

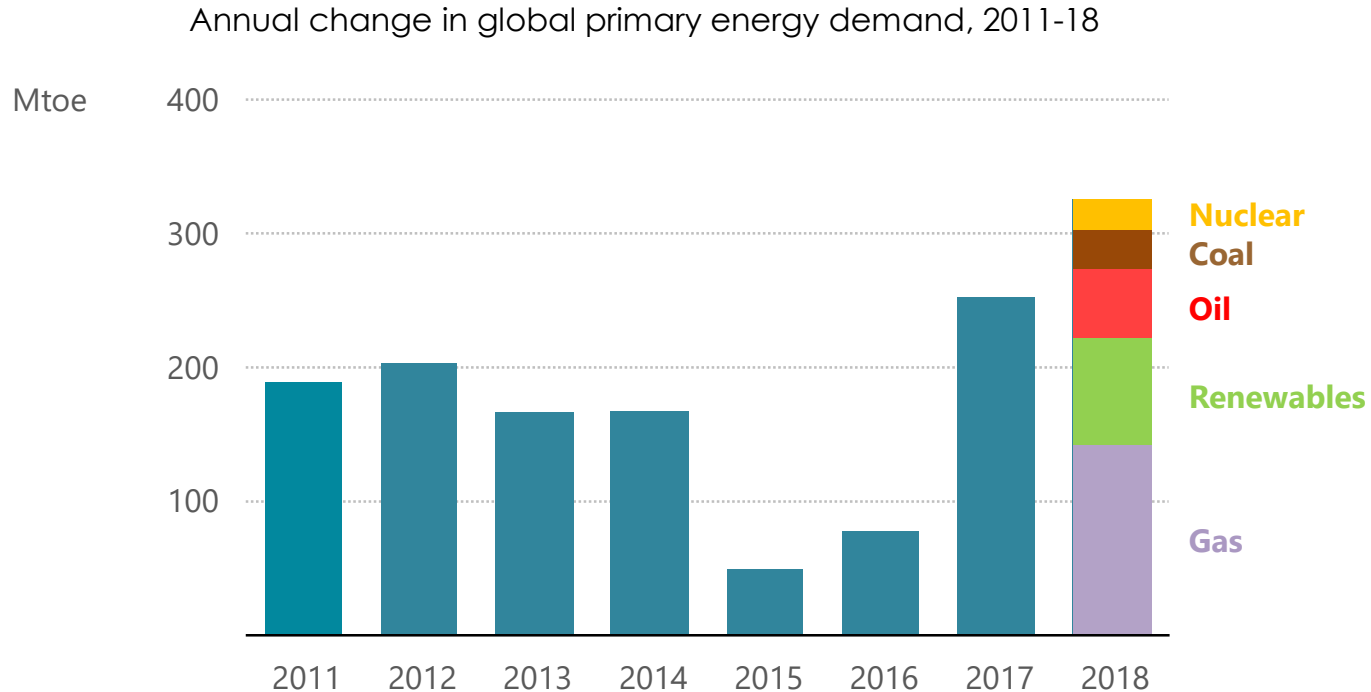


Progress toward Global Energy Transitions: U.S. Launch of IEA's Hydrogen and Nuclear Reports

Dave Turk, Head of Strategic Initiatives Office, International Energy Agency

CSIS, 16 July 2019

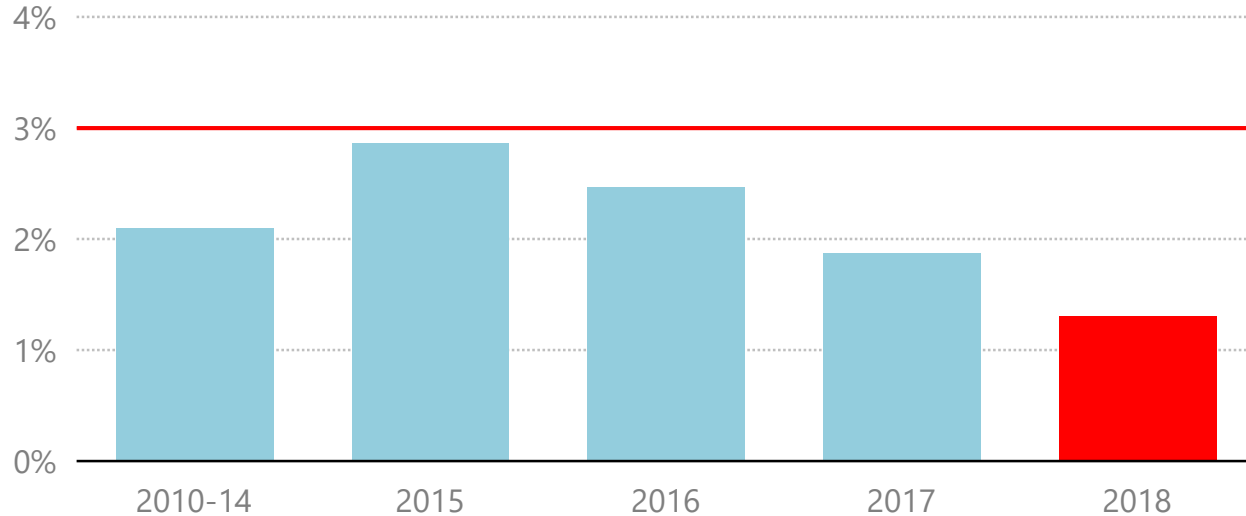
2018 – a remarkable year for energy



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

World energy efficiency improvements are slowing

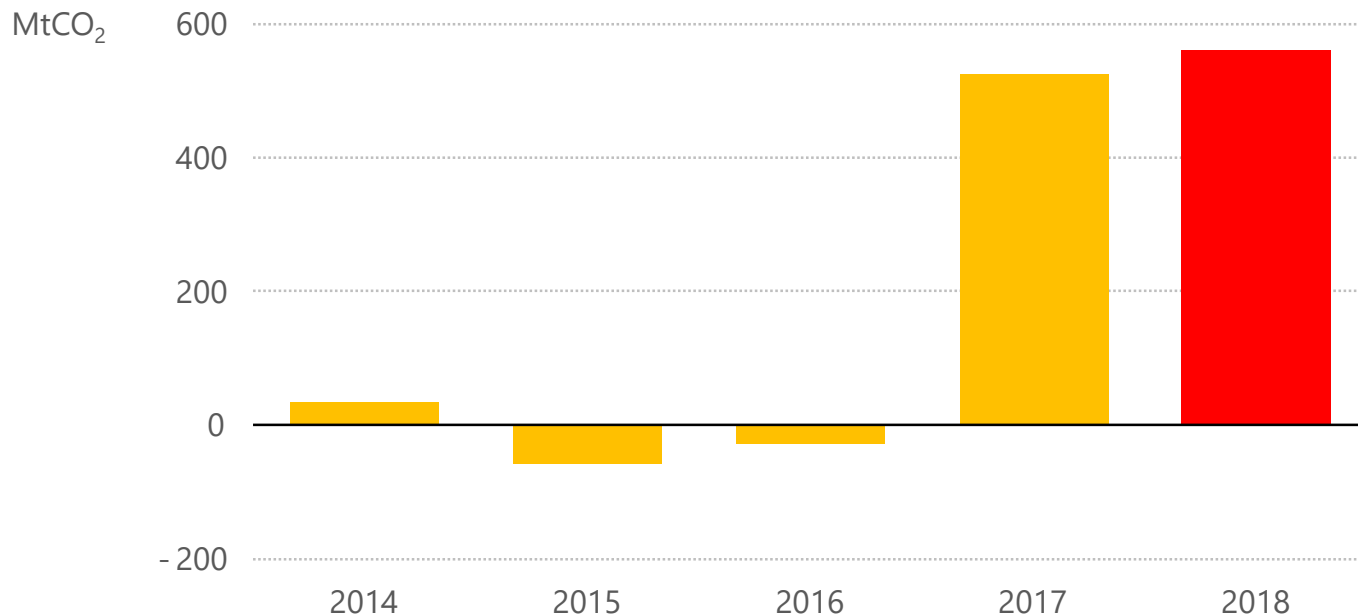
Average annual change in primary energy intensity, 2010-18



2018 saw a worrying slowdown in efficiency, despite IEA analysis showing huge untapped potential in all sectors

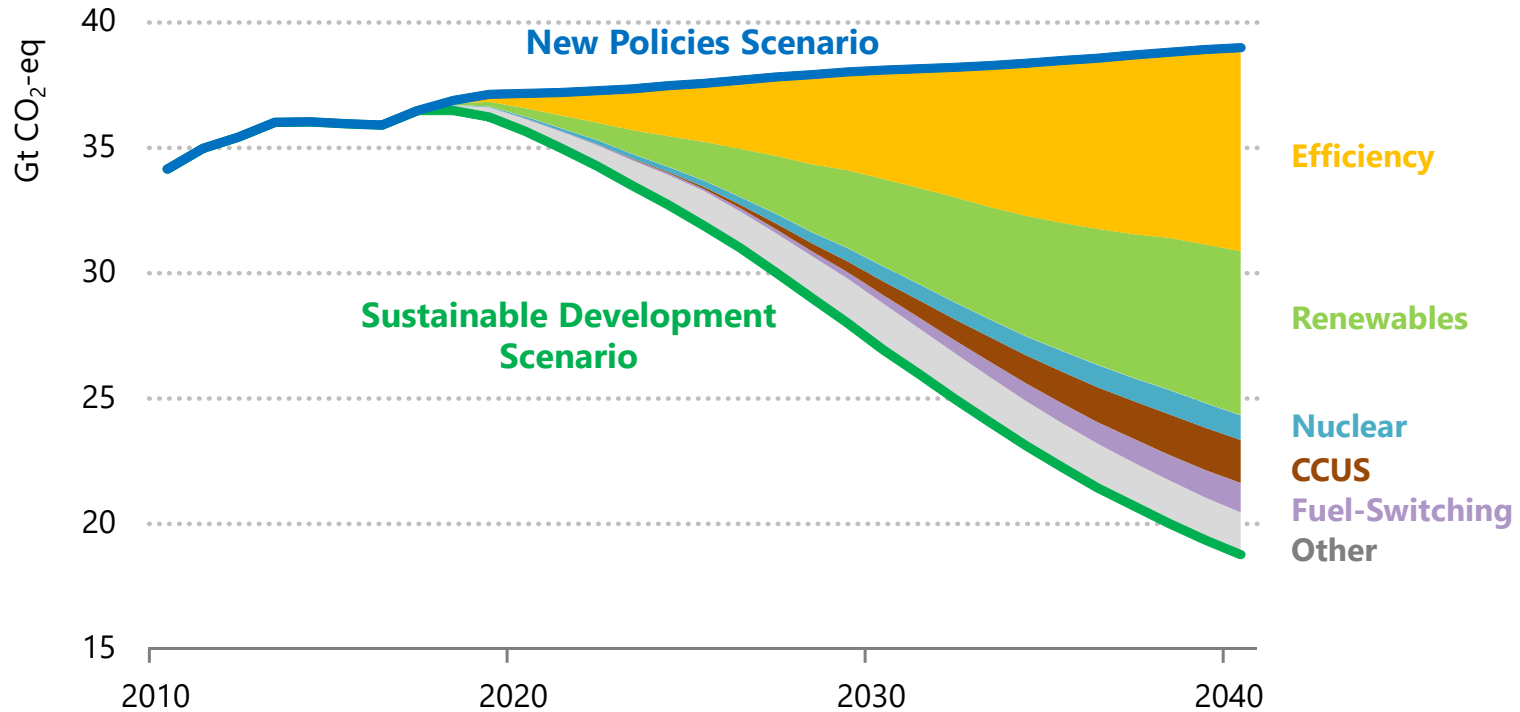
Energy-related CO₂ emissions hit a record high in 2018

Annual change in global energy-related CO₂ emissions



The need to accelerate clean energy transitions is underscored by CO₂ emissions reaching a record high in 2018

Where do we need to go? And how do we get there?



There is no single solution to our energy challenges: while efficiency & renewables account for the bulk of abatement, a host of other technologies including nuclear, CCUS, hydrogen & storage are also required

Tracking Clean Energy Progress 2019

● Power

- Renewable power
 - Solar PV
 - Onshore wind
 - Offshore wind
 - Hydropower
 - Bioenergy
 - Geothermal
 - CSP
 - Ocean
- Nuclear power
- Gas-fired power
- Coal-fired power
- CCUS in power

● Industry

- Chemicals
- Iron and steel
- Cement
- Pulp and paper
- Aluminium
- CCUS in industry & transformation

● Transport

- Electric vehicles
- Fuel economy
- Trucks & buses
- Transport biofuels
- Aviation
- Shipping
- Rail

● Buildings

- Building envelopes
- Heating
- Heat pumps
- Cooling
- Lighting
- Appliances & equipment
- Data centres and networks

● Fuel supply

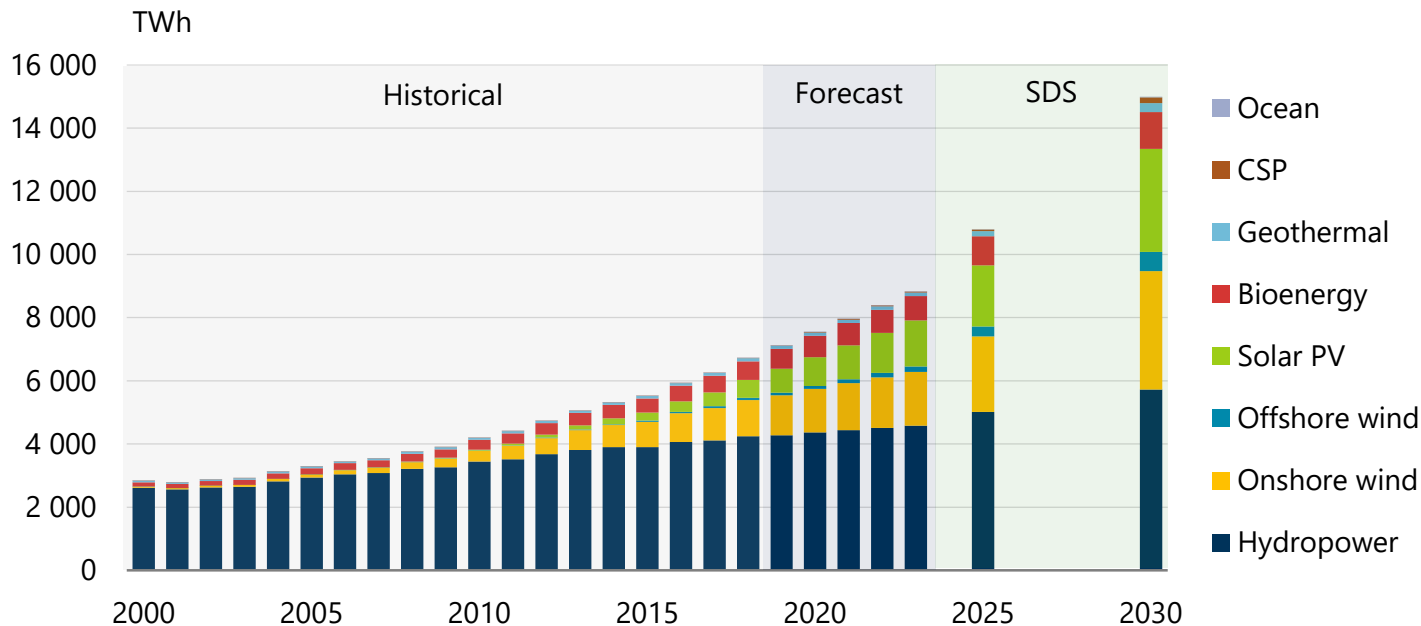
- Methane emissions from oil and gas
- Flaring emissions

● Energy integration

- Energy storage
- Hydrogen
- Smart grids
- Demand response

PV and bioenergy: only renewables fully “on track”

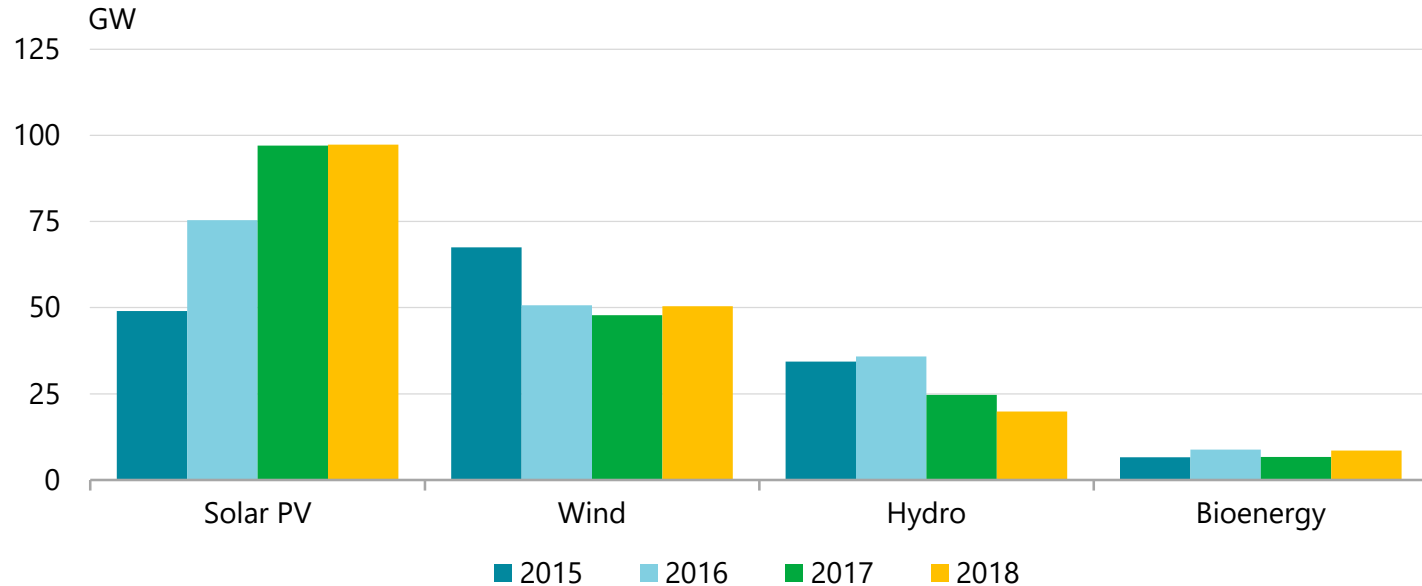
Renewable electricity generation by technology



Despite PV's stalling capacity expansion, prospects are optimistic for continuous growth; bioenergy's tracking status is improved due to positive policy developments in China and India

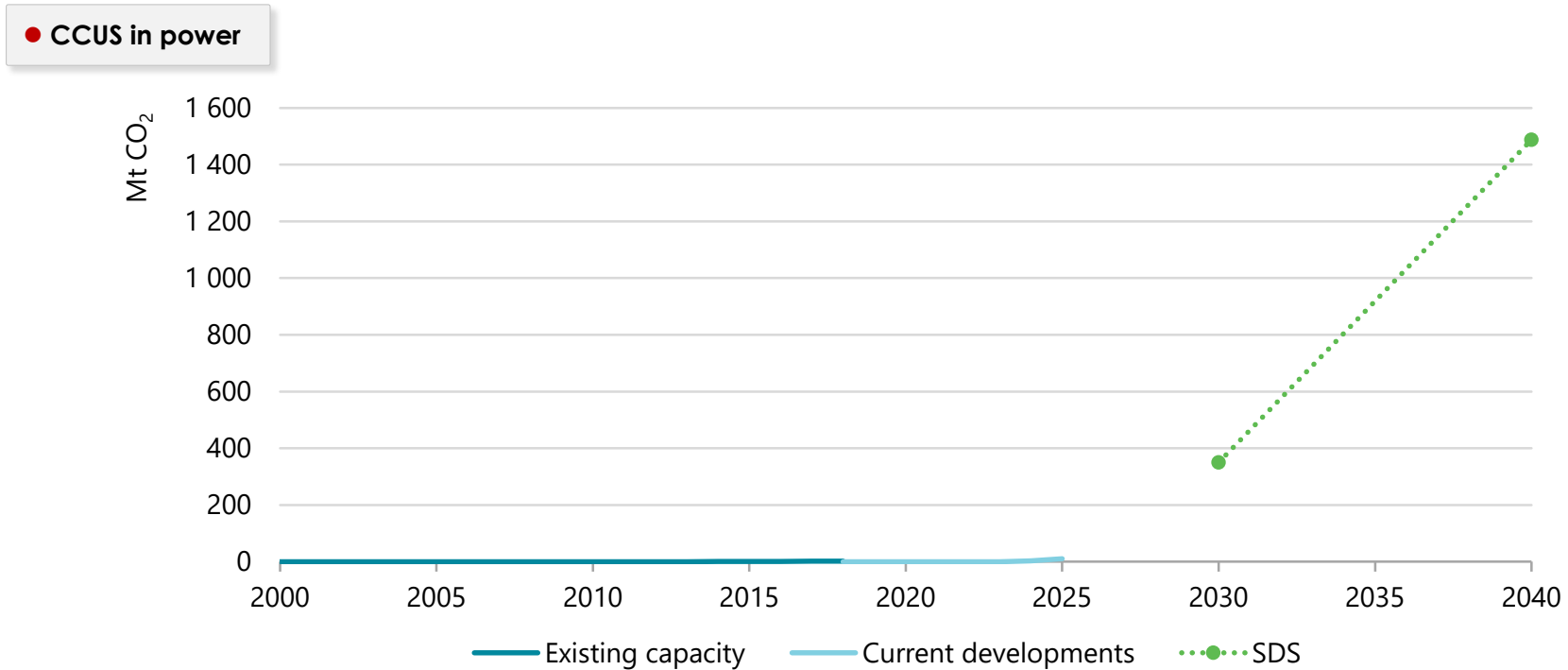
Overall renewables growth hinges on solar PV

Global net renewable capacity additions



The main reason behind the lack of acceleration in PV's growth was China's policy change to control the pace of expansion, tackle subsidy cost and curtailment challenges and ultimately achieve a more sustainable PV growth

A significant scale-up of CCUS efforts will be required globally

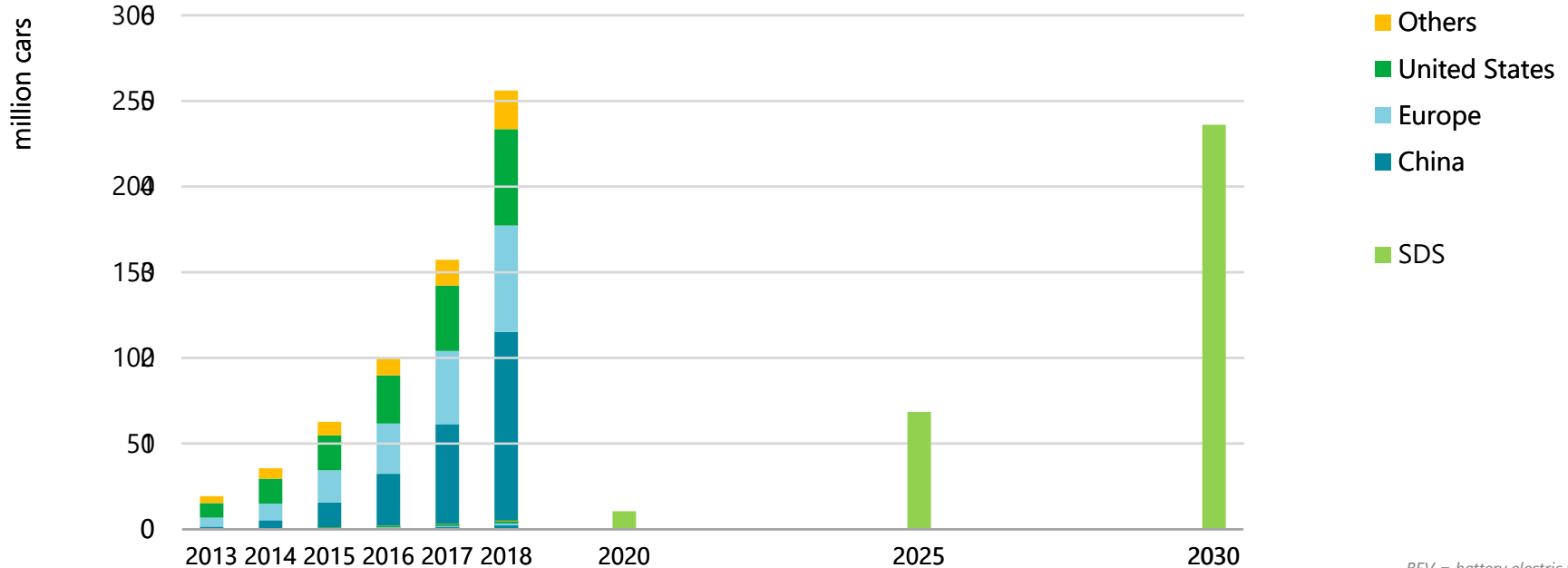


With only 2 large scale projects operating today, CCUS remains well off track to reach SDS level of 350 MtCO₂ per year

2018 was another record-breaking year for global electric car sales

● Electric vehicles

Global electric car stock



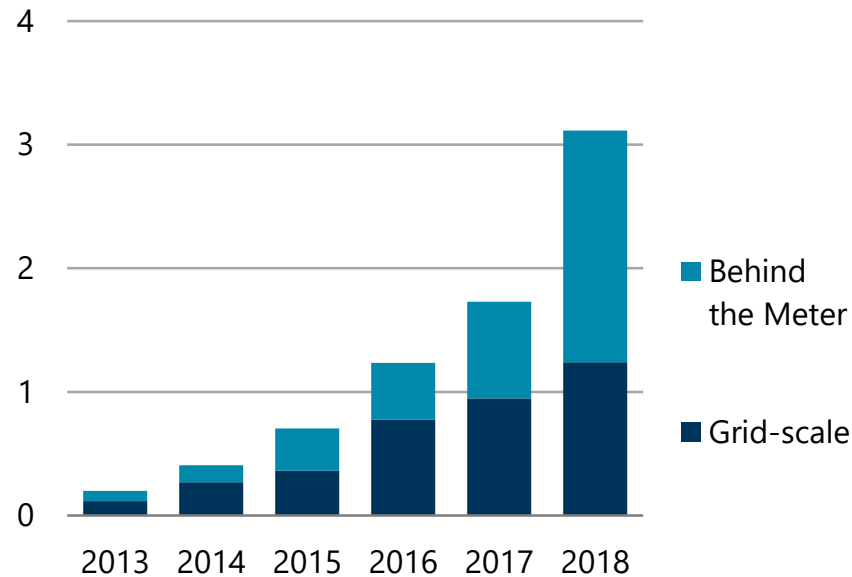
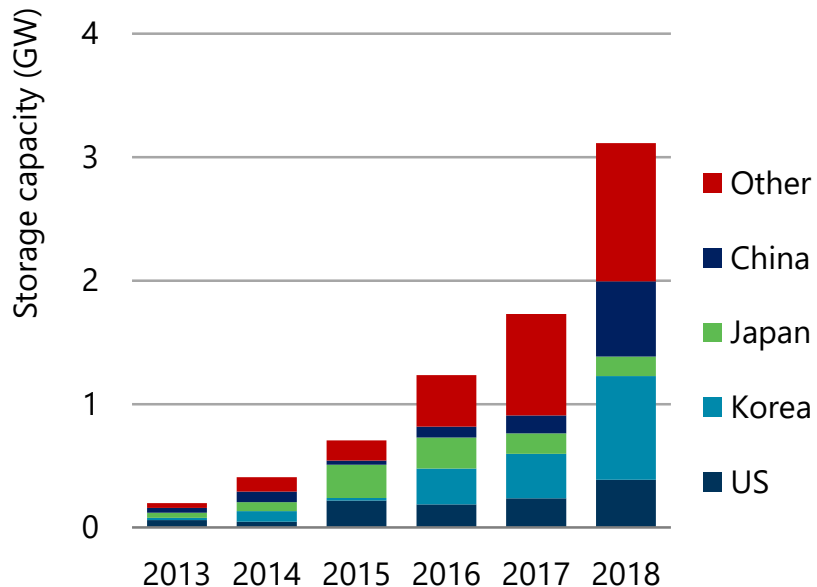
BEV = battery electric vehicle
PHEV = plug-in hybrid electric vehicle

The global electric car stock surpassed 5 million in 2018, of which nearly two-thirds are battery electric vehicles

Energy storage is again on track with the transition – but depends heavily on policy support

Energy storage

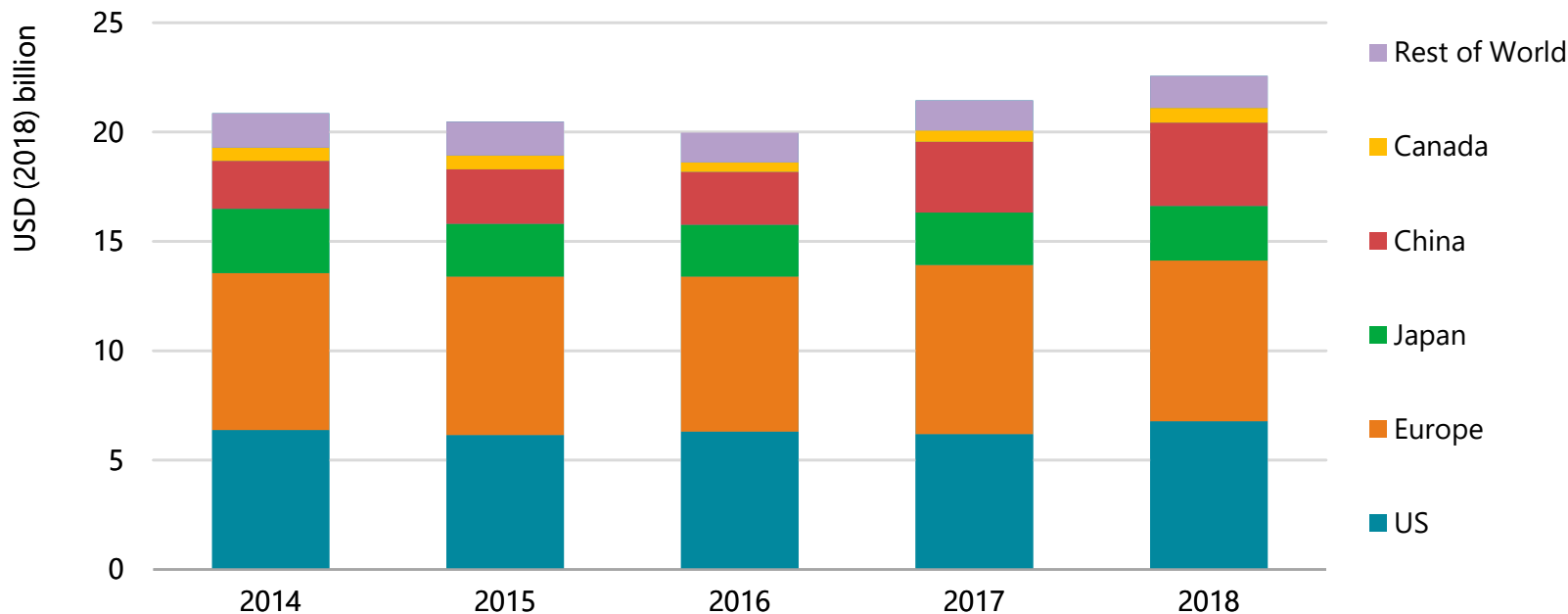
Annual battery storage installations



New markets have emerged quickly (SE Asia, South Africa) when policy became more favourable; continued growth in behind-the-meter storage depends on market frameworks

Global public R&D investment in clean energy needs to rise further

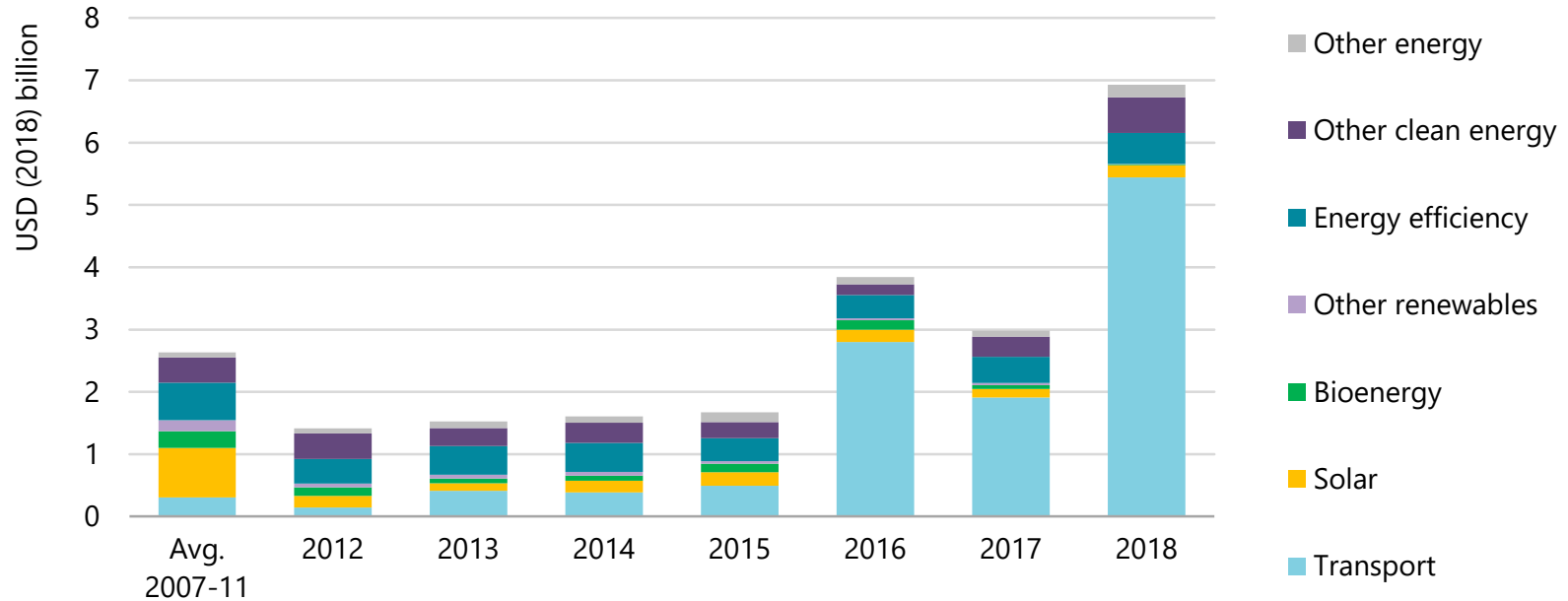
Total public spending on low-carbon energy R&D



Public R&D in clean energy increased to USD 22 billion, but amounts to just 0.1% of total government spending

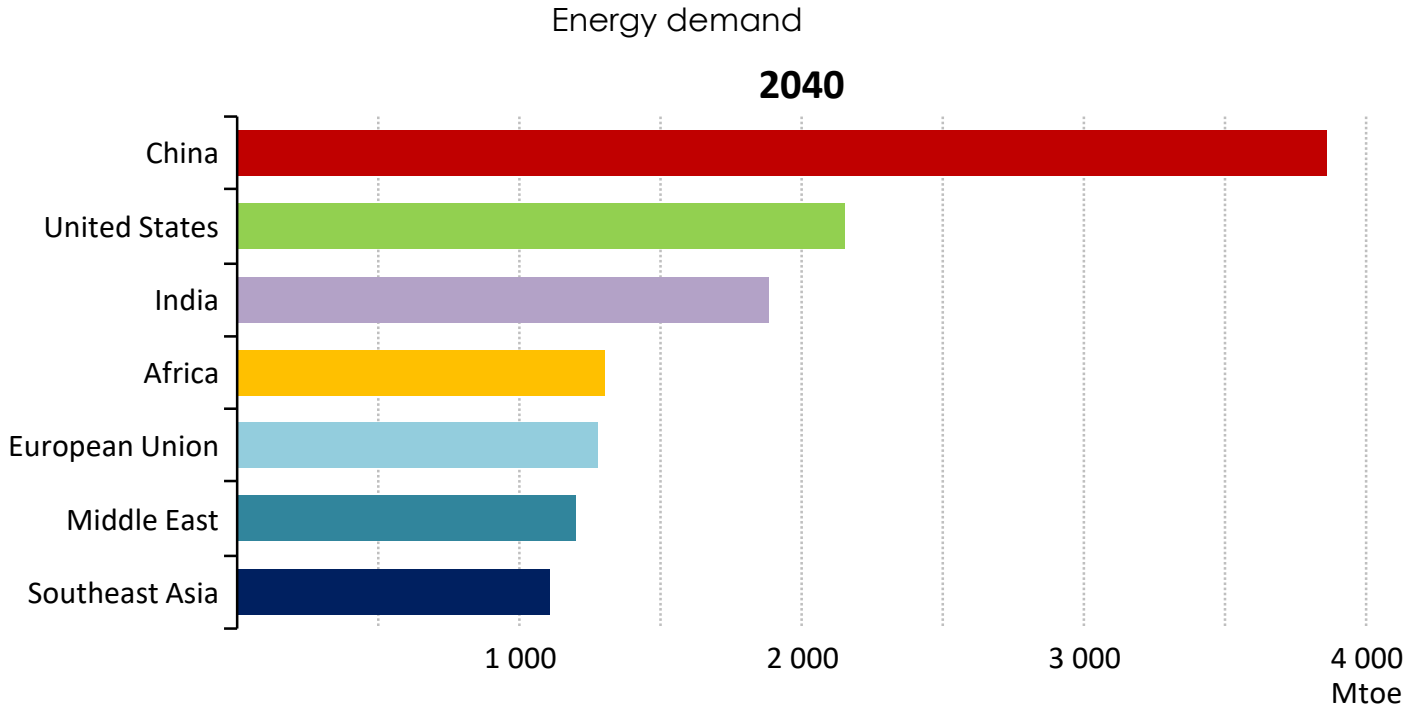
A record year for venture capital investment in clean energy

Global venture capital investment in energy technology companies



Early-stage VC investment in energy tech start-ups reached USD 6.9 billion, mostly focused on low-carbon (especially transport)

The *new* geography of energy...

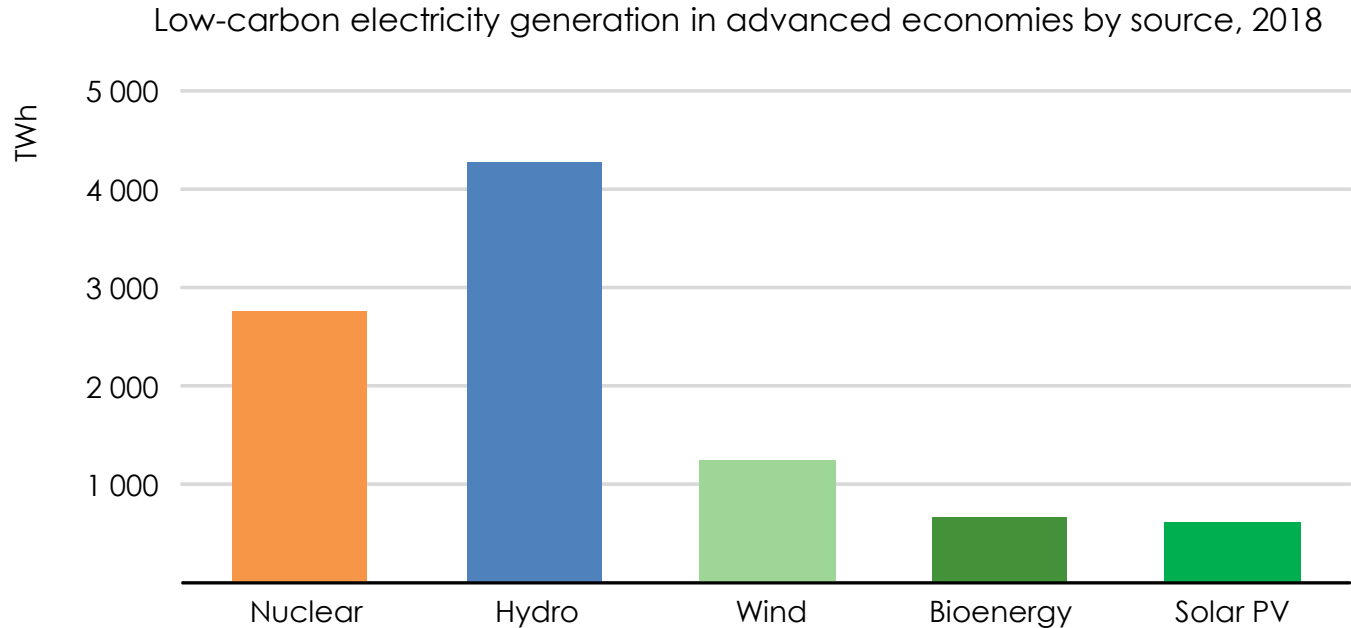


In 2000, more than 40% of global demand was in Europe & North America and some 20% in developing economies in Asia. By 2040, this situation is completely reversed



Nuclear Power in a Clean Energy System

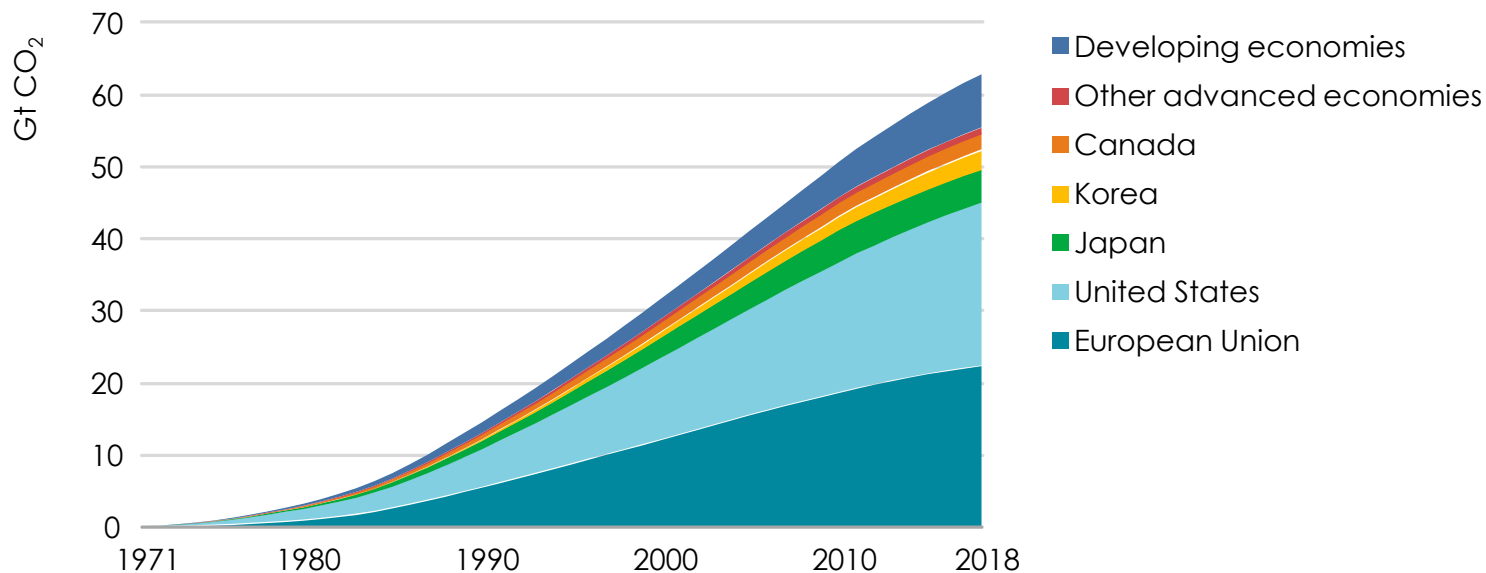
Nuclear is a leading source of clean electricity today



Nuclear power provided 10% of electricity supply worldwide in 2018, while in advanced economies, it has been the largest clean source of electricity for over 30 years

Nuclear power has avoided CO₂ emissions for 50 years

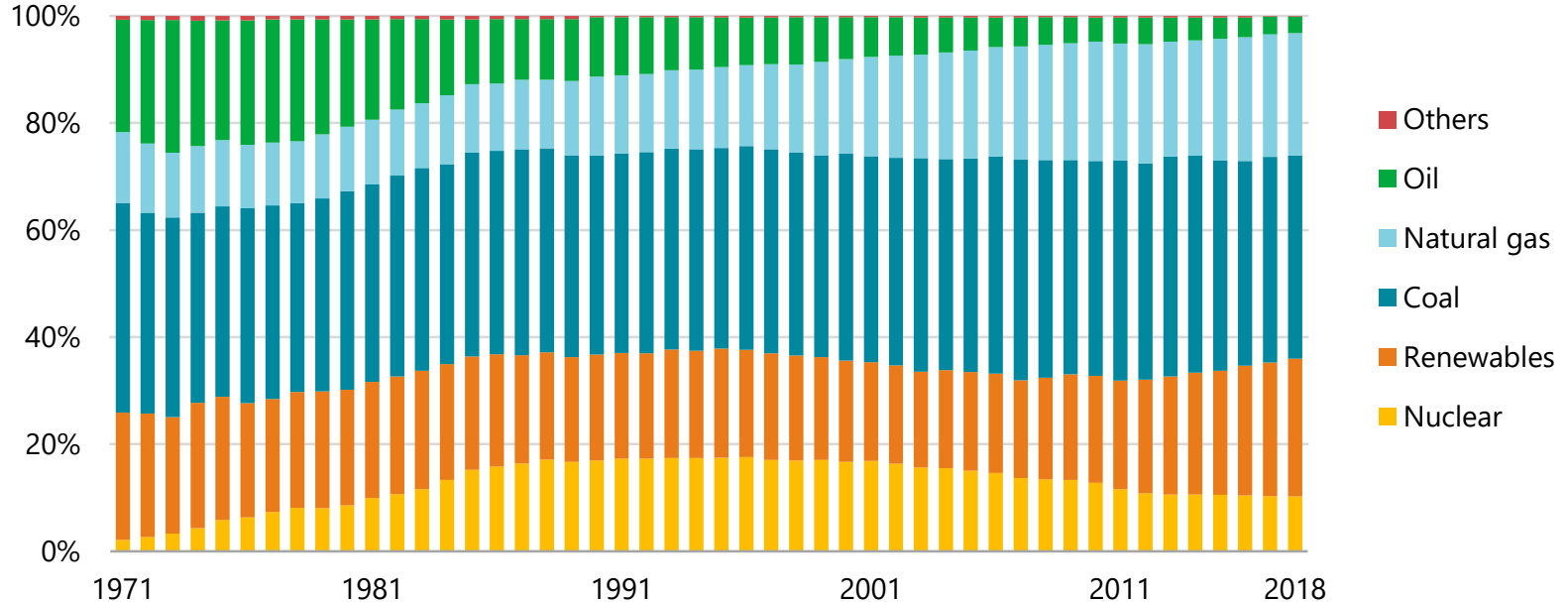
Cumulative CO₂ emissions avoided by nuclear power worldwide, 1971-2018



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

Share of non-fossil electricity is same now as it was 20 years ago...

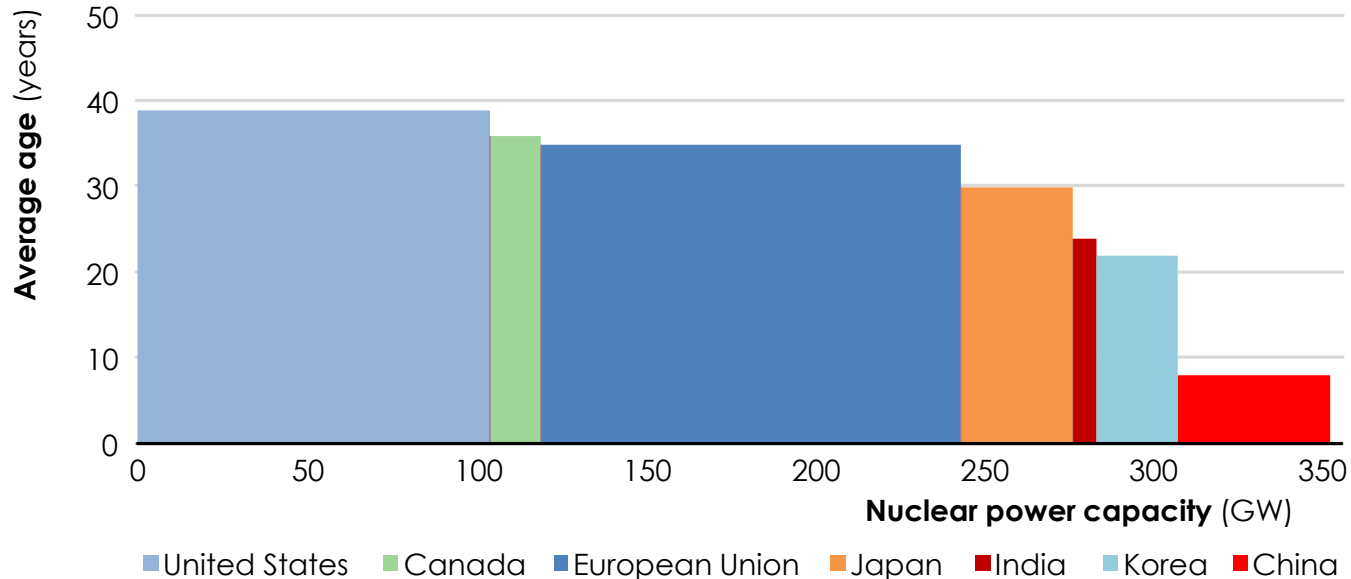
Share of energy sources in global electricity generation



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

The nuclear fleet is ageing

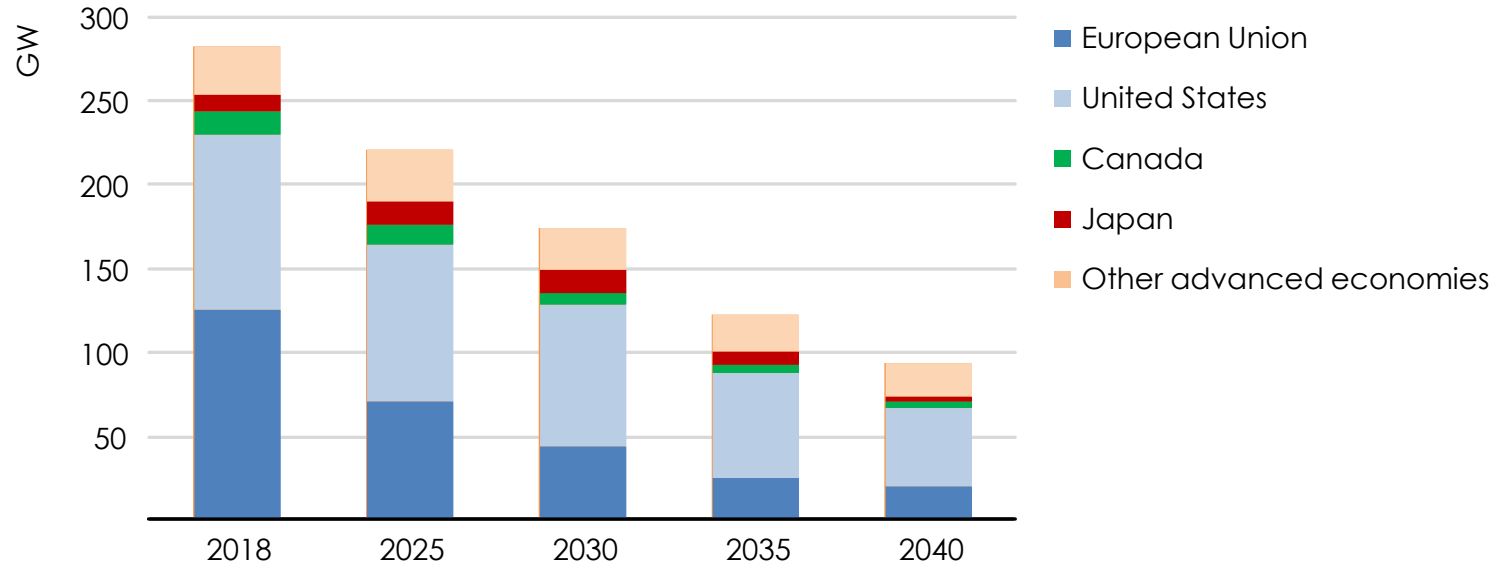
Age profile of nuclear power capacity in selected regions



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

Nuclear could face a steep decline in advanced economies

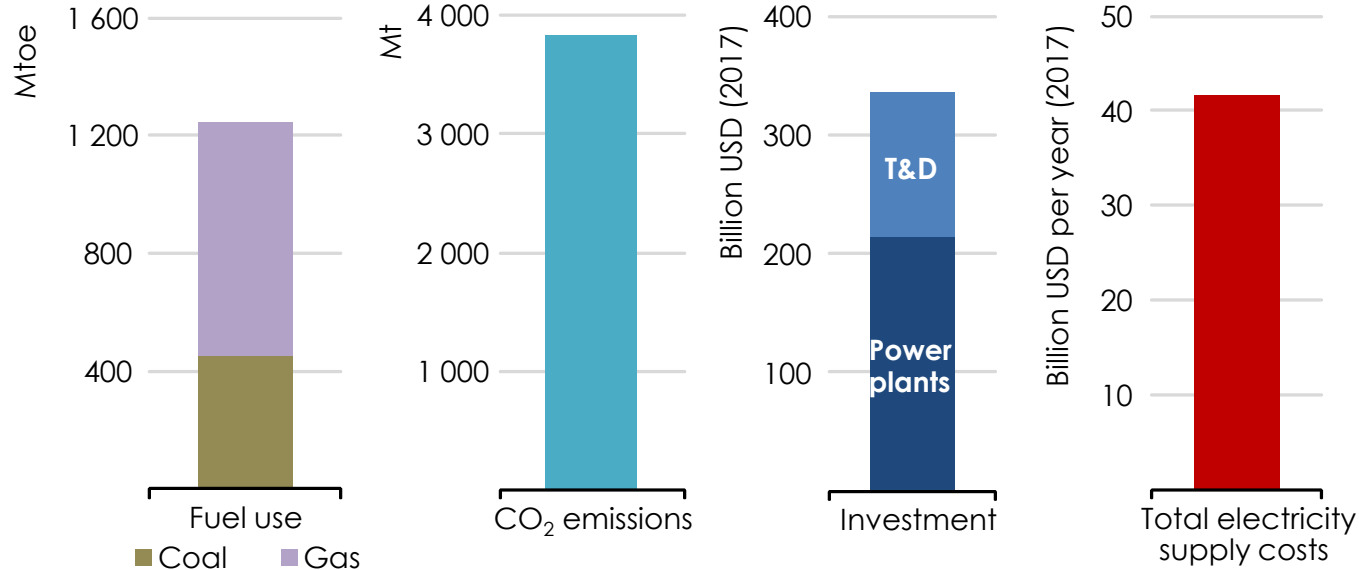
Nuclear power capacity (operational) in advanced economies in the *Nuclear Fade Case*, 2018-2040



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

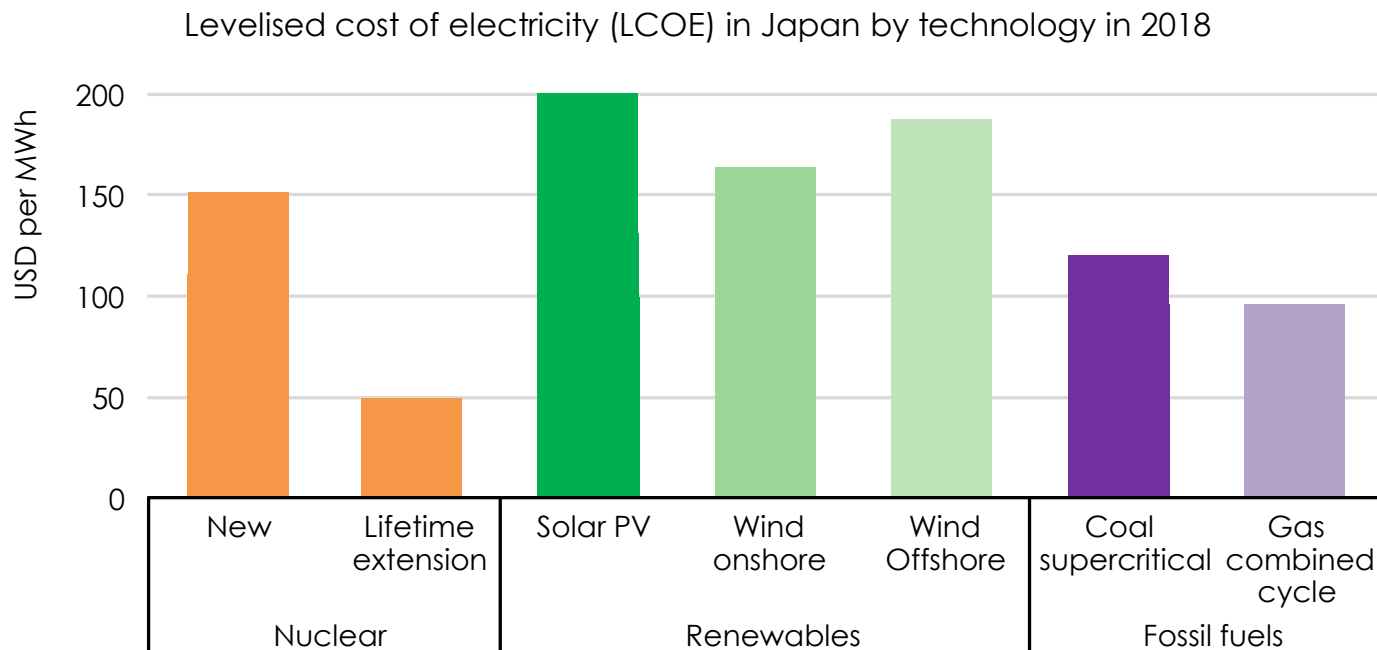
Lower nuclear raises CO₂ emissions and supply costs

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 lifetime extensions provide cheap clean electricity



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

Policy recommendations for countries pursuing nuclear power

Ensure a sound framework for lifetime extensions:

- 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:

- 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)

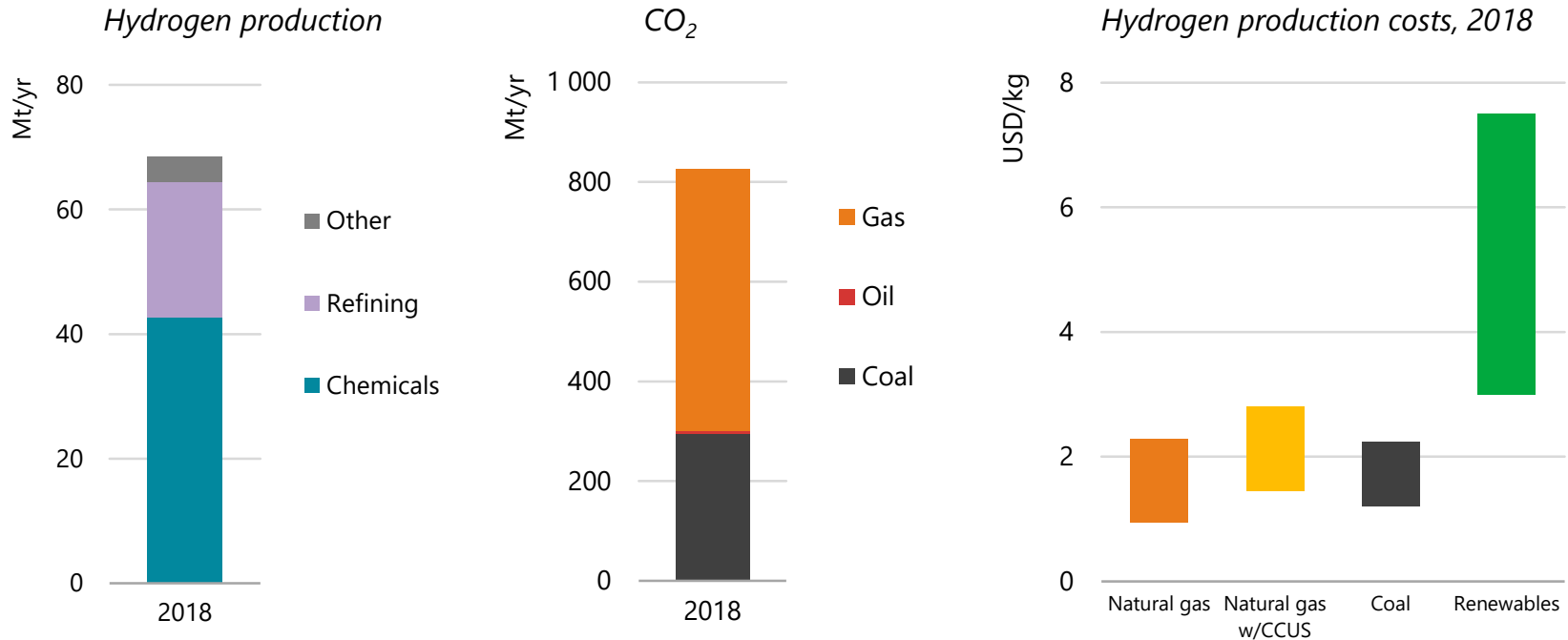


The Future of Hydrogen

Hydrogen – A common *element* of our energy future ?

- Momentum currently behind hydrogen is unprecedented, with more and more policies, projects and plans by governments & companies in all parts of the world
- Hydrogen can help overcome many difficult energy challenges
 - **Integrate more renewables**, including by enhancing storage options & tapping their full potential
 - **Decarbonise hard-to-abate sectors** – steel, chemicals, trucks, ships & planes
 - **Enhance energy security** by diversifying the fuel mix & providing flexibility to balance grids
- But there are challenges: **costs** need to fall; **infrastructure** needs to be developed; **cleaner hydrogen** is needed; and **regulatory barriers** persist

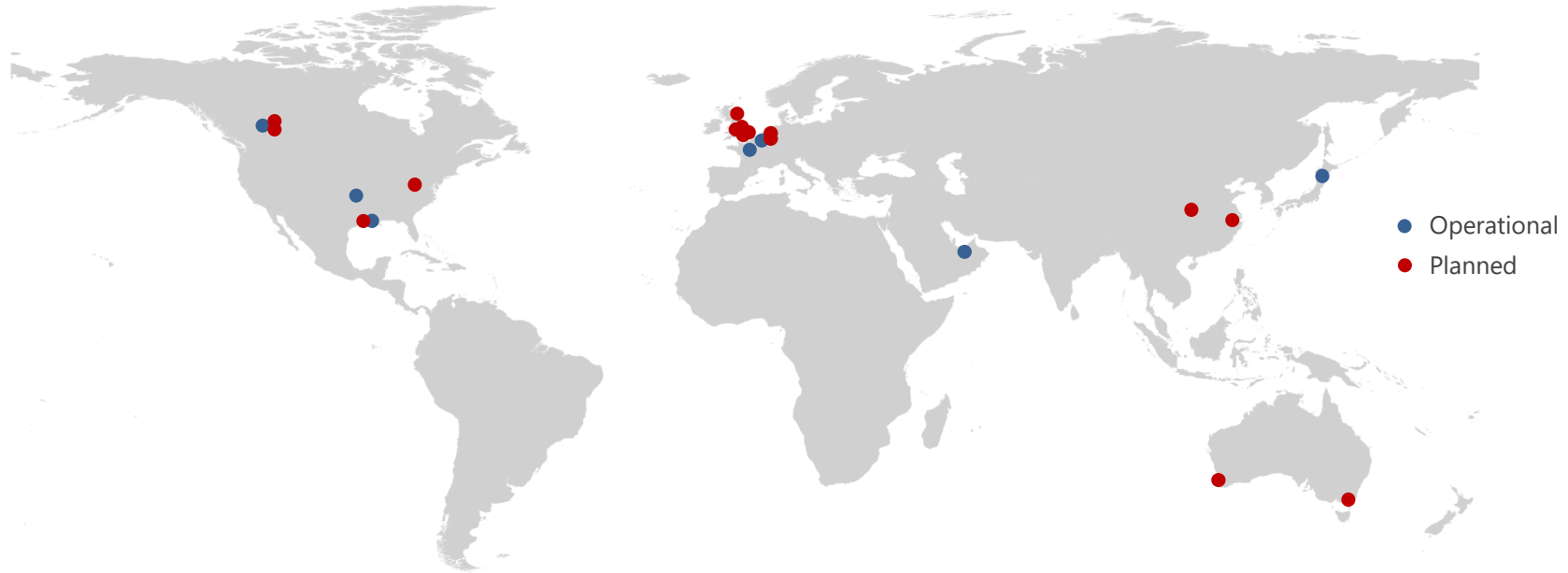
Hydrogen is already part of the energy mix



Dedicated hydrogen production is concentrated in very few sectors today, and virtually all of it is produced using fossil fuels, as a result of favourable economics

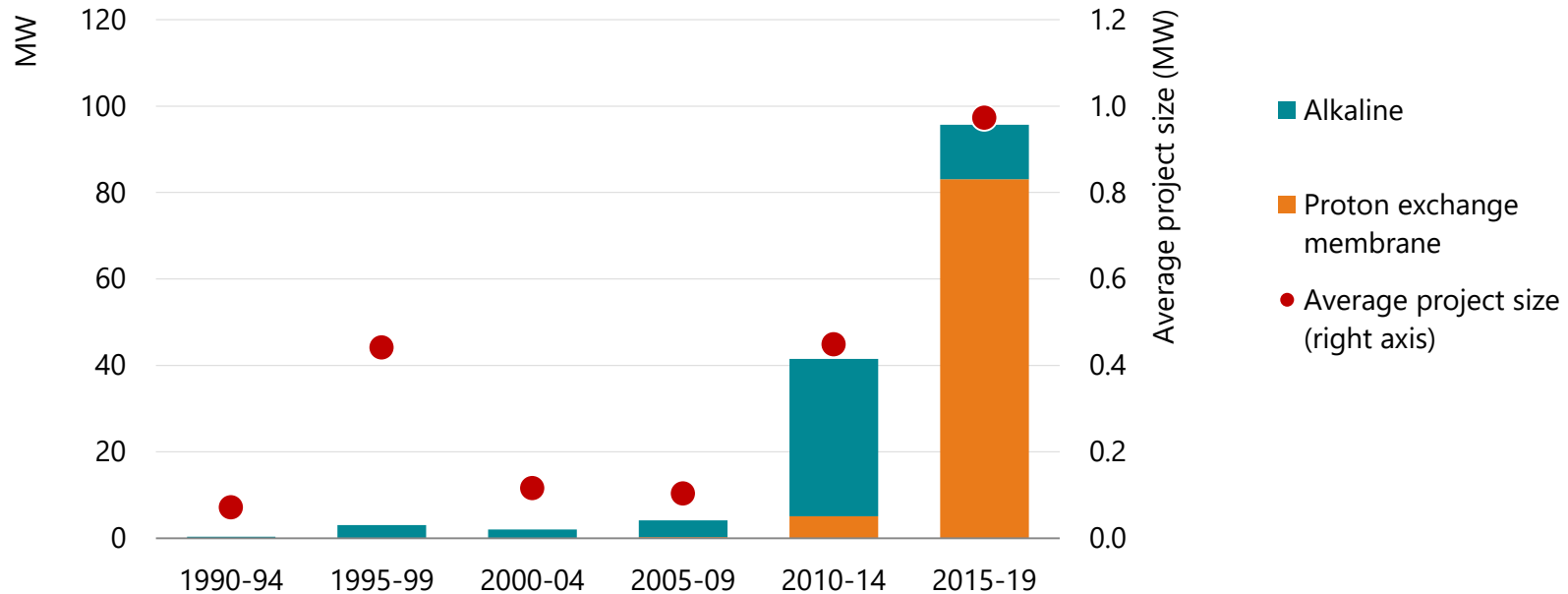
Hydrogen production with CO₂ capture is coming online

Facilities with hydrogen production and CCUS



Low-carbon hydrogen from fossil fuels is produced at commercial scale today, with more plants planned. It is an opportunity to reduce emissions from refining and industry

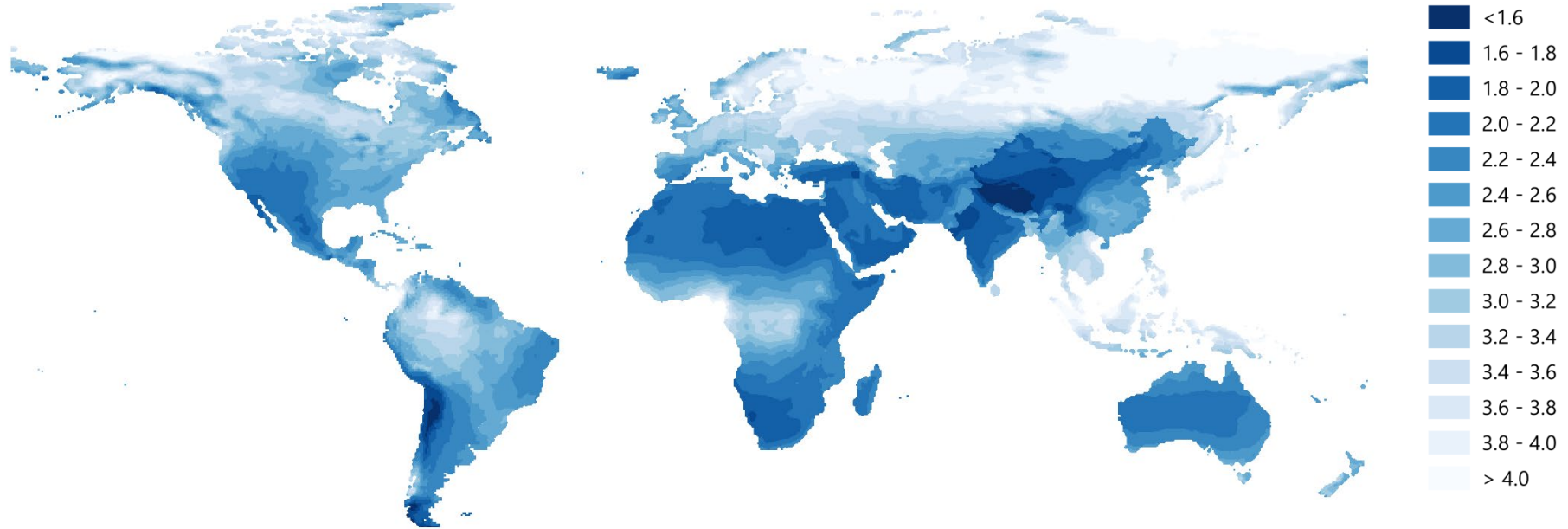
Global electrolyser capacity additions and average unit size



Electrolyser capacity additions and their average sizes have been growing rapidly in recent years, providing cost reductions from economies of scale and learning effects

Renewables hydrogen costs are set to decline

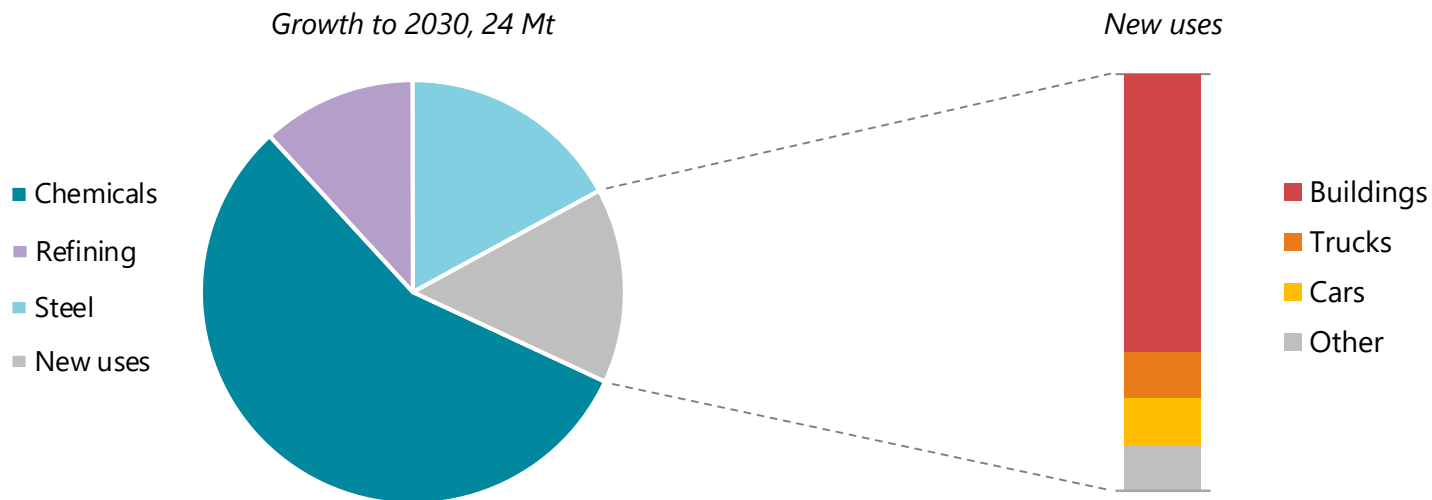
Long-term hydrogen production costs from solar & wind systems



The declining costs of solar PV and wind could make them a low-cost source for hydrogen production in regions with favourable resource conditions

The challenge to 2030: expand hydrogen beyond existing applications

Growth in hydrogen use based on announced policies, 2018-2030



Dependable demand from current industrial applications can boost clean hydrogen production; policies & industry targets suggest increasing use in other sectors, but ambition needs to increase

Four key opportunities for scaling up hydrogen to 2030



iea