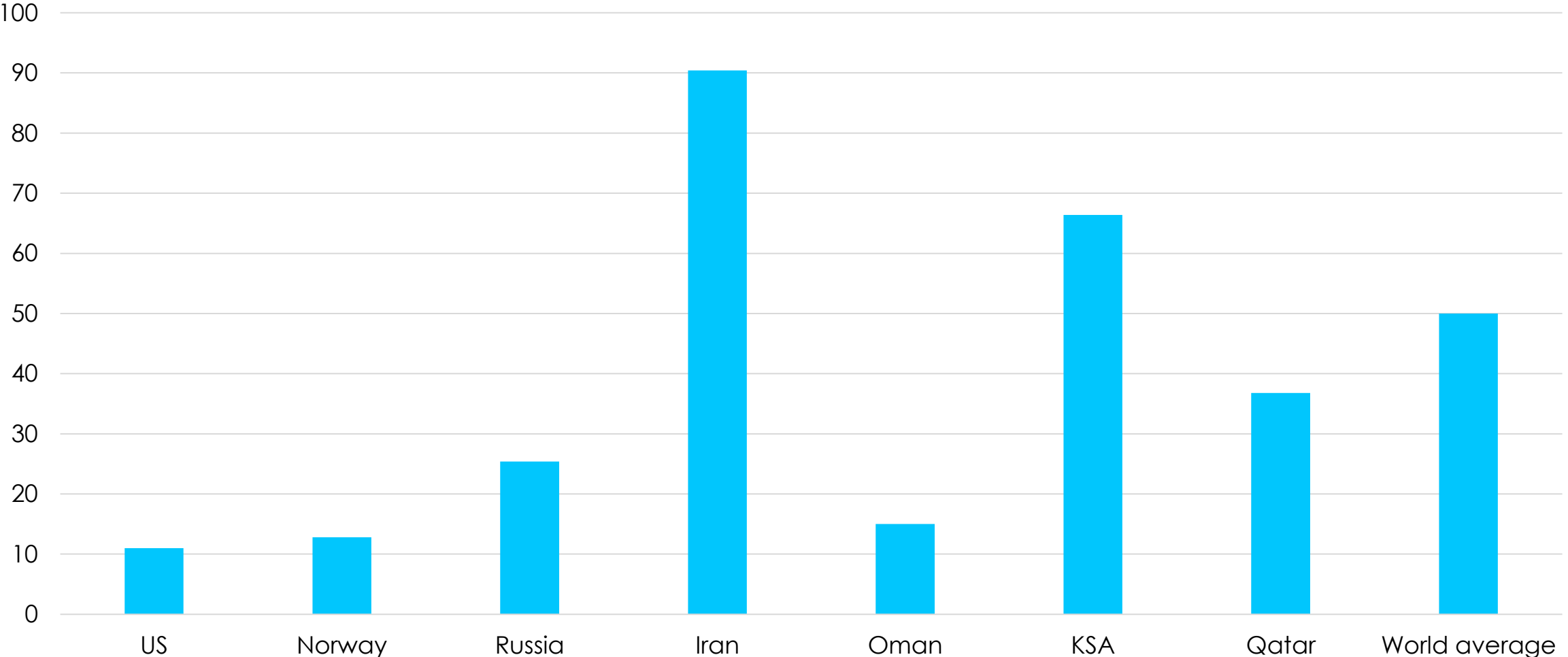


History

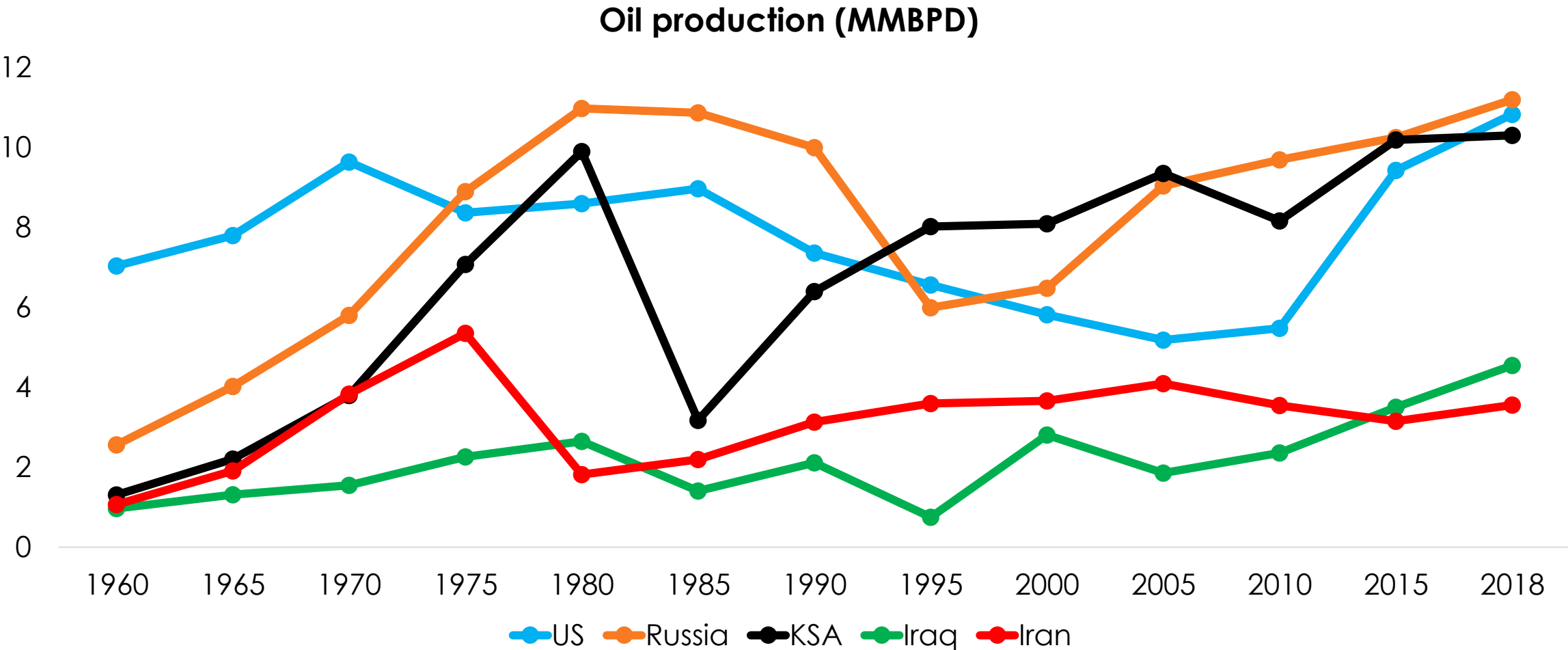


Oil reserves at the end of 2018 totalled 1730 billion barrels, up 2 billion barrels with respect to 2017. The global R/P ratio shows that oil reserves in 2018 accounted for 50 years of current production. Regionally, South & Central America has the highest R/P ratio (136 years) while Europe has the lowest (11 years). OPEC holds 71.8% of global reserves. The top countries in terms of reserves are Venezuela (17.5% of global reserves), closely followed by Saudi Arabia (17.2%), then Canada (9.7%), Iran (9.0%) and Iraq (8.5%)

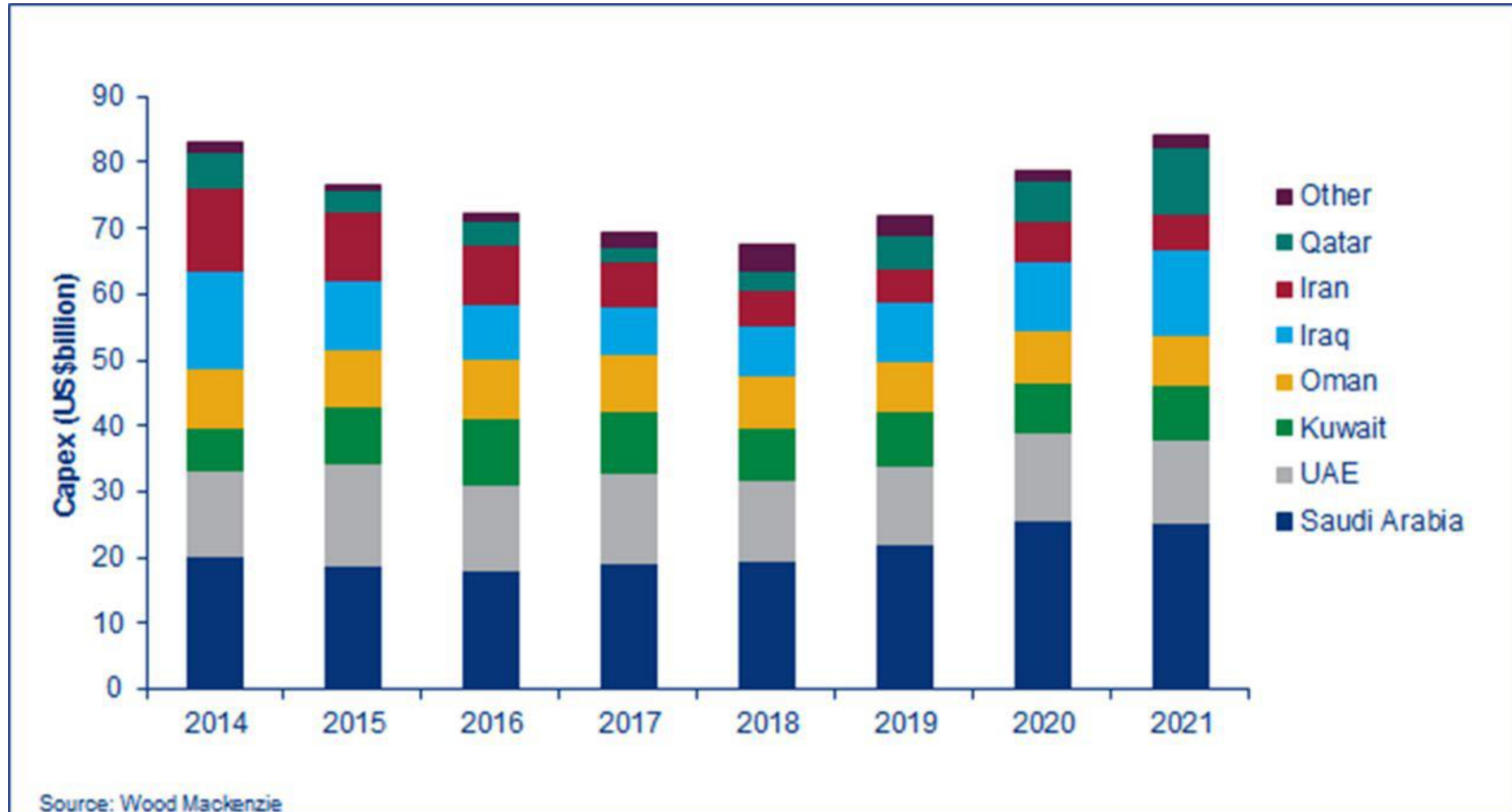
Reserve to production ratio-2



Iran oil production



Middle East upstream investment



Source: Wood Mackenzie

Other implications

- Energy vs. oil company
- Diversification
- Cost awareness
- M&A

“

The Stone Age did not end for lack of stone, and the Oil Age will end long before the world runs out of oil.

Zaki Yamani



Thank you



@EconomicsandOil