



The Future of Global Energy Markets: Implications for Security, Sustainability and Economic Growth

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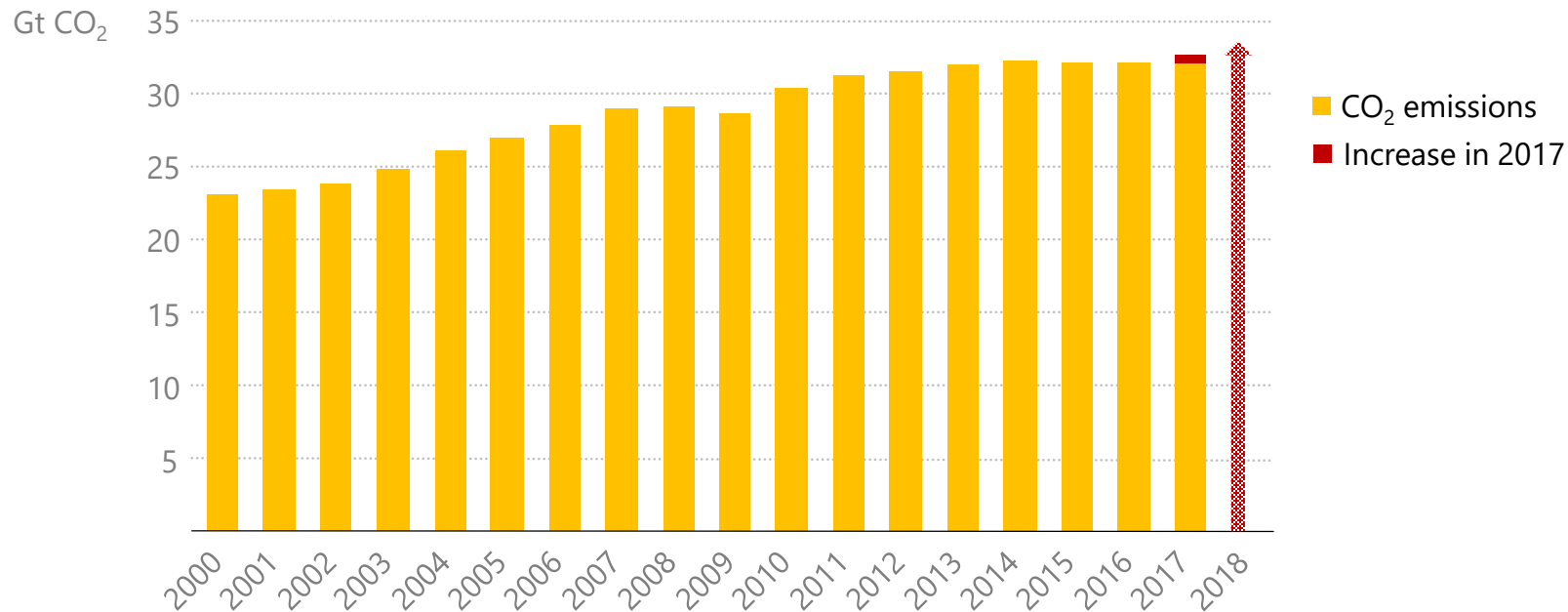
Delft University of Technology, 20 March 2019

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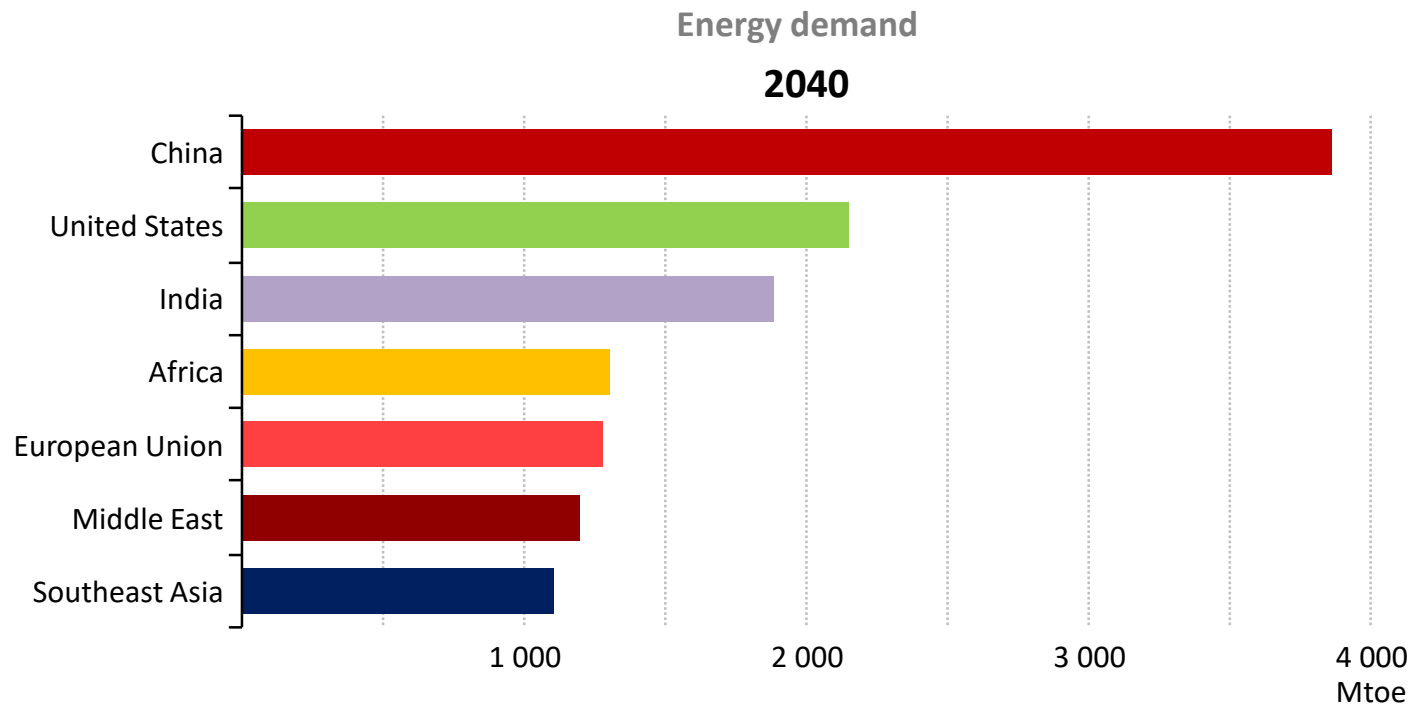
- Mixed signals about the pace & direction of change in global energy:
 - North America has entered a **new age of oil & gas wealth**
 - **Natural gas is on the rise**: China's rapid demand growth is erasing talk of a 'gas glut'
 - **Solar PV has the momentum** while other key technologies & efficiency policies need a push
- For the first time, global **population without access to electricity fell below 1 billion**
- **Electricity** is carrying great expectations, but questions remain over the extent of its reach in meeting demand & how the power systems of the future will operate
- Policy makers need well-grounded insights about different possible futures & how they come about.

Global emissions increased in 2018 – again

Global energy-related CO₂ emissions

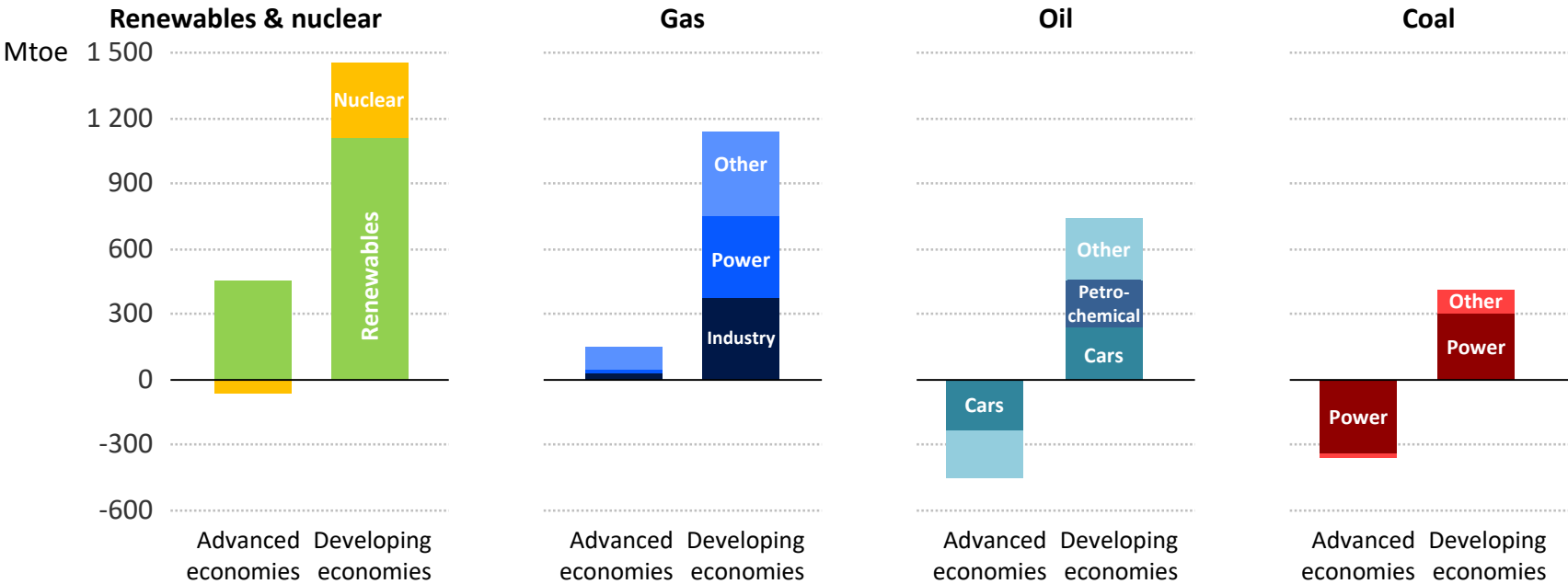


CO₂ emissions rose for a second year in a row, after remaining flat for the three previous years



In 2000, more than 40% of global demand was in Europe & North America and some 20% in developing economies in Asia. By 2040, this situation is completely reversed.

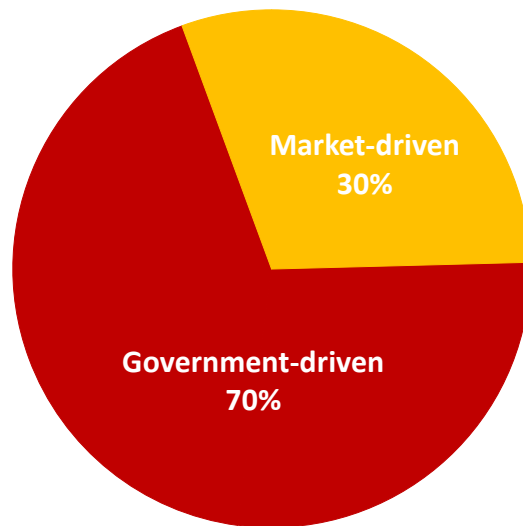
Fuelling the demand for energy



The increase in demand would be twice as large without continued improvements in energy efficiency, a powerful tool to address energy security & sustainability concerns

Our energy destiny rests with governments

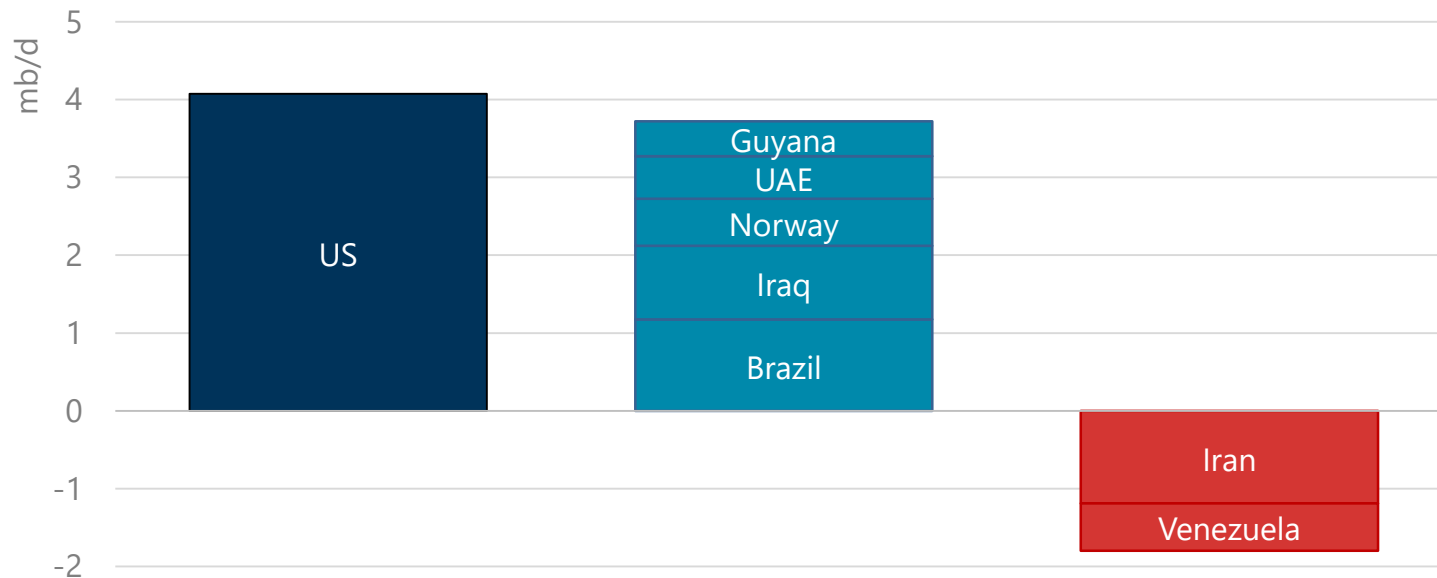
Total investment in energy supply to 2040:
\$42.3 trillion



More than 70% of the \$2 trillion required each year in energy supply investment either comes from state-directed entities or receives a full or partial revenue guarantee

US leads the way in global oil supply growth

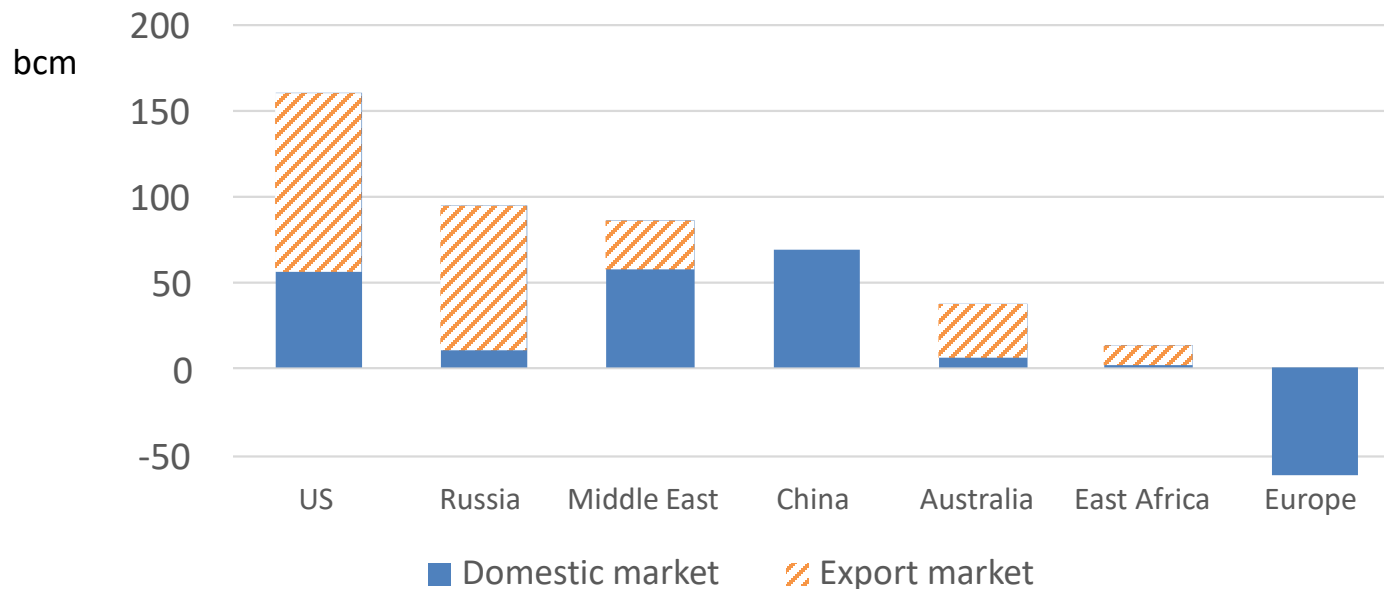
Change in total oil supply 2018-24



US expansion is 70% of global growth. Gains in Brazil, Iraq, Norway, the UAE and Guyana. Main declines in Iran and Venezuela.

US takes the lion's share of the growth in global gas supply

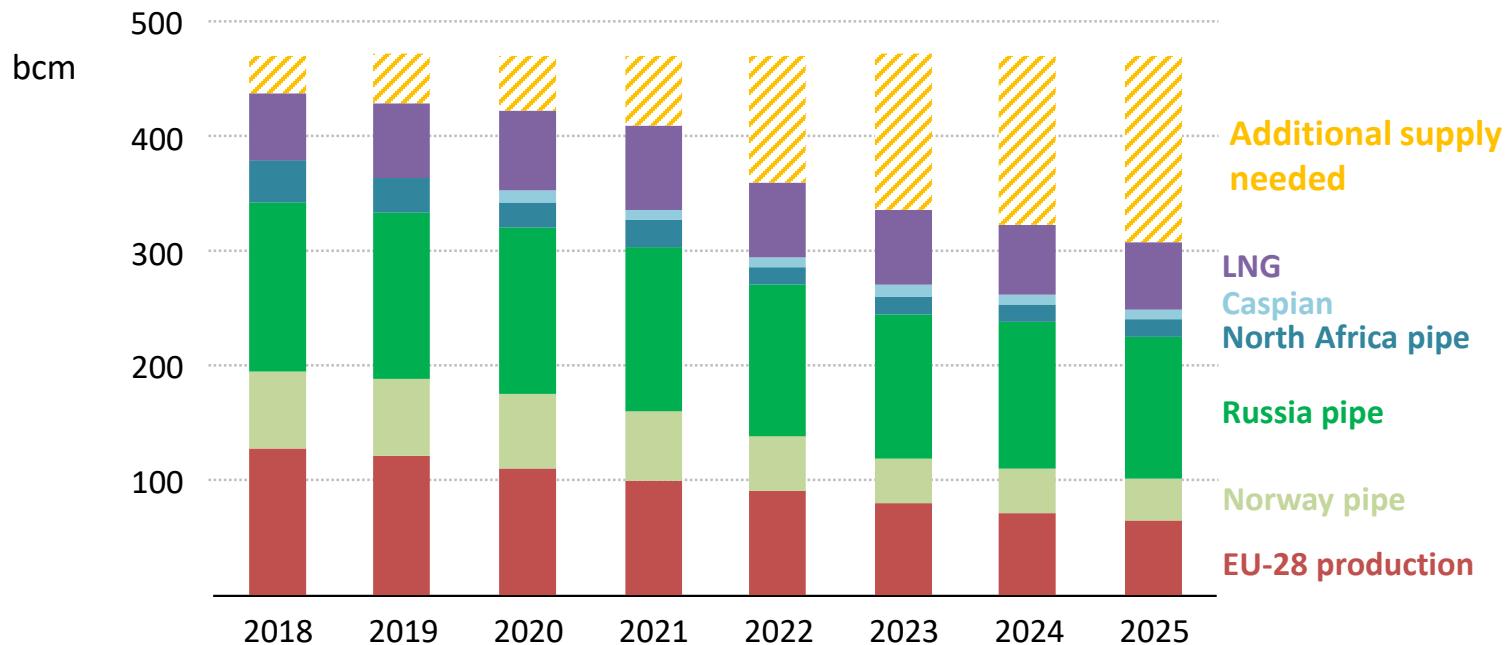
Natural gas production growth for selected countries and regions, 2018-2025



**The United States accounts for a third of growth in global natural gas production to 2025
& two-thirds of anticipated growth in LNG exports**

Europe will need to seek new gas imports

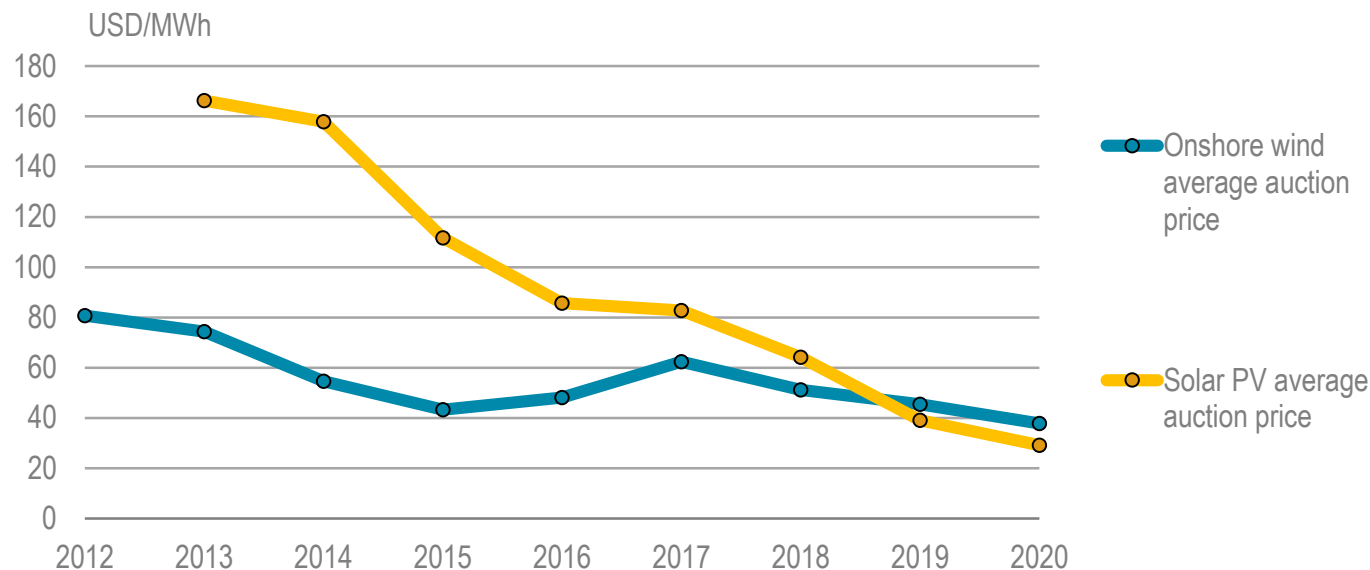
Produced / contracted gas & additional import requirements in the EU, 2018-2025



The European Union needs to find imports to cover one-third of its demand by 2025, due to sharp declines in the EU's own production & the expiry of nearly 100 bcm of long-term gas import contracts

Wind and solar PV costs falling rapidly

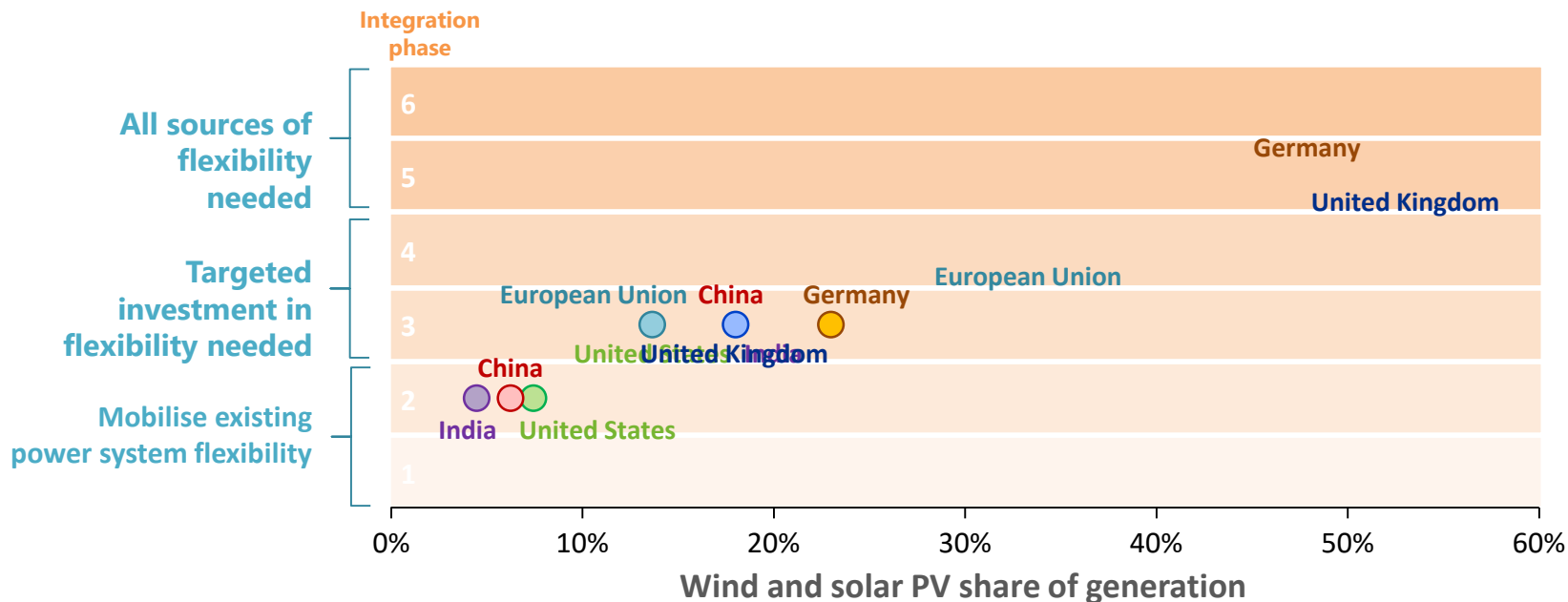
Announced wind and solar PV average auction prices by commissioning date



Technology progress and competition have driven down prices to record-low levels in countries with good renewable resources, transparent policies and well-designed auction schemes

Flexibility: the cornerstone of tomorrow's power systems

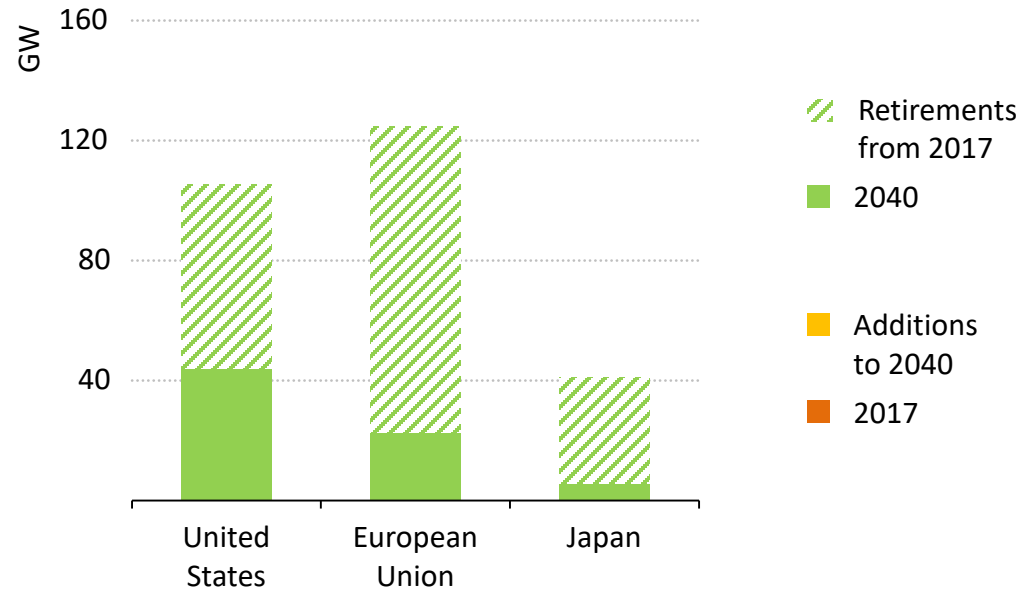
Phases of integration with variable renewables share, 2030



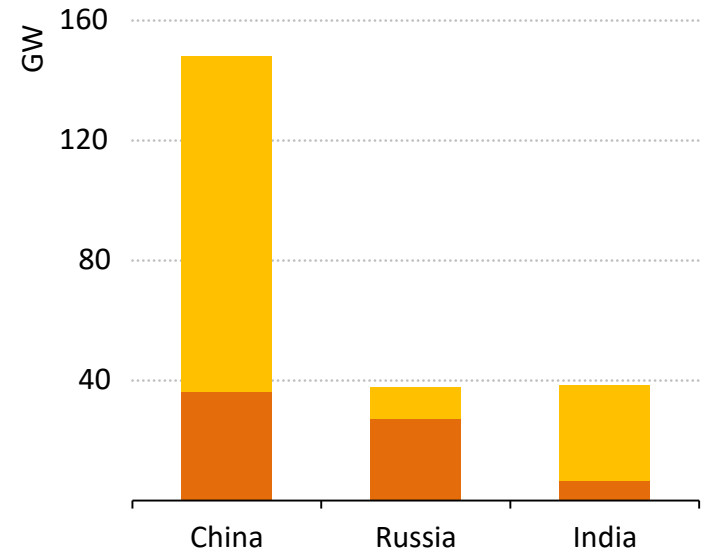
Higher shares of variable renewables raise flexibility needs and call for reforms to deliver investment in power plants, grids & energy storage, and unlock demand-side response

Two directions for nuclear power

Without policy changes

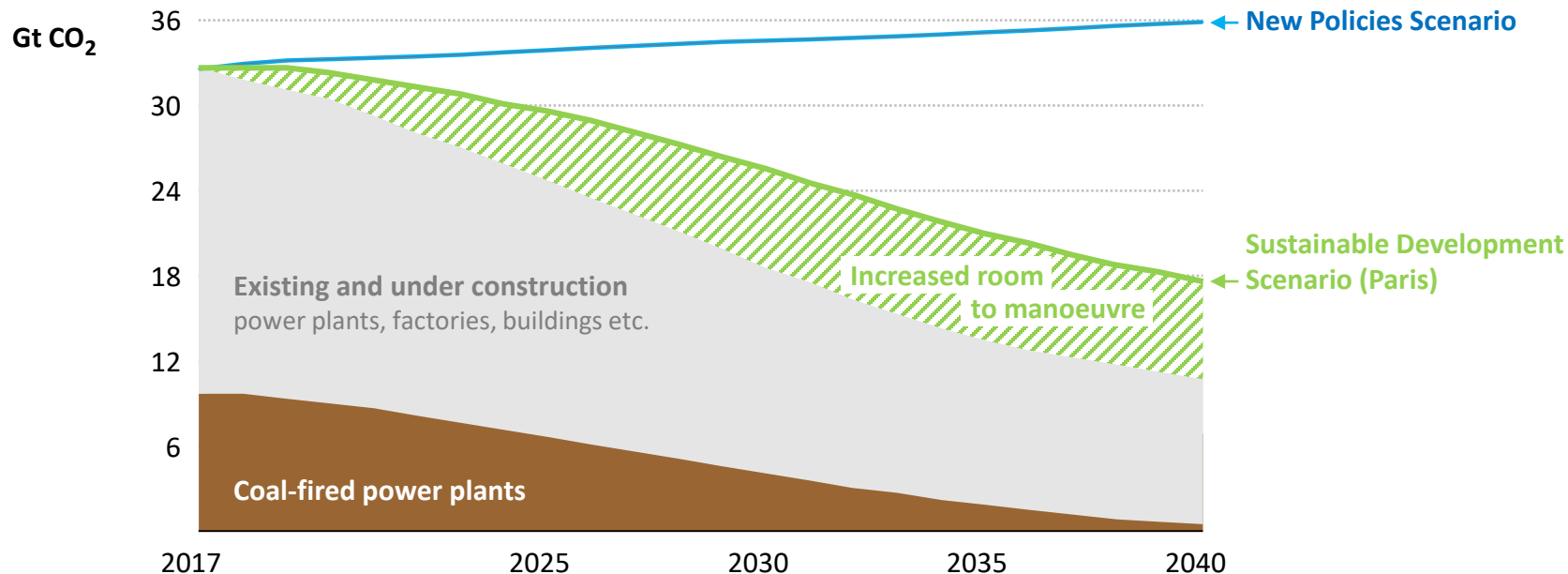


Growth markets



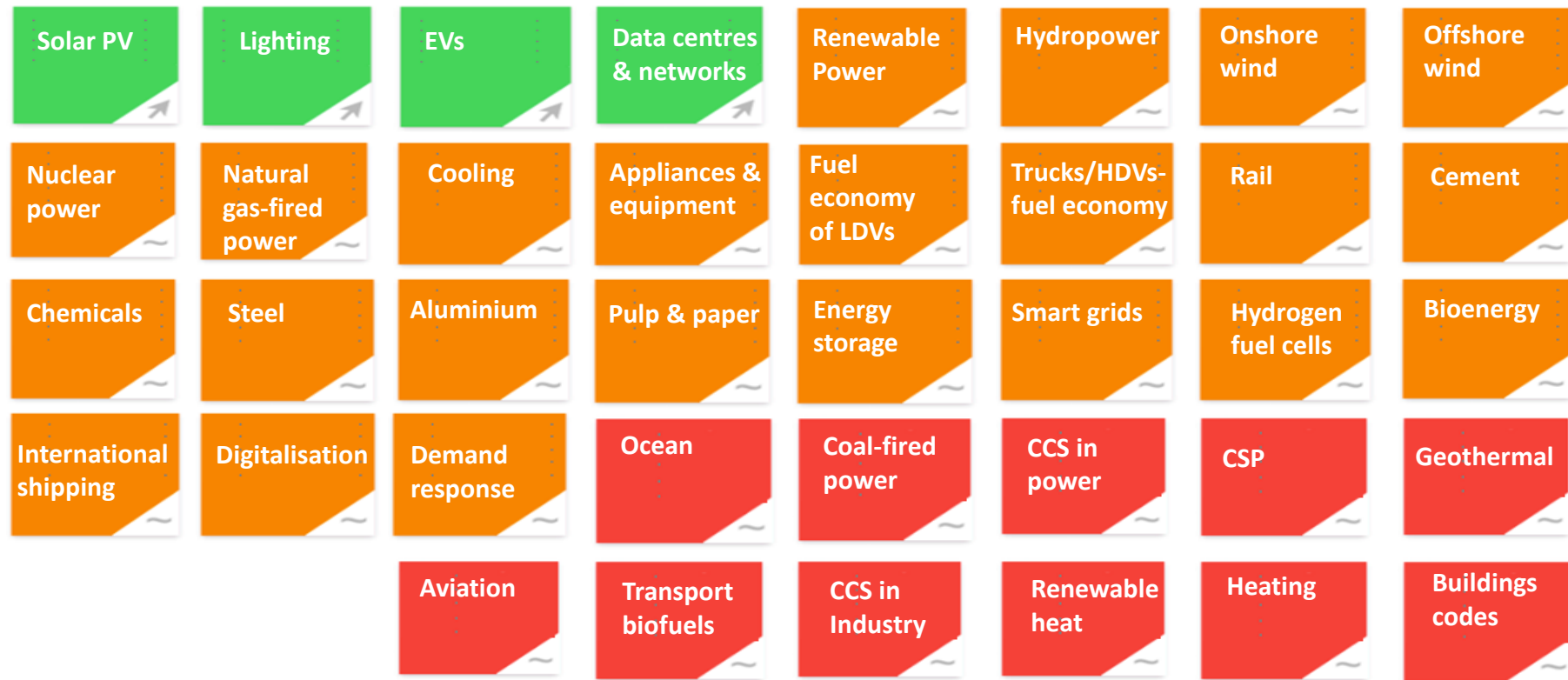
The contribution of nuclear power could decline substantially in leading markets, while large growth is coming, as China takes first position within a decade

Can we unlock a different energy future?



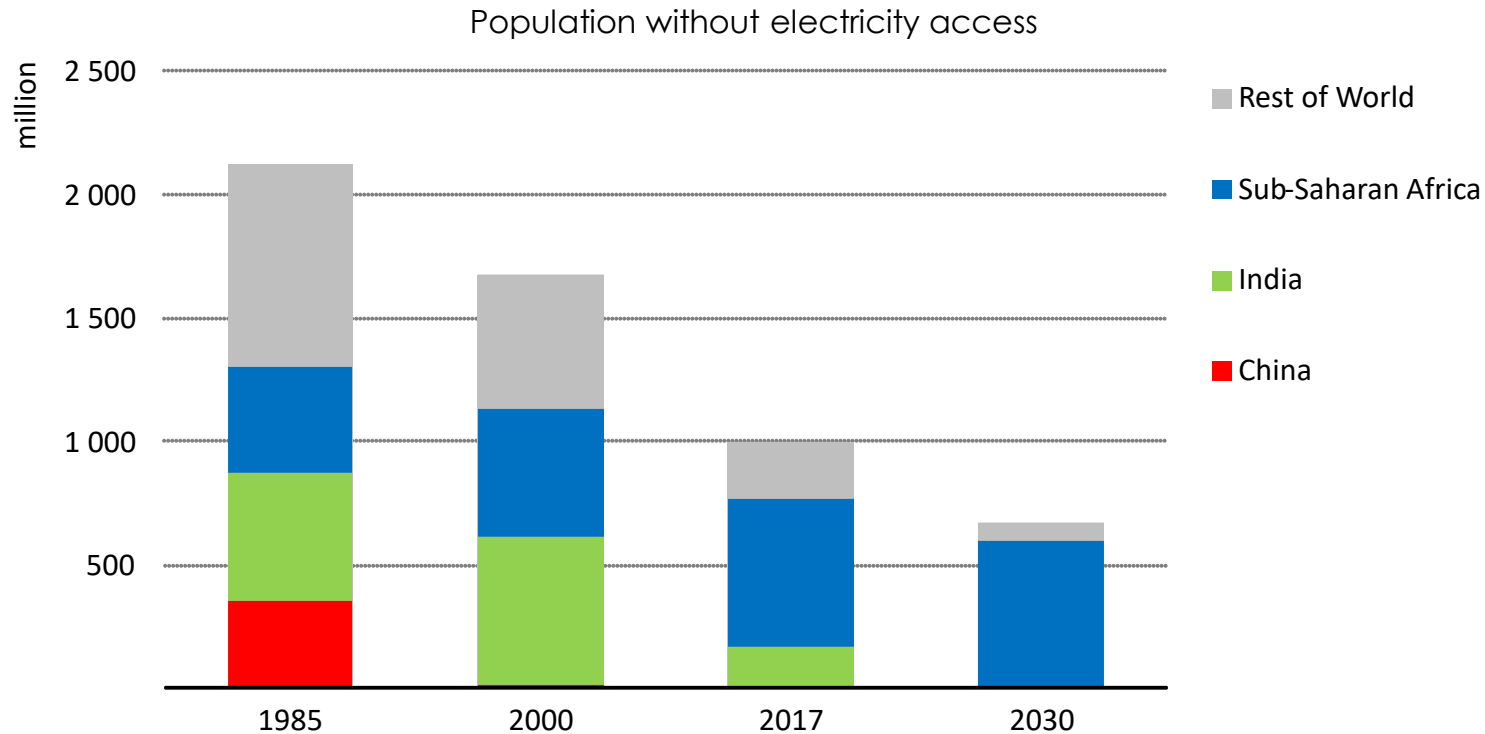
Coal plants make up one-third of CO₂ emissions today and half are less than 15 years old; policies are needed to support CCUS, efficient operations and technology innovation

How is clean energy technology progressing globally ?



Out of the 38 technologies included in *Tracking Clean Energy Progress (TCEP) 2018*, only 4 are on track, 23 need improvement

Electrification success elsewhere, but sub-Saharan Africa still remains in the dark



China was a remarkable success story for electrification, bringing access to hundreds of millions in record time; India achieved electricity access for all its villages in 2018; Today the challenge is concentrated in sub-Saharan Africa

- The links between **energy & geopolitics** are strengthening & becoming more complex, a major factor in the **outlook for energy security**
- **US emerges as the n.1 source** of oil and gas growth in the next five years. Despite rapid deployment of electric vehicles, **global oil demand shows no sign of peaking**
- **Electrification & digitalisation** is creating new opportunities in the global energy system, but market designs need to deliver both electricity and flexibility to keep the lights on
- **There is no single solution to our energy and climate challenges**: renewables, efficiency & a host of innovative technologies, including storage, CCUS & hydrogen, are all required
- The future pathway for energy is open: **governments will determine where our energy destiny lies**