



The role of coal in the evolving mix

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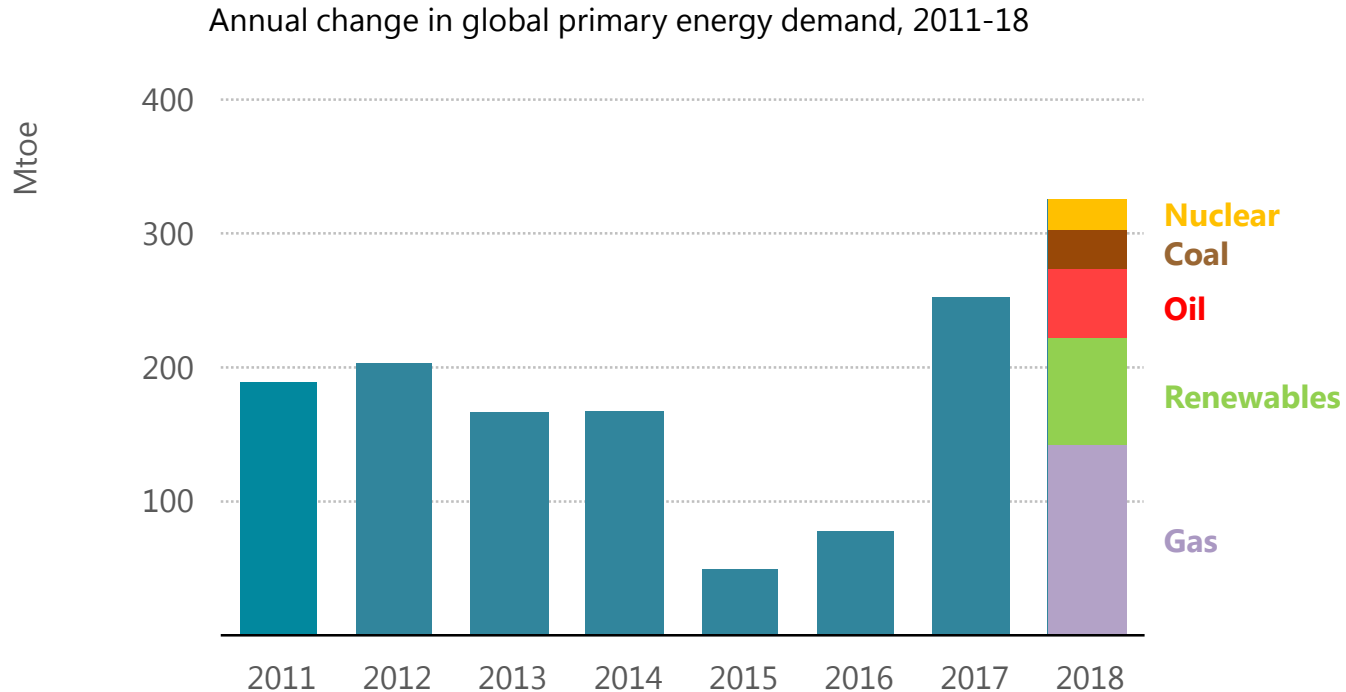
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Tokyo, 9 September, 2019

Agenda

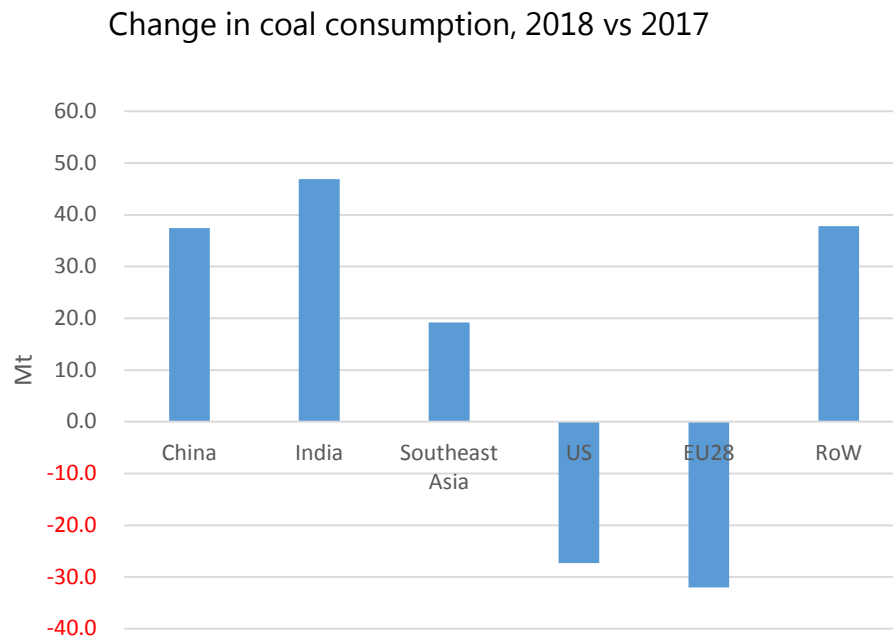
- Global trends in the use of coal
- Challenges for the use of coal
- Status of clean coal technologies

2018 – a remarkable year for energy



Global energy demand last year grew by 2.3%, the fastest pace this decade, an exceptional performance driven by a robust global economy, weather conditions and moderate energy prices.

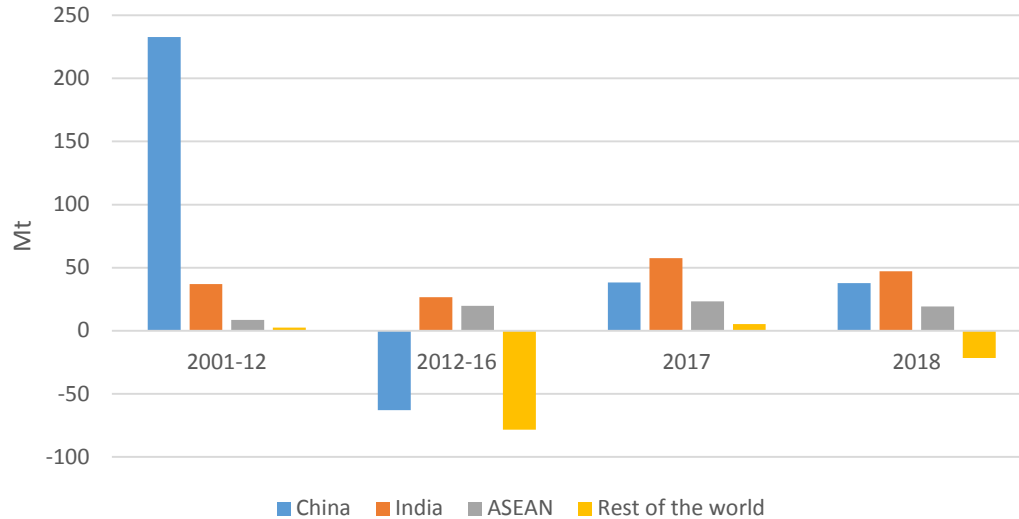
Very different regional trends on coal consumption



The big drop in coal use in US and Europe does not offset increase in Asia

The scale of growth for coal has changed

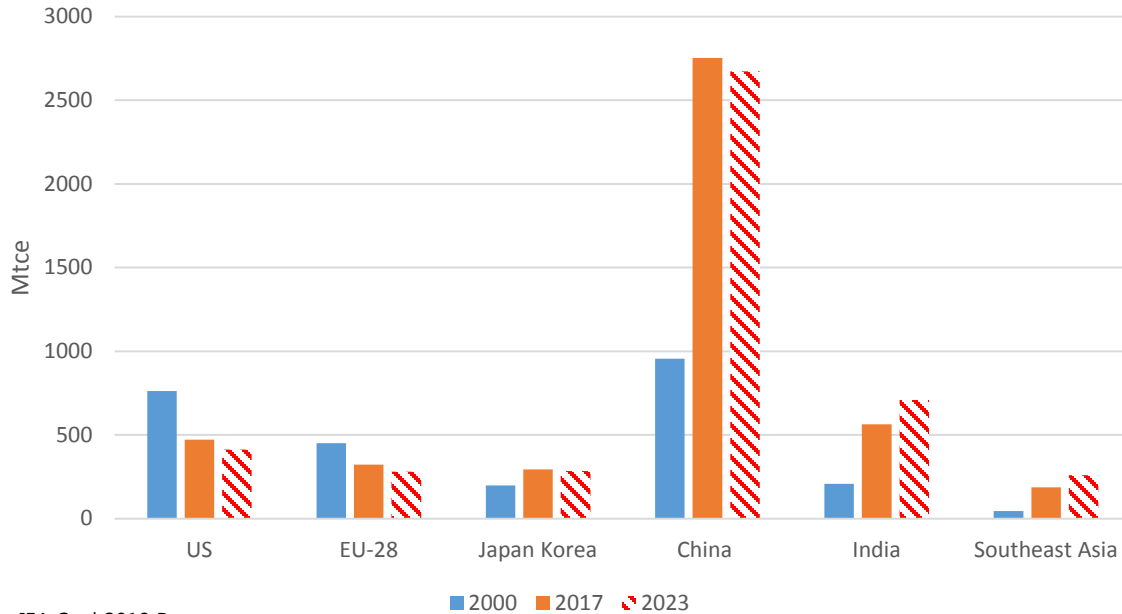
Annual incremental coal demand by region



The amazing growth in China in the 2000s is not going to be emulated anywhere

One planet, two worlds

Coal demand in select countries/regions in 2000, 2017 and 2023 (forecast)

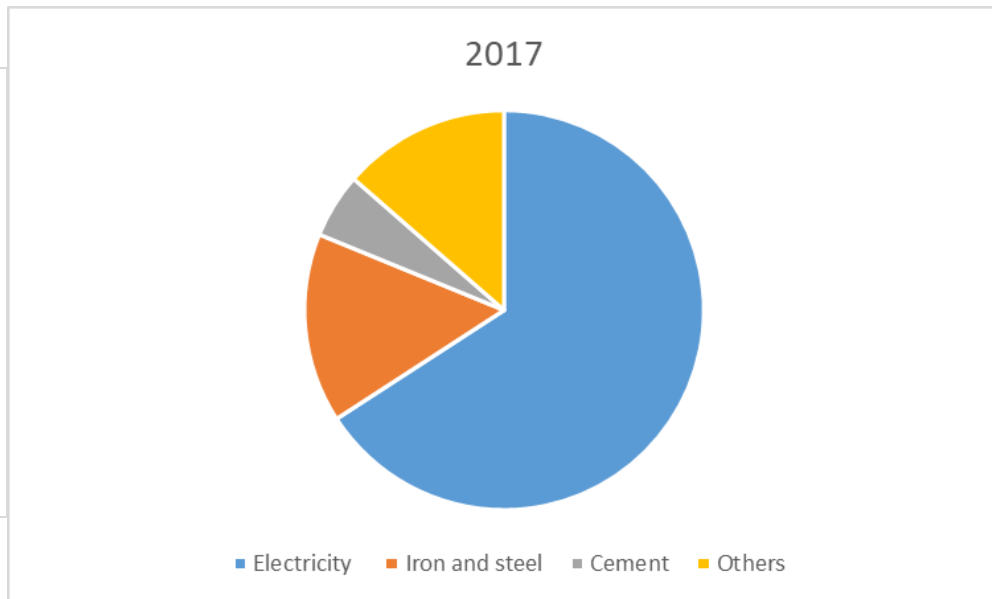
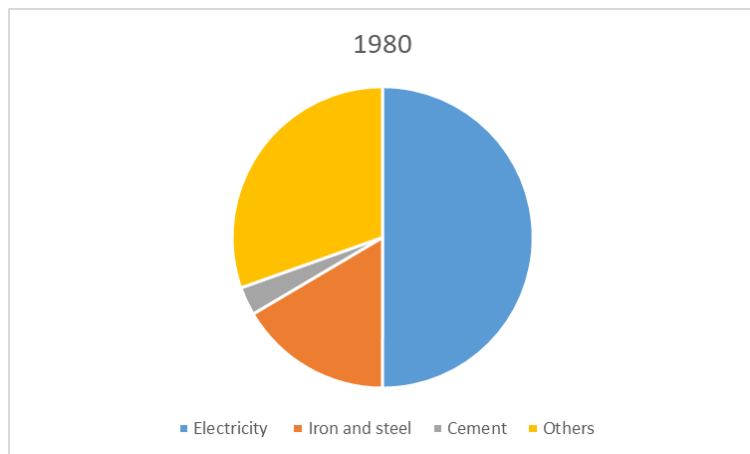


Source: IEA Coal 2018 Report

India and southeast Asia will lead coal demand growth while it will continue to decline in Europe and United States

Where is coal used?

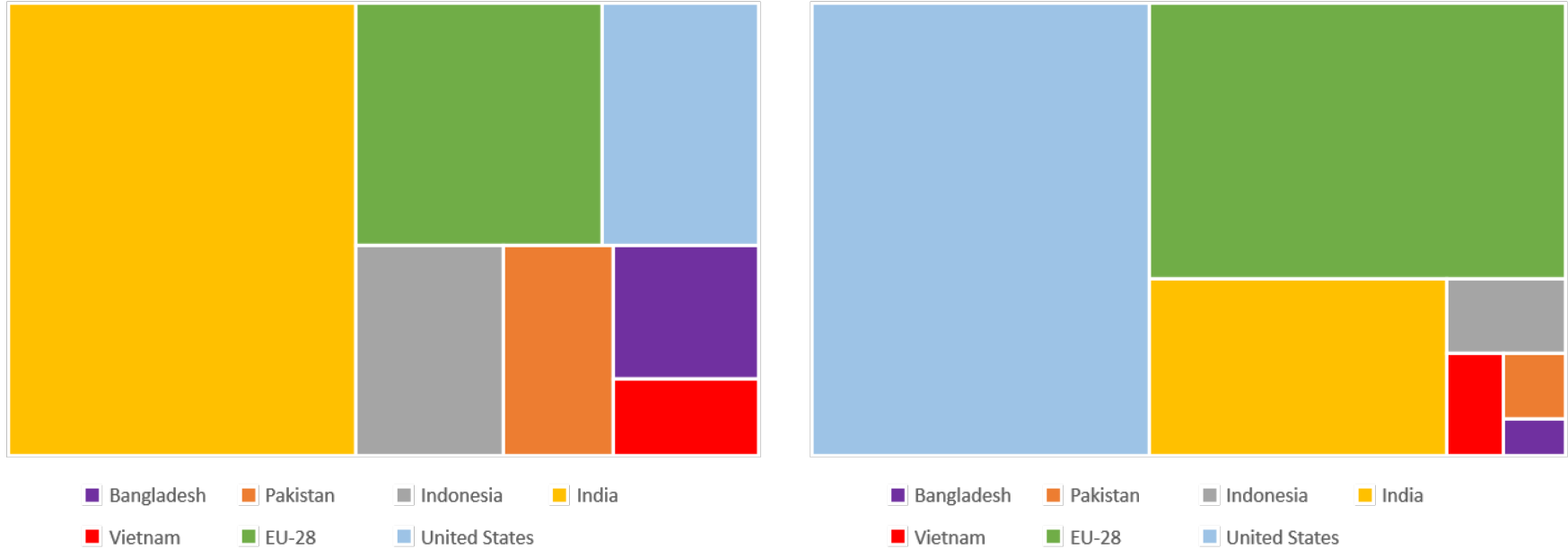
Sectoral breakdown of coal use (1980, 2017)



The share of coal used in electricity globally has increased at the expense of residential and industrial sectors

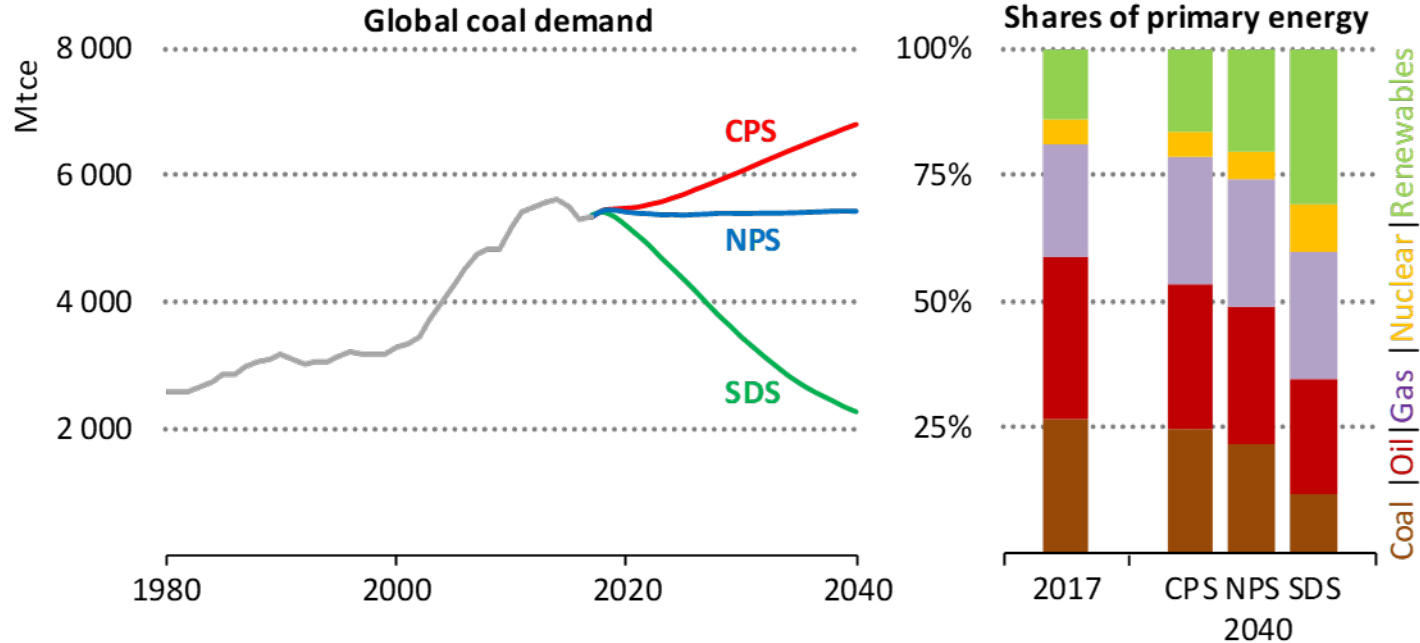
A large part of the world is electricity-thirsty

Population (left) and electricity consumption (right) in select country regions



Increase in coal power demand largely occurs in countries where per capita electricity use is very low

The different paths of coal demand

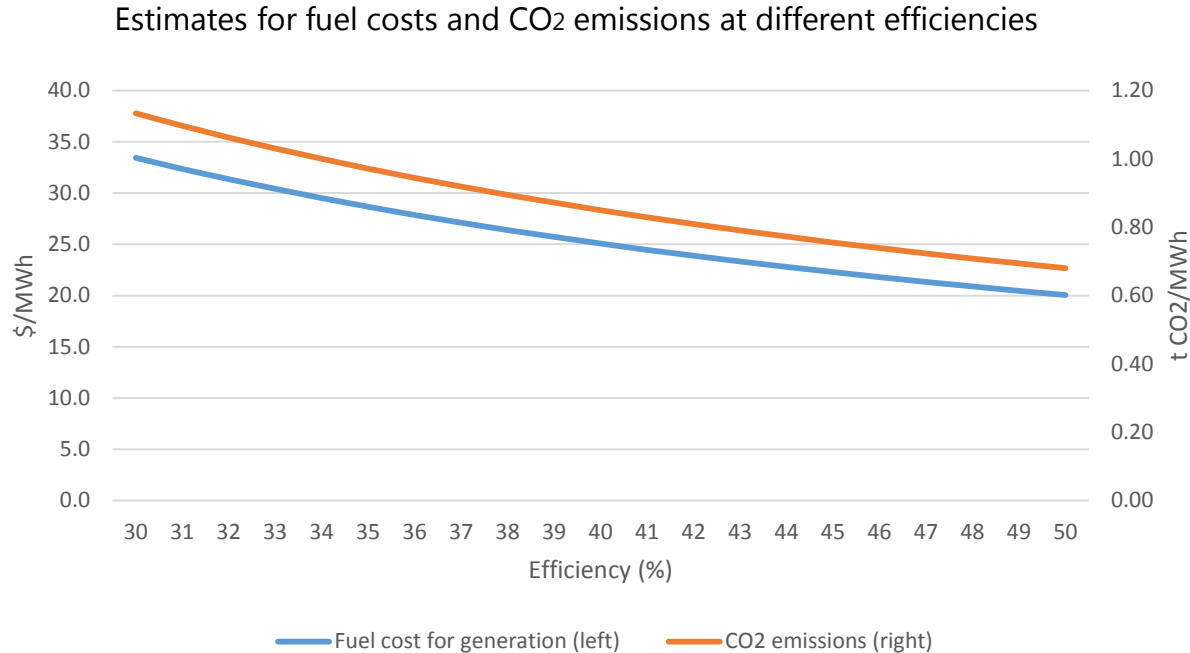


Source: World Energy Outlook 2018

Stringency of environmental policies determines coal's fortunes in the scenarios

Challenges for coal use

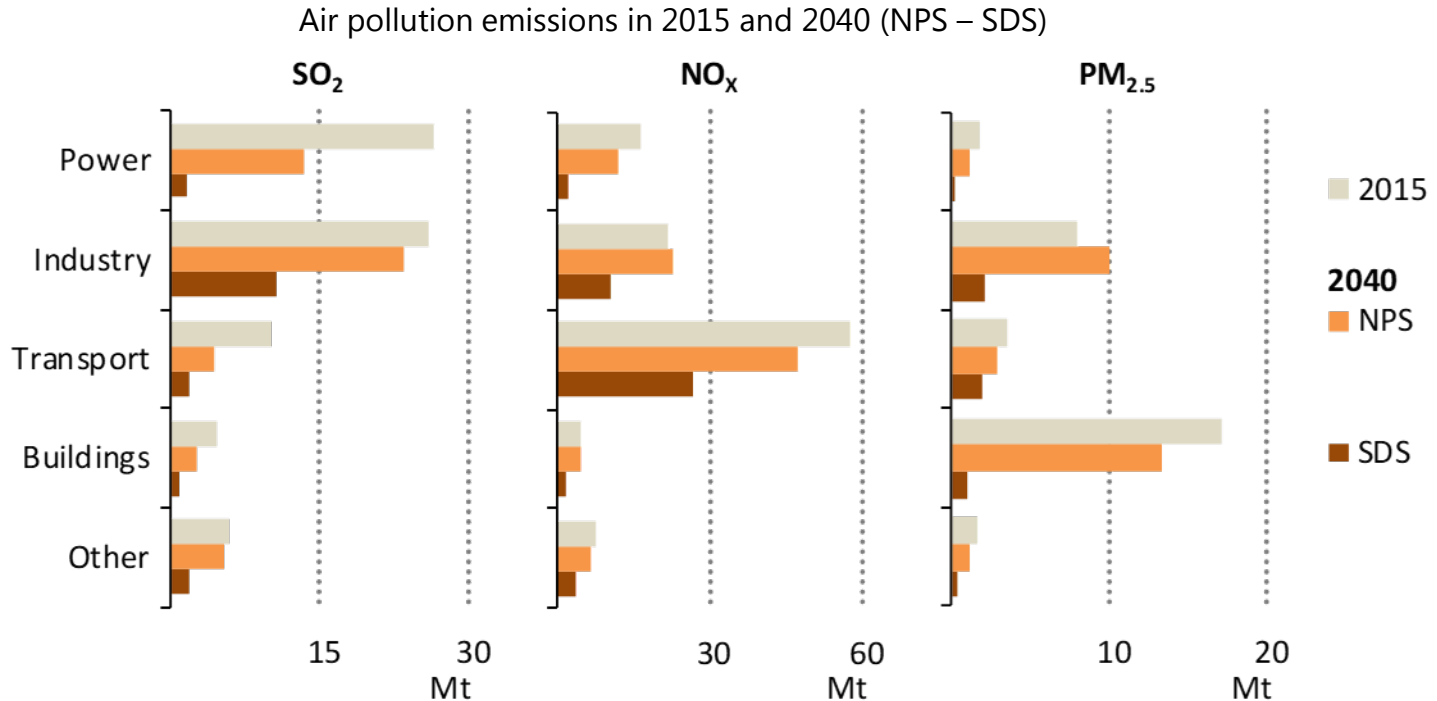
Higher efficiency brings clear benefits



Assuming a coal price of \$70/t (6,000kcal/kg) and coal specific emissions of 94.5 kg CO₂/GJ

Efficiency is pivotal for the economics of the plant and the CO₂ footprint.
Today's efficiency is well below 40%, whereas the state of the art is well above 45%

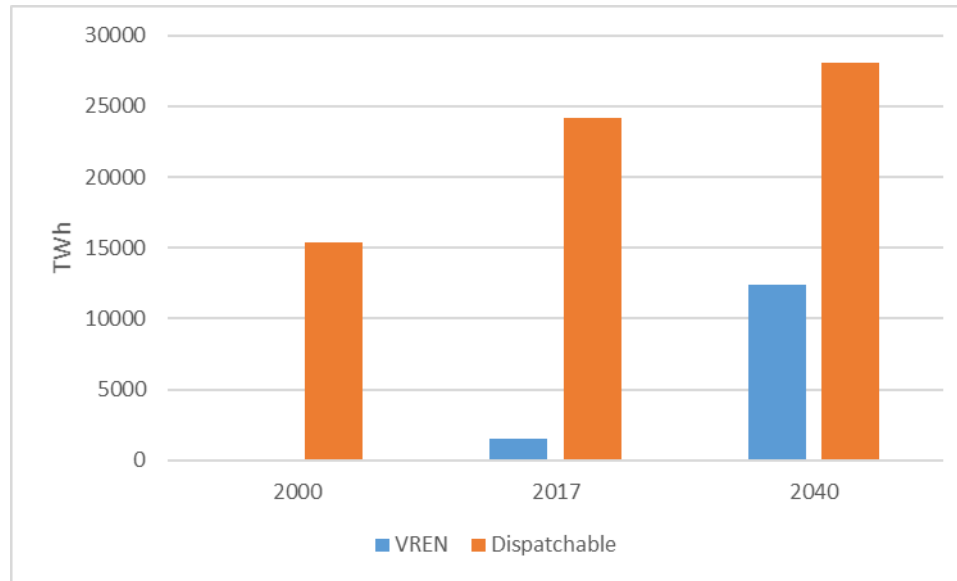
Air pollution is a growing issue in many jurisdictions



Whereas AQCS are well known and widely used, air pollution from coal is still an important issue in many jurisdictions

Flexibility of power plants, an increasing need

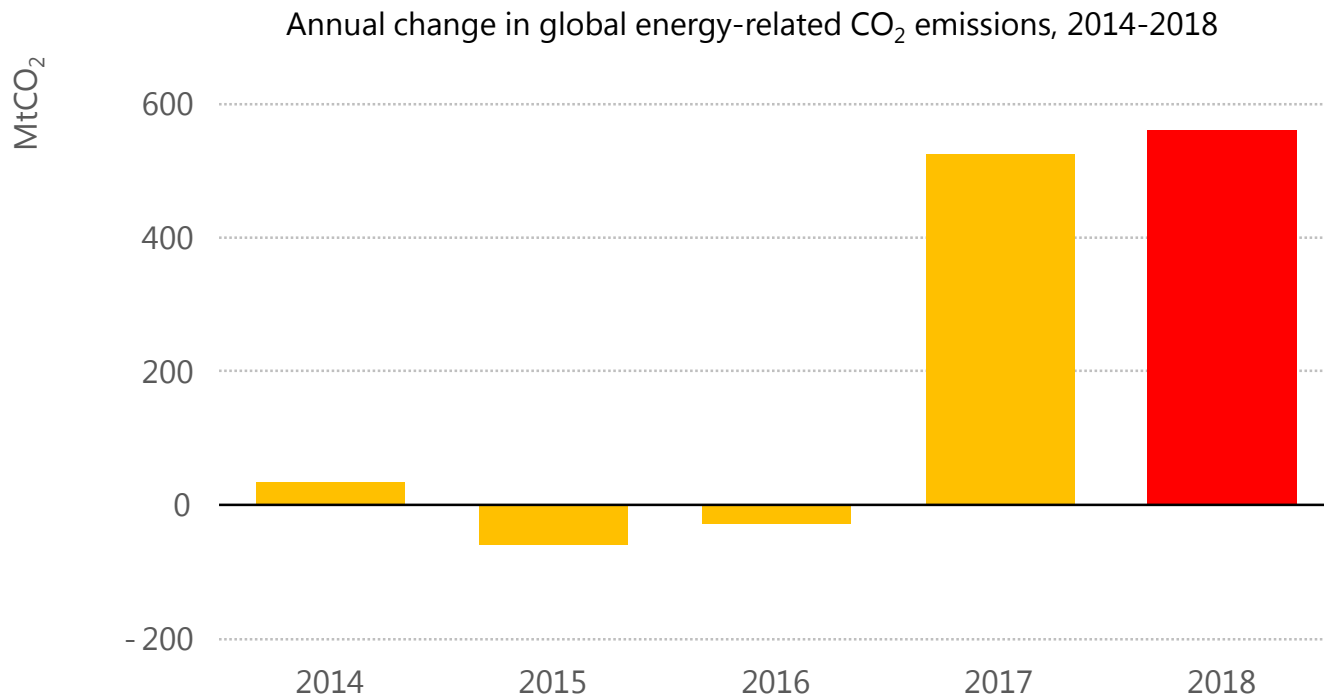
Electricity generation mix (2000, 2017, 2040 NPS)



Source: World Energy Outlook 2018

The deployment of wind and solar requires flexibility across the whole electricity system

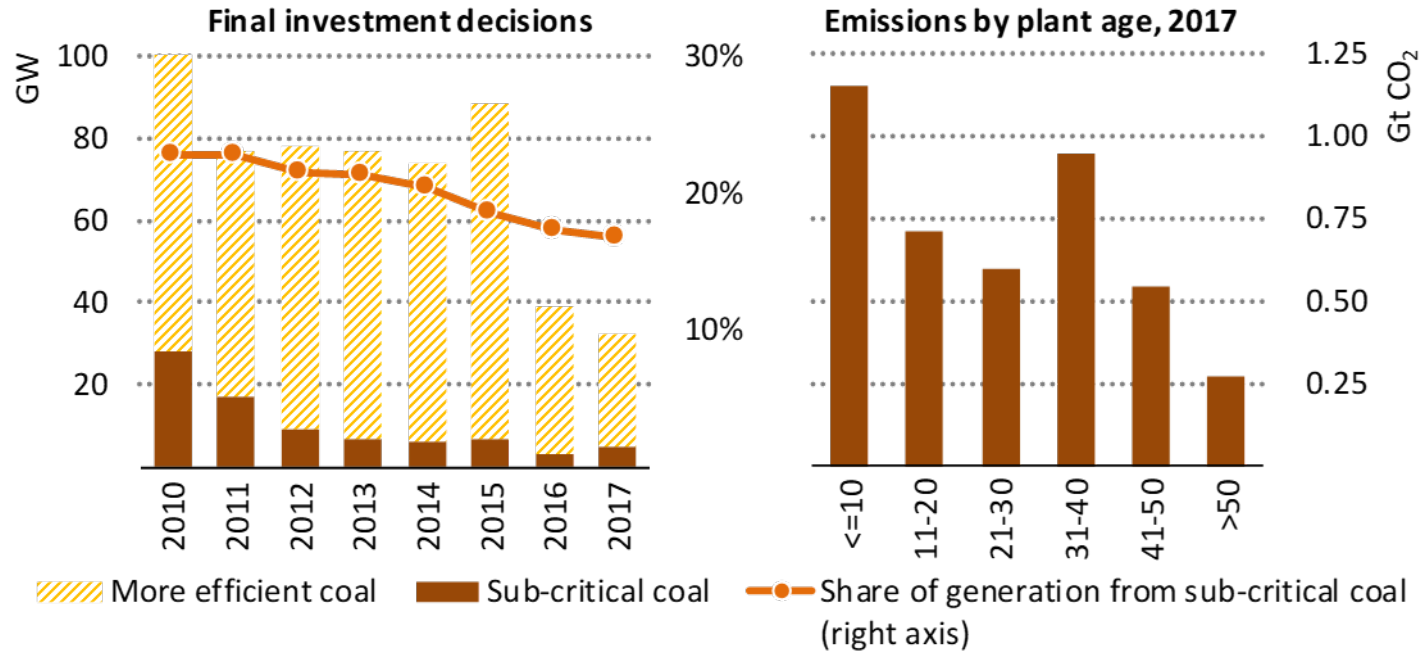
Energy-related CO₂ emissions hit a record high in 2018



Coal, the more carbon intensive fossil fuel, is the largest CO₂ contributor.
Reducing CO₂ emissions from coal is the main challenge to overcome for coal to have a future

Status of clean coal technologies

Plants are becoming more efficient



The transition from subcritical to supercritical technologies is almost done for new plants. However, there are still a large legacy of subcritical plants in the world.

Power plants dominate flexibility options today



Main technical parameters

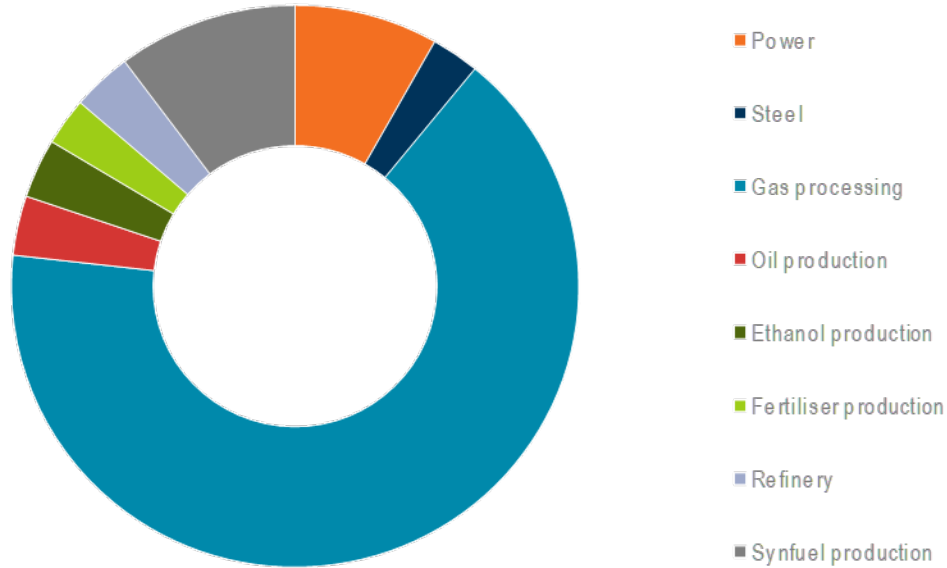
- Minimum output – less shut-downs and costs
- Ramp rate and start-up time – faster response
- Minimum up and down times – Flexible scheduling



Power plants provide over 90% of flexibility, interconnections 5%, demand response 1% and batteries less than 1%.
But to unlock latent flexibility in power plants is important to run modern electricity systems

CCUS, slow and imbalanced progress

Annual capture from large-scale CCUS facilities



Today, most CCUS is applied to gas processing.
Coal, despite being the largest source of CO₂, represents only a small fraction of the CO₂ captured

Key messages

- Today, coal supplies one quarter of the global primary energy and generates almost 40% of the electricity in the world
- Our forecast for coal consumption is to stabilize in the coming years, with different regional trends: growth in Asia, decline in Europe and North America
- Increasing electricity consumption in Asia, owing to economic growth, universal access to electricity, and a growing middle class is the main driver for growth of coal demand in Asia
- Increasing efficiency, reducing air pollution, enhancing flexibility in power generation and reducing the CO₂ footprint are the main areas of improvement when coal is used
- Among those challenges, a rapid and urgent scale-up of investment on CCUS should be a priority if coal is to have a place in a sustainable future