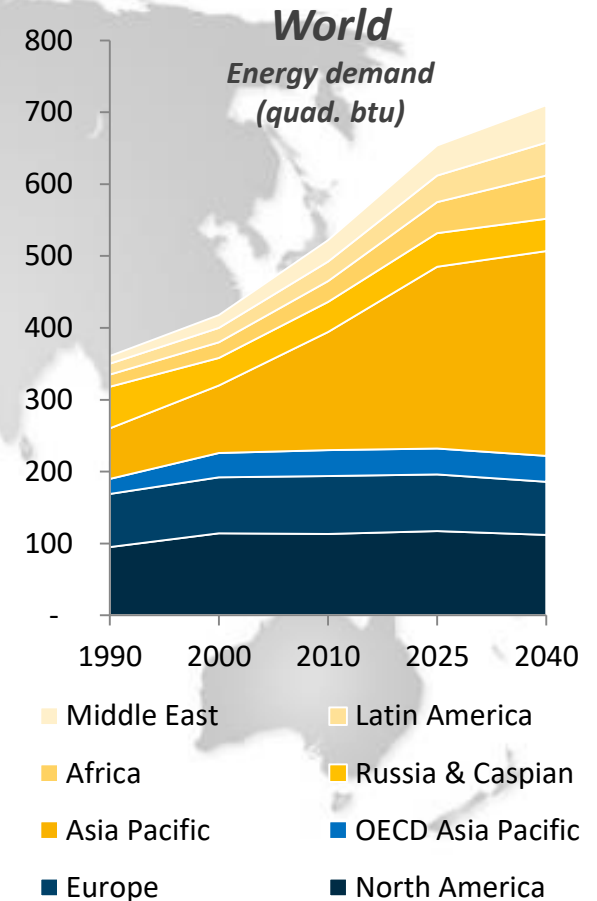
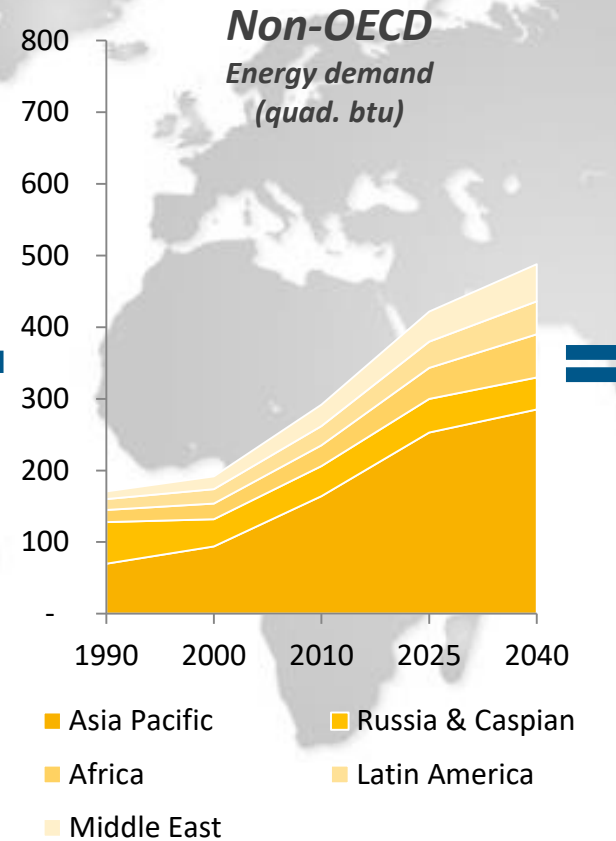
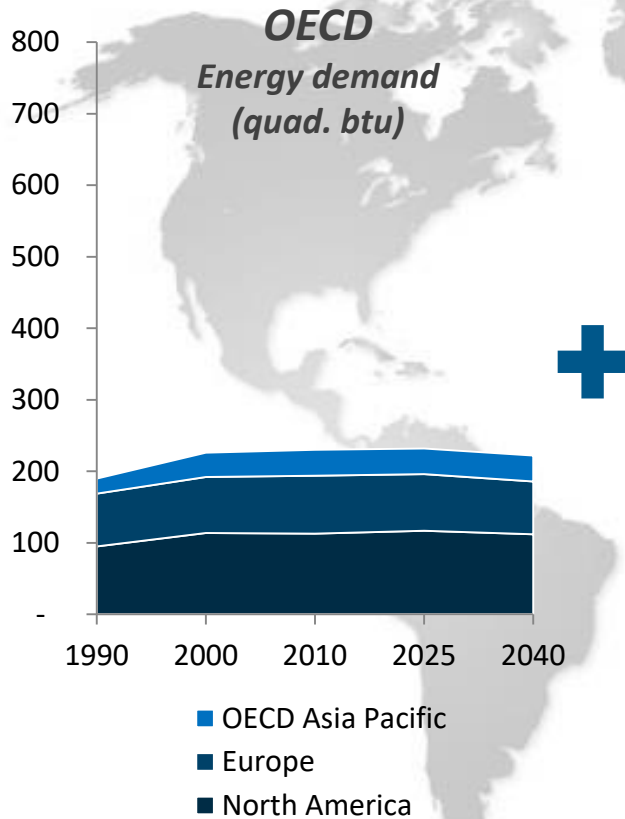


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# Energy Fundamentals

# Energy demand by region – 1990-2040 (est.)

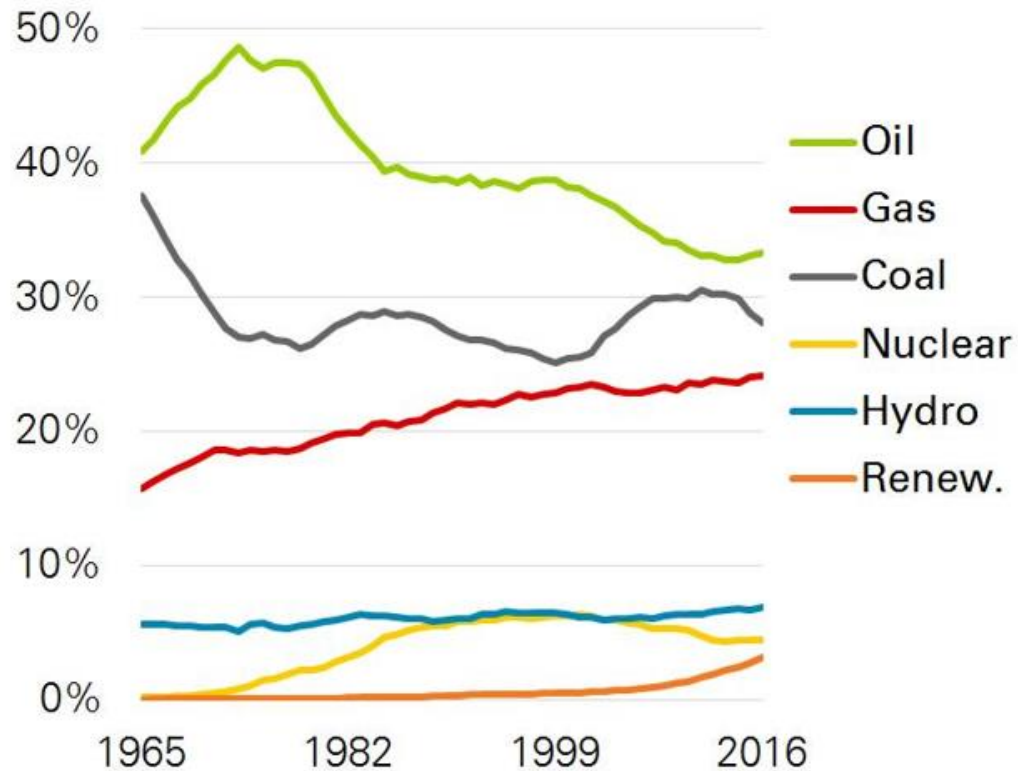


Source: ExxonMobil

- Expected growth in global energy demand will be exclusively in non-OECD/emerging markets. Demand in OECD countries is expected to decline.

# Primary energy consumption by fuel – 1965-2016

Shares of primary energy consumption

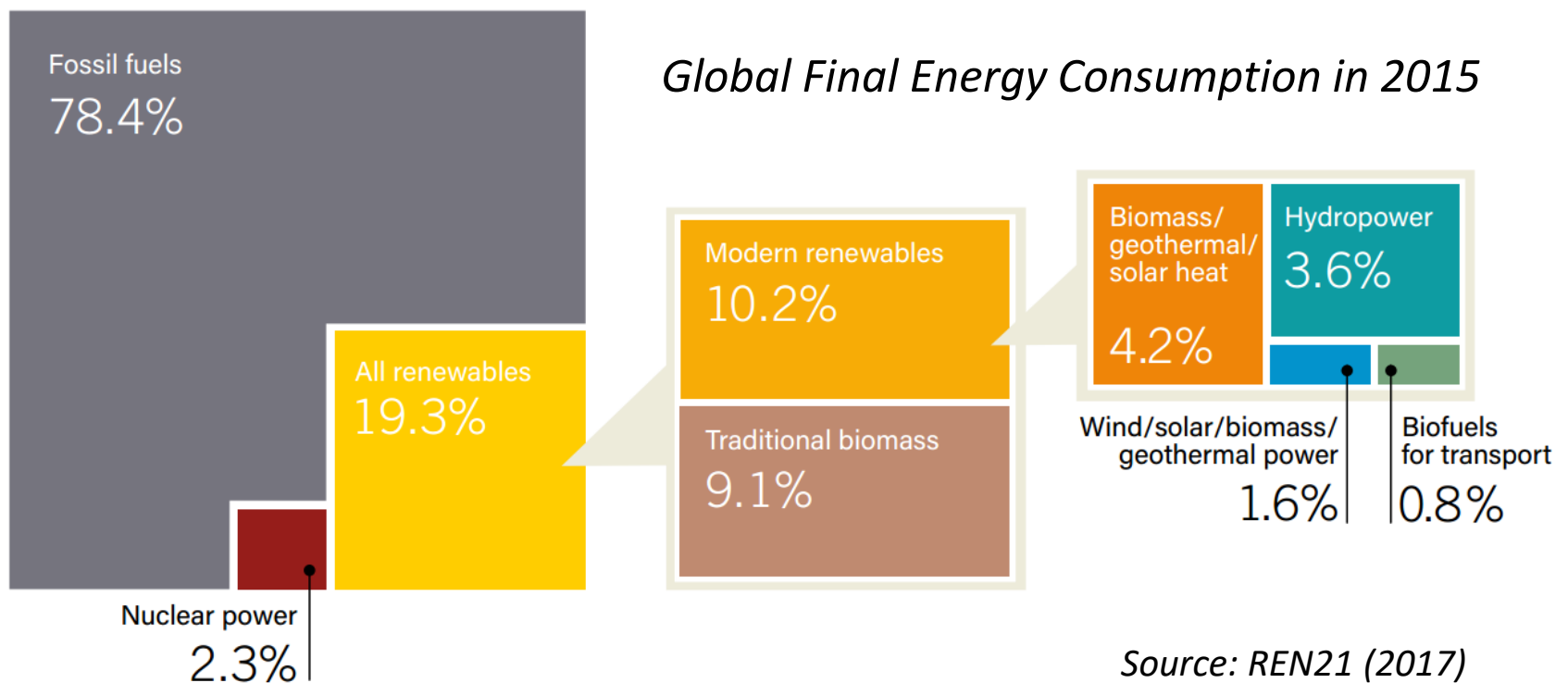


BP Statistical Review of World Energy  
© BP p.l.c. 2017

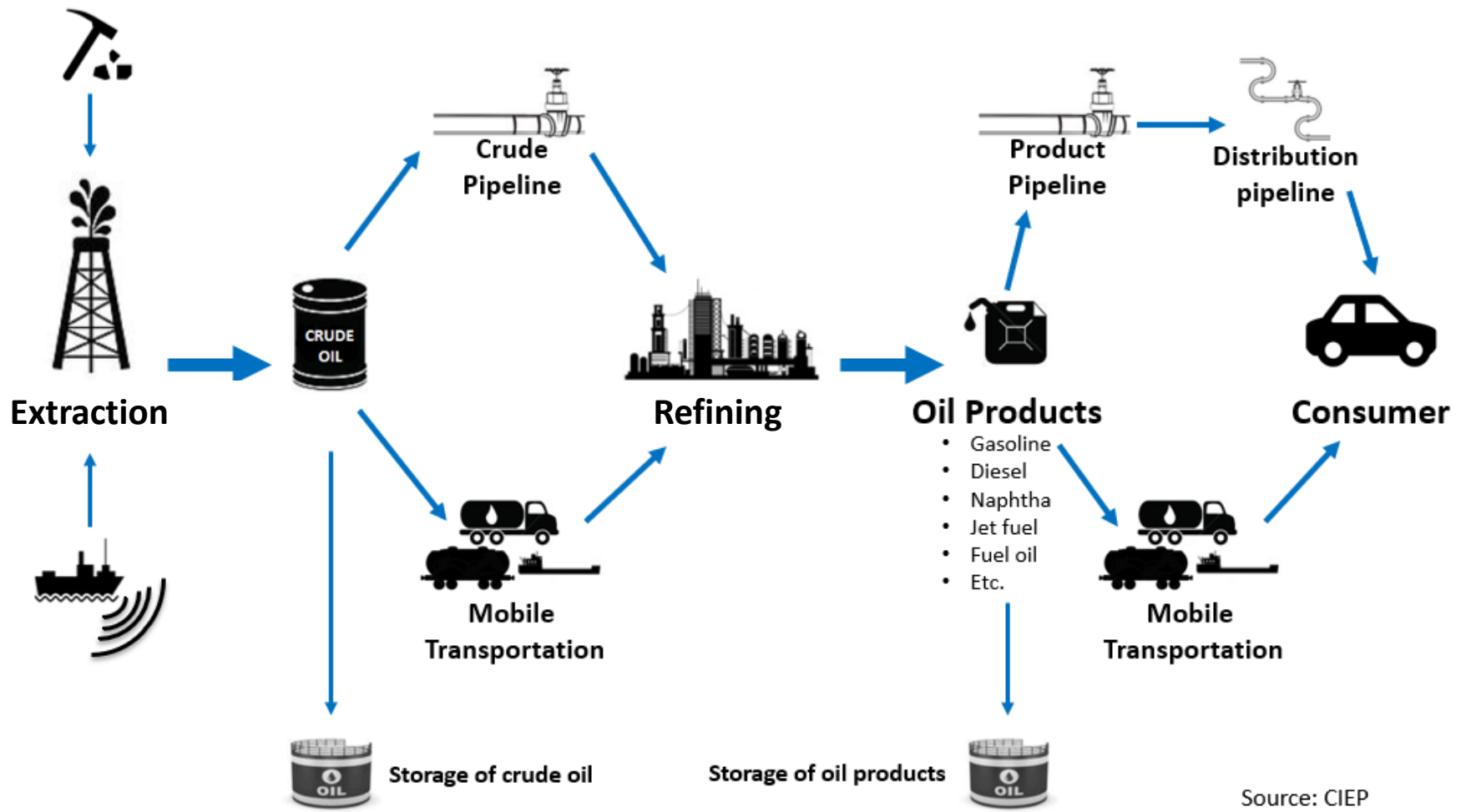
Source: BP

# Breakdown of RES shares

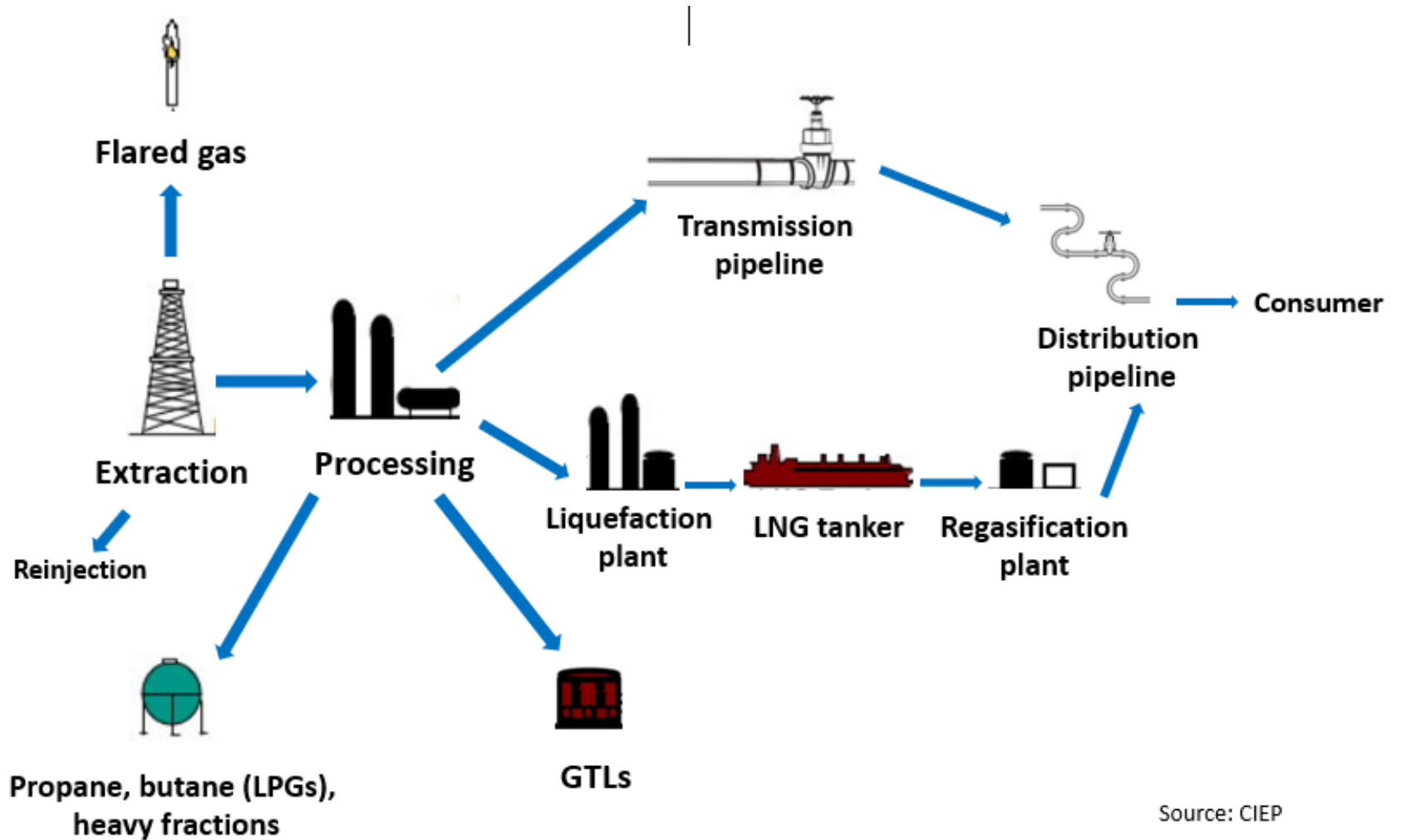
- While 'modern renewables' grow, the mix is dominated by fossil fuels
- Biomass dominates RES, the share of wind & solar is very limited



# Simplified oil value chain

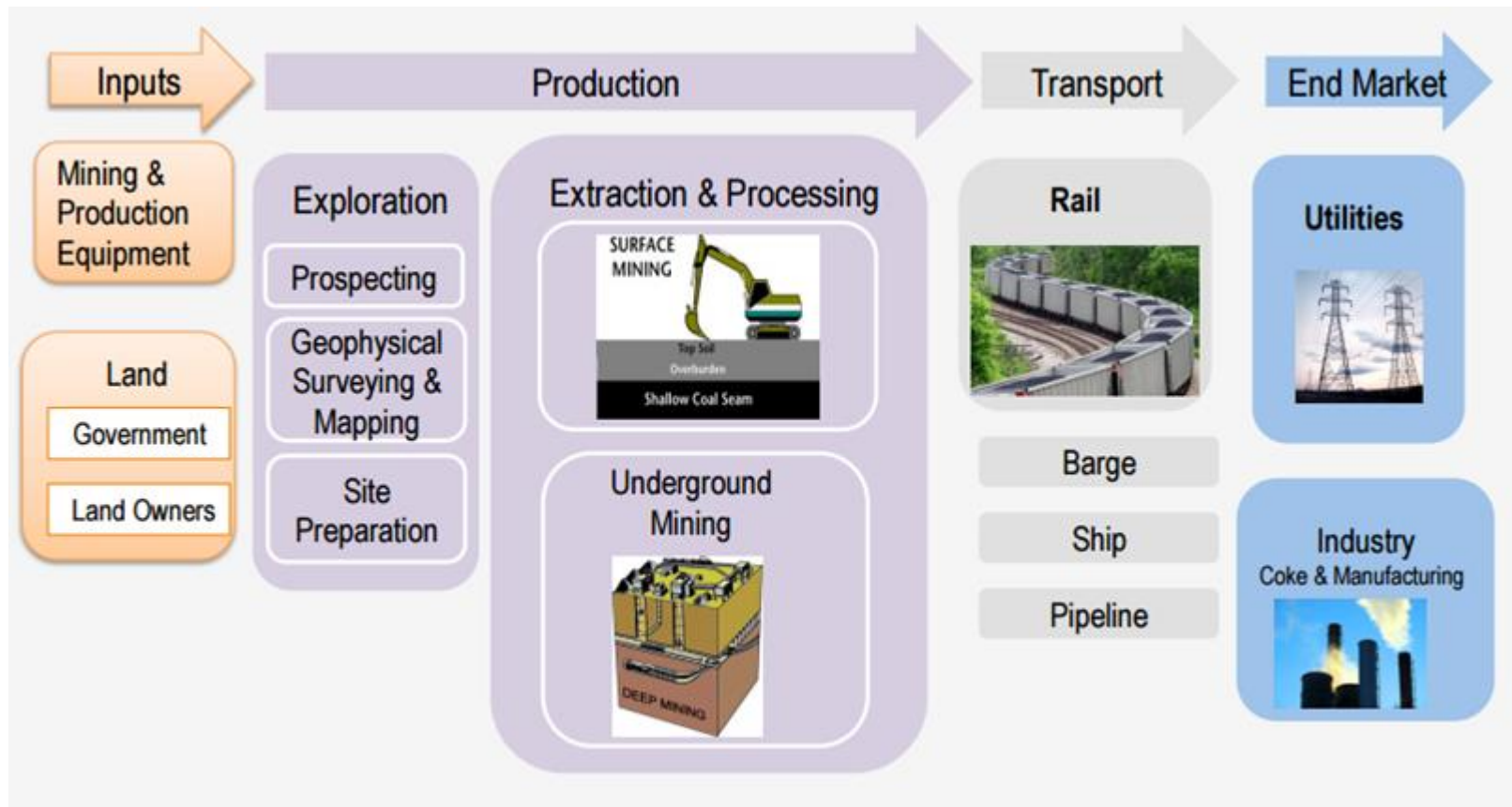


# Simplified gas value chain



Source: CIEP

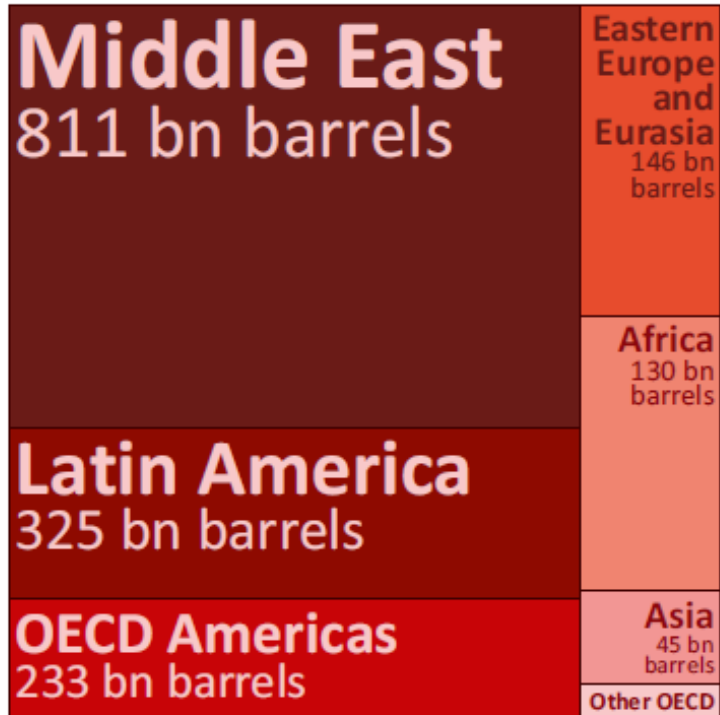
# Simplified coal value chain



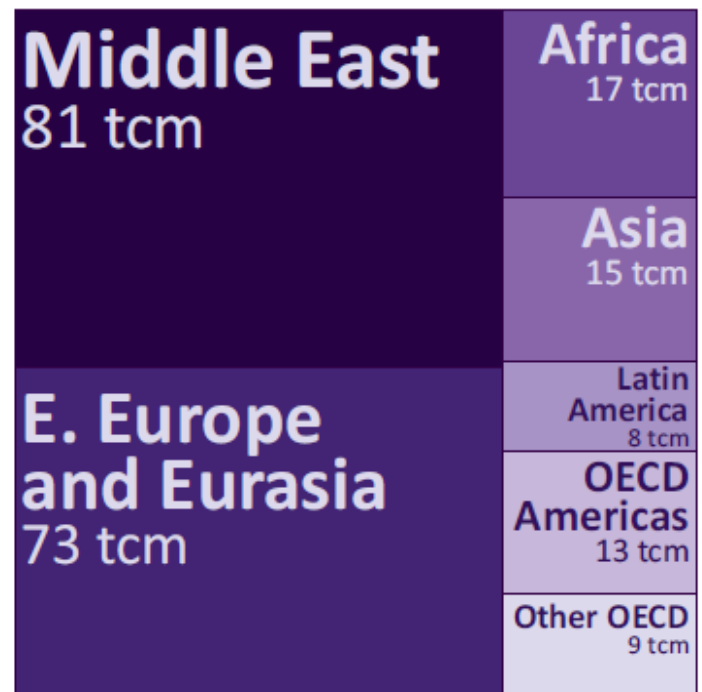
Source: Duke Center on Globalization

# Oil and gas reserves by region

World proven oil reserves: 1 706 billion barrels



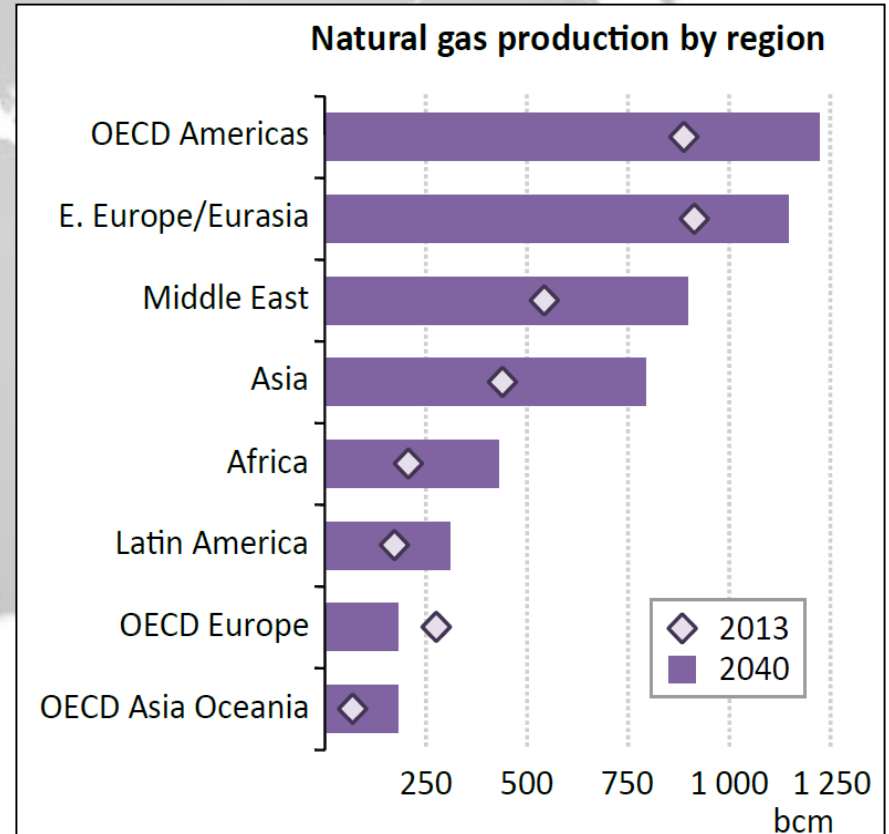
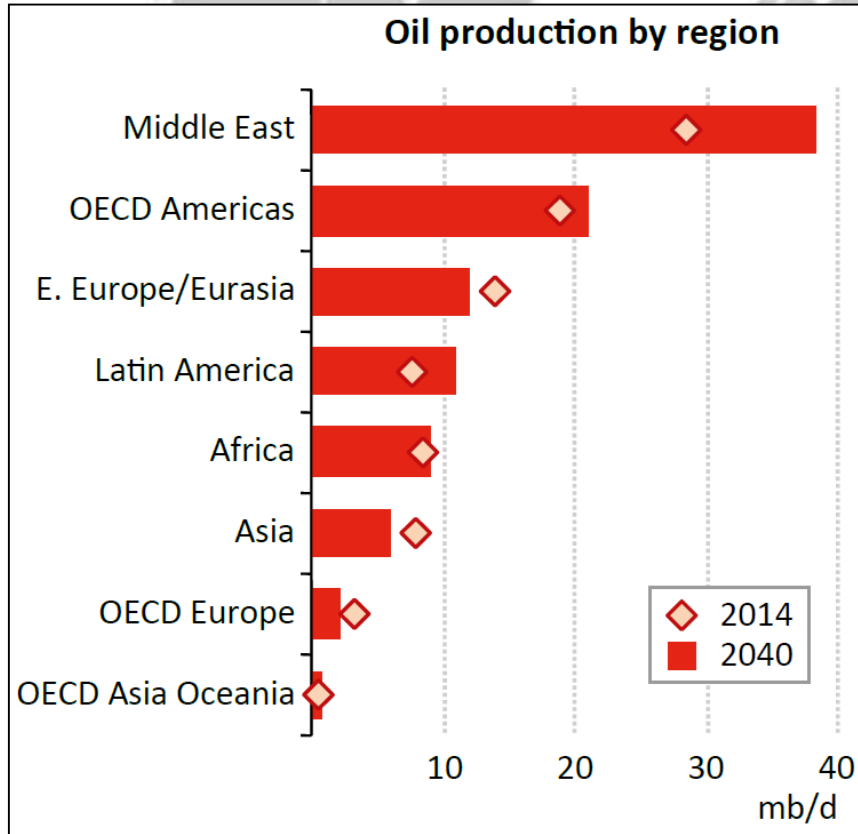
World proven gas reserves: 216 trillion cubic metres



Source: IEA World Energy Outlook

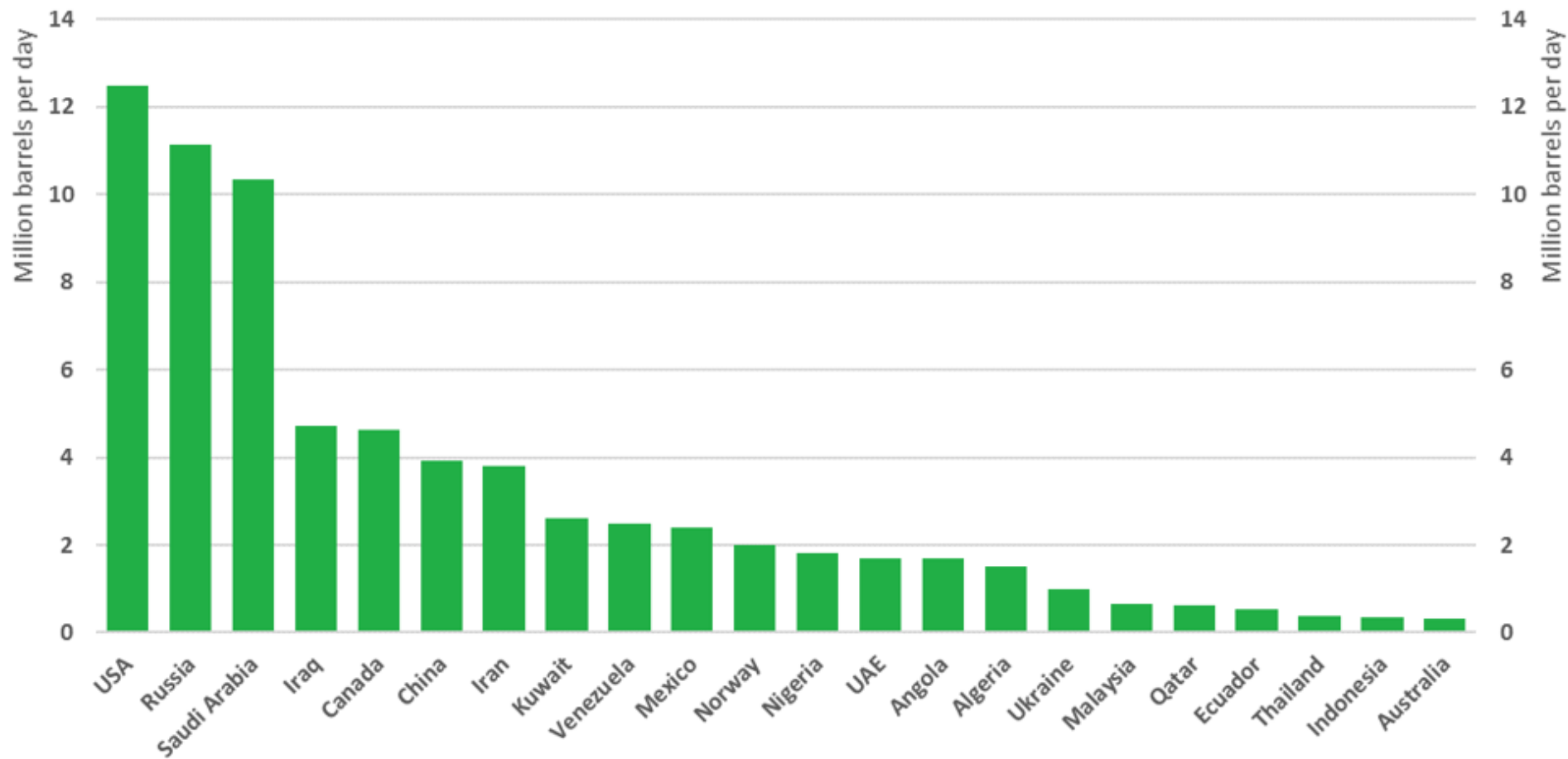


# Production of oil and gas by region – 2015



Source: IEA World Energy Outlook

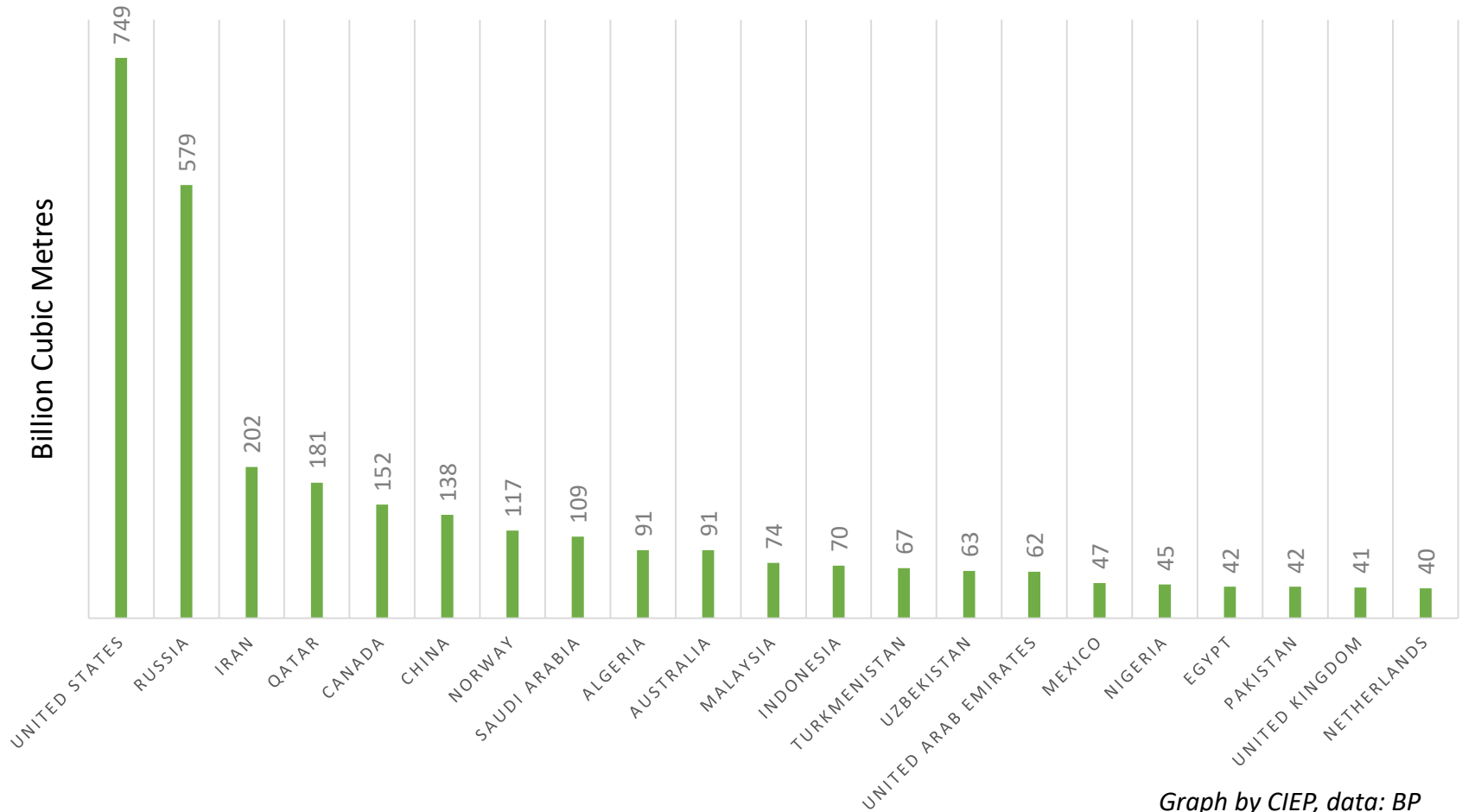
# Production of oil by country



Year: 2016  
Source: Jodi

# Production of gas by country – 2016

## GAS PRODUCTION



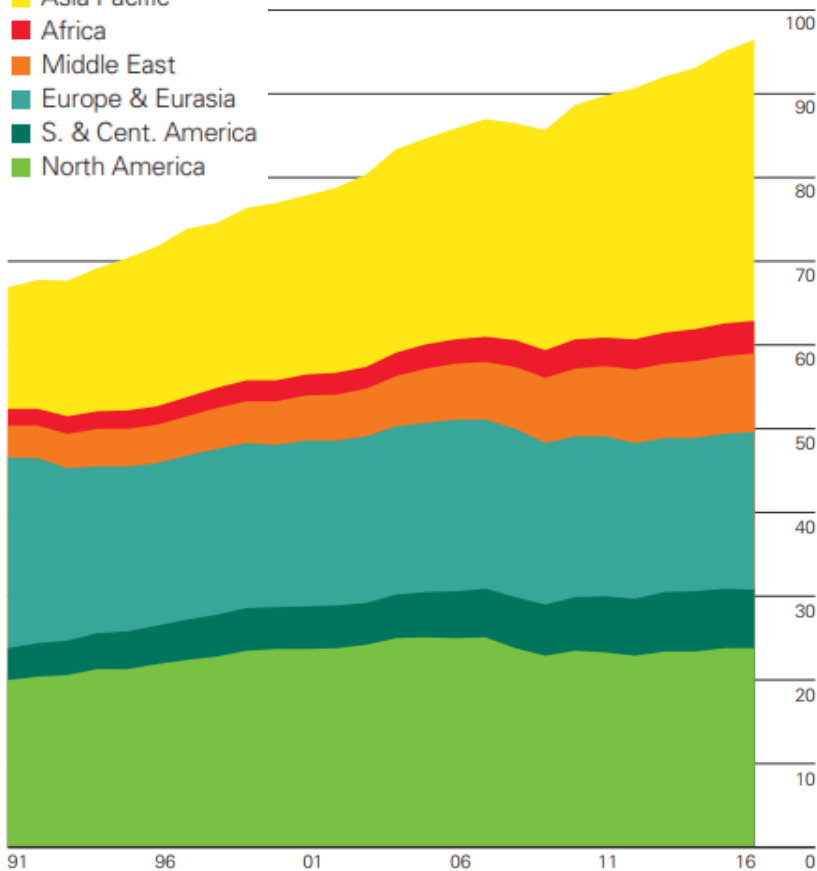
Graph by CIEP, data: BP

# Consumption of oil and gas by region – 2016

## Oil: Consumption by region

Million barrels daily

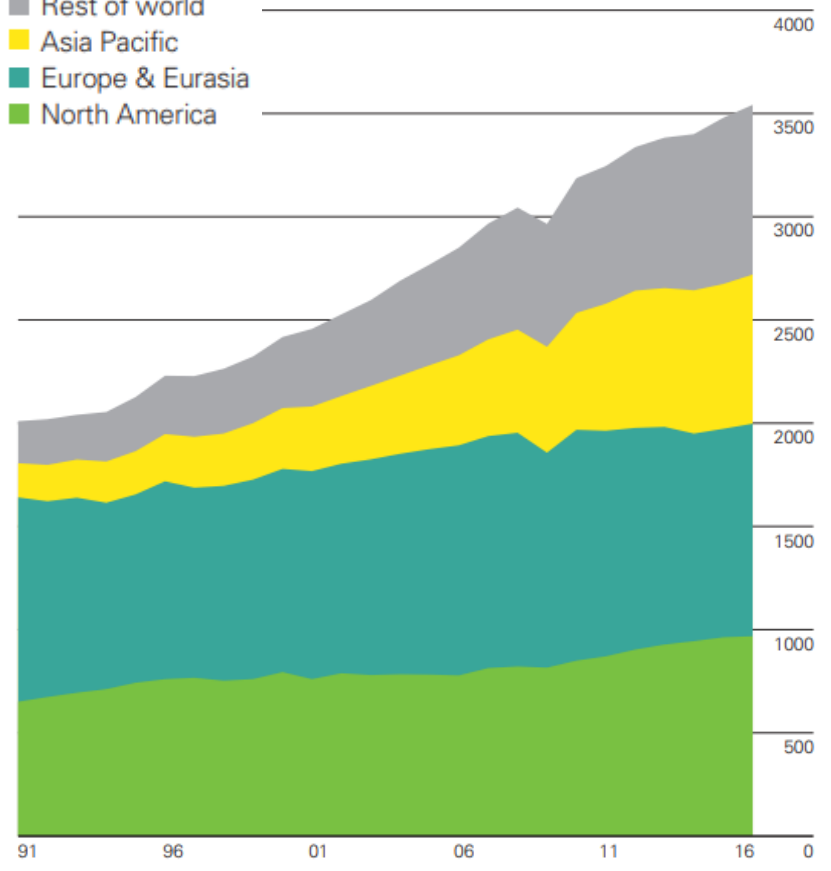
- Asia Pacific
- Africa
- Middle East
- Europe & Eurasia
- S. & Cent. America
- North America



## Natural gas: Consumption by region

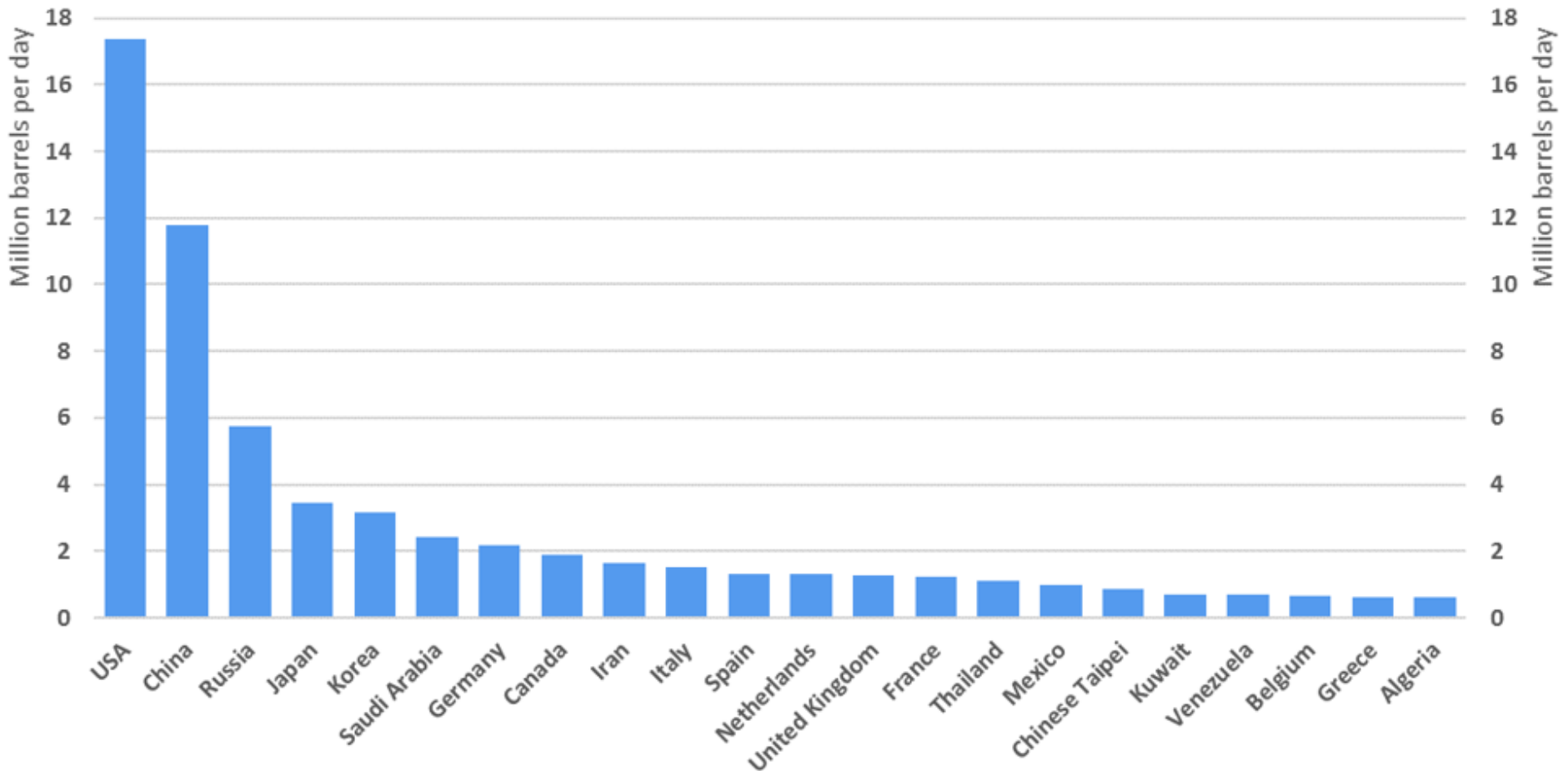
Billion cubic metres

- Rest of world
- Asia Pacific
- Europe & Eurasia
- North America



Source: BP

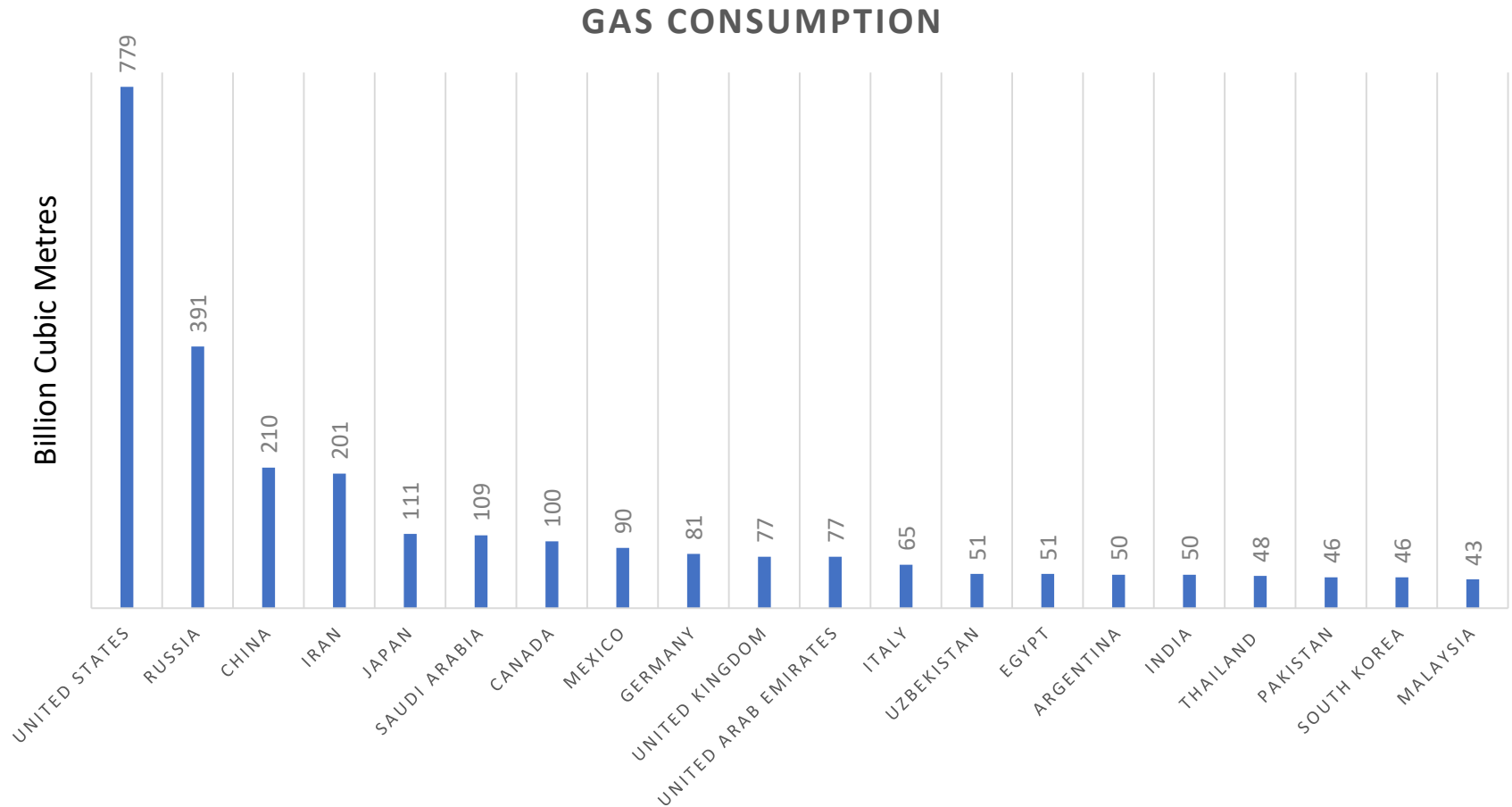
# Consumption of oil by country – 2016



Year: 2016

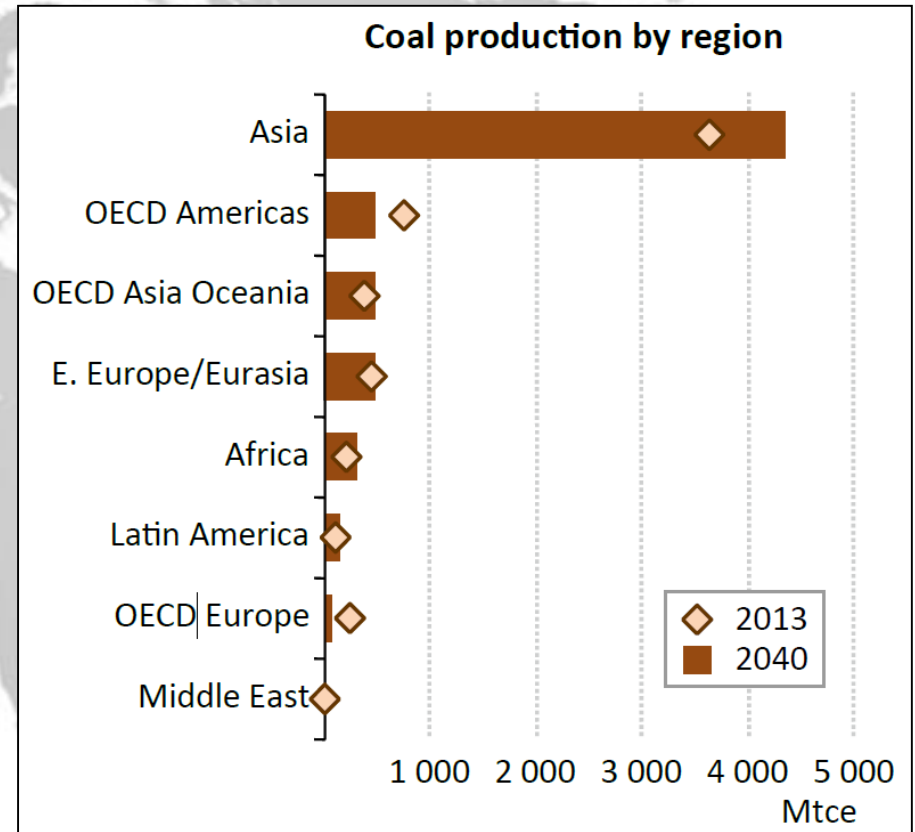
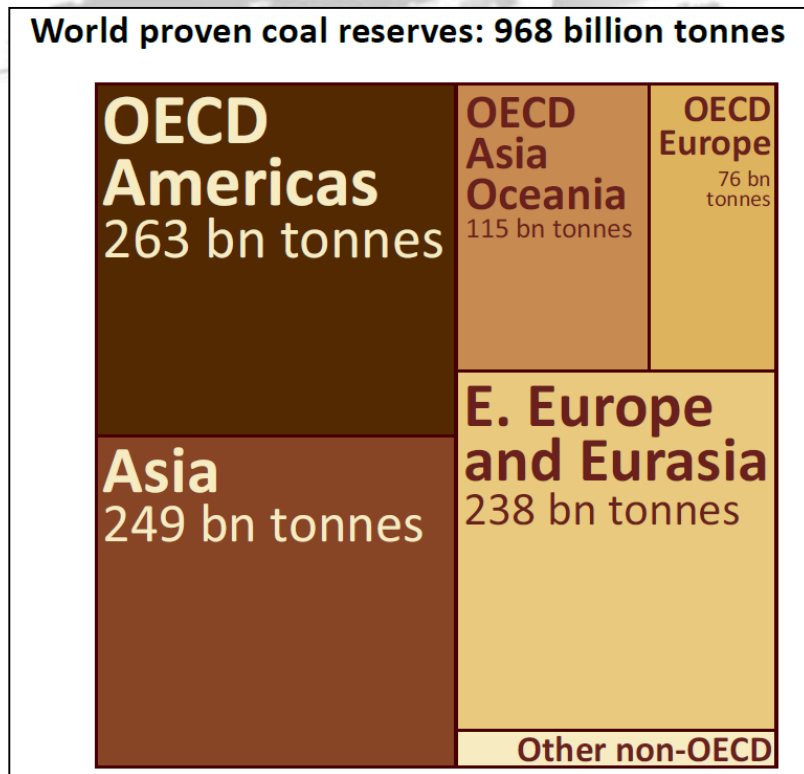
Source: Jodi

# Consumption of gas by country – 2016



Graph by CIEP, data: BP

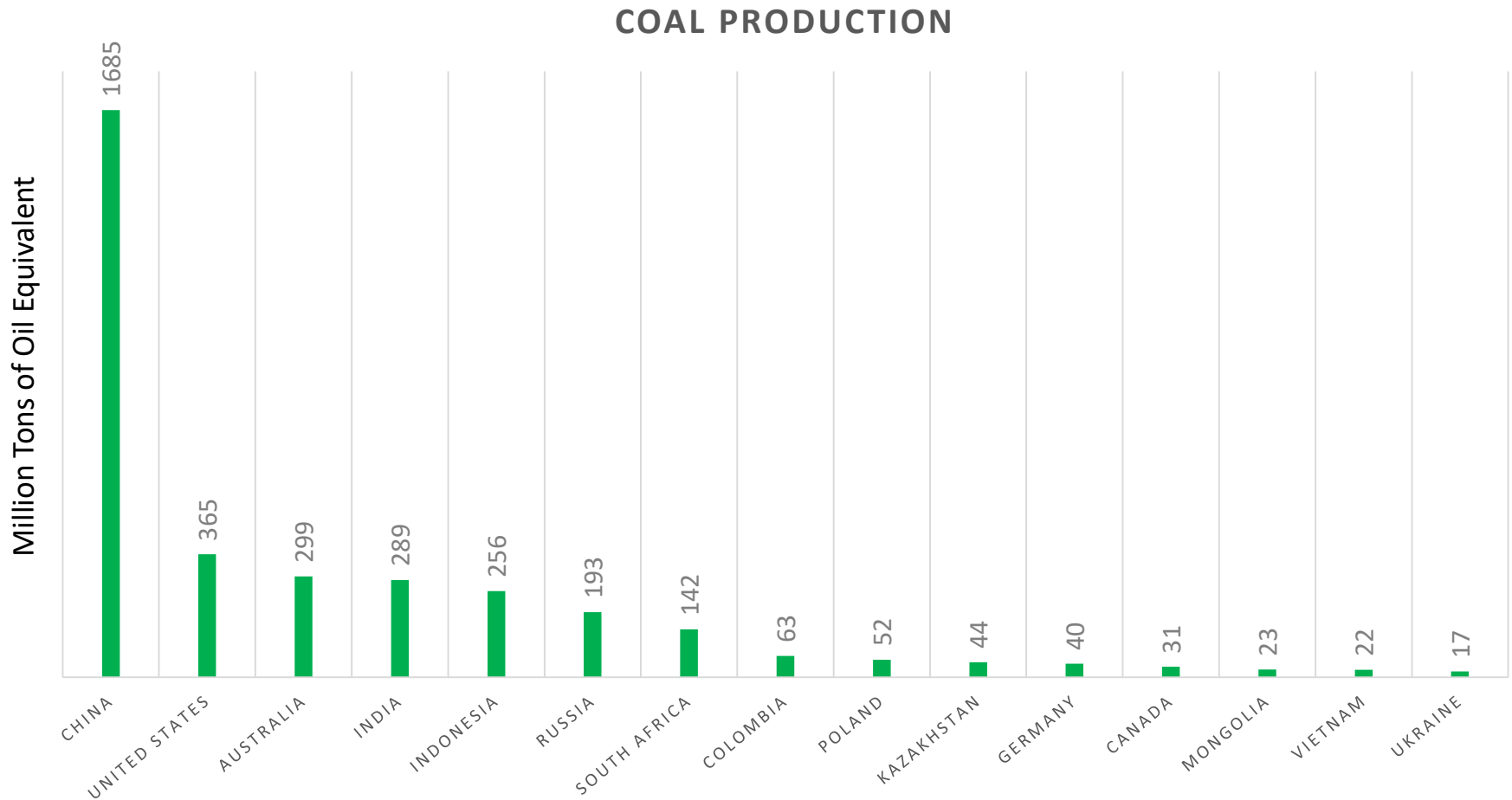
# Coal reserves and production by region



Source: IEA World Energy Outlook 2015

- China produces and consumes nearly half of all the world's coal
- India's coal consumption is on the rise

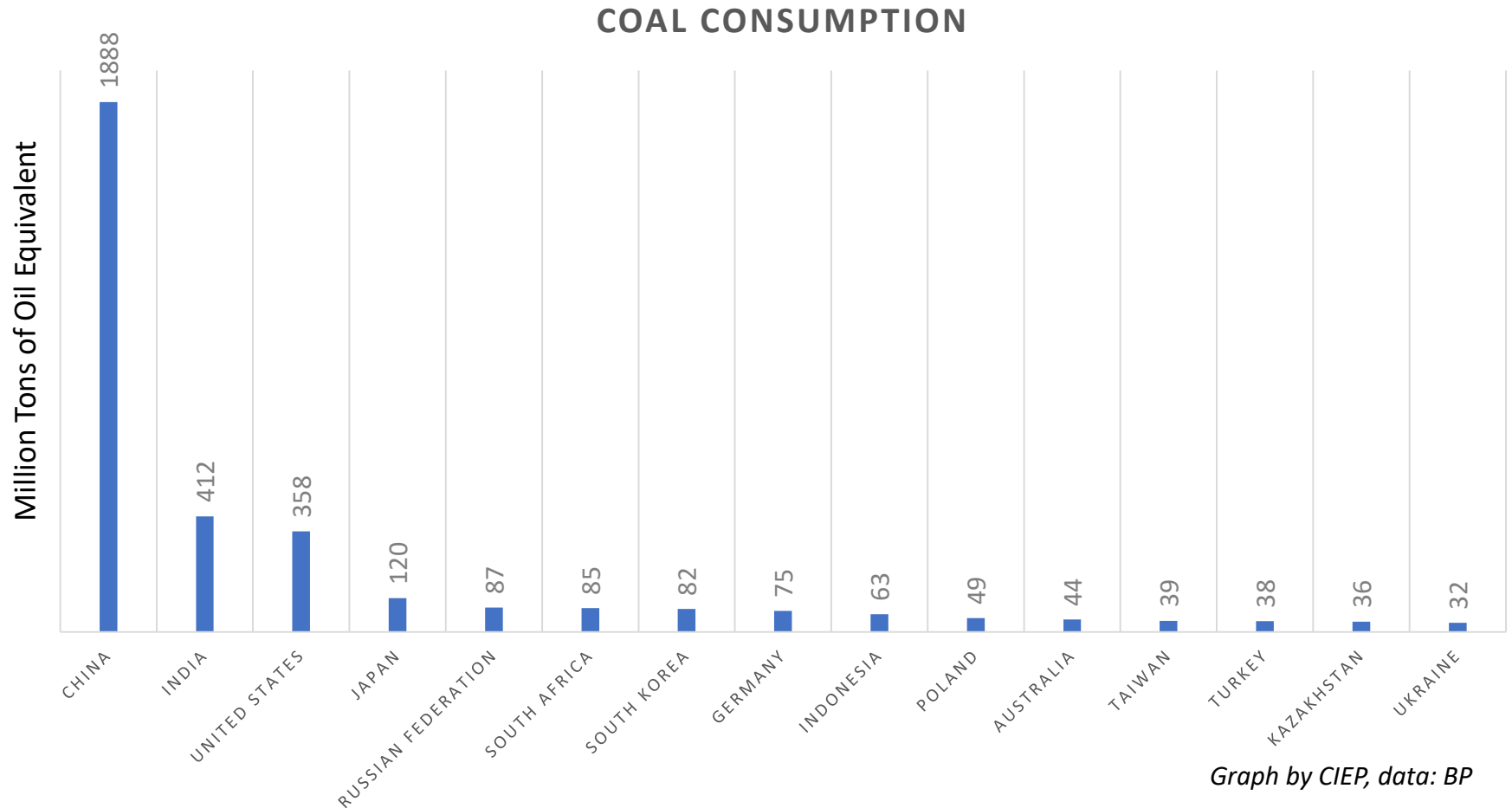
# Production of coal by country – 2016



Graph by CIEP, data: BP



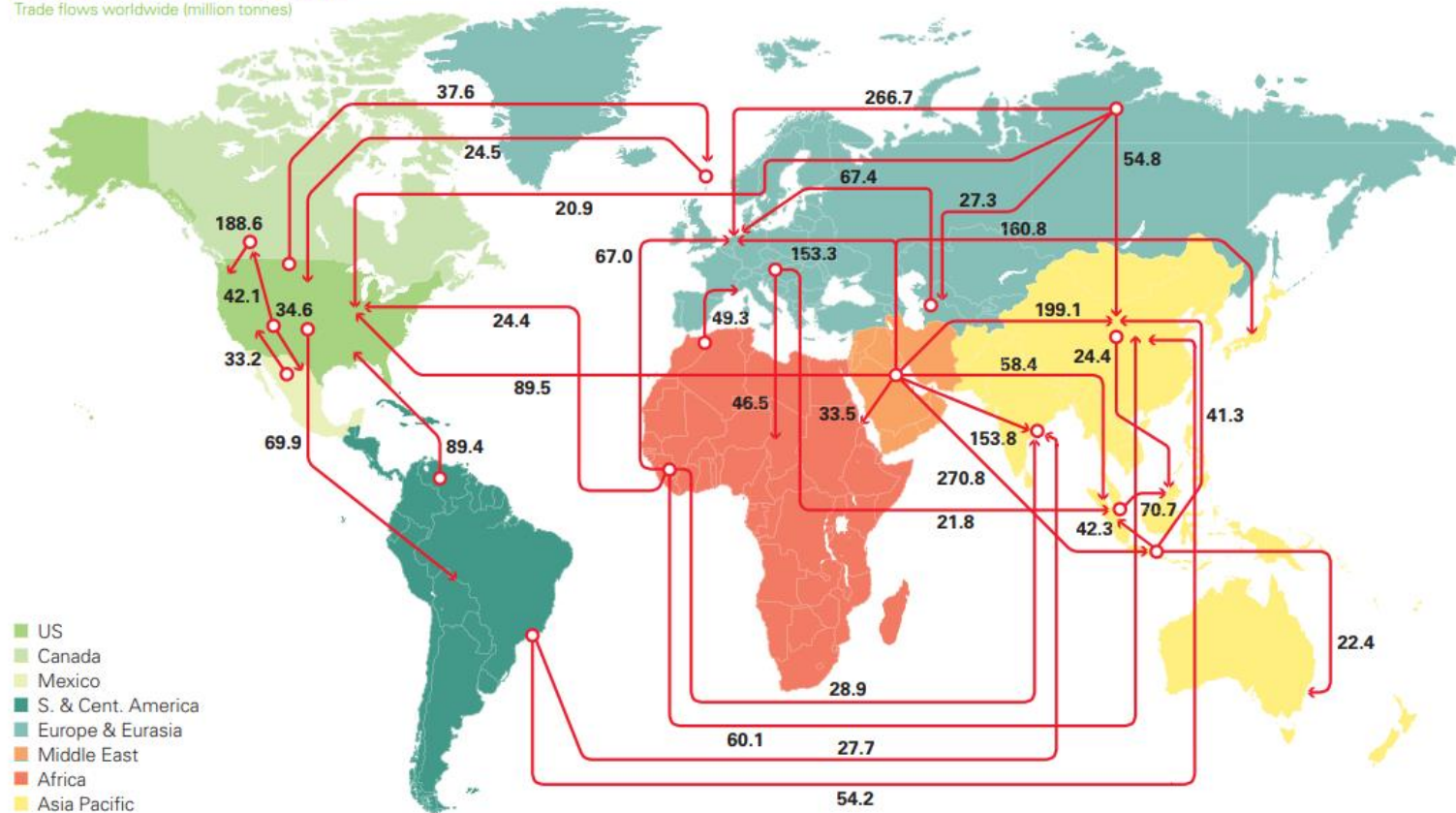
# Consumption of coal by country – 2016



# Major interregional oil trade flows

## Major trade movements 2016

Trade flows worldwide (million tonnes)

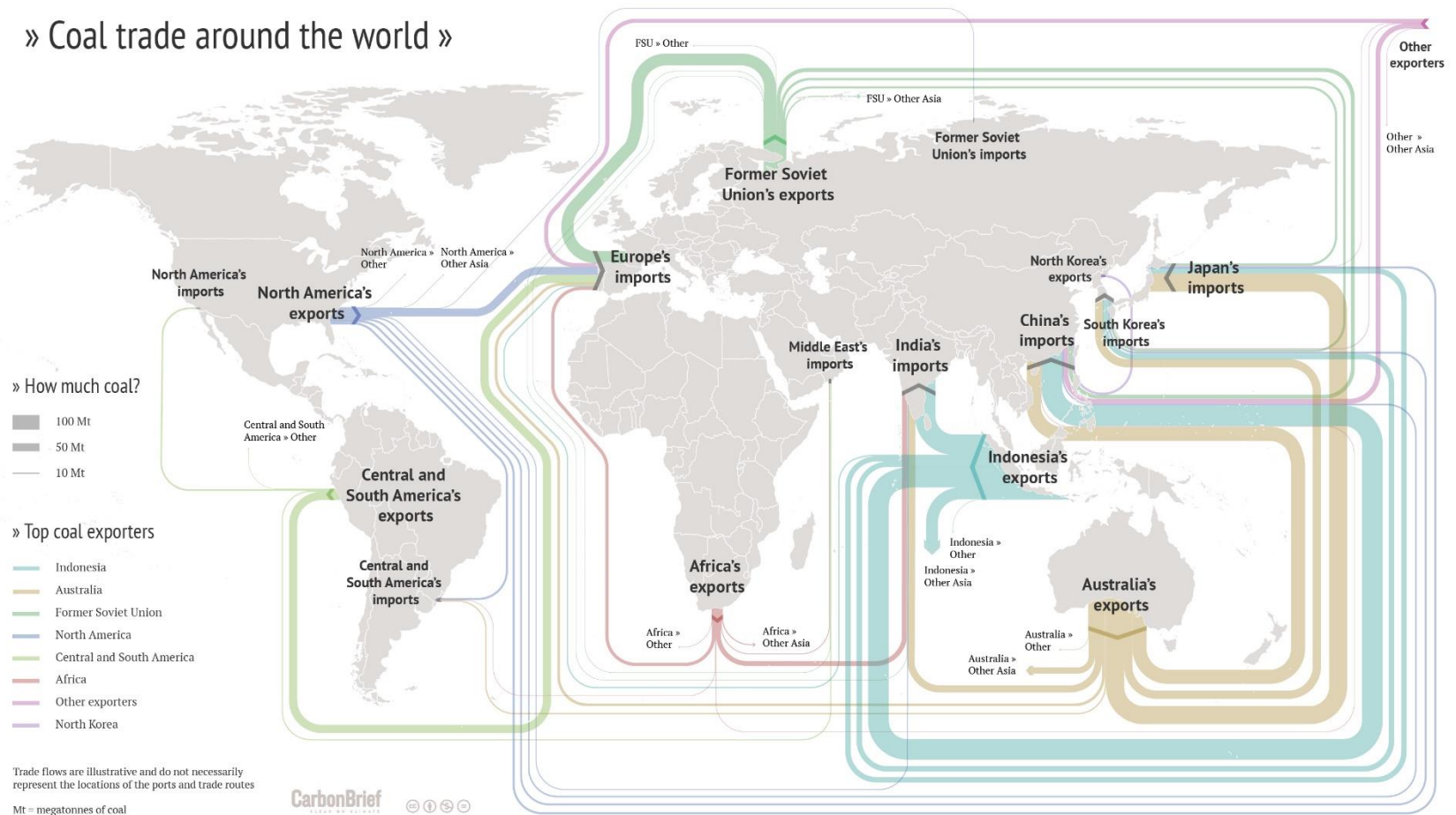


Source: BP



# Major interregional coal trade flows

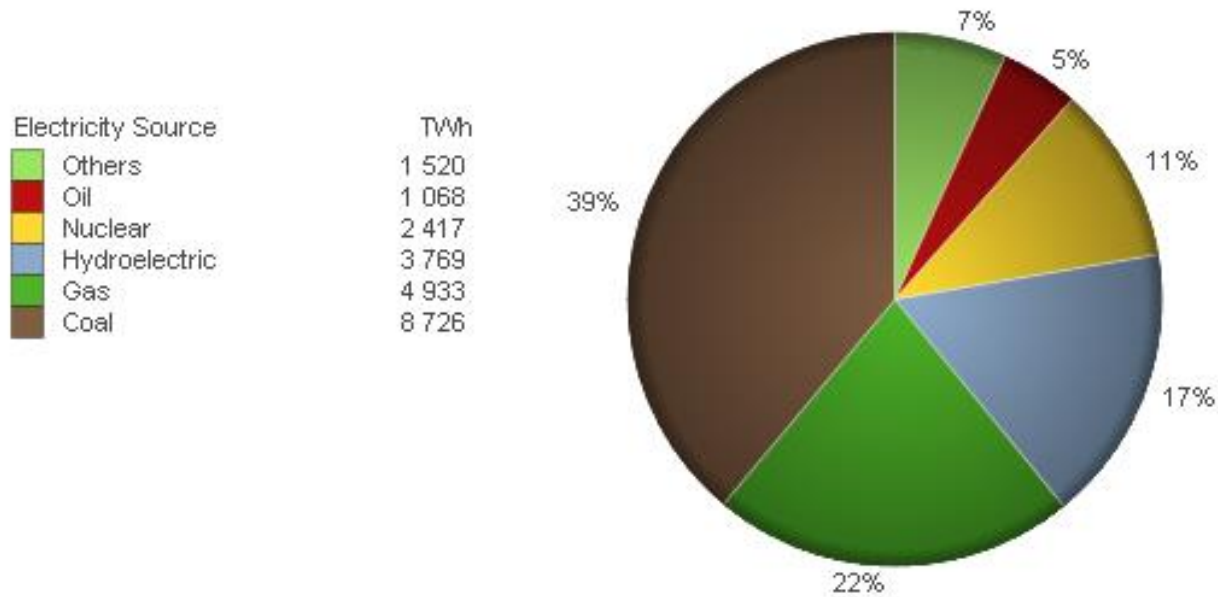
» Coal trade around the world »



Source: Carbon Brief

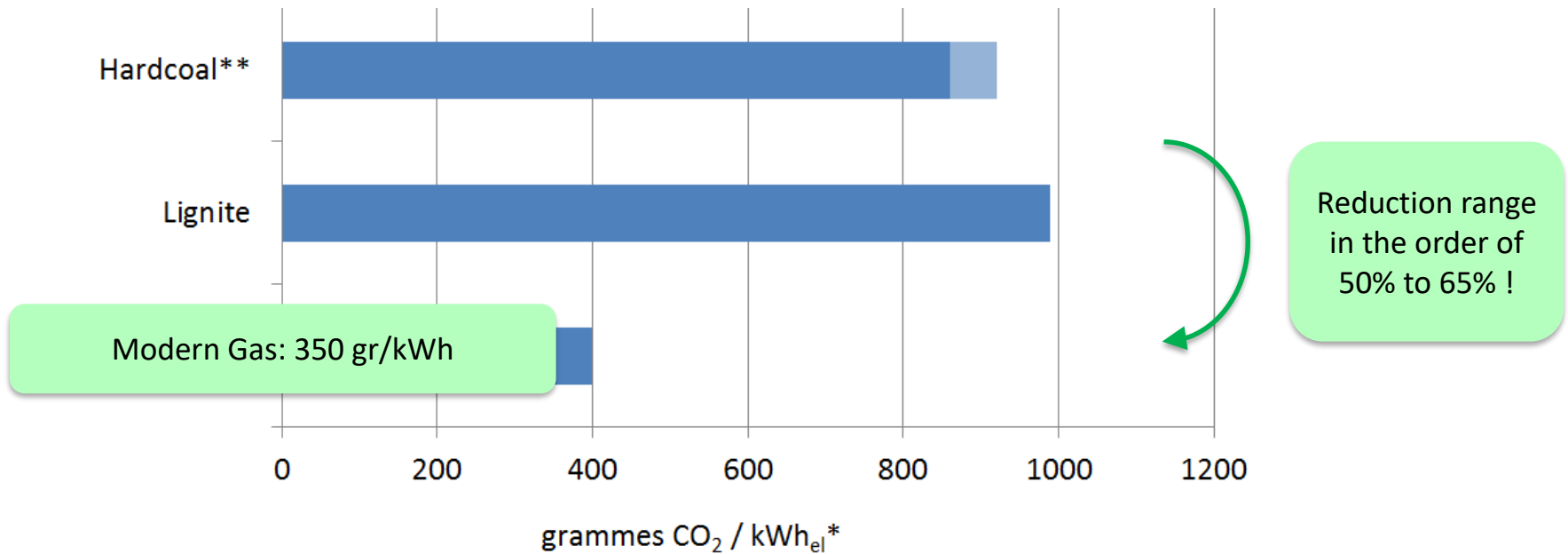
# Electricity generation by source – world

World Electricity Production  
from All Energy Sources in 2014 (TWh)



Sources: World Bank and EIA

# Coal vs. Gas in Electricity generation



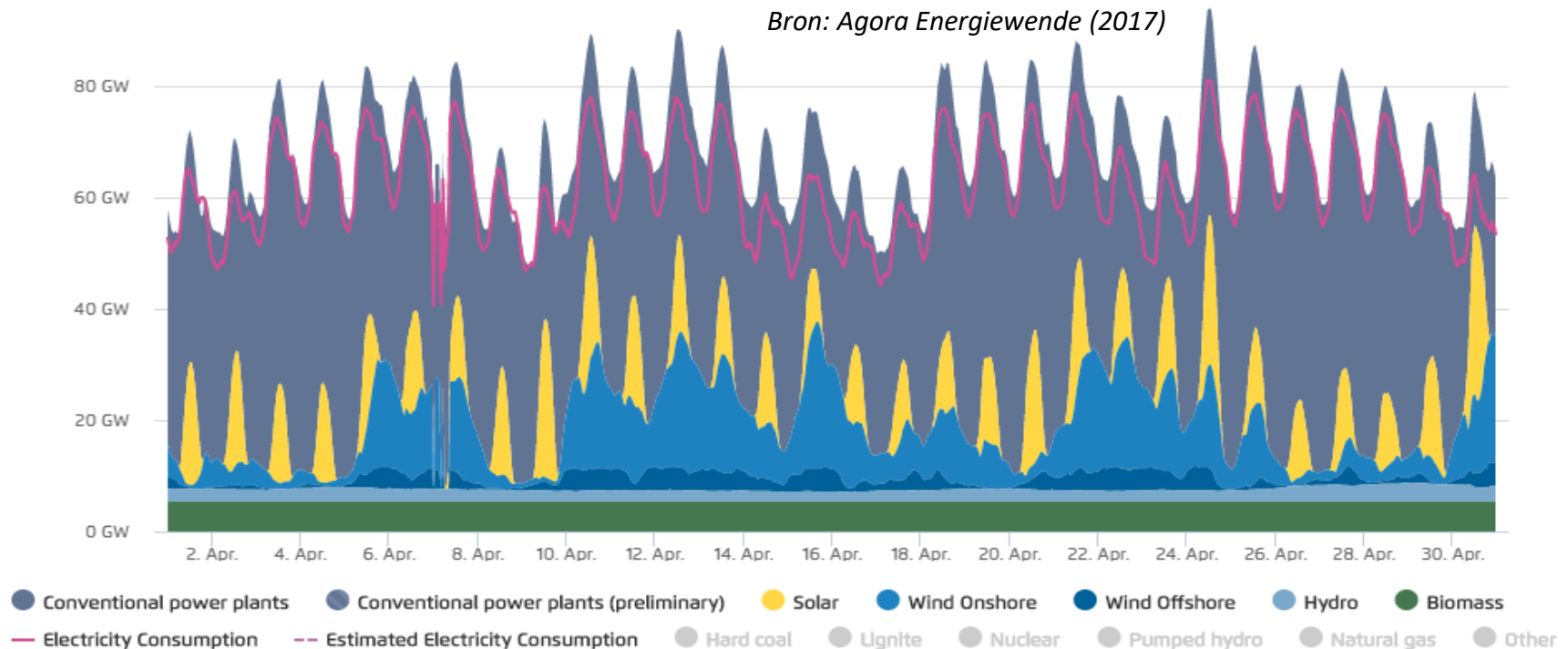
Source: IEA (2012: 41)\*\*\*

\* These values represent the average grammes of CO<sub>2</sub> of per kWh electricity produced in the OECD member countries between 2008 and 2010.

\*\* Range of bituminous coal (860 gr/kWh) and sub-bituminous coal (920 gr/kWh)

\*\*\* Available at [www.iea.org/co2highlights/co2highlights.pdf](http://www.iea.org/co2highlights/co2highlights.pdf)

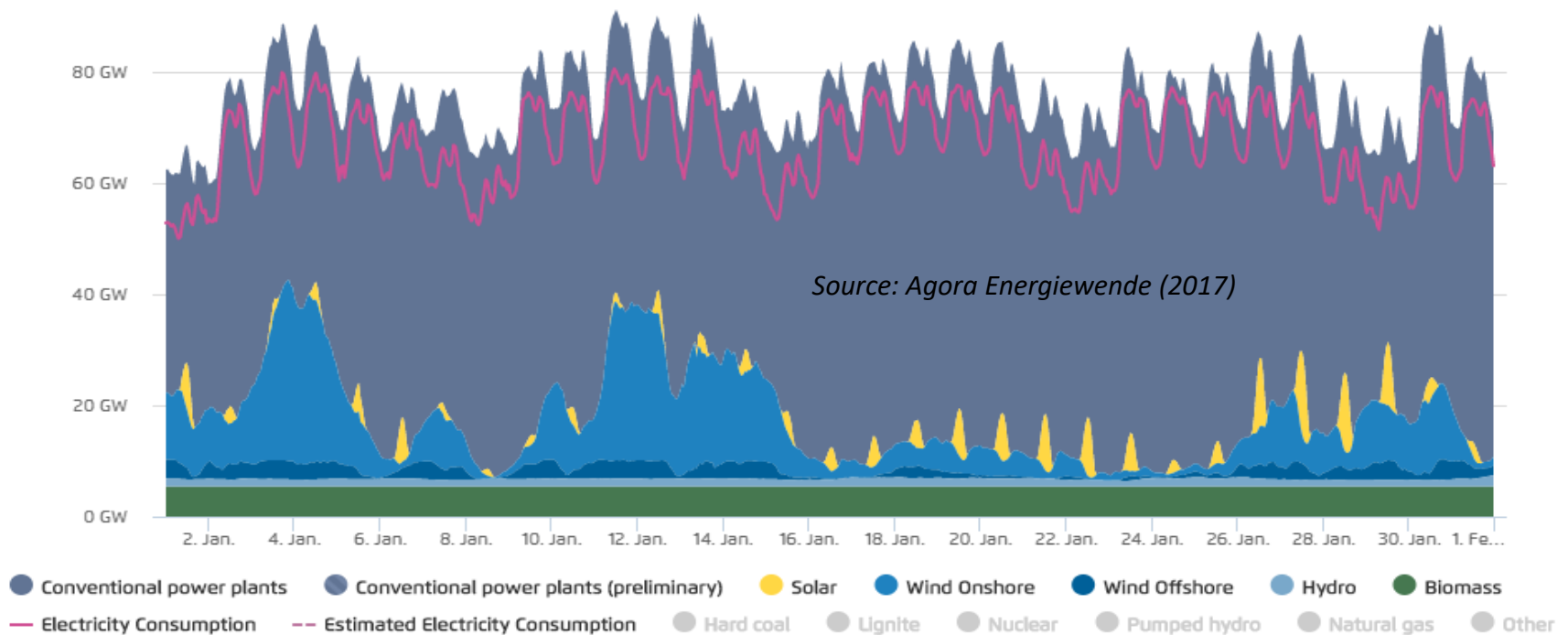
# Energy from wind & solar is 'variable' (1/2)



- Generation from solar/wind in **Germany** in the month of **April 2017**
- Every day **solar energy** (yellow) emerges, and fades away when daytime ends
- Many days, too, **wind energy** (blue) is produced, but some days is barely available
- Different seasons are characterized by different generation patterns

# Energy from wind & solar is 'variable' (2/2)

- Generation from solar/wind in **Germany** in the month of **February 2017**
- Every day **solar energy** (yellow) emerges, and fades away when daytime ends
- Many days, too, **wind energy** (blue) is produced, but some days is barely available
- Different seasons are characterized by different generation patterns

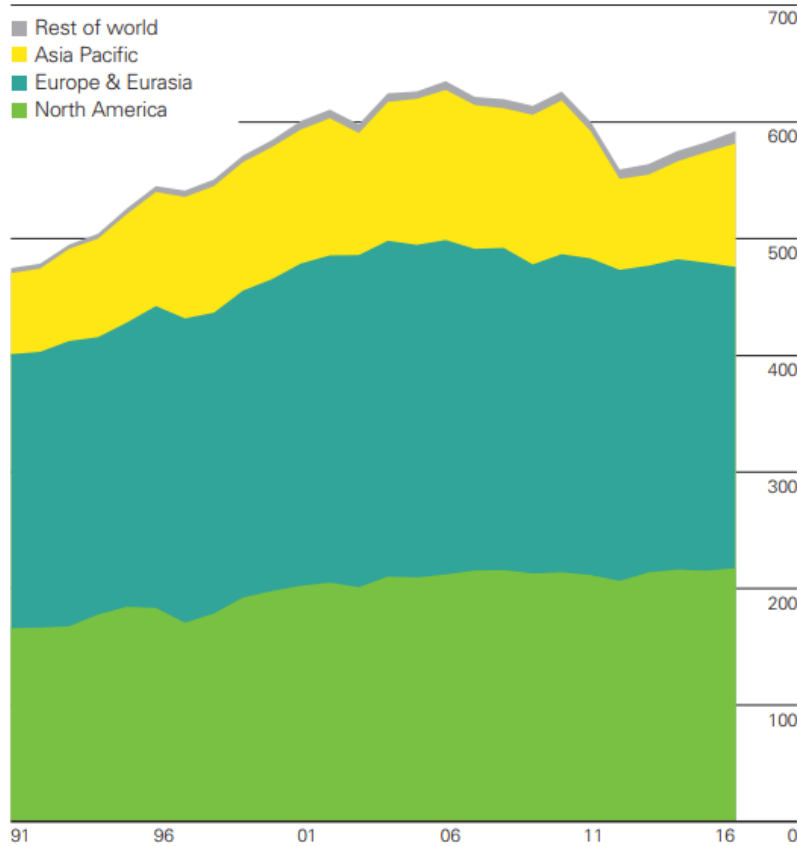




# Consumption of nuclear and hydroelectricity by region

## Nuclear energy consumption by region

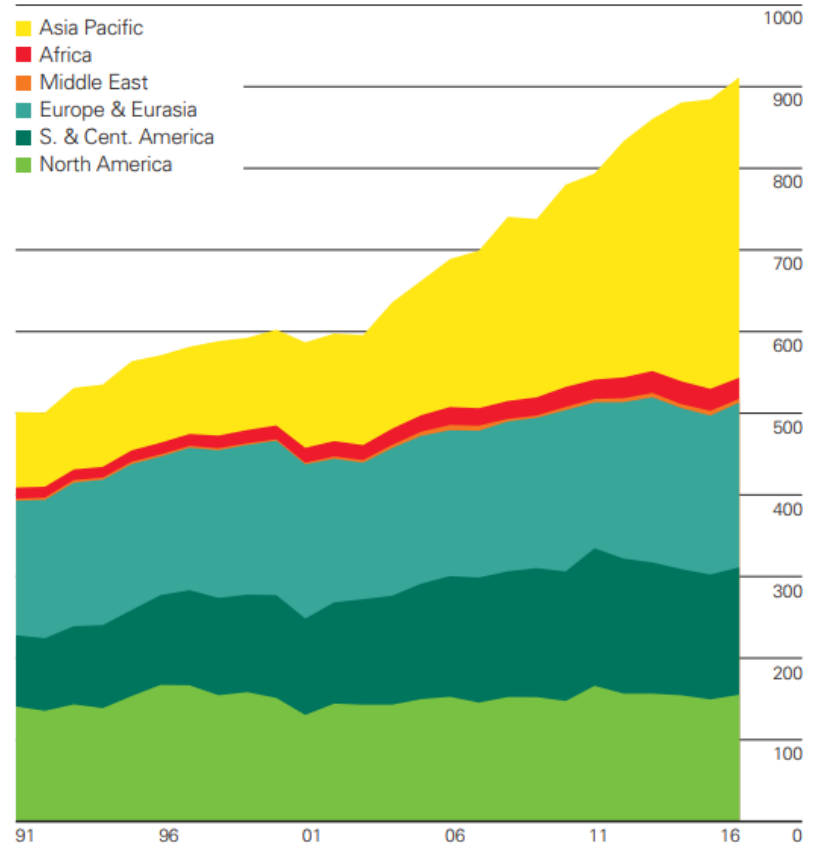
Million tonnes oil equivalent



## Hydroelectricity consumption by region

Million tonnes oil equivalent

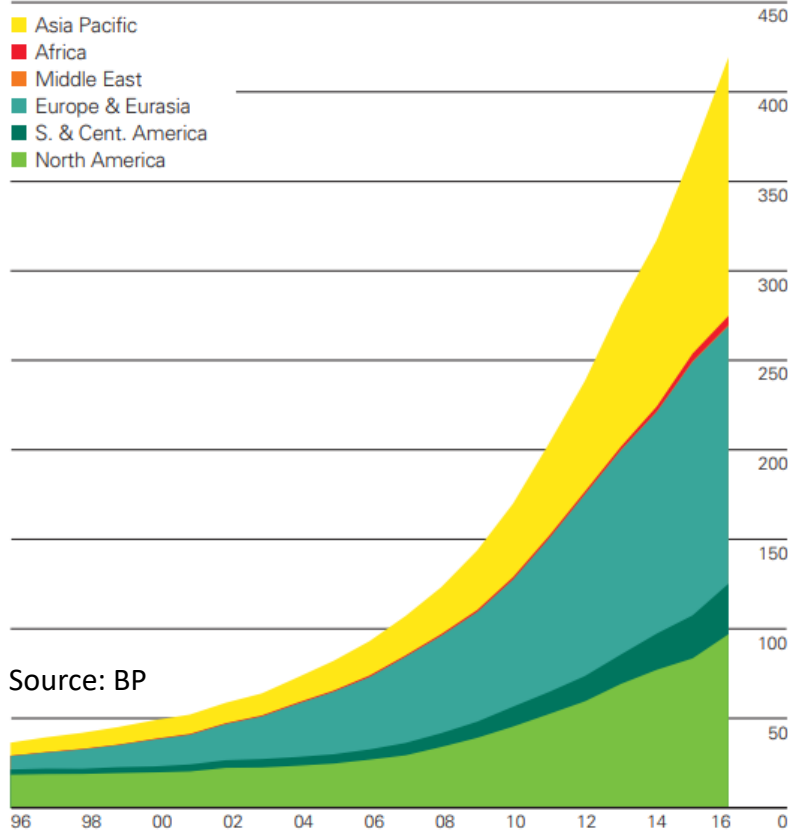
Source: BP



# Consumption of 'other renewables' (wind, solar, etc.) by region and their share in power generation

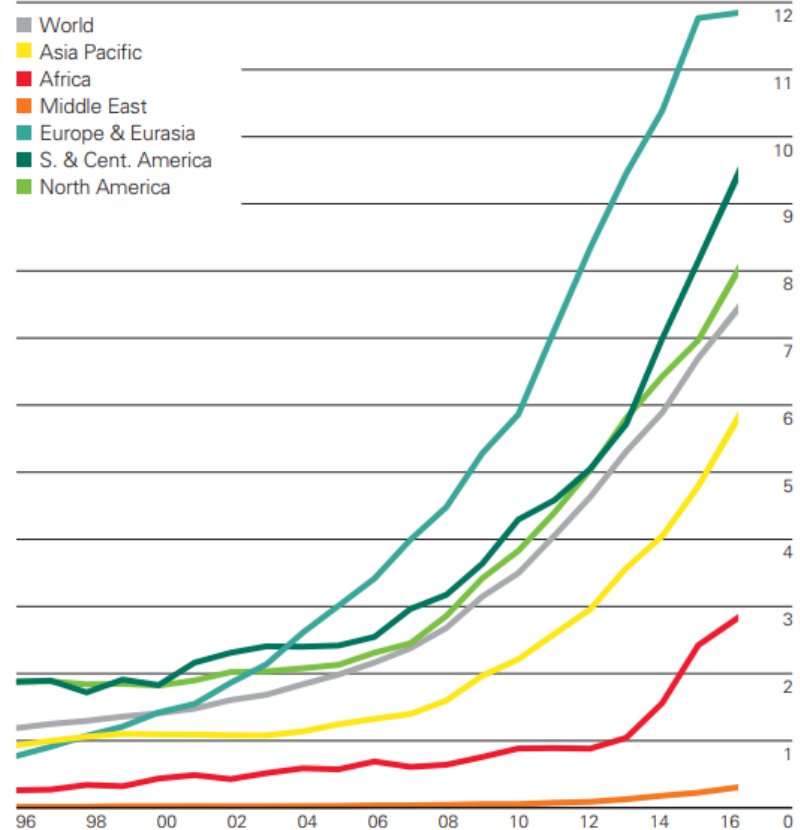
**Other renewables consumption by region**

Million tonnes oil equivalent



**Other renewables share of power generation by region**

Percentage



Renewable energy in power generation (not including hydro) grew by 14.1% in 2016, slightly below the 10-year average, but the largest increment on record (52.9 mtoe). Wind provided more than half of the growth, while solar energy contributed almost a third despite accounting for only 18% of the total. Asia Pacific contributed 60% of growth, with China overtaking the United States to become the world's largest renewable power producer. Renewable energy accounted for 7.5% of power generation, up from 6.7% in 2015. Europe & Eurasia has the highest share of power from renewables at 11.8%, but its share rose by the smallest increment on record in 2016.