



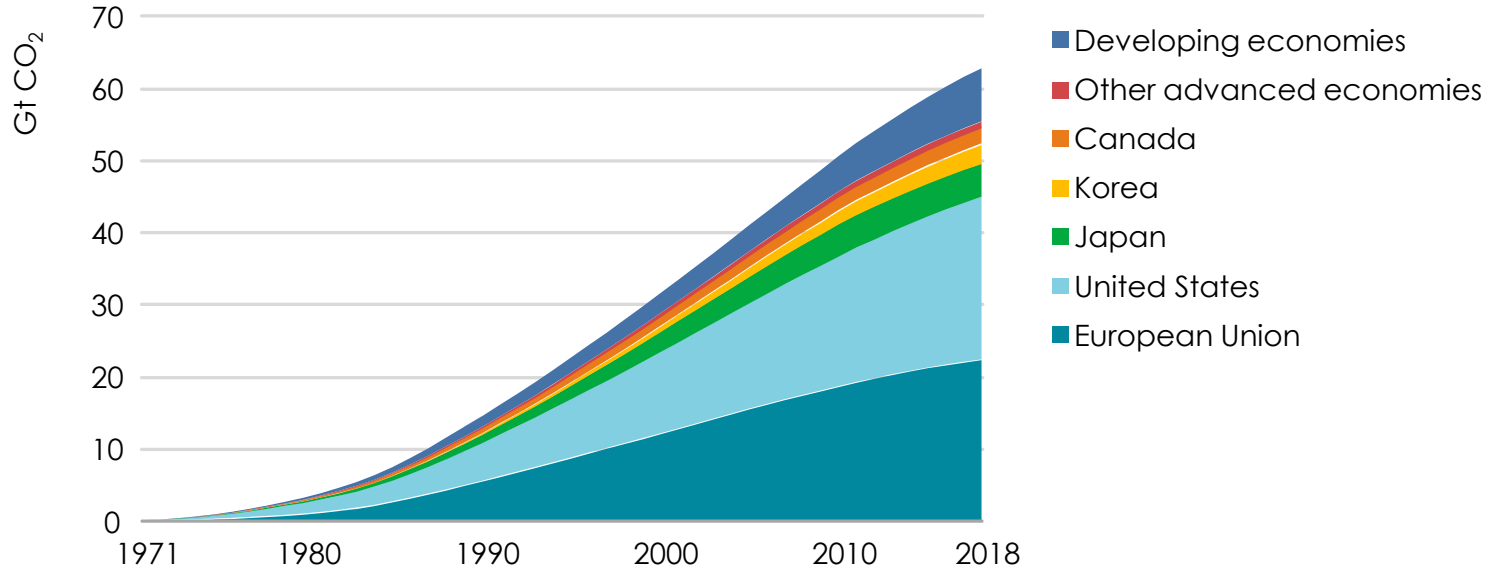
Nuclear power in a clean energy system

Peter Fraser, Head of the Gas, Coal and Power Markets Division

71st Meeting of the NDC
Boulogne, 10 July 2019

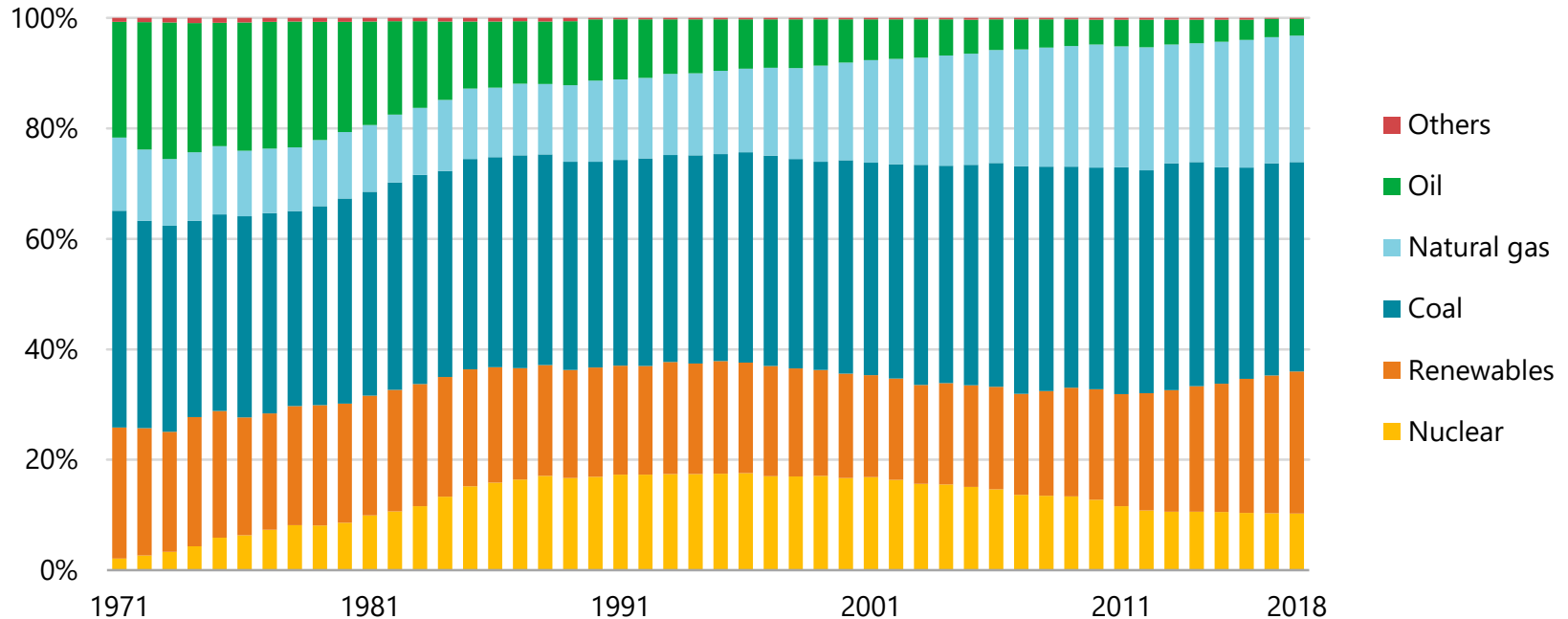
Nuclear power has avoided CO₂ emissions for 50 years

Cumulative CO₂ emissions avoided by nuclear power worldwide, 1971-2018



Without nuclear power, CO₂ emissions from electricity generation would have been almost 20% higher over the period

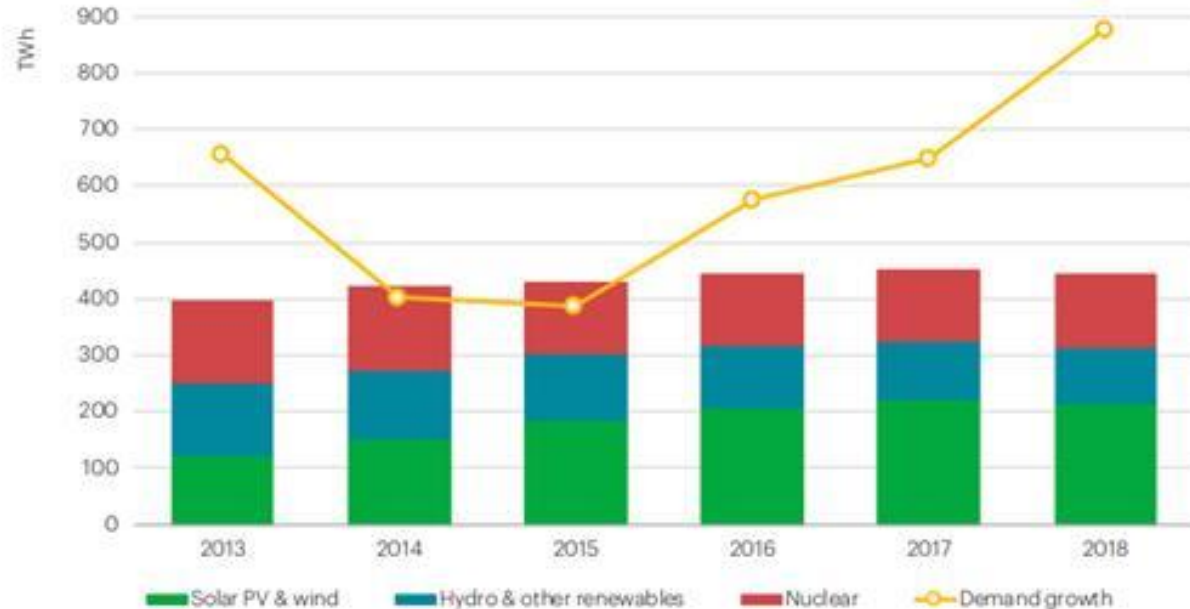
Share of energy sources in global electricity generation



The decline in nuclear power's share in electricity generation has entirely offset the growth in the share of renewables since the late-1990s

Today's clean energy investments are not keeping pace

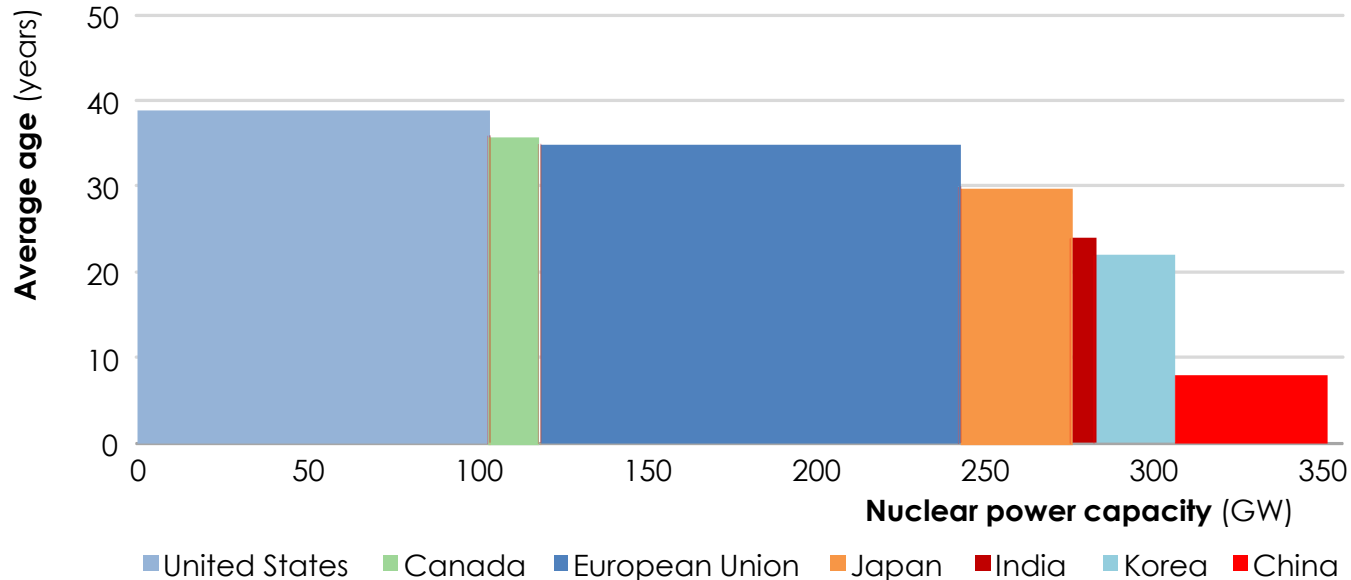
Expected generation from low-carbon power investments compared to electricity demand growth



Global electricity demand is growing faster than low carbon generation investment

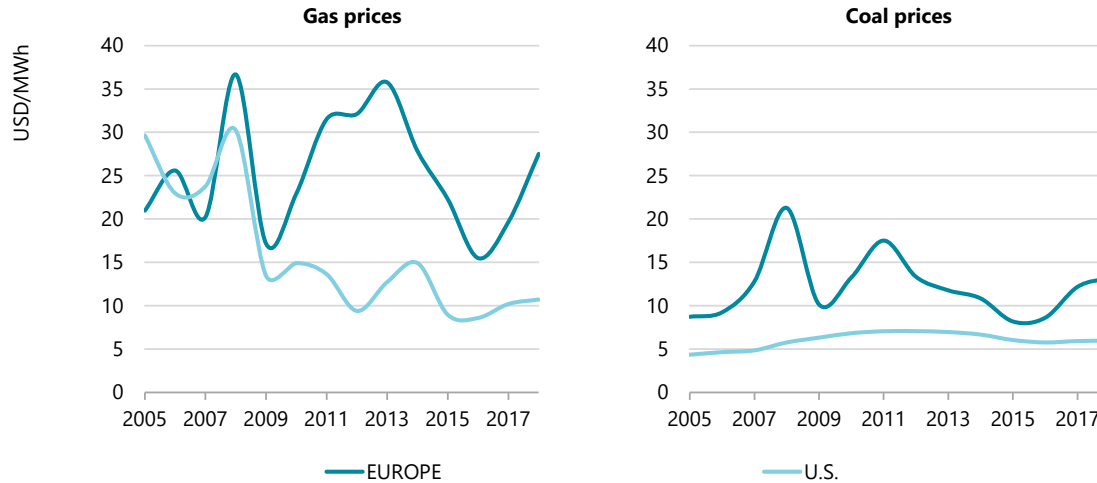
The nuclear fleet is ageing

Age profile of nuclear power capacity in selected regions



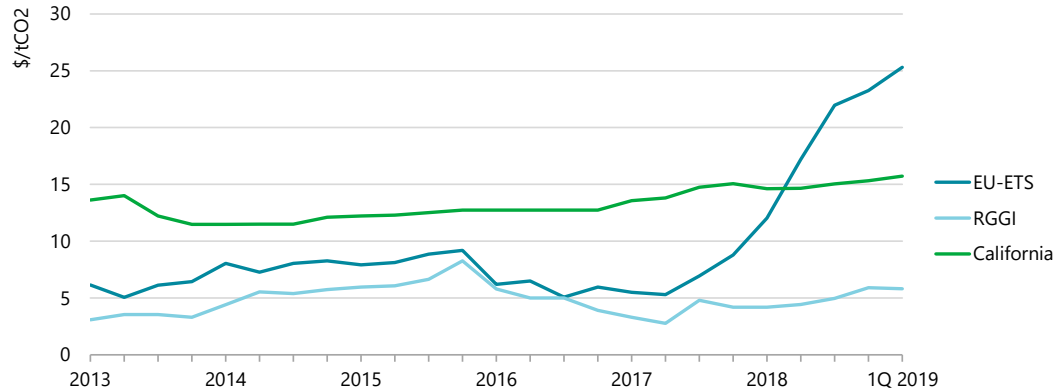
Many nuclear power plants in advanced economies are facing retirement as they approach the end of their original 40-year design lifetime

Average natural gas and coal prices in Europe and the United States



The fall in US natural gas prices, thanks to the shale revolution, has reshaped the US electricity market

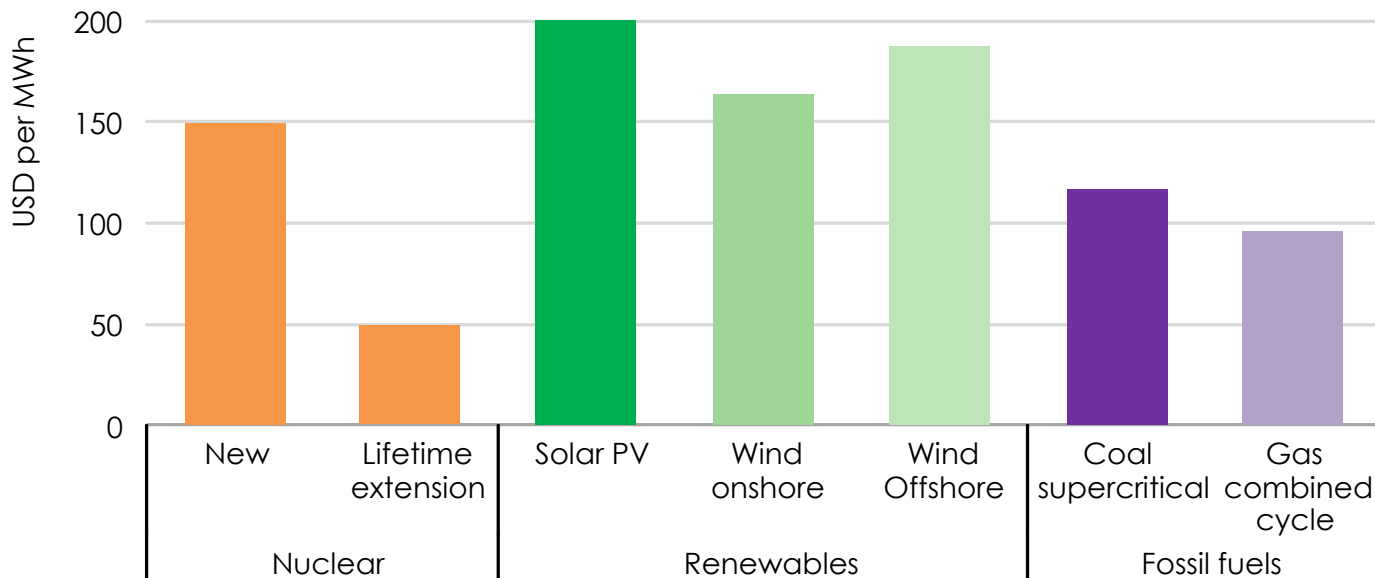
CO2 prices in emissions trading schemes in Europe, northeast United States and California (USD/ tCO₂), 2013-2019



Carbon prices have remained relatively low until the recent surge in the EU ETS

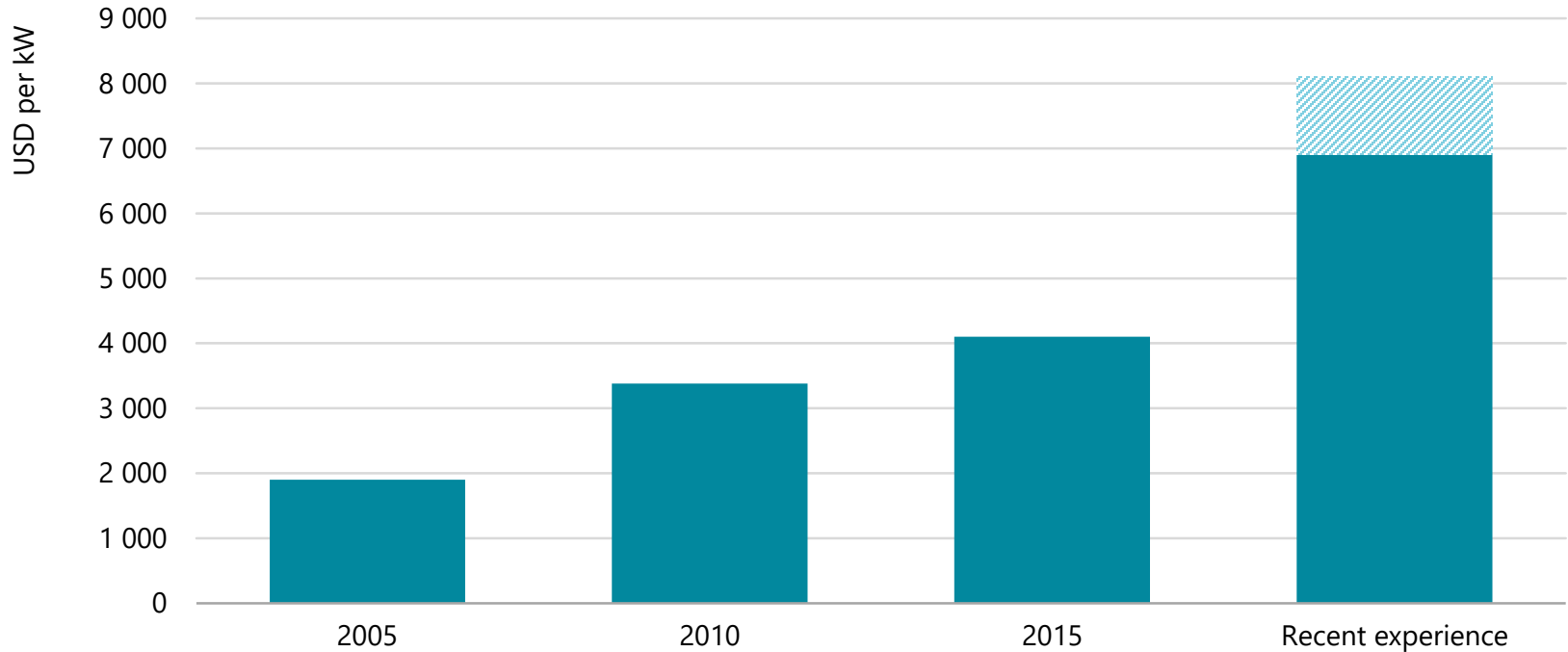
Nuclear lifetime extensions could provide cheap clean electricity

Levelised cost of electricity (LCOE) in Japan by technology in 2018



Nuclear lifetime extensions are cost-competitive with new solar and wind, and provide a dispatchable source of clean electricity

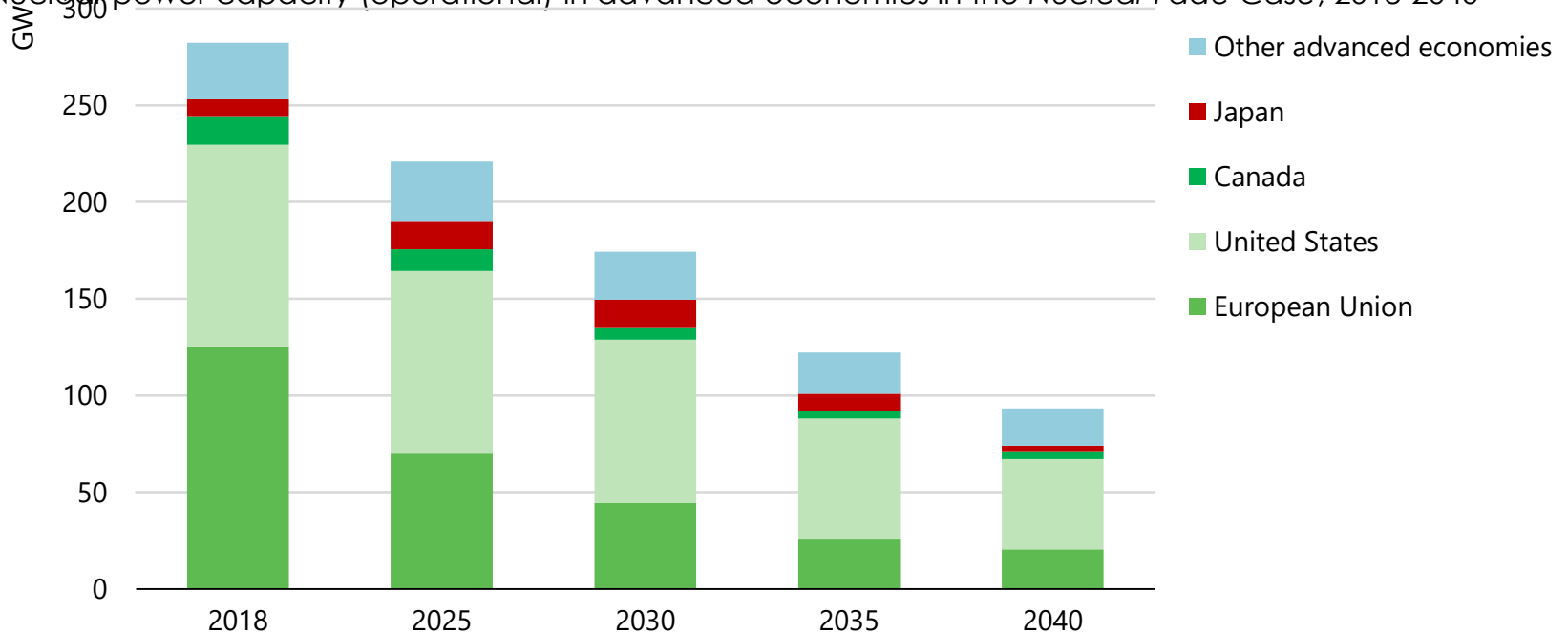
Projected overnight construction cost of nuclear power capacity vs recent experience (USD/kW)



The actual construction cost of new nuclear power plants in the US and Europe has proven to be much higher than projected

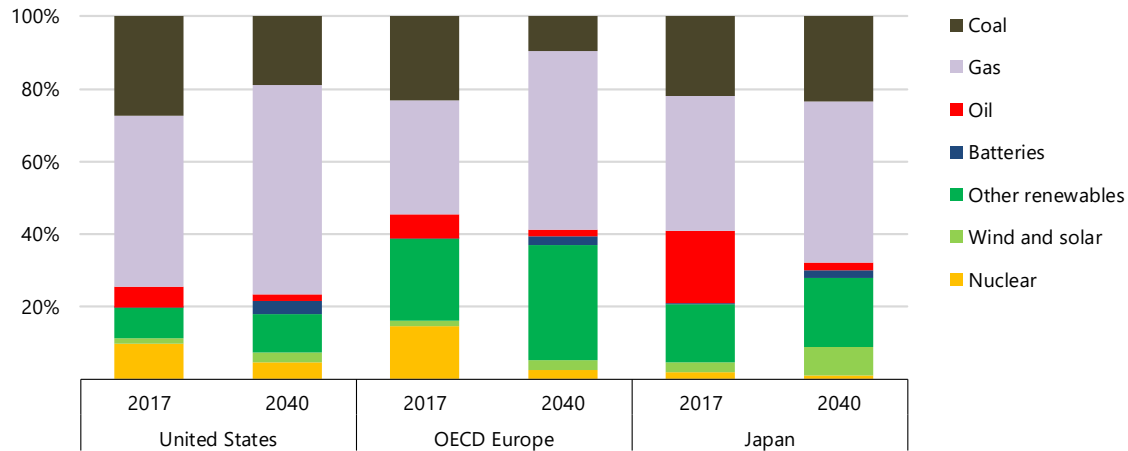
Nuclear could face a steep decline in advanced economies

Nuclear power capacity (operational) in advanced economies in the *Nuclear Fade Case*, 2018-2040



Without additional lifetime extensions or new projects, nuclear capacity in advanced economies would decline by two-thirds by 2040

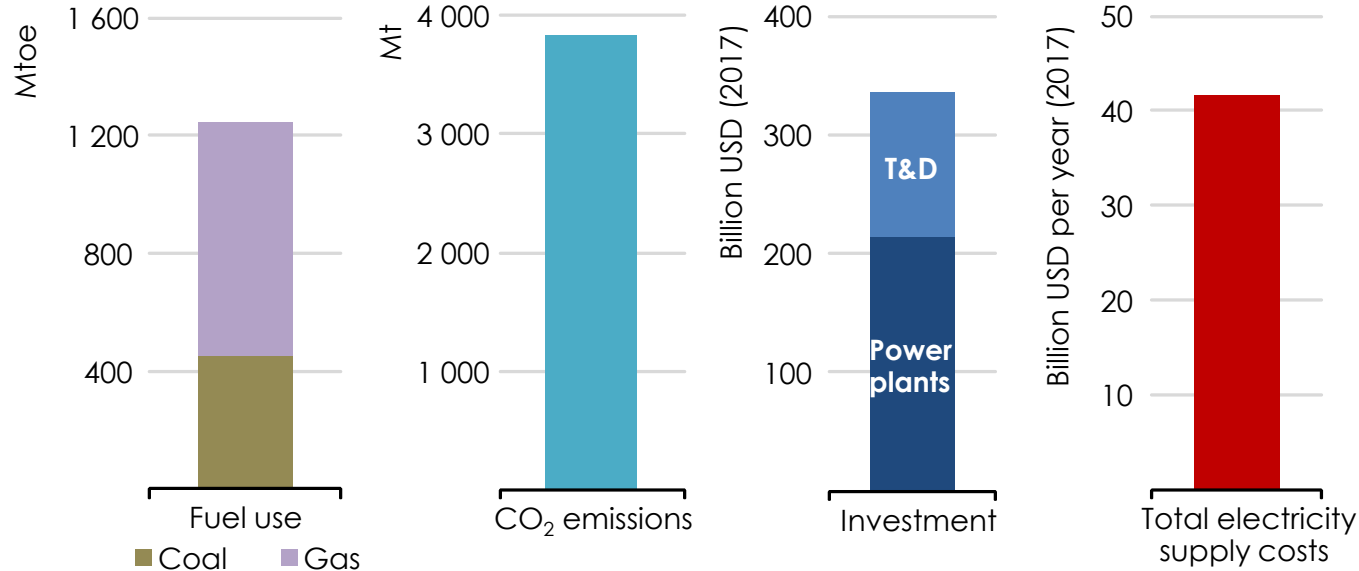
Contribution to system adequacy in the Nuclear Fade Case of the New Policies Scenario by source and region/country



To compensate for the loss of nuclear power capacity, more capacity from other sources – primarily gas-fired plants – is needed to ensure that total capacity is always adequate to meet peak load

Lower nuclear raises CO₂ emissions and supply costs

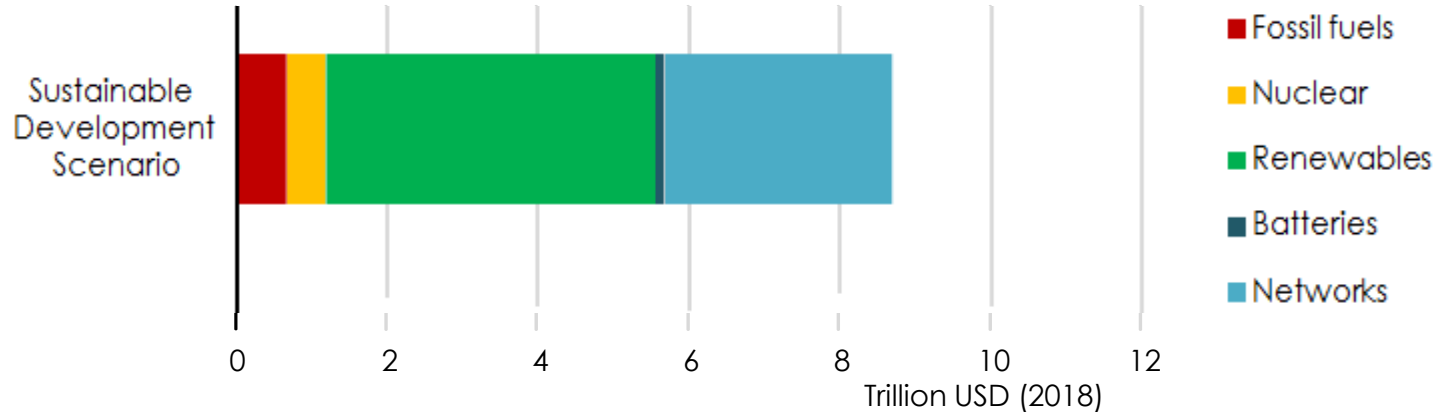
Change in key indicator in advanced economies in the *Nuclear Fade Case* under current policies, 2019-2040



Lower nuclear raises fossil fuel use and power sector CO₂ emissions by 5% to 2040, raising investment needs by close to \$600 billion to 2040 and supply costs to consumers

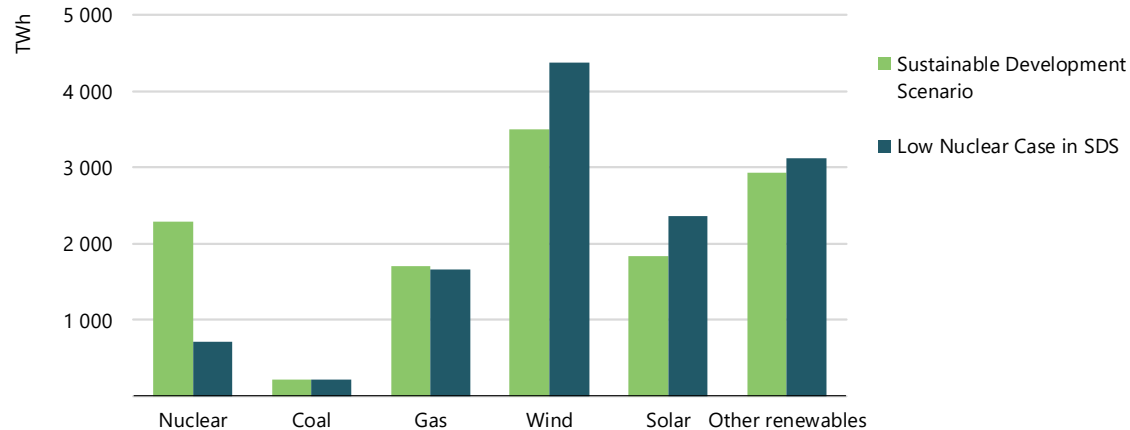
Nuclear power is part of a cost-effective clean energy transition

Power sector investment needs in advanced economies on a sustainable energy pathway, 2019-2040



Investment needs to achieve the energy transition are \$1.6 trillion higher without nuclear complementing renewables in the fight against climate change

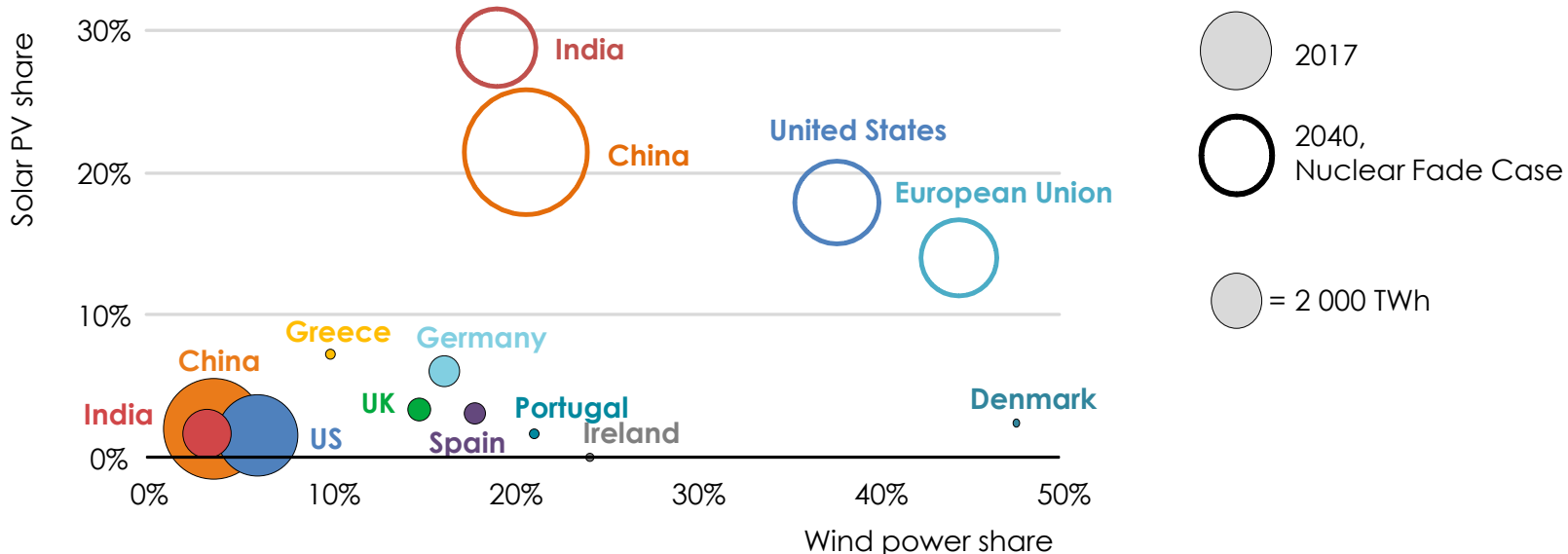
Change in power generation in the advanced economies by source in the Nuclear Fade Case compared with the Sustainable Development Scenario



A combination of wind power, solar PV and other renewables are needed to make up the shortfall in nuclear output in meeting sustainable development goals

Further emphasis on solar and wind raises integration challenges

Wind and solar PV shares of generation by region in the *Nuclear Fade Case* on a sustainable energy pathway



Rising shares of wind and solar PV require more flexibility in power systems, calling on power plants, grids, storage technologies and demand-side management

Policy recommendations for countries pursuing nuclear power

- **Ensure a sound framework for lifetime extensions** by:
 - Value the clean nature of nuclear power and contributions to electricity security
 - Clarify safety requirements for longer life and more flexible operations
- **Support new construction** by:
 - Establish appropriate frameworks to reduce financial risks
 - Maintain technical competencies related to nuclear power
 - Pursue research & development of new technologies (e.g. small modular reactors)

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