GLOBAL CCS INSTITUTE

WHY IS CCS COST-EFFECTIVE FOR MITIGATING CLIMATE CHANGE?

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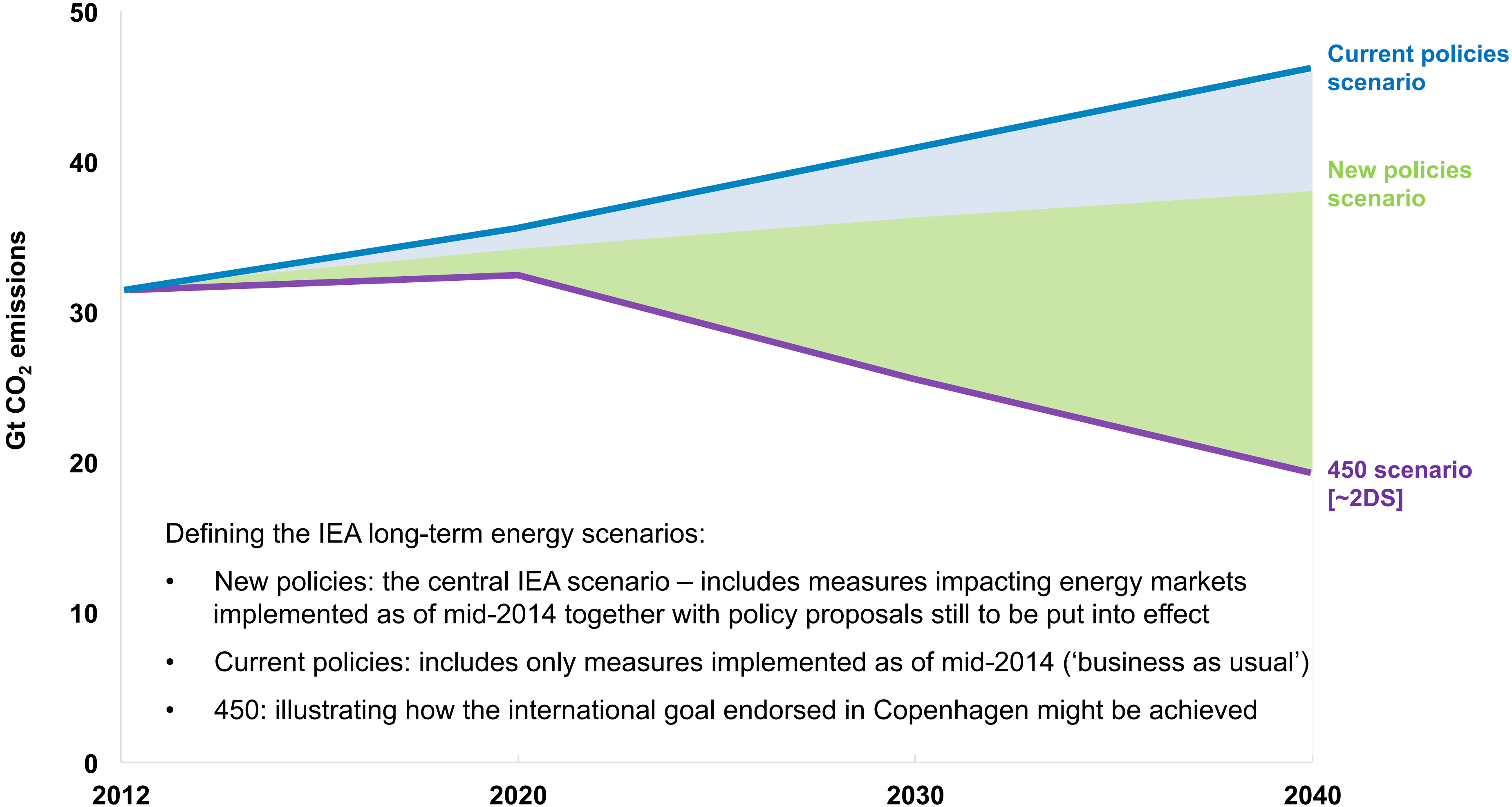
Claude Mandil, Board Director – Global CCS Institute and former Executive Director of the International Energy Agency (IEA)

A substantial transformation in energy systems is required to achieve 2°C



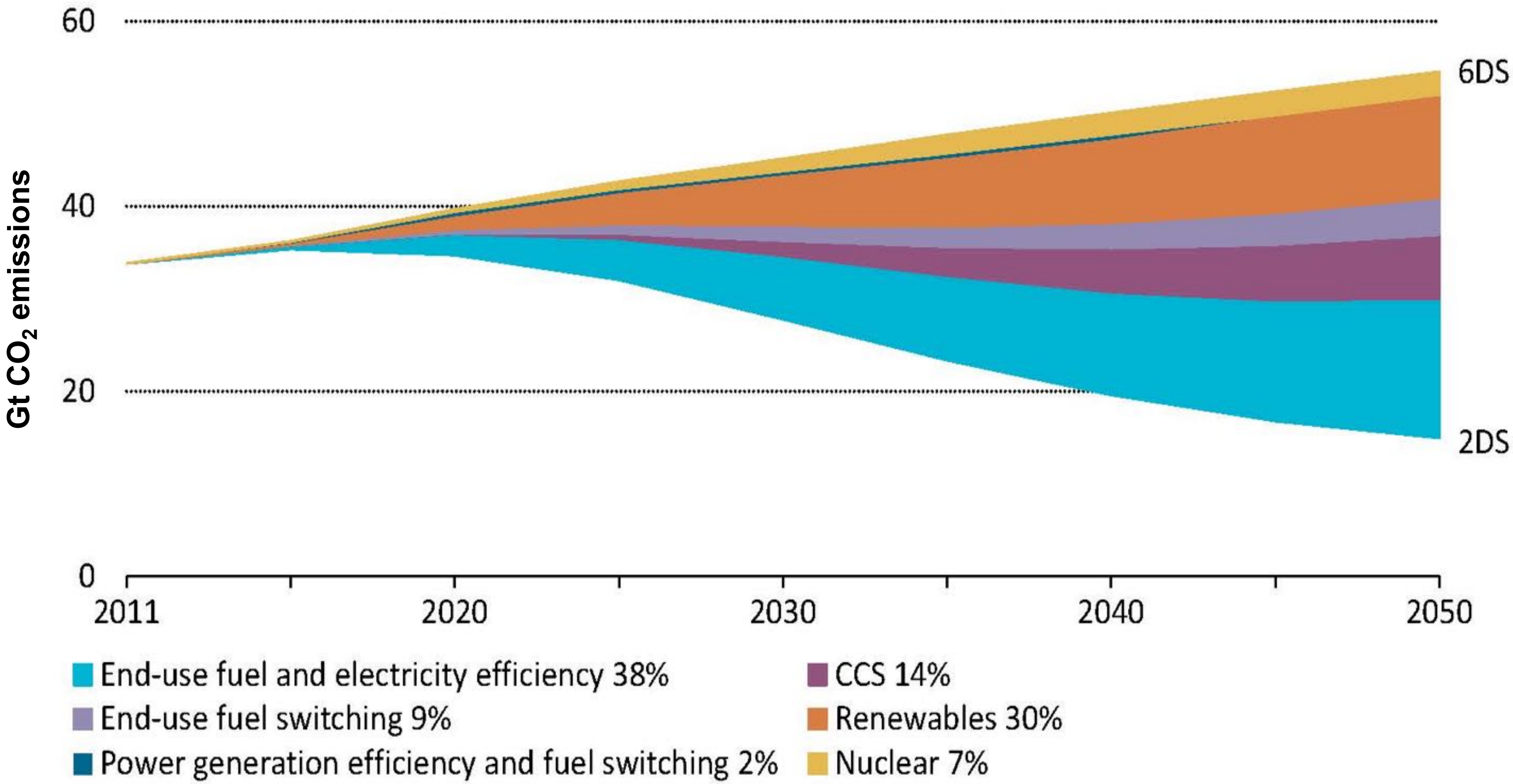
Defining the IEA long-term energy scenarios:

- New policies: the central IEA scenario – includes measures impacting energy markets implemented as of mid-2014 together with policy proposals still to be put into effect
- Current policies: includes only measures implemented as of mid-2014 (‘business as usual’)
- 450: illustrating how the international goal endorsed in Copenhagen might be achieved

Source: IEA World Energy Outlook (2014).

Global climate modelling shows CCS is necessary for cost-effective climate change mitigation

CCS contributes 14% of cumulative CO_2 emission reductions through 2050 compared to 'business as usual'

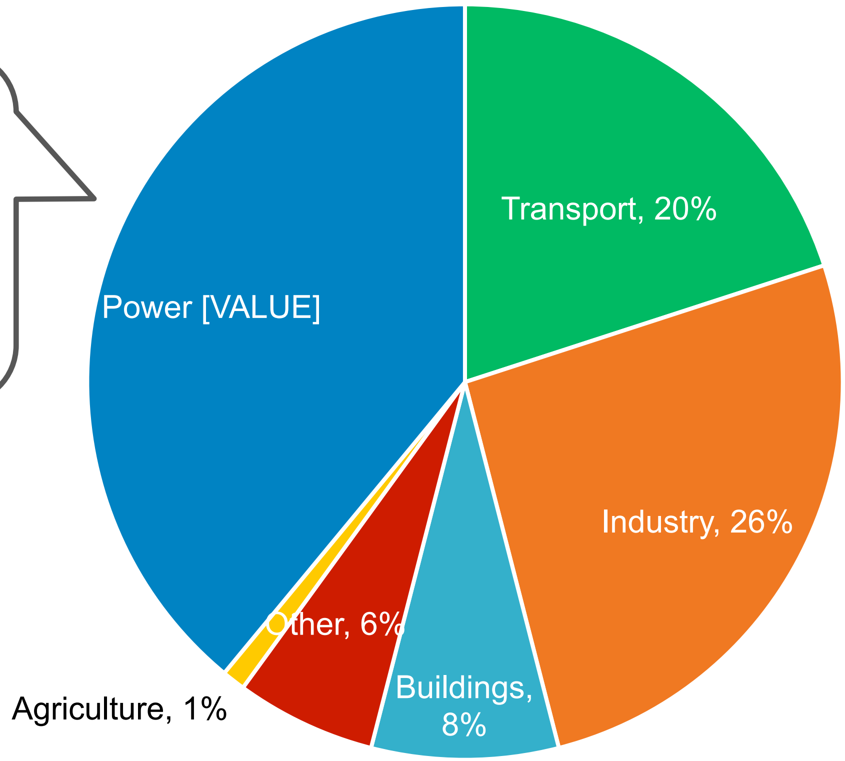


Source: IEA Energy Technology Perspectives (2014).

The importance of CCS in least-cost climate change mitigation

2011 CO_2 emissions: 33.8 gigatonnes

CCS should play a key role in curbing CO_2 emissions from fossil-based power generation, potentially reducing the overall cost of power sector decarbonisation by around US $2 trillion by 2050.



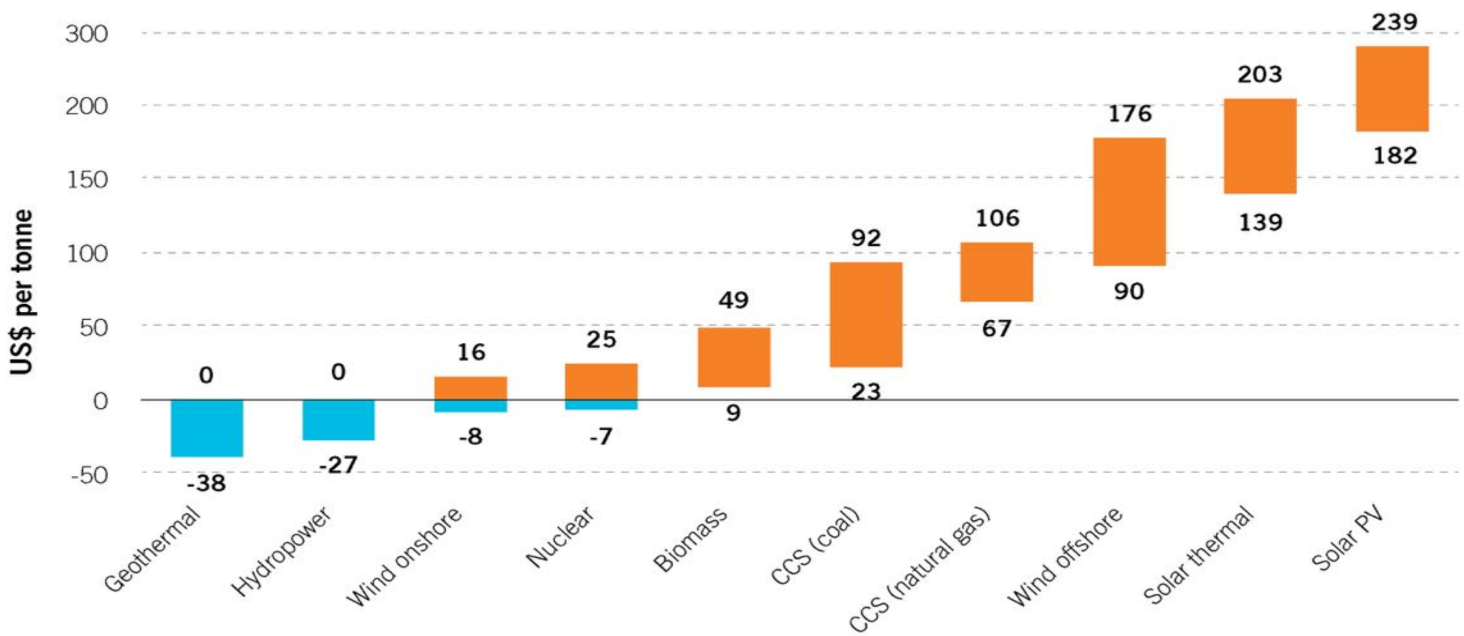
CCS is the only option available to reduce direct emissions from industrial processes at the large scale needed in the longer term

Without CCS, reducing CO_2 emissions through 2050 in a 2°C world is highly unlikely in industry and at best very expensive in power.

Source: IEA Energy Technology Perspectives (2012 and 2014).

Decarbonising the power sector without CCS would involve more expensive technologies

Costs of CO_2 avoided in the power sector



Note: For all technologies except gas-fired CCS plants, the amount of CO_2 avoided is relative to the emissions of a supercritical pulverised coal plant. For gas-fired CCS, the reference plant is an unabated combined cycle plant.

Source: *Strategic analysis of the global status of carbon capture and storage Economic assessment of carbon capture and storage technologies,* Global CCS Institute (2011).

Mitigation cost increases in scenarios with limited availability of technologies

Percentage increase in total discounted mitigation costs (2015-2100) relative to default technology assumptions – median estimate

2100 concentrations (ppm CO_2eq)	no CCS	nuclear phase out	limited solar/wind	limited bioenergy
450	138%	7%	6%	64%

Source: IPCC Fifth Assessment Synthesis Report (November 2014).

The longer the delay in climate change action, the greater the requirement for CCS as the basis for BECCS

"BECCS offers additional mitigation potential, but also an option to delay some of the drastic mitigation action that would need to happen to reach lower GHG-concentration goals by the second half of the century"

IPCC WG3 AR5, Chapter 6 (page 486)

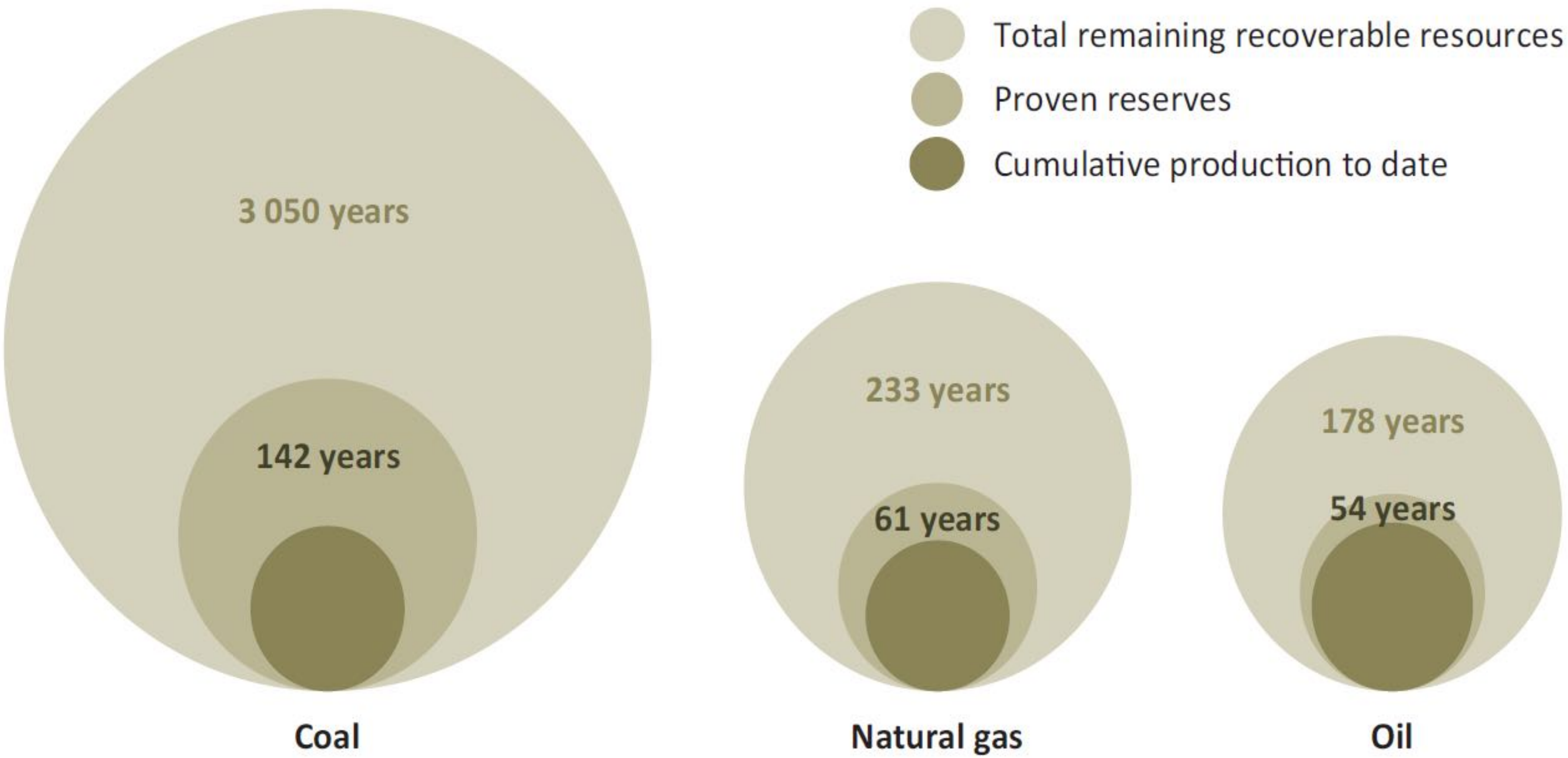
- Mitigation scenarios modelled for reaching 2°C in 2100 involve temporary overshoot of atmospheric concentrations and typically rely on availability and widespread deployment of bioenergy with carbon capture and storage (BECCS).
- 85% of IPCC scenarios (101 of 116) consistent with 2°C requirements require global net negative emissions before 2100, typically through BECCS and afforestation
- Half of the IPCC scenarios feature BECCS supplying 5% or more of primary energy.

The longer the delay in climate change action, the greater the need for net negative emissions technologies like BECCS.

Sources: IPCC WG3 Fifth Assessment Report and *Betting on negative emissions,* Fuss et al (2014).

Underlying trends in fossil fuels that impact global climate modelling

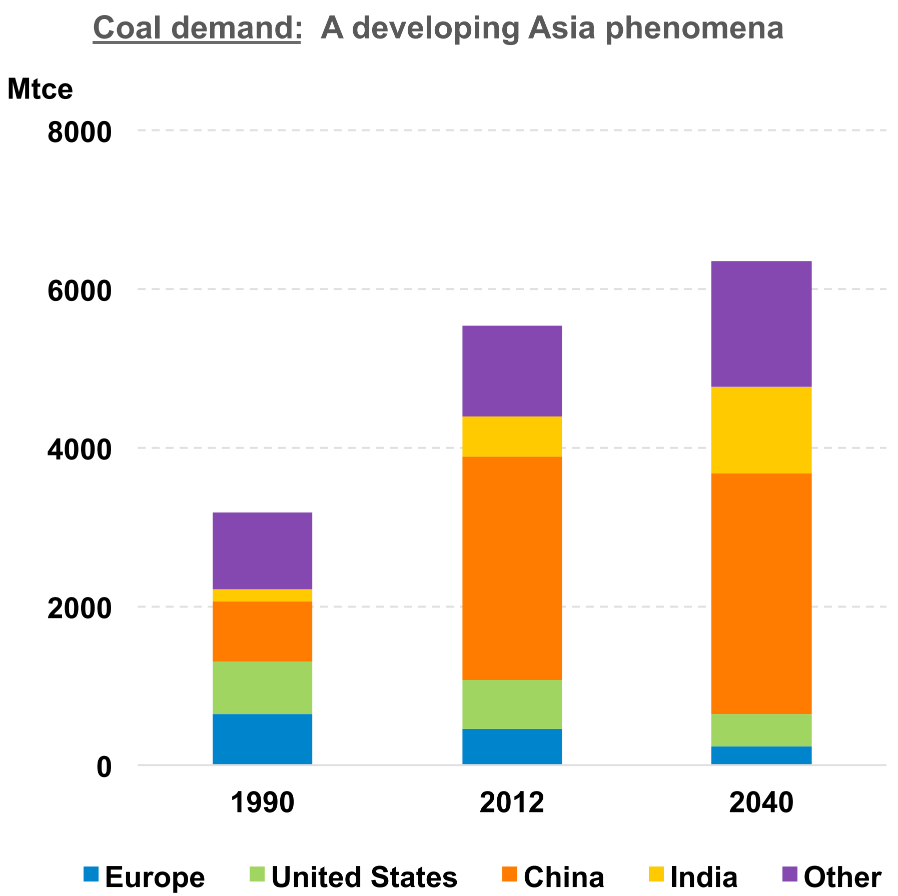
Fossil fuels will be important for a long time to come

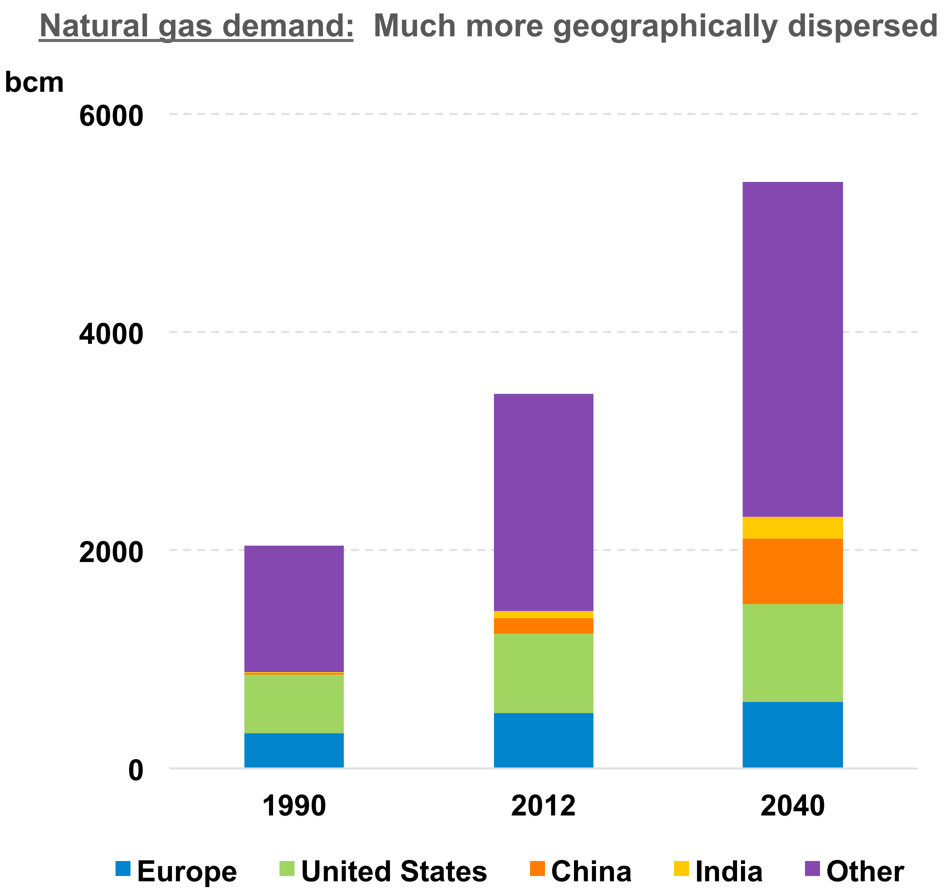


All bubbles are expressed as a number of years of production based on estimated production in 2013.
The size of the bubble for total remaining recoverable resources of coal is illustrative and is not proportional to the others.

Source: IEA World Energy Outlook (2013).

Fossil fuels continue to underpin global energy and power demand

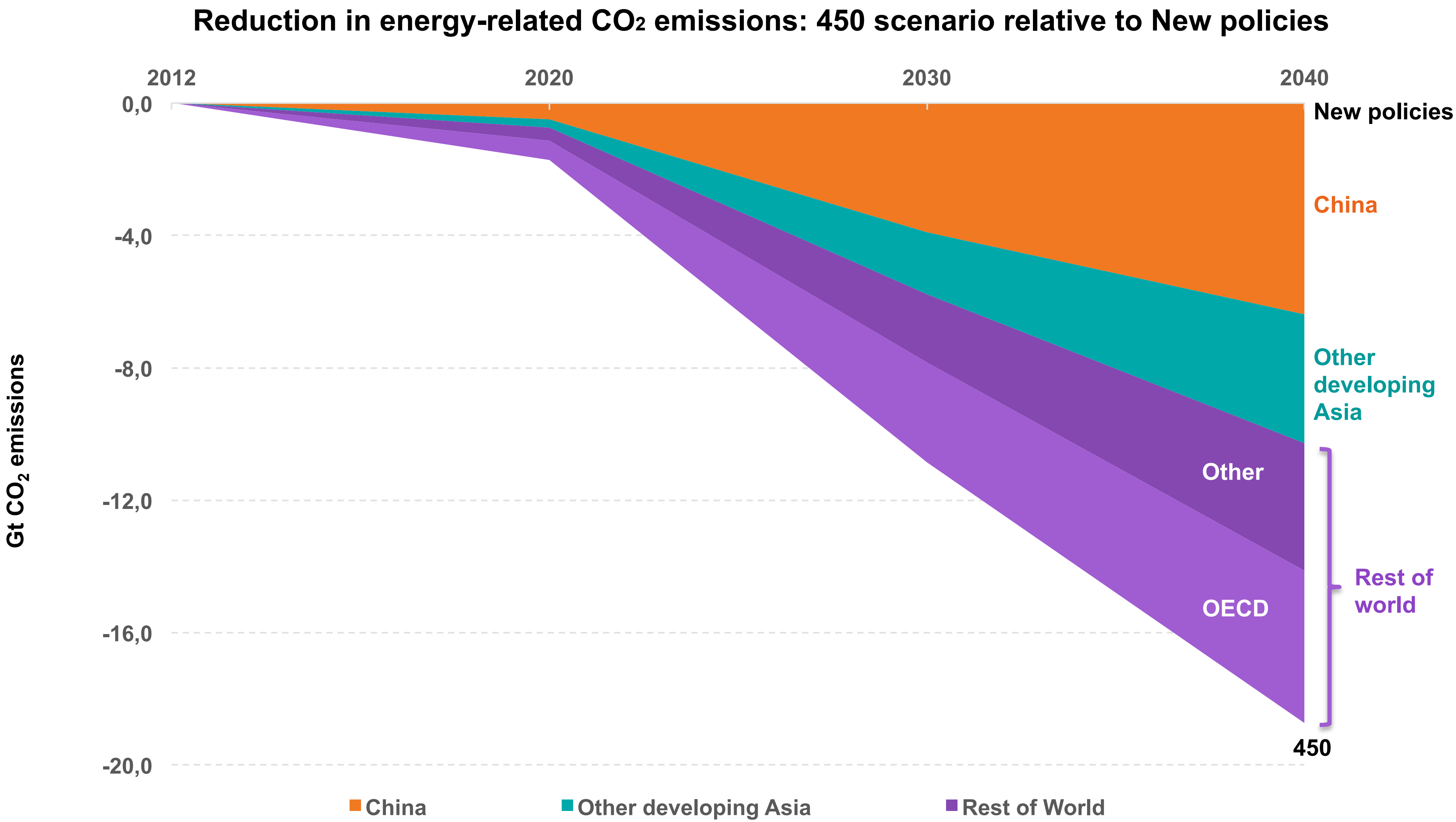




CCS is critical in decarbonising coal, especially in developing Asia. Gas on its own will not deliver 2DS and will also require CCS.

Source: IEA World Energy Outlook (2014) - New policies scenario.

Developing Asia is an especially important contributor to future emission reductions



Source: IEA World Energy Outlook (2014).

The case for CCS is clear…

Without CCS, achieving 2°C is even more challenging

The absence of CCS will significantly increase the cost of achieving 2°C

The longer the delay in climate change action, the greater the requirement for CCS as the basis for BECCS

CCS is necessary for cost-effective climate change mitigation.

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