DELIVERING THE CLEAN GROWTH PLAN:

TRANSITION TO A LOW CARBON ECONOMY

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AMERICA SQUARE CONFERENCE CENTRE, LONDON

ENERGY & ENVIRONMENT

Coal power and CCS trends in the IEA World Energy Outlook 2017 Sustainable Development Scenario

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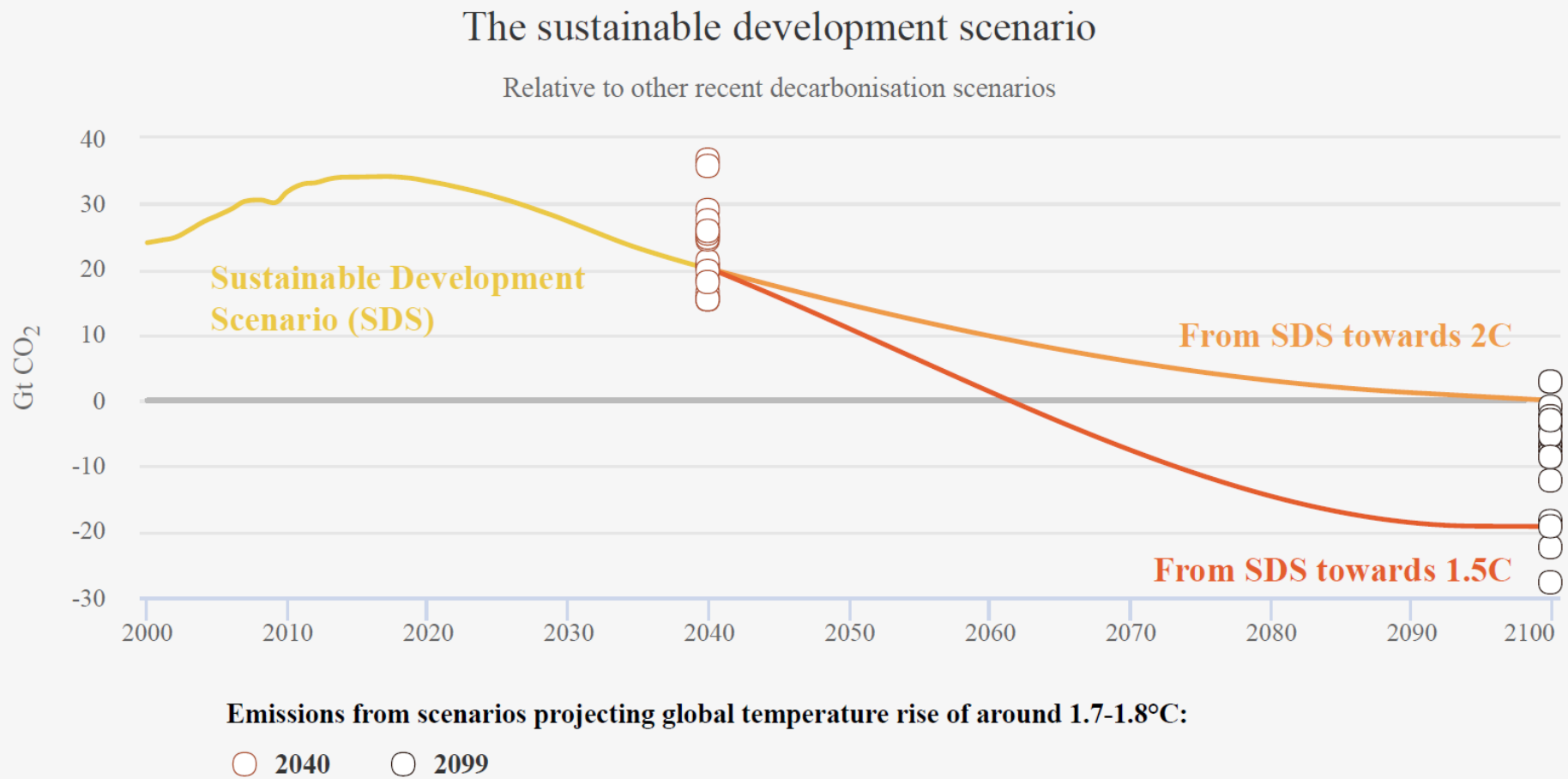
UKCCS RESEARCH CENTRE

Now recognised that net zero or net negative emissions are required – so CCS is essential

International Energy Agency (2017), World Energy Outlook 2017, OECD/IEA, Paris

Emissions going to zero means that the world has a finite budget for all future CO_2 emissions



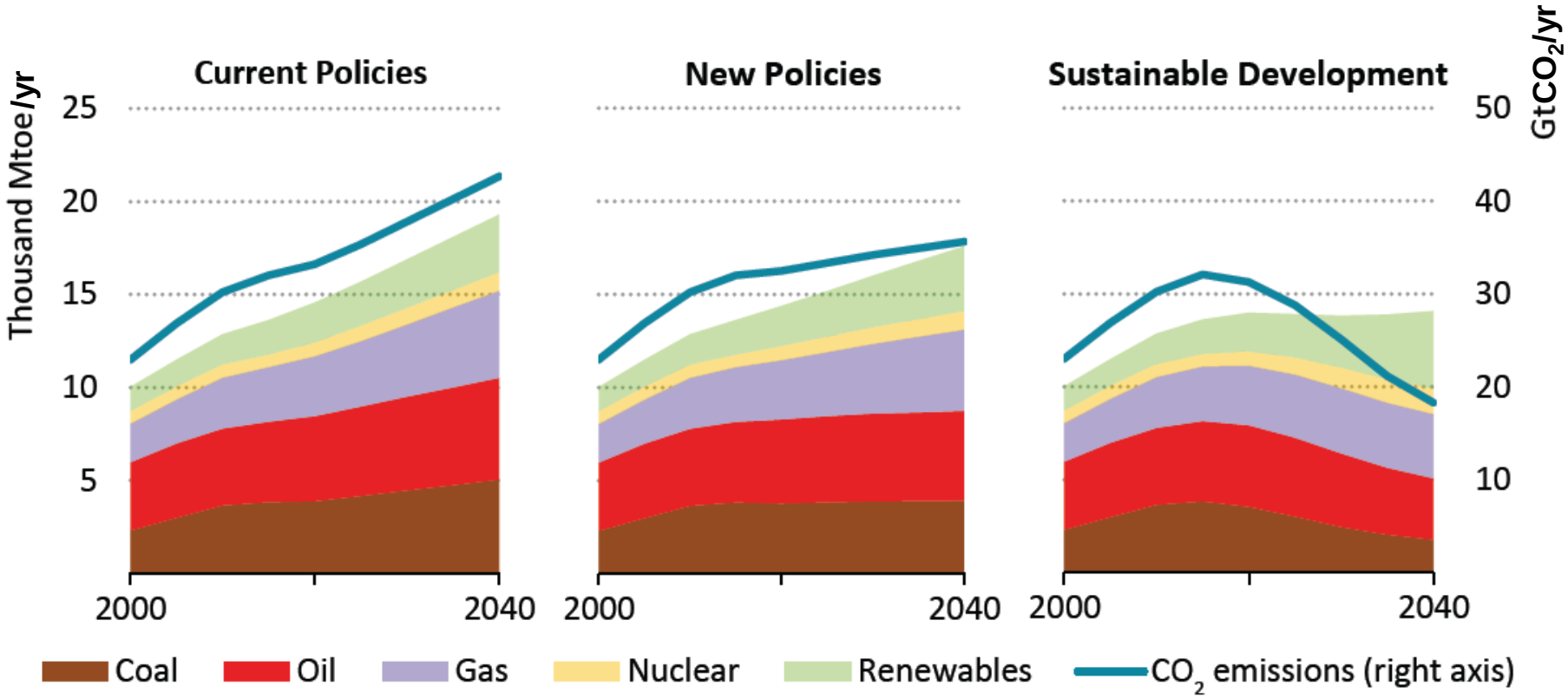
http://www.iea.org/weo2017/

World Energy Outlook 2017, IEA

IEA Sustainable Development Scenario achieves global 2040 CO_2 emission targets by cutting coal and oil use while increasing gas only slightly

International Energy Agency (2017), World Energy Outlook 2017, OECD/IEA, Paris

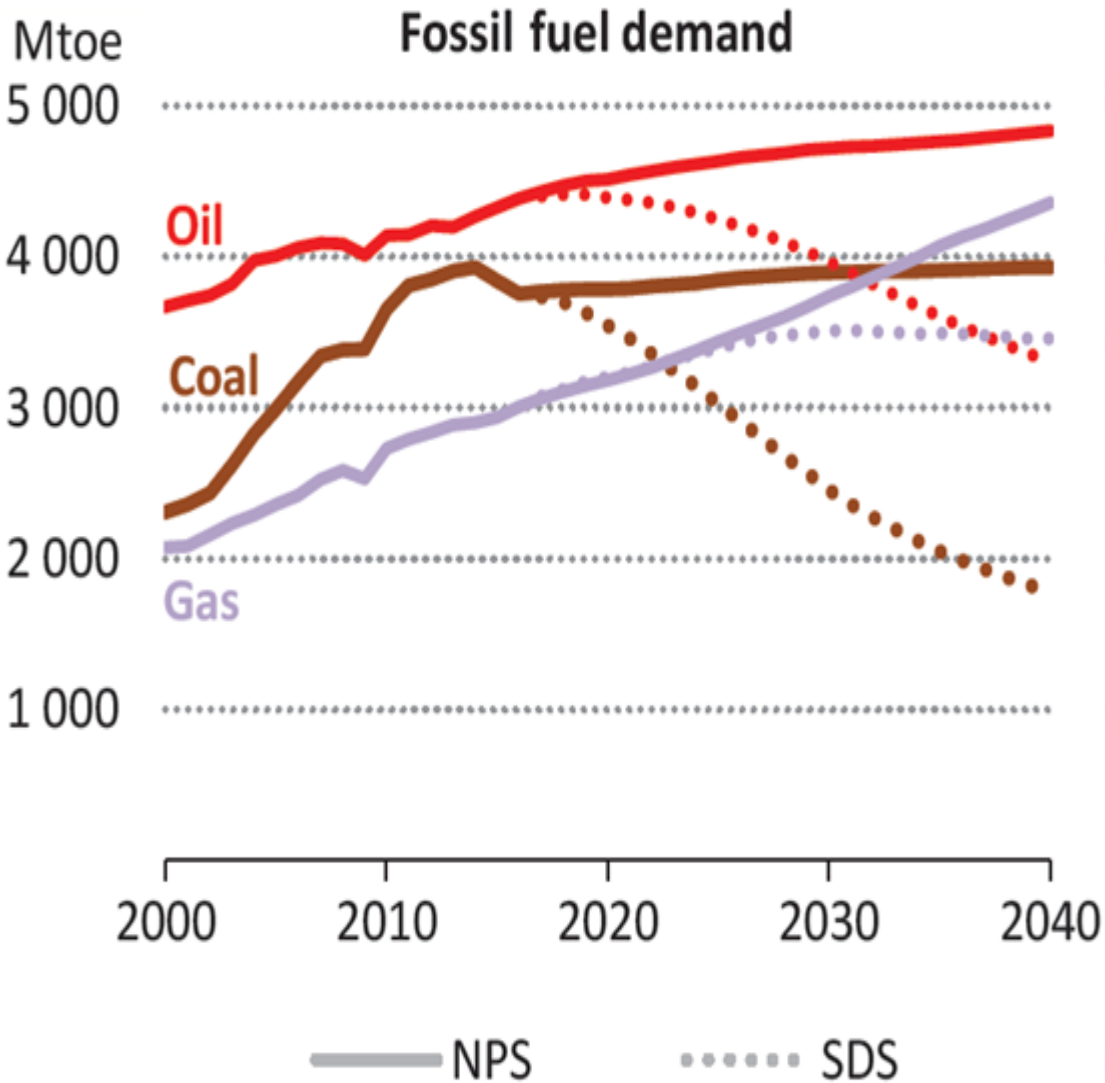
World primary energy demand by fuel and energy related CO_2 emissions



Fossil fuel prices fall or stabilise to 2040 in SDS

- Serious action on climate change will exert long-term downward pressure on fossil fuel prices
- Lower prices weakens the original driver for renewables

International Energy Agency (2017), World Energy Outlook 2017, OECD/IEA, Paris



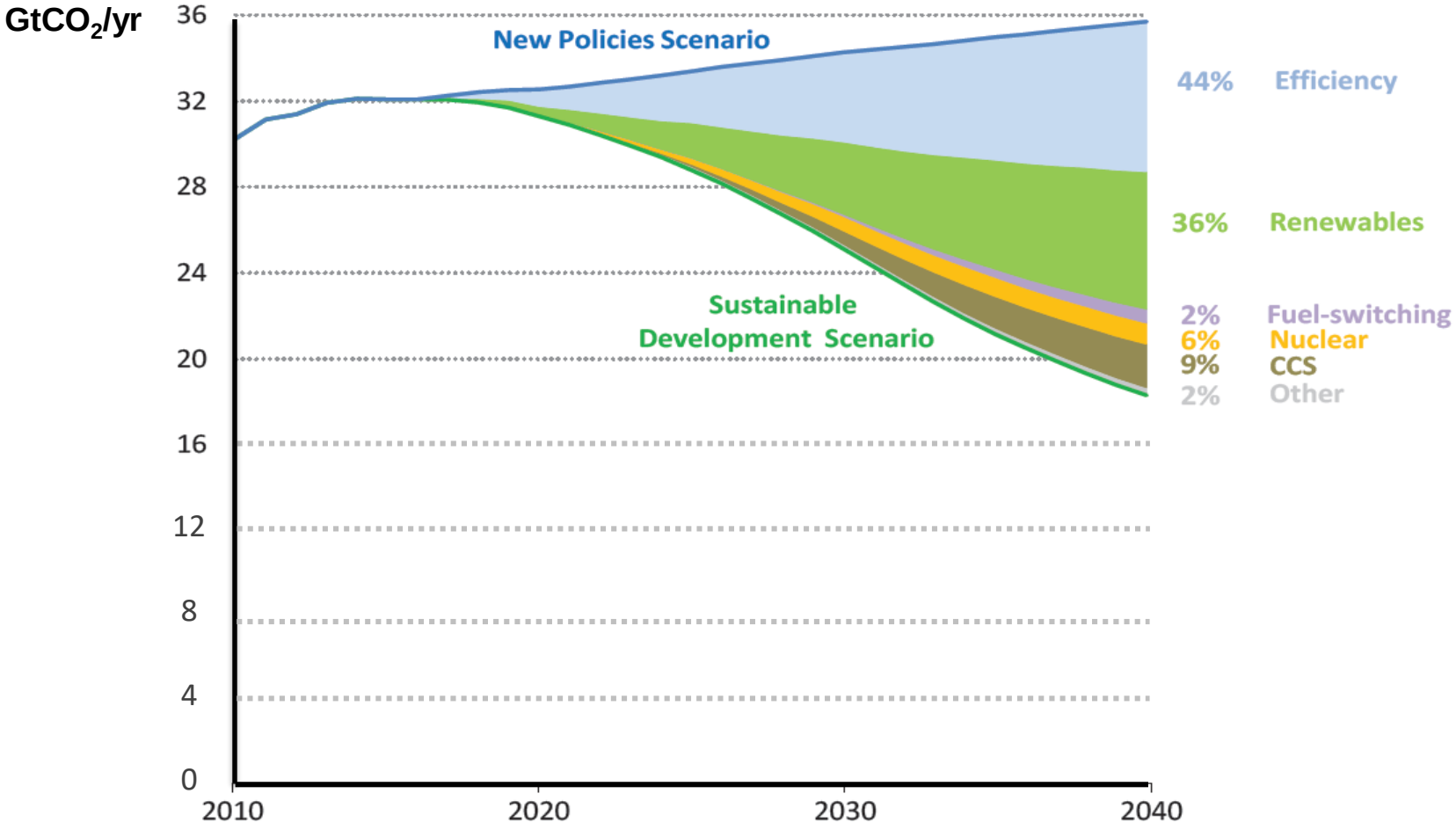
Fossil fuel import prices

	New Policies		Sustainable Development	
Real terms ($2016)	2025	2040	2025	2040
IEA crude oil ($/barrel)	83	111	72	64
Natural gas ($/MBtu)				
United States	3.7	5.6	3.4	3.9
European Union	7.9	9.6	7.0	7.9
China	9.4	10.2	8.2	8.5
Japan	10.3	10.6	8.6	9.0
Steam coal ($/tonne)				
United States	61	62	56	55
European Union	77	82	67	64
Japan	82	87	71	68
Coastal China	87	91	78	77

CCS has a much smaller role than renewables, but this is still a very significant increase from essentially zero CCS now, to CCS on 10% of total fossil fuel use in 20 years

International Energy Agency (2017), World Energy Outlook 2017, OECD/IEA, Paris

- 2040 storage of > 1 $GtCO_2$/yr would need perhaps 100 large sources or clusters each taking 5-10 years to develop, even in China
- Larger amounts of CCS by 2040 have also been considered in previous IEA studies+



* http://www.globalccsinstitute.com/news/institute-updates/paris-climate-change-targets-cannot-be-met-without-ccs-cop23

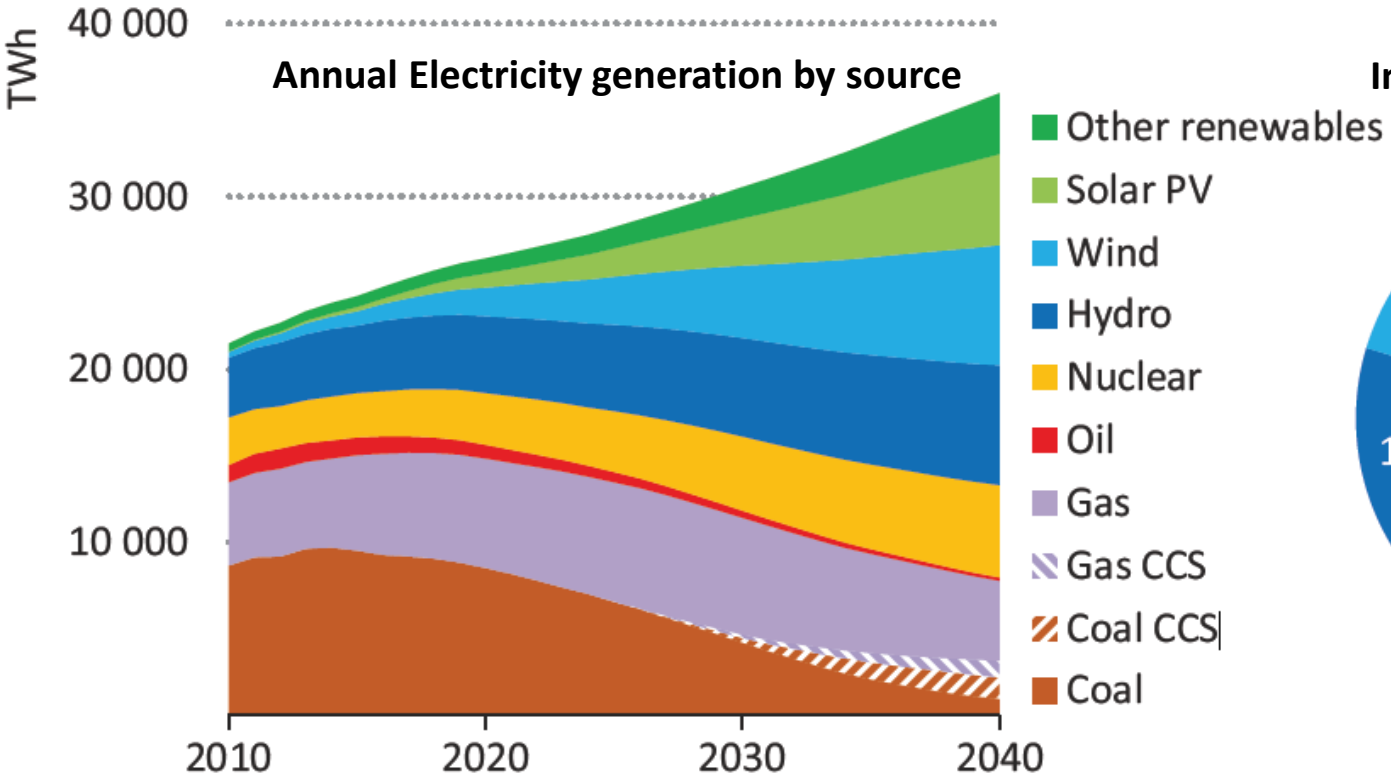
+ https://www.iea.org/publications/freepublications/publication/20-years-of-carbon-capture-and-storage.html

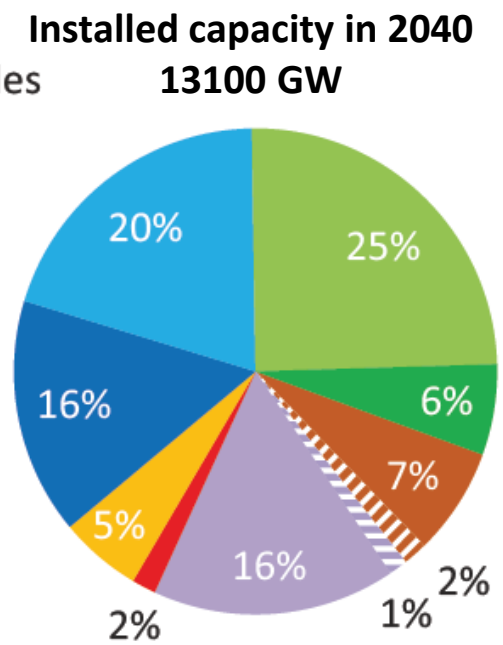
By 2040 in the Sustainable Development Scenario CCS is 'only' 6% of global electricity generation, with renewables over 60% and nuclear 15%, but this is a major increase

International Energy Agency (2017), World Energy Outlook 2017, OECD/IEA, Paris

2040 power CCS capacity is 375GW vs 360MW now* (plus capture from industry)

- 210 GW of coal power capacity with CCS
- 150 GW of this is in China (~15% of current Chinese power plant capacity)[+]
- 165 GW of gas power capacity with CCS worldwide
- Most of the coal CCS likely to be post-combustion and retrofits to existing plants





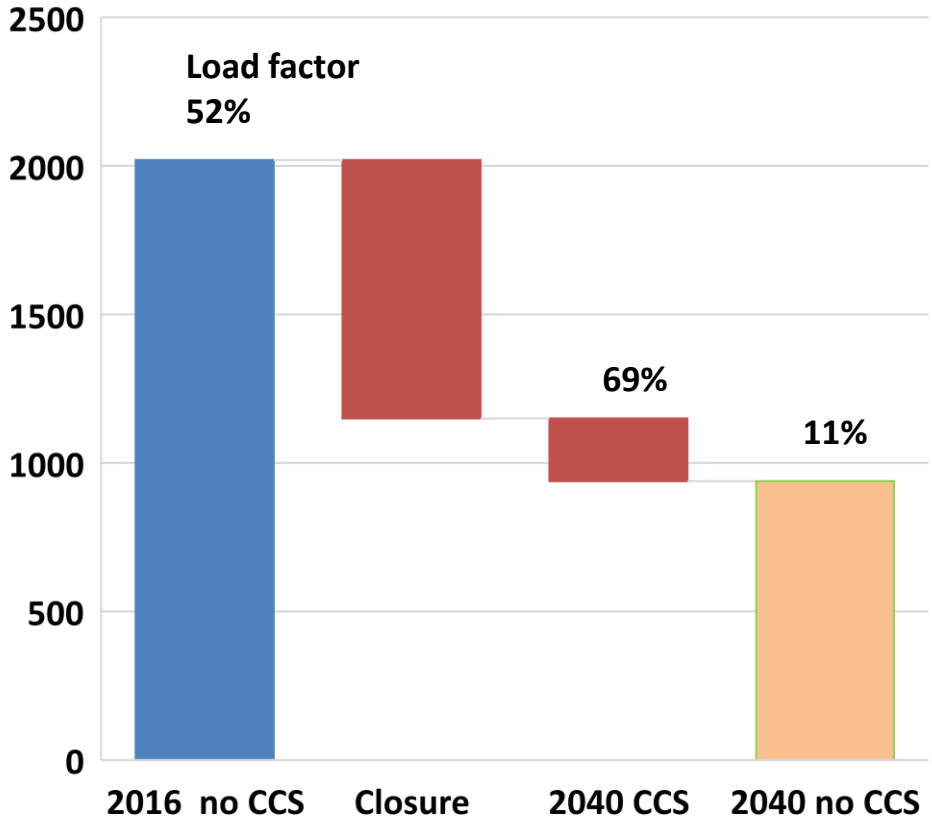
* Boundary Dam 3 120MW, Petra Nova 240MW

[+] https://www.iea.org/publications/insights/insightpublications/ThePotentialforEquippingChinasExistingCoalFleetwithCarbonCaptureandStorage.pdf

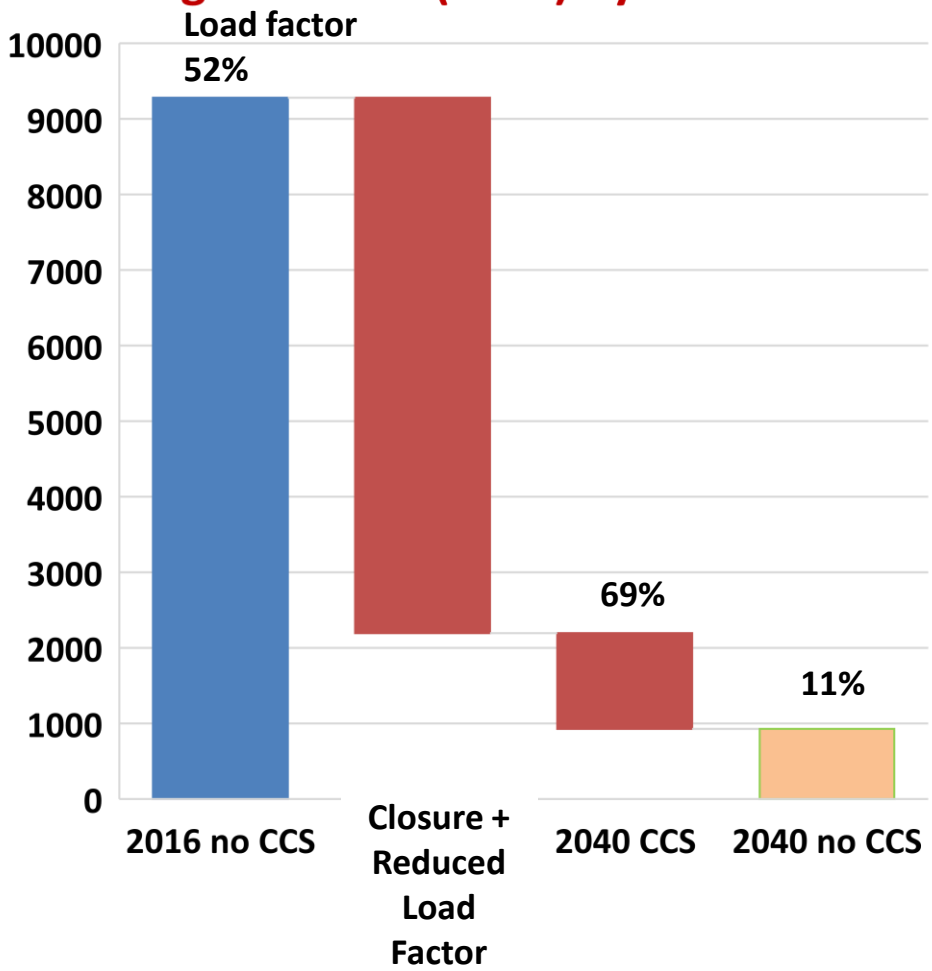
Global coal capacity without CCS in 2040 is still equivalent to nearly half of current capacity – but unabated coal power plants without CCS are run at very low load factors

International Energy Agency (2017), World Energy Outlook 2017, OECD/IEA, Paris

Net reduction in unabated coal plant capacity (GW) by 2040



Net reduction in 2016 unabated coal generation (TWh) by 2040

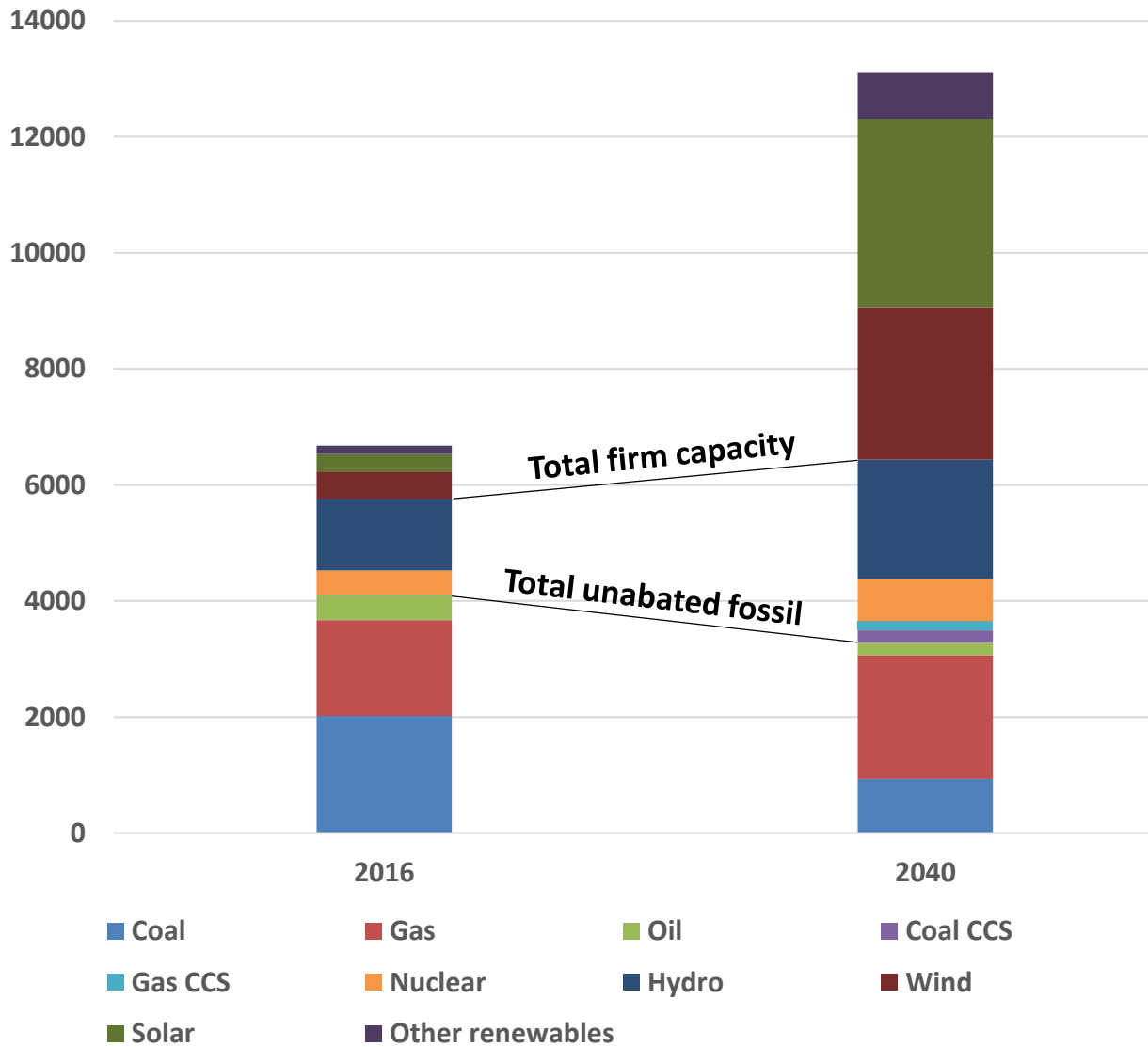


Global electricity generation capacity trends from 2016 to 2040 in the SDS

International Energy Agency (2017), World Energy Outlook 2017, OECD/IEA, Paris

While total electricity generation (TWh) increases by 42%:

- Total fossil+nuclear+hydro capacity increases by 12%
- Total unabated fossil capacity decreases by 20%
- 37% of the decrease in unabated coal and oil capacity is replaced by unabated natural gas capacity
- 29% of the decrease in unabated coal and oil capacity is replaced by CCS capacity using coal or natural gas
- Total wind+solar capacity increases by 670%



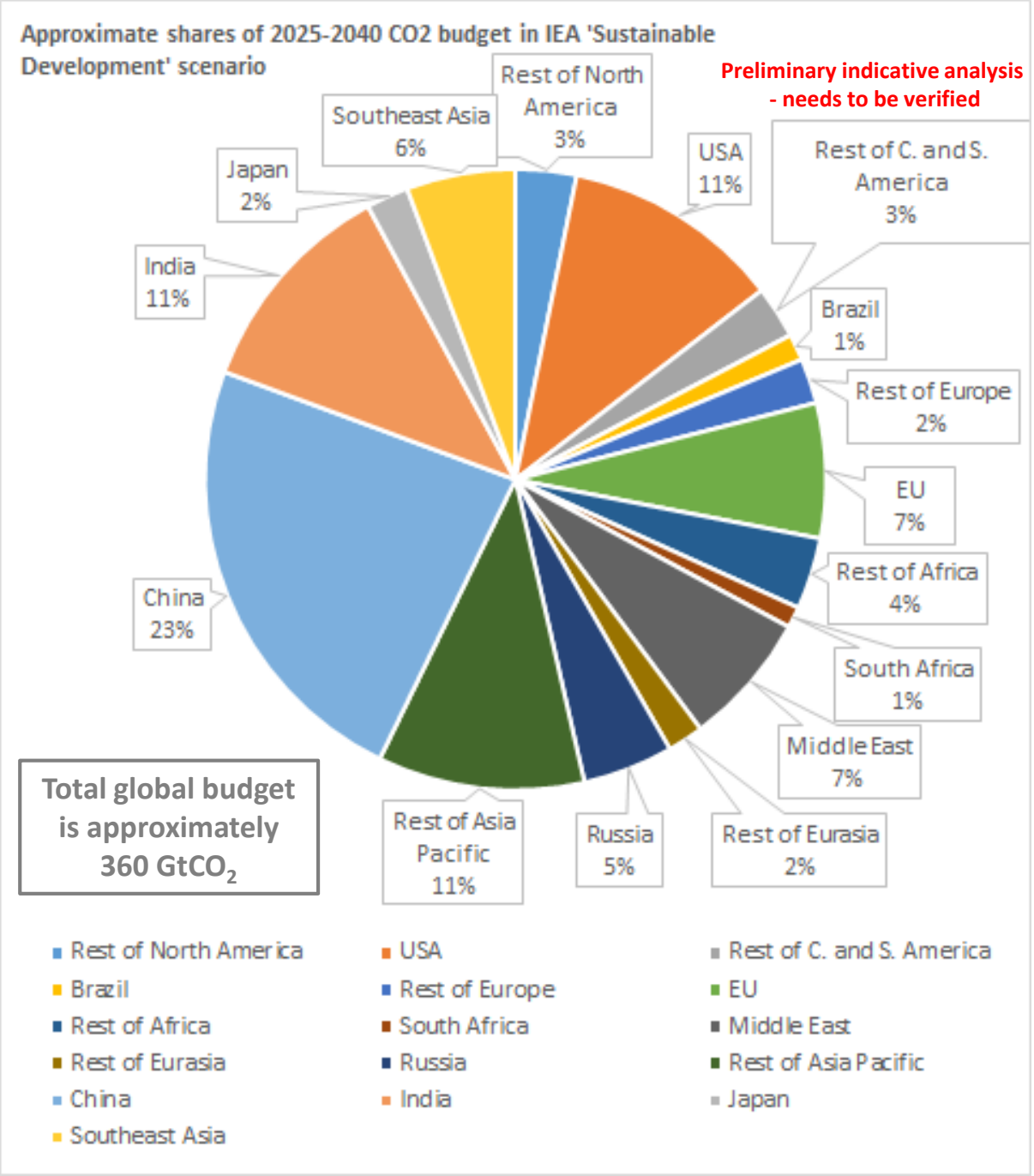
Annual emissions relative to 2025 by country/region in the IEA WEO 2017 Sustainable Development Scenario

- The highlighted countries with major reductions are likely CCS markets

Country/Region	2025	2030	2040
Rest of North America	100%	92%	74%
USA	100%	78%	46%
Rest of C. and S. America	100%	93%	79%
Brazil	100%	88%	73%
Rest of Europe	100%	86%	69%
EU	100%	80%	50%
Rest of Africa	100%	106%	115%
South Africa	100%	82%	48%
Middle East	100%	98%	82%
Rest of Eurasia	100%	99%	91%
Russia	100%	89%	72%
Rest of Asia Pacific	100%	92%	77%
China	100%	81%	42%
India	100%	103%	96%
Japan	100%	74%	44%
Southeast Asia	100%	94%	81%

Fixed carbon budgets and CCS

- China gets the largest fraction of the 2025-2040 CO_2 global emissions budget in the SDS, but this is still much less than current rates of emission.
- CCS on power plants and industry sources can help China to save as much as possible of its CO_2 emission budget for applications such as air transport that are more difficult to decarbonise.
- And if even more of the budget can be saved to use after 2040 it will have a higher value…
- … when there is a much smaller amount of CO_2 that can be emitted before net zero must be achieved.



Coal power and CCS trends in the Sustainable Development Scenario

This is only a scenario

- But the global CO_2 emission cuts and finite budget would have to be achieved somehow to limit the global temperature rise
- And China and Chinese coal are major components in global emissions

In this scenario there is a large market for post-combustion and CCS generally

- Building even the SDS amount of coal power CCS (210GW globally, 150GW in China) by 2040 starting from almost nothing would be a very significant increase
- Before 2040 there is excess coal capacity so most of this is expected to be post-combustion capture retrofits i.e. Capture Ready becomes important
- After 2040 there may be scope to retrofit further existing coal plants
- After 2040 more gas CCS or new coal with CCS, possibly via hydrogen, may be also be required, as well as biomass (retrofits?) with CCS for negative emissions
- China has a natural advantage in coal CCS with the biggest single market
- Building 150GW of CCS by 2040 in China is an average of over 7 GW per year starting in 2020, it equates to retrofitting 15% of the current fleet – but the fleet itself was mostly built in a couple of decades
- There may also be opportunities for gas+CCS and biomass+CCS, with similar post-combustion technology
- But CCS deployment at scale will need an early market to develop expertise and proven designs before rapid rollout