International Energy Agency

Nuclear power in a clean energy system

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

Energía Nuclear: fuente imprescindible en la transición energética

Madrid, 6 September 2019

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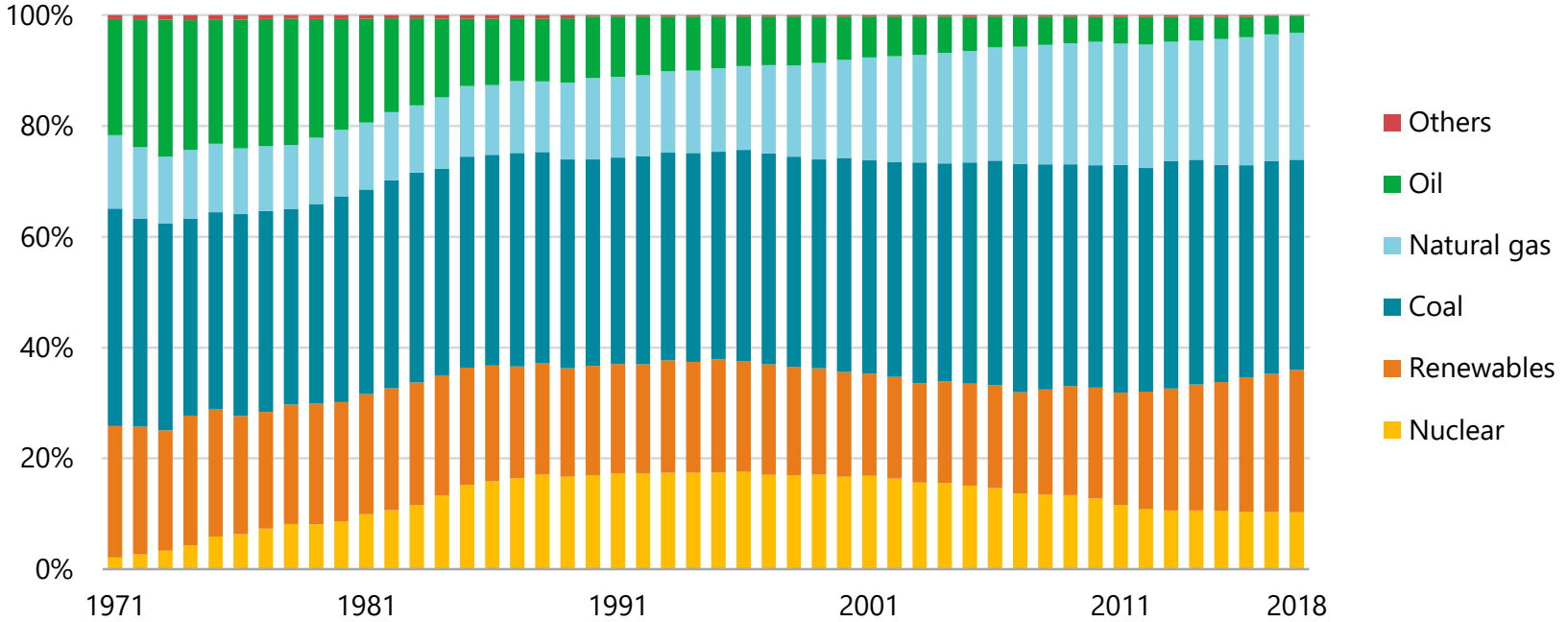
Nuclear has been a key part of the low-carbon electricity story



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

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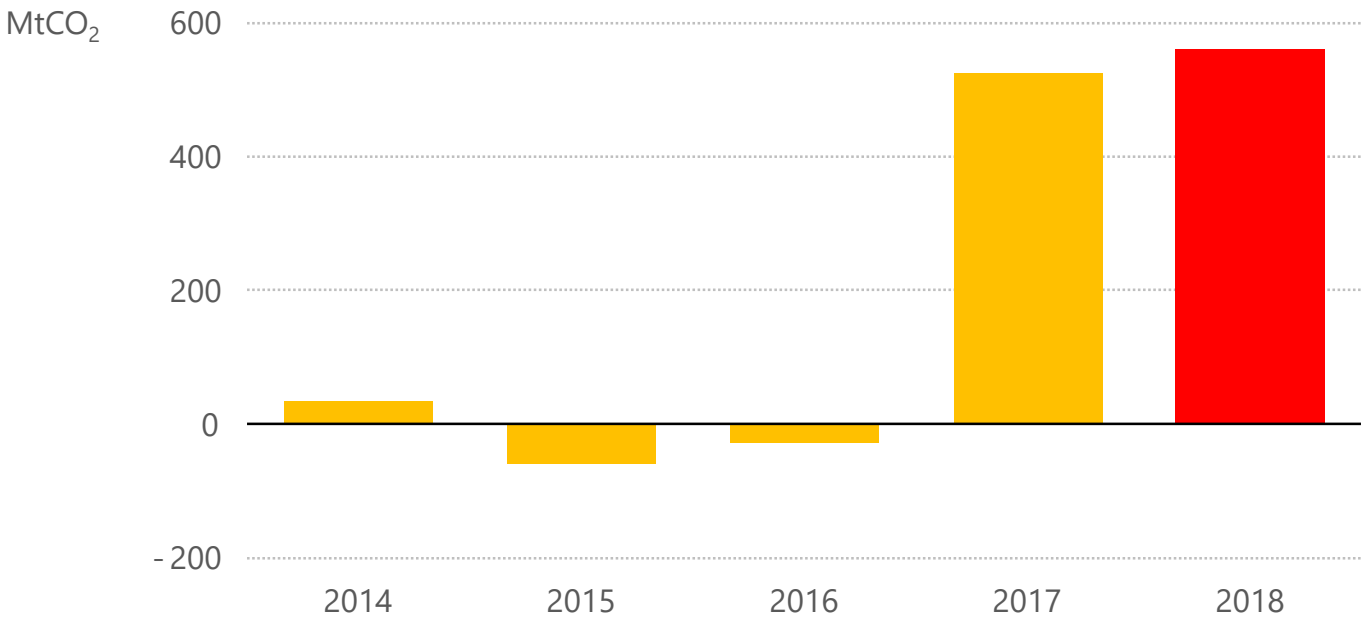
But global CO2 emissions are still growing…

Annual change in global energy-related CO_2 emissions, 2014-2018



Higher demand for fossil fuels drove up global CO_2 for a second year in a row in 2018. In many parts of the world, strategies that reduce greenhouse gas emissions while also improving air quality are paramount

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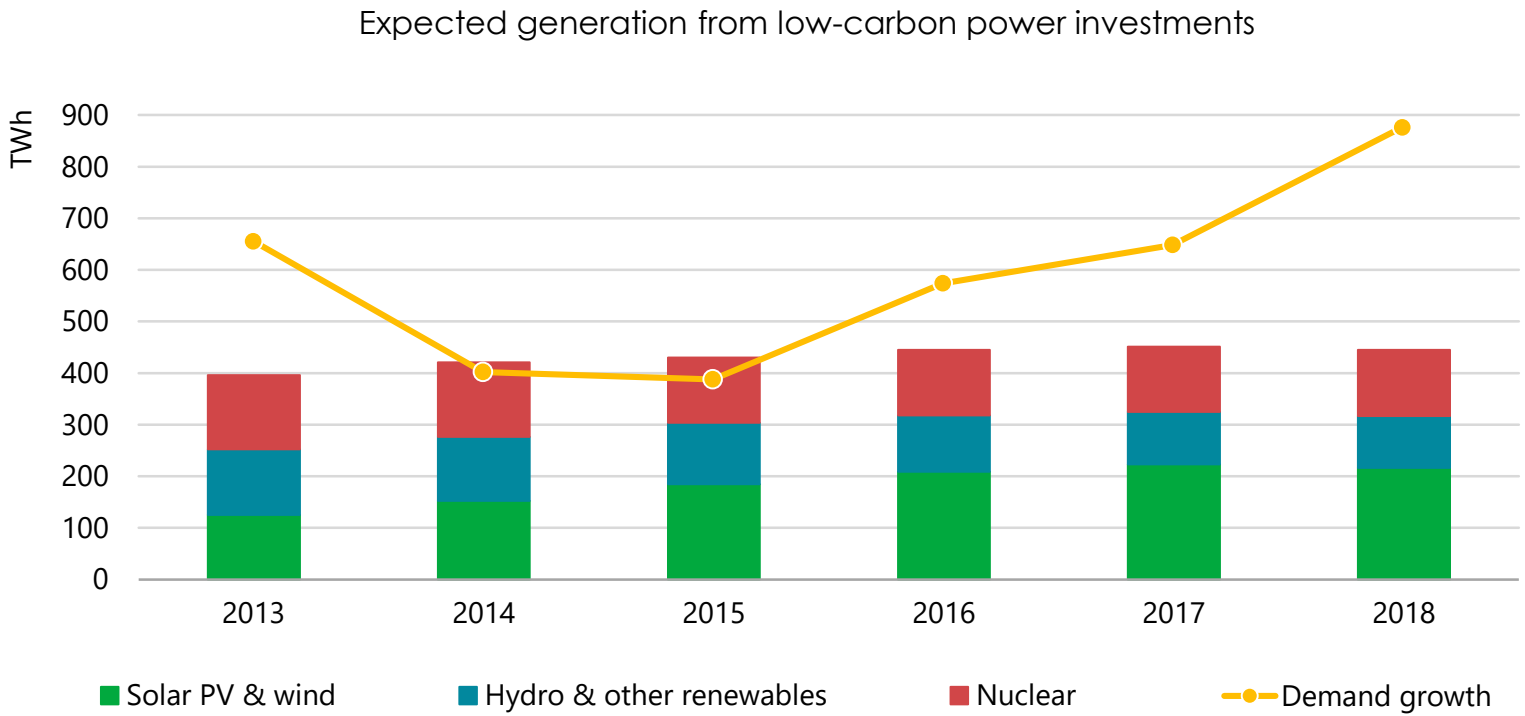
… and low-carbon investment is not keeping pace with power demand



The output expected from investment in renewable & nuclear power levelled off in 2018 while demand growth soared. To meet sustainability goals, spending on renewable power would need to double.

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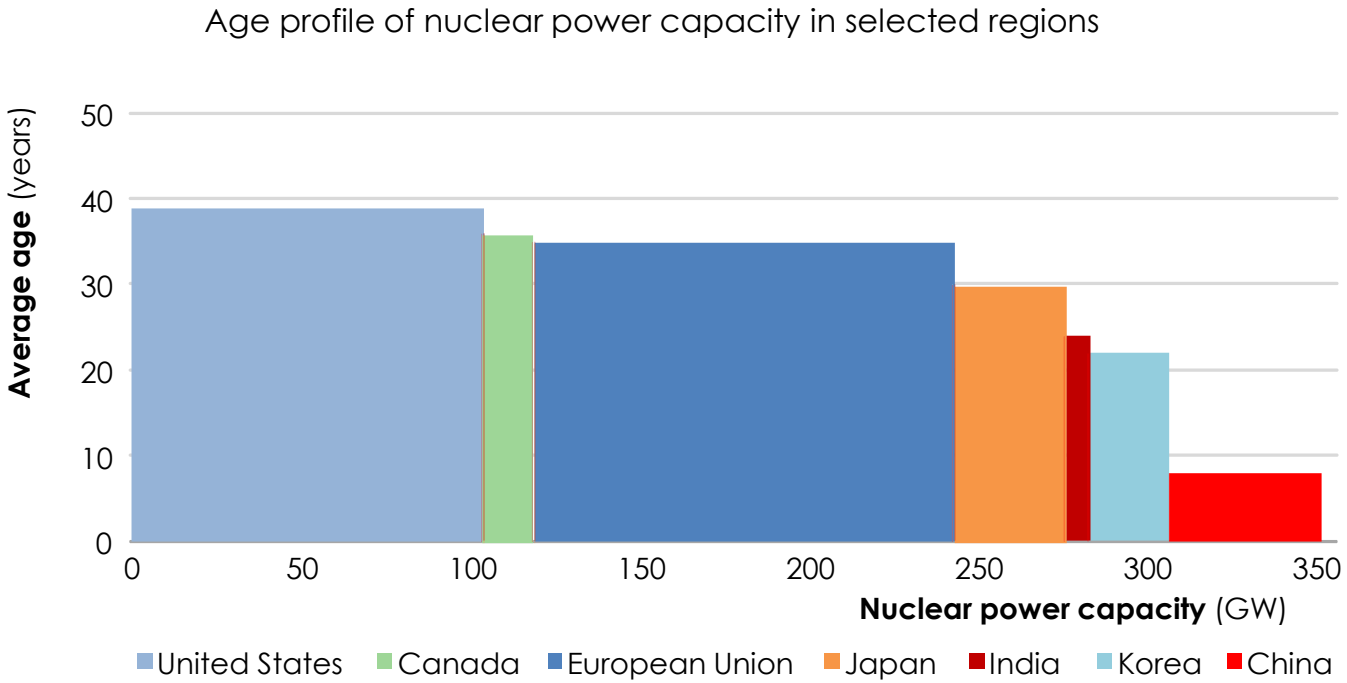
The advanced economy nuclear fleet is ageing



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

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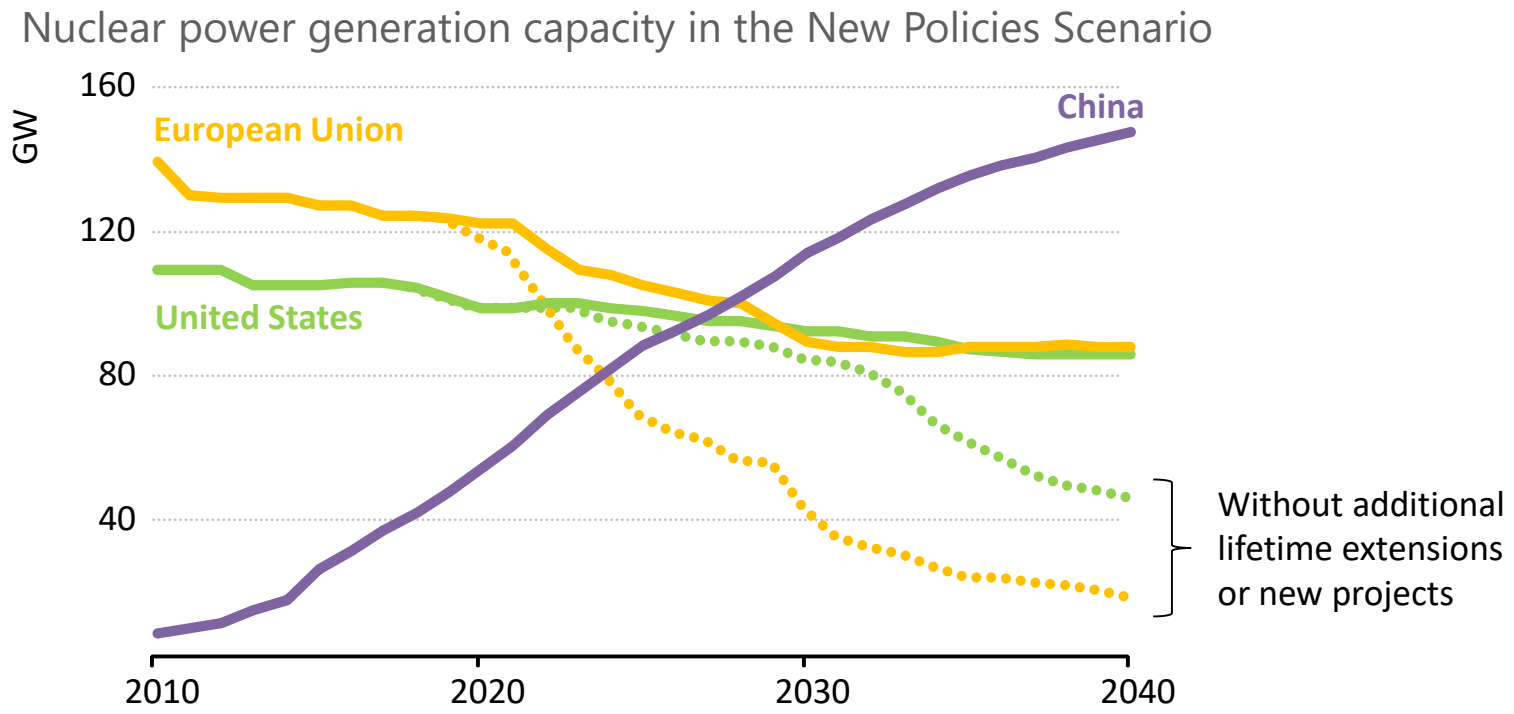
How long will existing plants last?



Without additional lifetime extensions, the largest nuclear fleets face significant declines, while China is soon set to overtake the United States as the global leader

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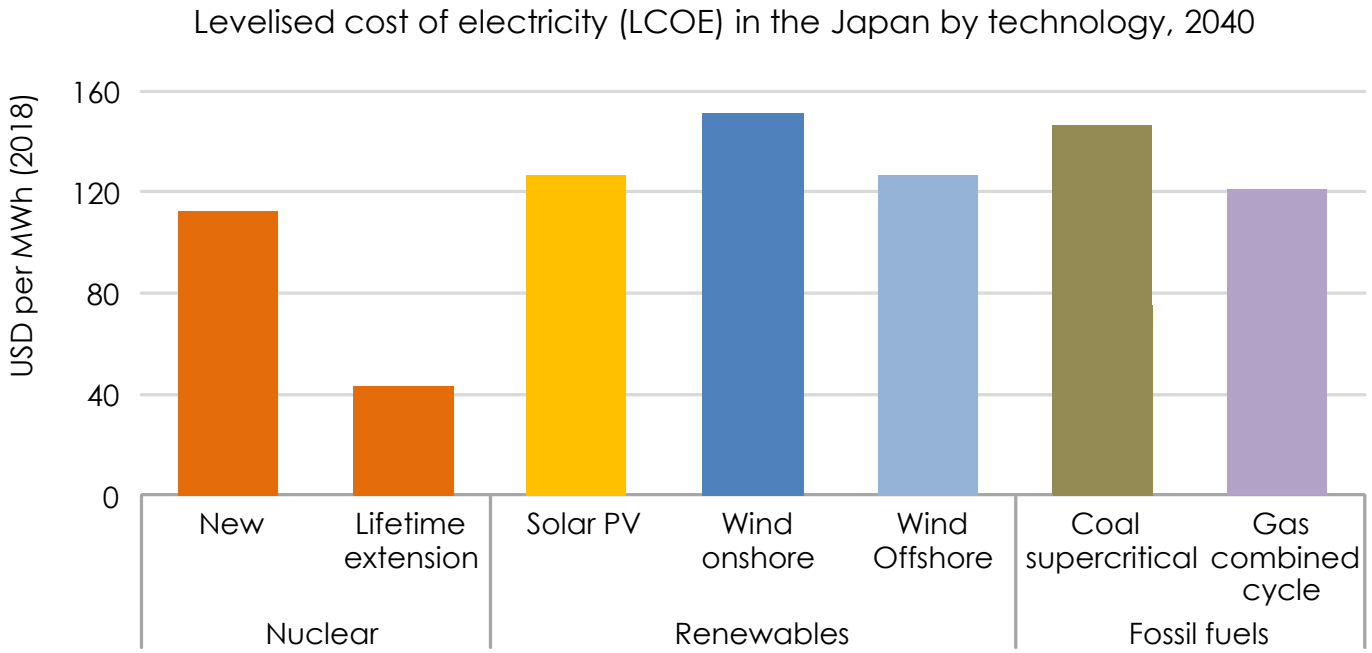
Although nuclear lifetime extensions can provide cheap low-carbon energy …



Extending the operational lifetime of nuclear power plants is cost-competitive with new solar and wind, and provides a dispatchable source of low-carbon electricity

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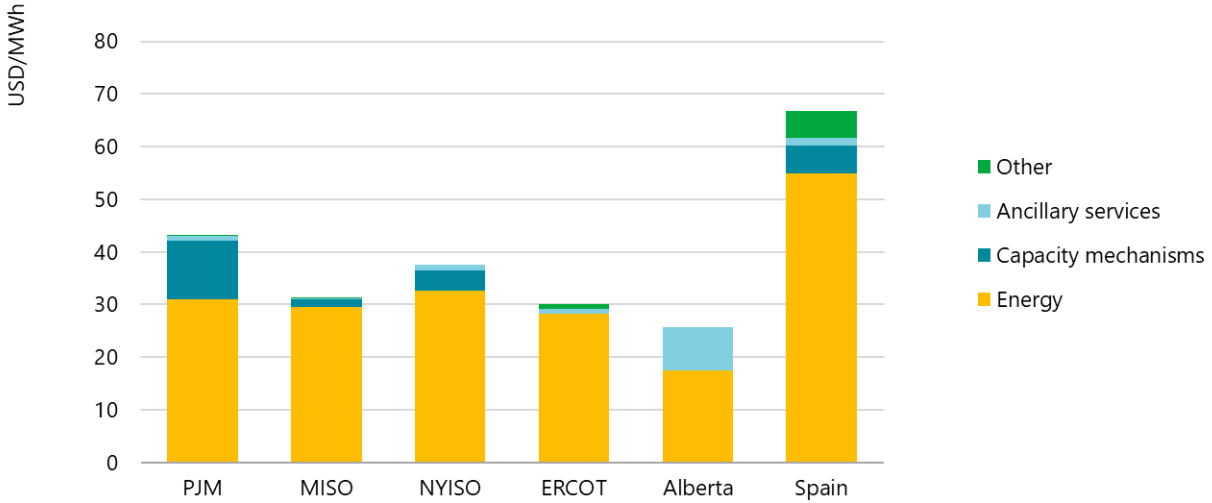
Wholesale market revenues have been low

Revenues per kWh from wholesale electricity markets, 2017



Capacity and ancillary service revenues have not been sufficient to offset low energy market revenues

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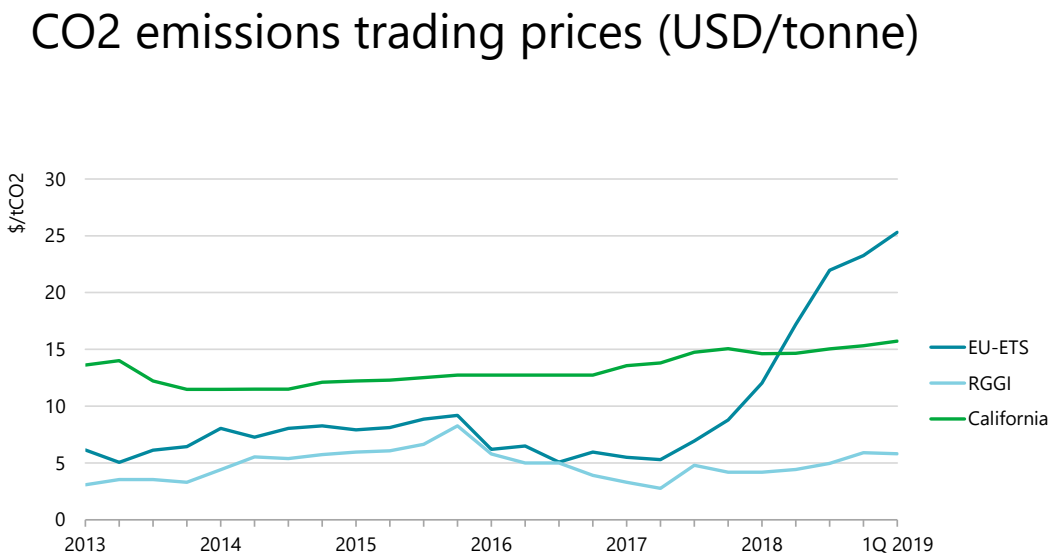
As have CO_2 prices ...



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

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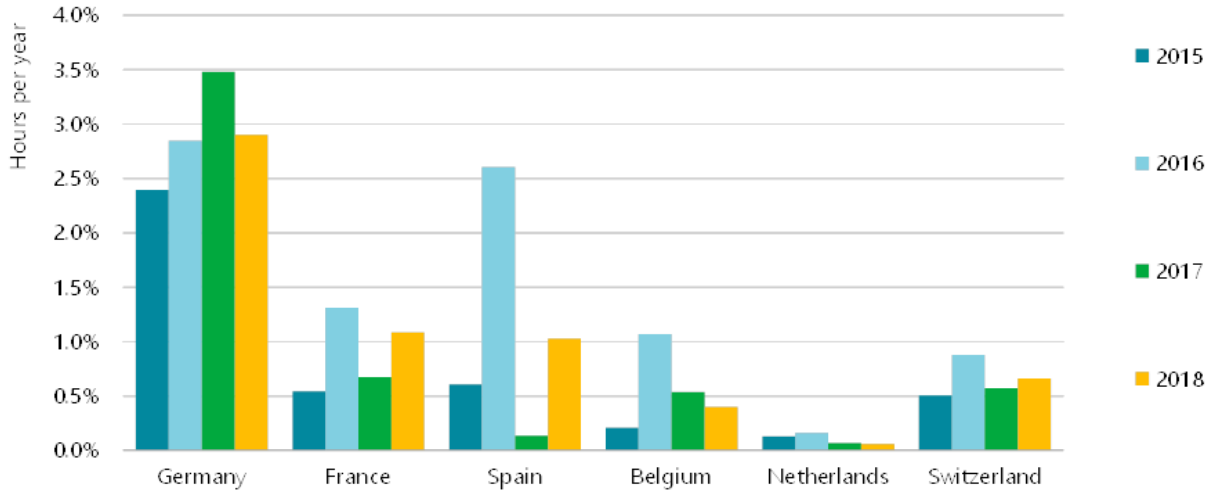
… market conditions challenge further investment in life extension

Share of hours in each year when wholesale prices are lower than the estimated variable cost of nuclear power in selected European countries



CO_2 prices and capacity payments help, but have been insufficient to make a strong business case for extending the operating lifetime of nuclear power plants

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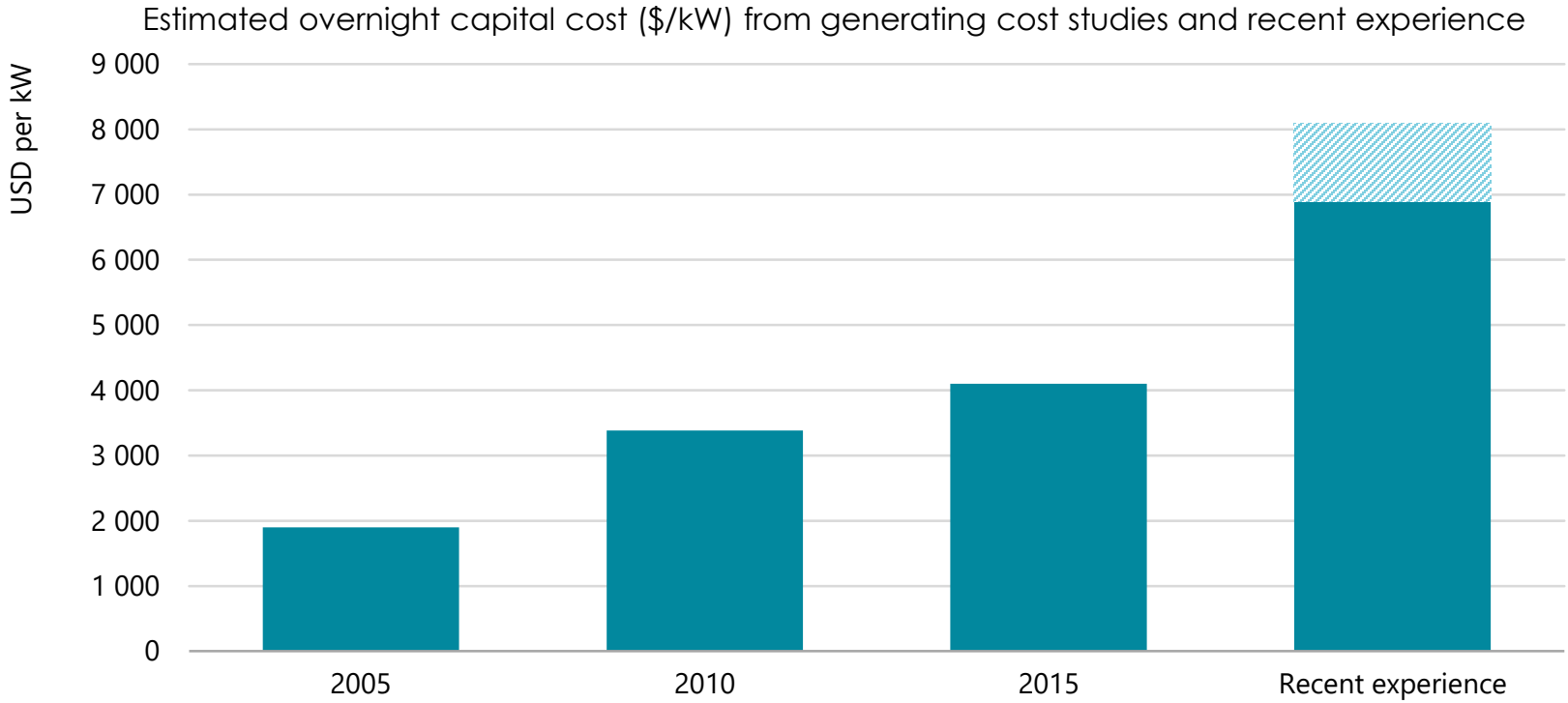
New investments in US and Europe have proven expensive



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

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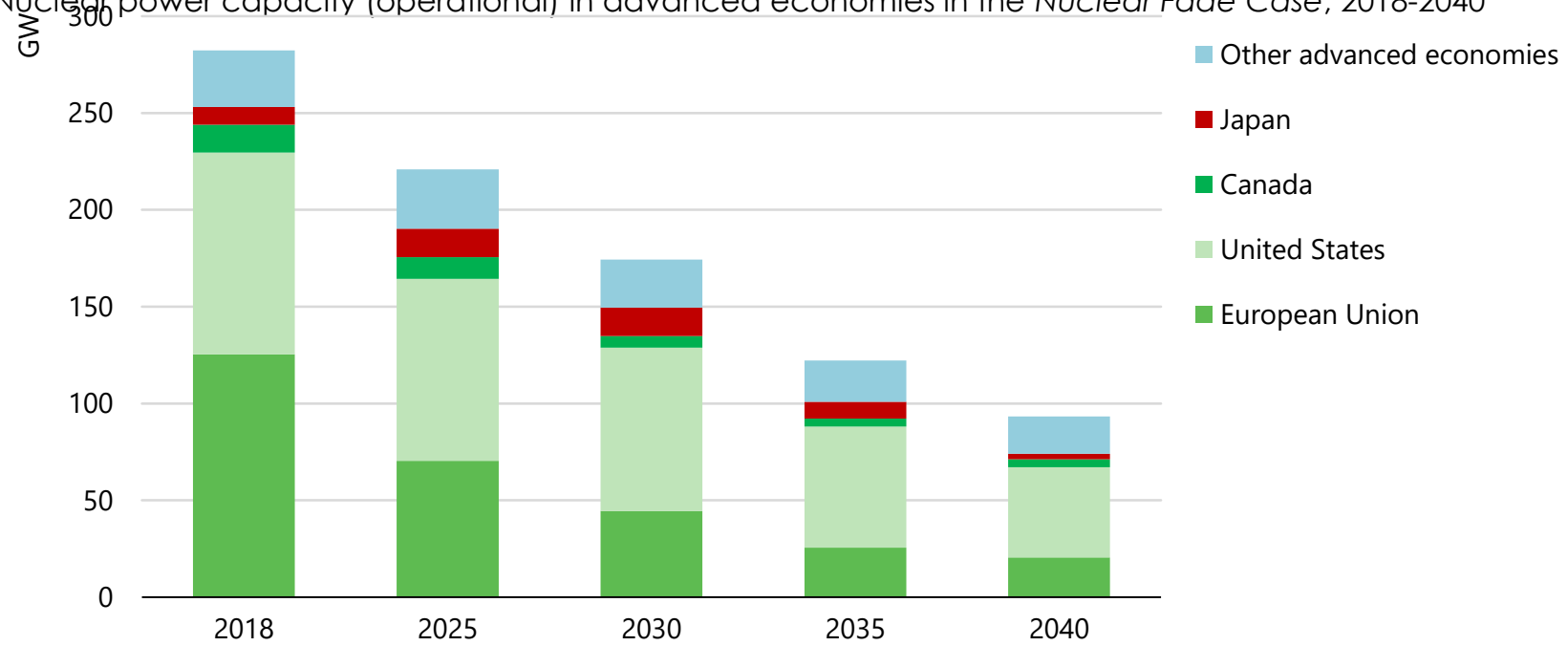
Nuclear could face a steep decline in advanced economies

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

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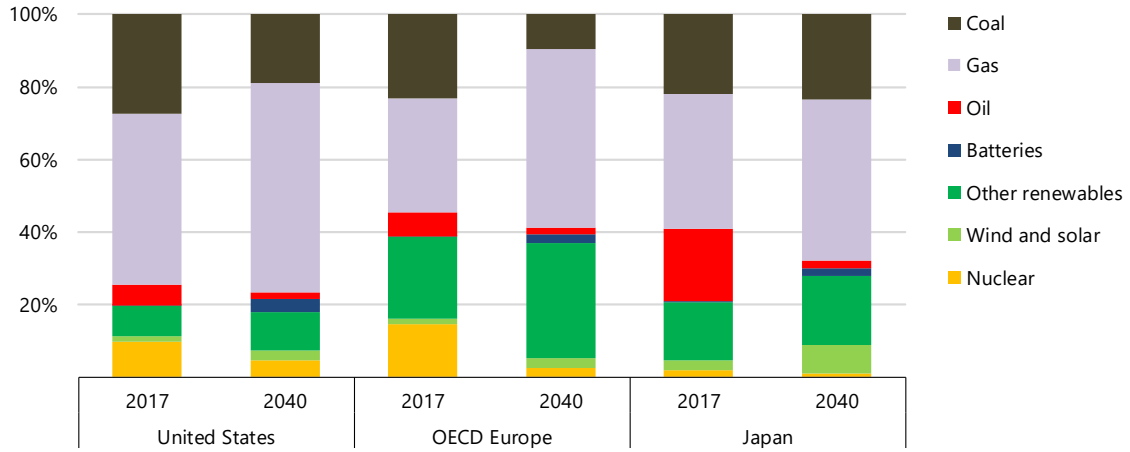
Contribution to system adequacy in the Nuclear Fade Case of the New Policies Scenario by source and region/country



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

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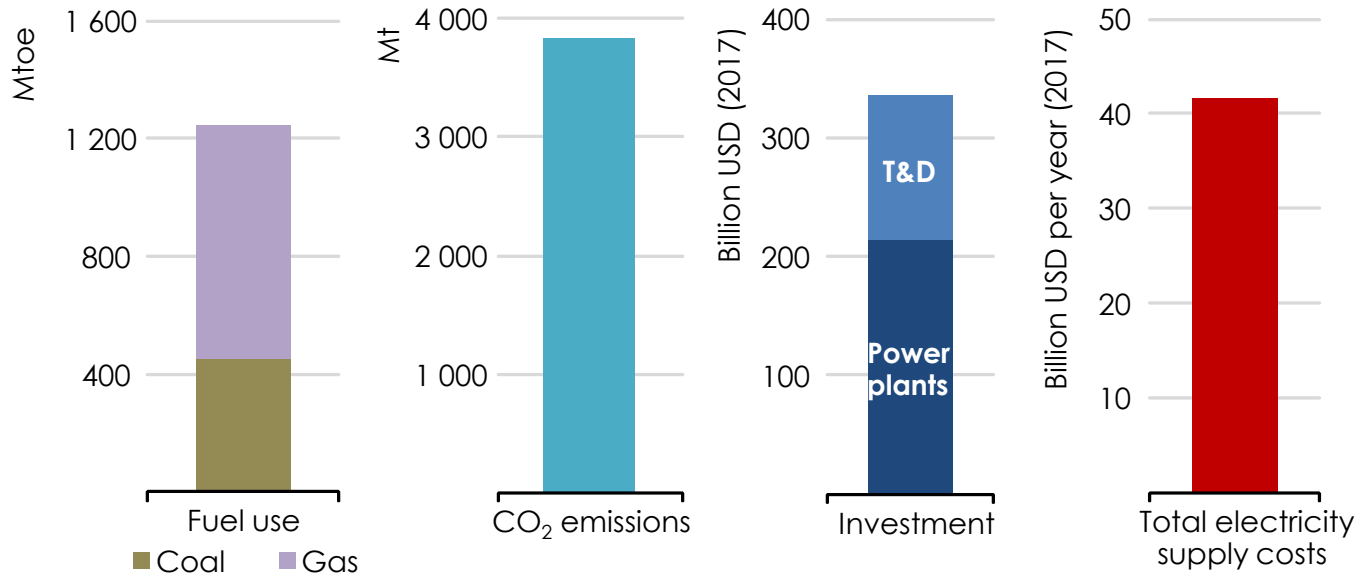
Lower nuclear raises CO_2 emissions and supply costs

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 over $300 billion to 2040 and supply costs to consumers

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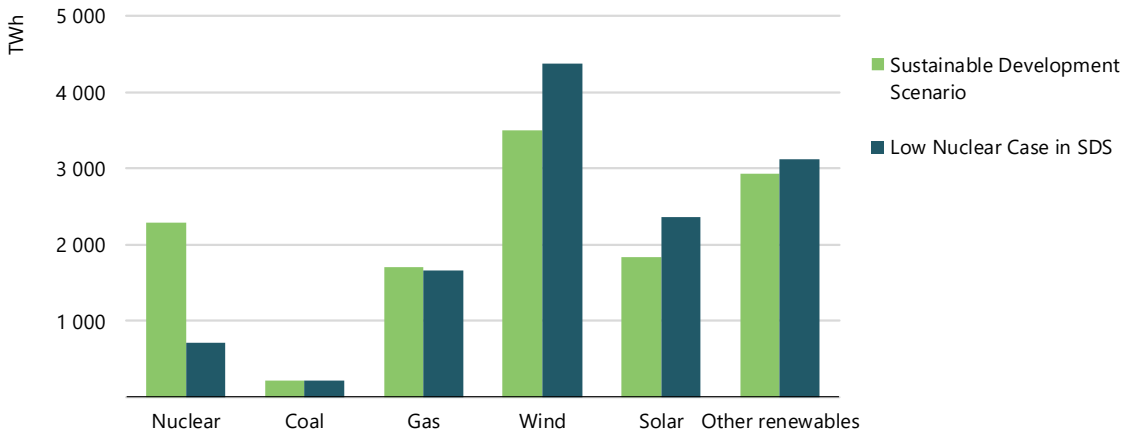
Power generation in the advanced economies by source in the Nuclear Fade Case compared with the Sustainable Development Scenario



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

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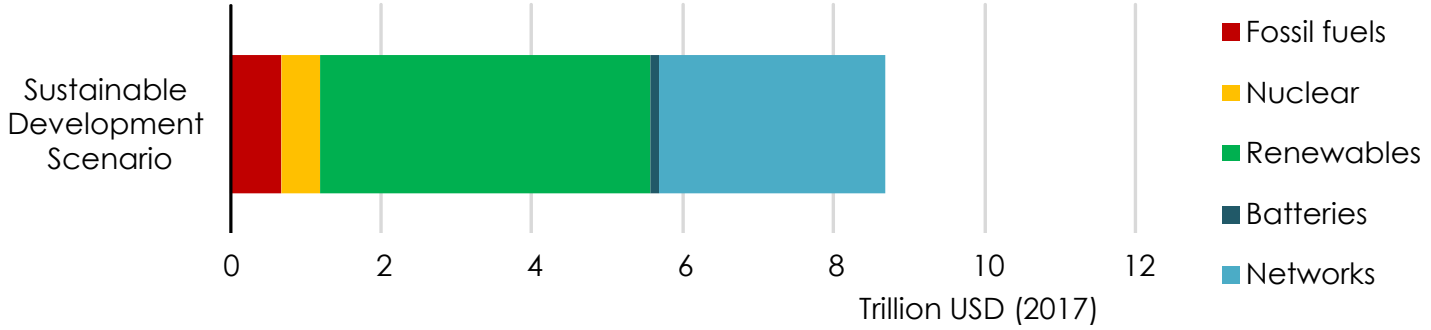
Nuclear power is part of a cost-effective clean energy transition

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

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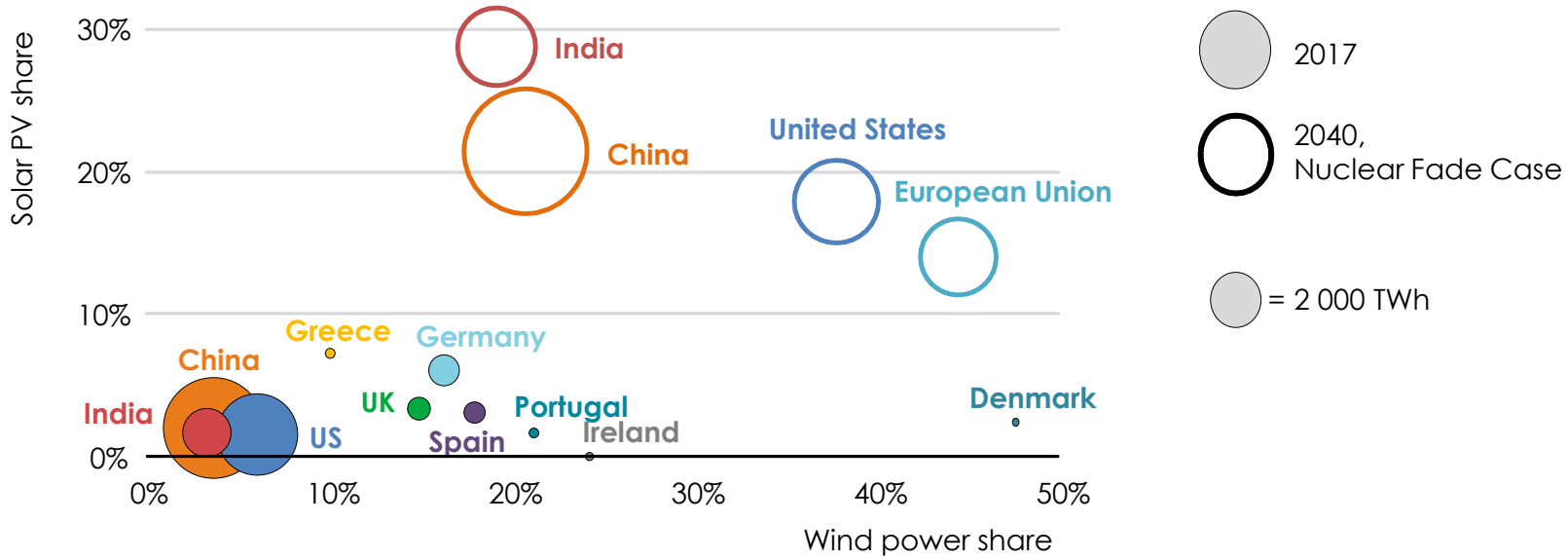
Further emphasis on solar and wind raises integration challenges

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

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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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