

THE CLIMATE CHANGE POLICY DEBATE

Which way is the world heading?

By Robert Lyman © 2019

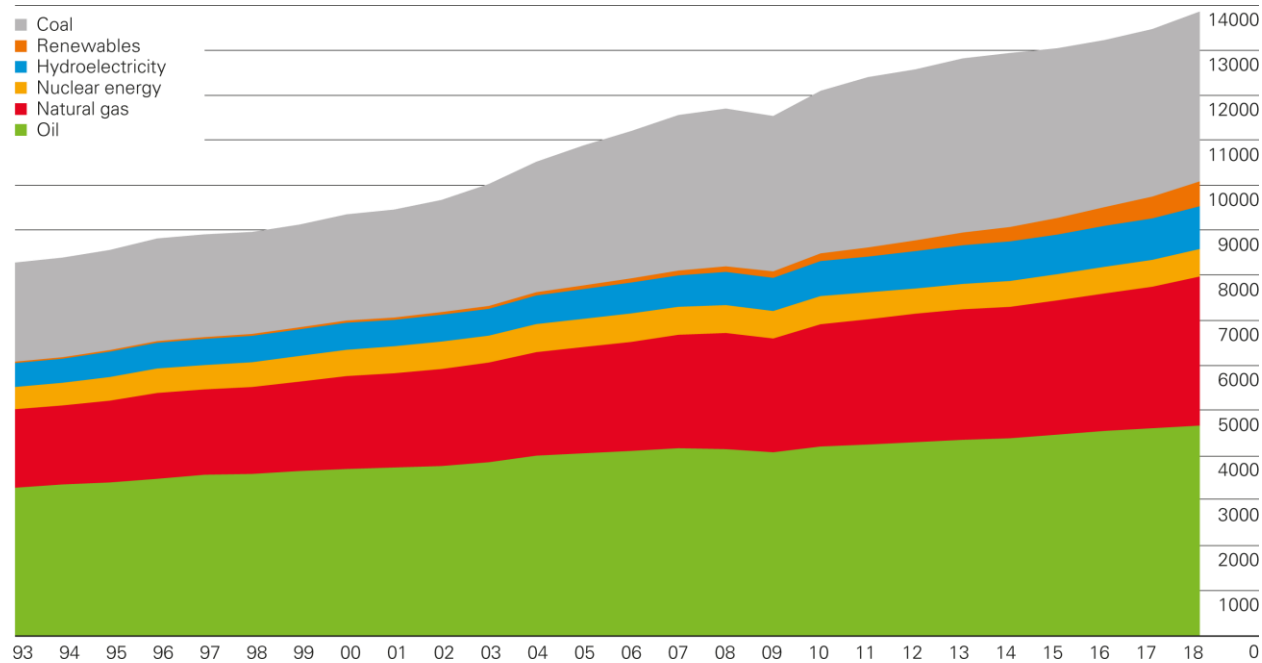
THE ISSUE

- Proponents of the thesis that humans are causing catastrophic global warming claim that renewable energy sources (wind, solar, and others) inevitably will replace fossil fuels (coal, oil and natural gas) as the world's primary sources of energy.
- They further claim that this is driven by competitive market forces.
- Opponents of this view claim that current market trends, driven by economic growth in the less developed countries, are leading to increasing use of fossil fuels, in spite of immense subsidies to renewables.

TRENDS TO CONSIDER

- Global primary energy demand
- Global oil demand
- Global natural gas demand
- Global coal demand
- Electricity generation by source
- Global renewables demand
- Future projections by experts
- GHG emissions trends
- Governmental agreements and policies

GLOBAL PRIMARY ENERGY DEMAND (MILLION TONNES OF OIL EQUIVALENT)



WHAT IS PRIMARY ENERGY DEMAND?

- This refers to the world's commercial use of all energy sources. It thus excludes the energy consumed in many parts of the developing countries through the burning of wood, wood wastes, charcoal and dried animal dung.
- The main influences on primary energy demand are population and economic growth in the short term and technological change in the long term.
- **Primary energy demand** is different from **secondary energy demand**, which is mainly the use of electricity through generation and delivered by transmission to power a wide range of energy services.

POINTS TO NOTE

Primary energy consumption grew from 11.7 billion tonnes of oil equivalent (Mtoe) in 2008 to 13.9 Mtoe in 2018, a 19% increase.

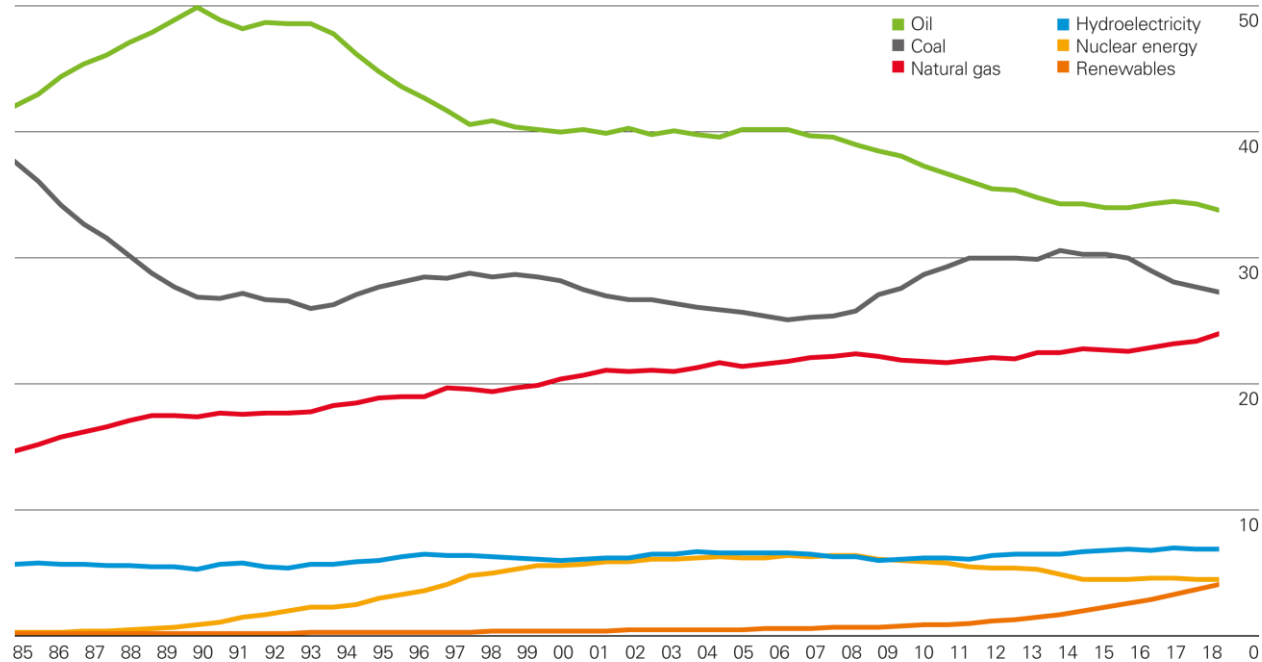
This occurred despite a major economic recession in the early part of the decade.

Almost all of the growth has occurred in the non-OECD countries.

By 2018, the non-OECD constituted 59% of global energy demand.

Source of data: BP Statistical Review of World Energy 2019

FUEL SHARES IN PRIMARY ENERGY DEMAND (PERCENTAGE)



WHAT DO FUEL SHARES SHOW?

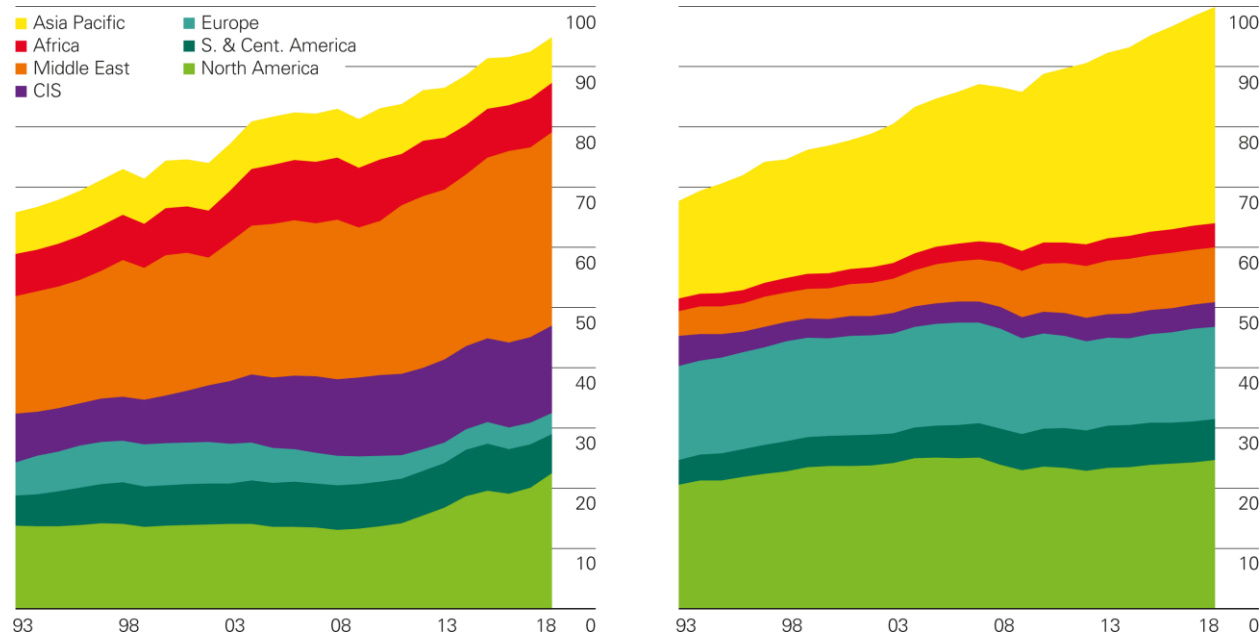
- The shares held by each fuel indicate how much the people of the world depend on those fuels to provide energy services – mobility, light, heat for cooking and residential comfort, air-conditioning and a wide range of other uses and products.
- The changes in shares over time indicate, for most fuels, how plentiful and low cost they are; this is less true for fuels used to produce electricity, which are usually determined by government decisions.
- The changes in shares among countries generally indicate the comparative economic growth in those countries.

POINTS TO NOTE

In 2018, fossil fuels (coal, oil and natural gas) constituted 84% of global primary energy demand.

The share held by fossil fuels has been declining at the rate of 1 per cent per decade since 1990.

Despite trillions of dollars in subsidies, renewable energy constitutes only 4% of primary energy demand.



**OIL PRODUCTION
(LEFT) AND
CONSUMPTION
(RIGHT) BY
REGION (MILLION
BARRELS DAILY)**

WHAT INFLUENCES OIL SUPPLY AND DEMAND?

- Oil has advantages over other fuels in that it has a relatively high level of energy density (i.e. amount of energy stored in a given mass) and it is relatively easy, cheap and safe to transport and store. This makes it an ideal transportation fuel.
- Crude oil is refined into many different products that serve needs in transportation, manufacturing, commercial and residential sectors, and it is a key feedstock for the production of petrochemicals and fertilizers
- Over 97% of the energy needs of transportation are served by oil products.

POINTS TO NOTE

Both oil production and consumption have risen by more than one million barrels per day per year since 2012.

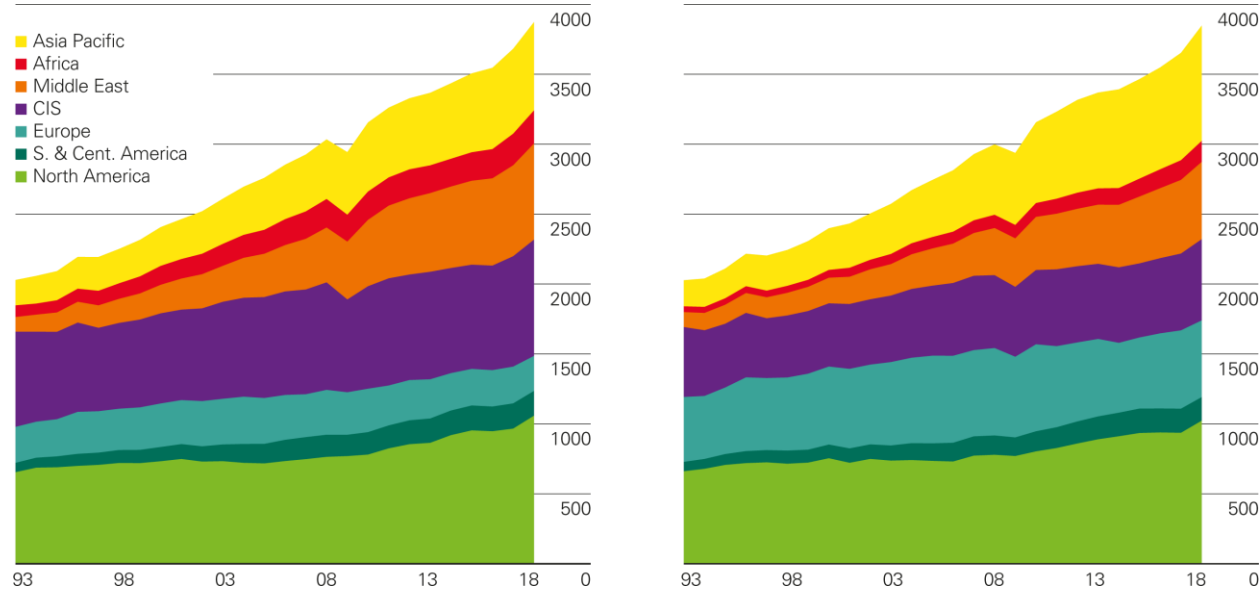
Oil demand is at its highest level in history.

In absolute terms, oil demand is growing twice as fast as renewables.

Global oil reserves have risen throughout the period, from 1141 billion barrels in 1998 to 1730 billion barrels in 2018; peak oil is nowhere in sight.

Most of the growth in demand is in the Asia-Pacific region.

GAS PRODUCTION (LEFT) AND CONSUMPTION (RIGHT) BY REGION (BILLION CUBIC METRES)



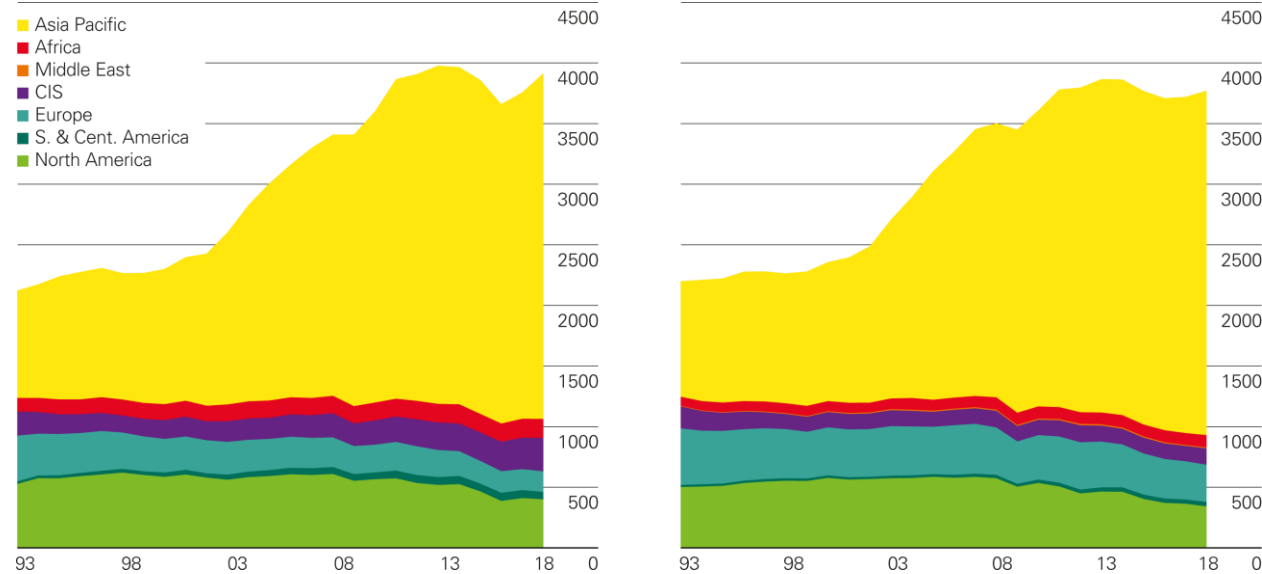
WHAT INFLUENCES GAS PRODUCTION AND CONSUMPTION?

- Natural gas, like oil but to a lesser extent, is a dense form of energy that can be easily and cheaply transported by pipeline.
- It is comparatively expensive to store. Its advantage is that it is a clean-burning fuel, with very few pollutants that affect local air quality.
- The growth of natural gas trade internationally has been due to the increased use of technologies by which gas is liquified and transported in ships then re-gasified at a port before being moved to final markets by pipeline.
- Gas is used mainly for electricity production, residential heating and industrial processes.

POINTS TO NOTE

- In absolute terms, natural gas is experiencing the fastest rate of growth of all energy sources, almost three times as fast as renewables.
- Natural gas demand is at its highest level in history, with no end in sight for the growth.
- Gas reserves rose from 131 trillion cubic metres in 1998 to 197 trillion cubic metres in 2018.
- Gas demand is increasing in both the OECD and non-OECD regions

COAL PRODUCTION (LEFT) AND CONSUMPTION (RIGHT) BY REGION (MILLION TONNES OIL EQUIVALENT)



WHAT INFLUENCES COAL PRODUCTION AND CONSUMPTION?

- About 20 countries produce coal but about two-thirds of production are in China, India and the United States.
- Coal can be produced at relatively low cost, but it contains many impurities that can affect local air quality unless it is burned in plants that have advanced “scrubbing” technologies.
- Most coal is used for power generation, but about 10 per cent is used for steel making.
- Coal-fired generation is reliable and dispatchable (i.e. it can be varied up and down to meet changes in electricity demand).

POINTS TO NOTE

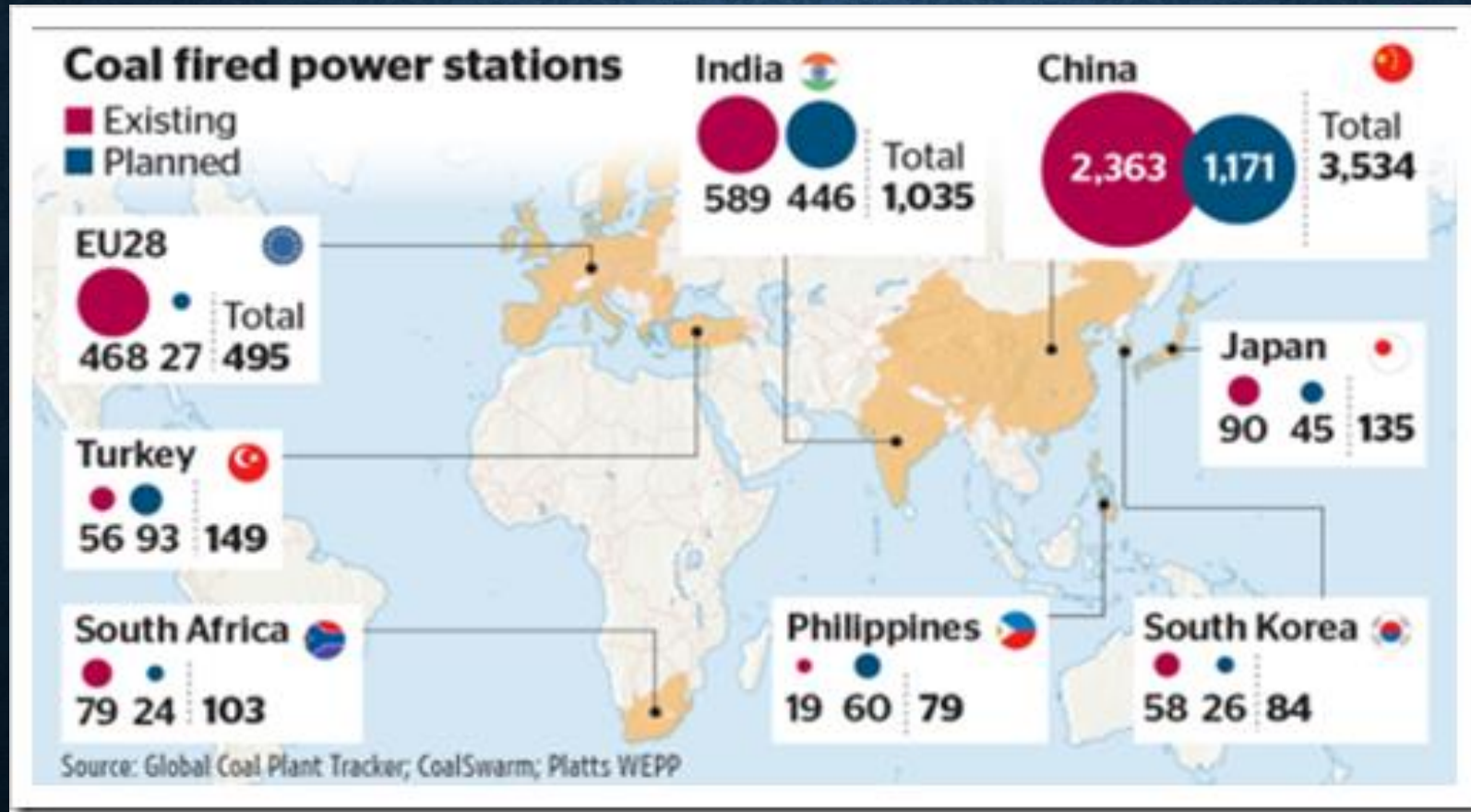


Coal consumption rose from 1993 to 2013, declined to 2017, but rose in 2018.

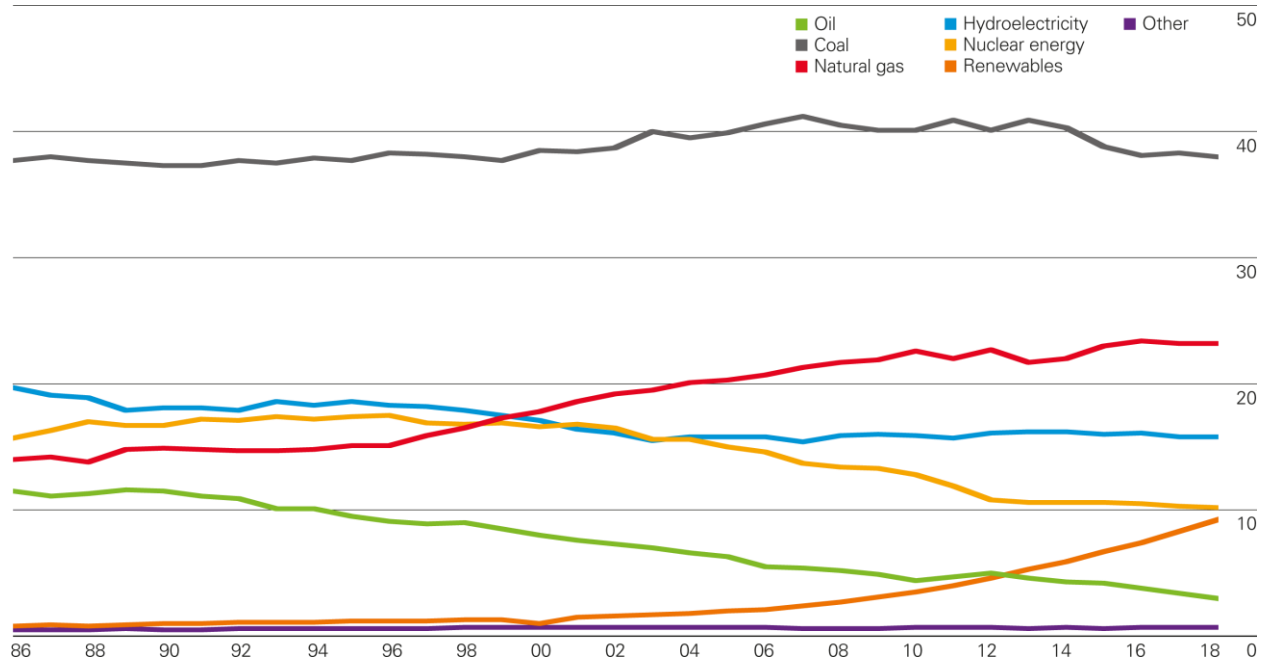


Coal reserves are immense and are present in many Asian and African countries.

1600 COAL PLANTS PLANNED OR UNDER CONSTRUCTION IN 2017



SHARE OF ELECTRICITY GENERATION BY FUEL (PERCENTAGE)



POINTS TO NOTE

Globally, coal remains by far the most important source of fuel for electricity generation.

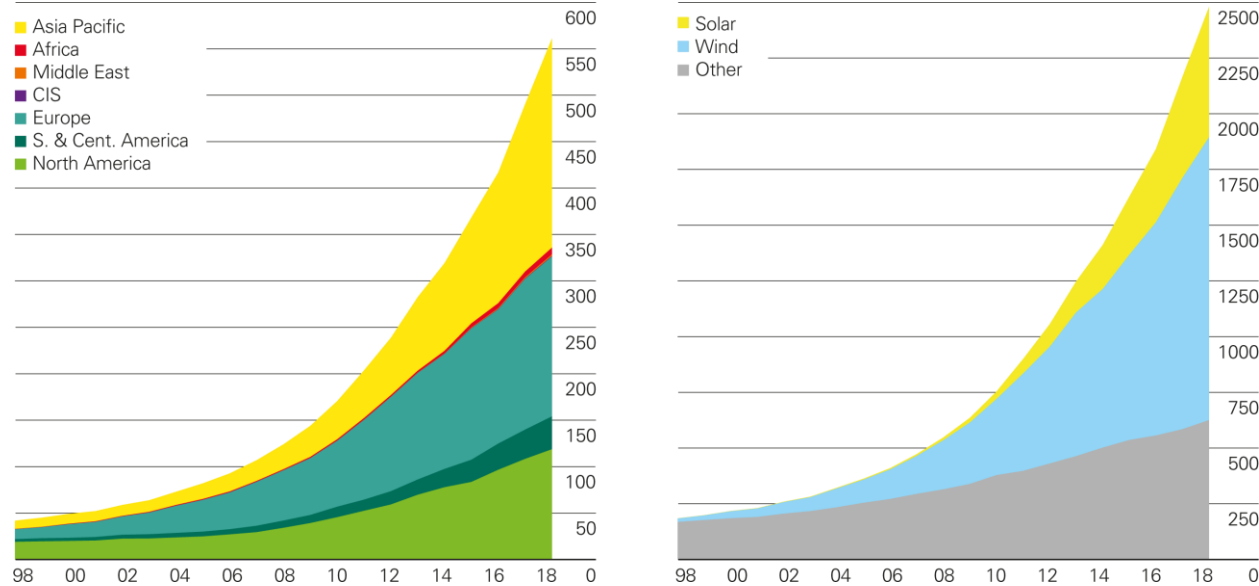
47% of China's power generation is based on coal.

Natural gas is in second place and is rising fast.

Of global electricity generation of 26,615 terawatt hours in 2018, renewables provided 2,480 terawatt hours, or 9%.

Electricity demand must be met instantaneously, but generation sources vary considerably in terms of whether they can provide power when needed; nuclear, hydro, coal and natural gas-fired generators can; wind and solar cannot.

RENEWABLE ENERGY CONSUMPTION BY REGION(LEFT) AND GENERATION BY SOURCE (RIGHT)



POINTS TO NOTE:

The consumption graph on the left is in million tonnes of oil equivalent and the generation graph on the right shows terawatt-hours.

Renewable energy generation has increased rapidly from a small beginning, with wind turbines dominating the growth so far.

Global consumption of renewables grew from 124 million tonnes of oil equivalent in 2008 to 561 million tonnes of oil equivalent in 2018.

Intermittency means a mismatch between generation and electricity demand; as the renewables share rises above 30%, the risk of blackouts and brownouts increases.

Bulk electricity storage systems, even where technologically proven, are extremely expensive (over 70 cents per kilowatt-hour)

ELECTRICITY STORAGE

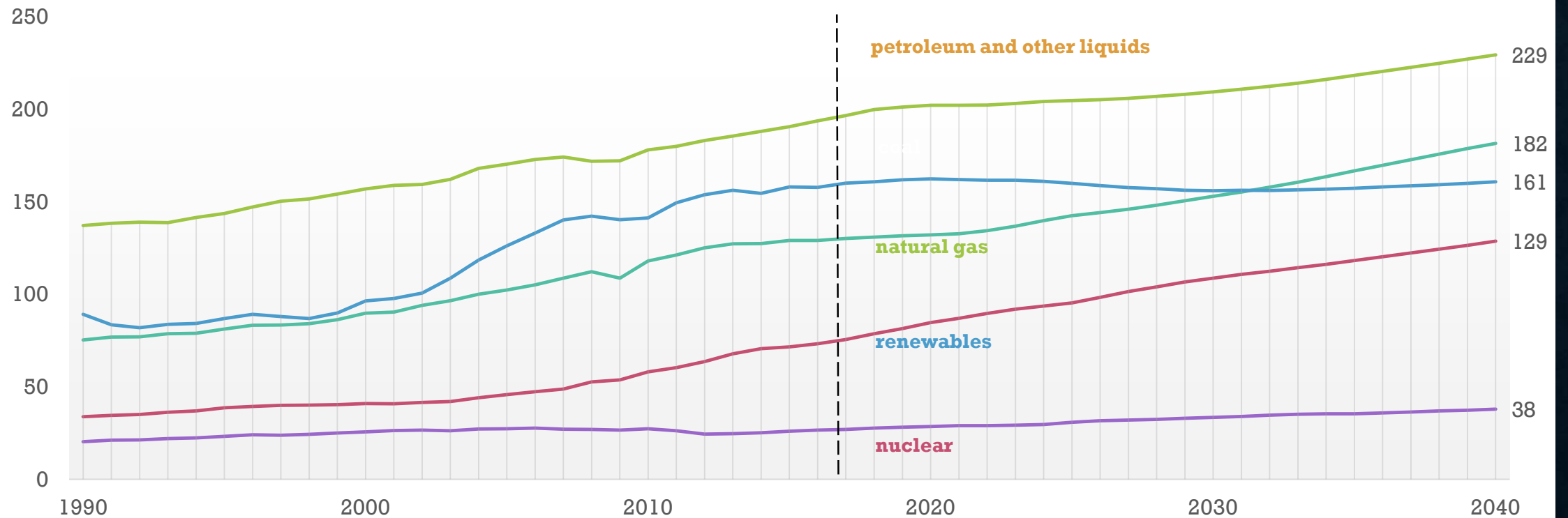
- On average, wind turbines produce electricity about 30% of the time and solar energy about 15% of the time.
- Proponents hope that someday new electricity storage technologies will emerge.
- Today, however, 3000 MW of battery storage would cost about \$7.5 billion and if needed as backup to 9,000 MW of wind generation capacity could do so for only two hours. Yet days of storage would be needed to assure reliability.
- Today, battery storage available is less than one millionth of U.S. national electricity output.

WORLD ENERGY CONSUMPTION INCREASES FOR FUELS OTHER THAN COAL

IEO2018 Reference case

world energy consumption by energy source

quadrillion Btu



Source: EIA, International Energy Outlook 2018

POINTS TO NOTE

- The United States Energy Information Administration is one of the most authoritative analysts of future energy supply and demand trends.
- The projections shown here are to 2040.
- While there are differences among forecasters, the broad conclusions are shared by all, including the International Energy Agency, EXXON and British Petroleum.
- In a nutshell, at least 75% global energy use will be supplied by oil, natural gas and coal out to 2040 and beyond, with renewable energy rising into fourth place over time.

GHG EMISSIONS FROM ENERGY USE

Region	2008 (Gt)	2018 (Gt)	Change	Share (%) in 2018
OECD	13.4	12.2	-1.2	37
Non-OECD	16.9	21.4	4.5	63
World	30.3	33.7	3.4	100

POINTS TO NOTE

- Global emissions continue to rise, with almost all emissions growth occurring in the non-OECD area.
- The non-OECD area accounts for 63% of global emissions now.
- Emissions grew by 2% in 2018, double the annual average of the previous decade.
- China has a 28% share of global emissions, India 7.4 %, Japan 3.4%, South Korea 2.1 %; the Asia Pacific region is the fastest growth area, along with the Middle East.

THE COP21 AGREEMENT

- Under the U.N. Framework Convention on Climate Change, countries agreed to submit individually-determined plans as to how they will reduce GHG emissions so as to meet the aspirational goal of avoiding temperature increases of 1.5 to 2 degrees Celsius over the next century
- The commitments are not legal and there are no penalties for non-compliance
- Many developing countries are exempt from the obligation to submit plans; most of those that have submitted plans have indicated that they are conditional on receiving funding and technology from the wealthier countries.

GOVERNMENT POLICIES

- The countries of the world are not complying with the COP21 commitments.
 - The commitments only run to 2030.
 - Even if all complied and extended their actions to 2100, it would reduce global temperatures by 0.17 degrees C.
 - The United States has indicated its intentions to withdraw.
 - There is little likelihood OECD countries will comply with commitment to pay \$100 billion per year to the Green Climate Fund.
- As the gap between commitments and actions widen, it offers an opening for countries to forego their commitments altogether.

CONCLUSION

- Current trends strongly favour continued and increased use of fossil fuels globally.
- The actual (i.e. real) energy supply, demand and emissions trends are sharply different from the claims of those who foresee a rapid global decarbonization.
- These trends are underpinned by plentiful resources, increasing population, increasing economic activity and technological change.
- For a very long time to come, history is on the side of traditional energy sources.