

2013

2015

2020

2025

2030

2035

2040

2045

2050



The Role of Fossil Fuels and CCS

Climate Change Mitigation: Making Progress in Challenging Times
MIT Workshop, Seville
4 May 2016
Samantha McCulloch
CCS Unit, IEA

Presentation Outline

1. Global energy outlook



2. The path to 2DS: A role for fossil fuels and CCS



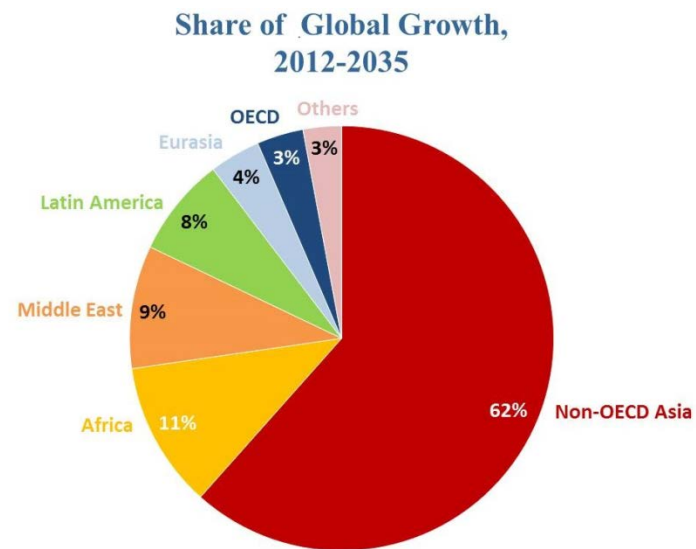
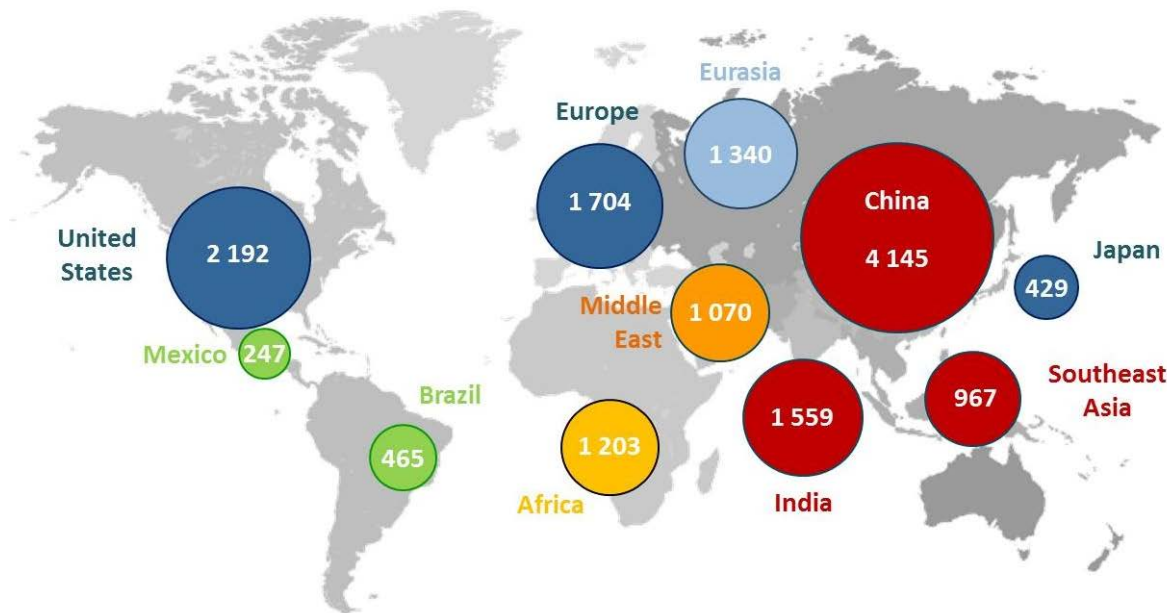
3. Paris Agreement: Implications for CCS



Geography of Global Energy Demand

Over 95% of the projected growth in energy demand between now and 2035 happens outside the OECD (NPS)

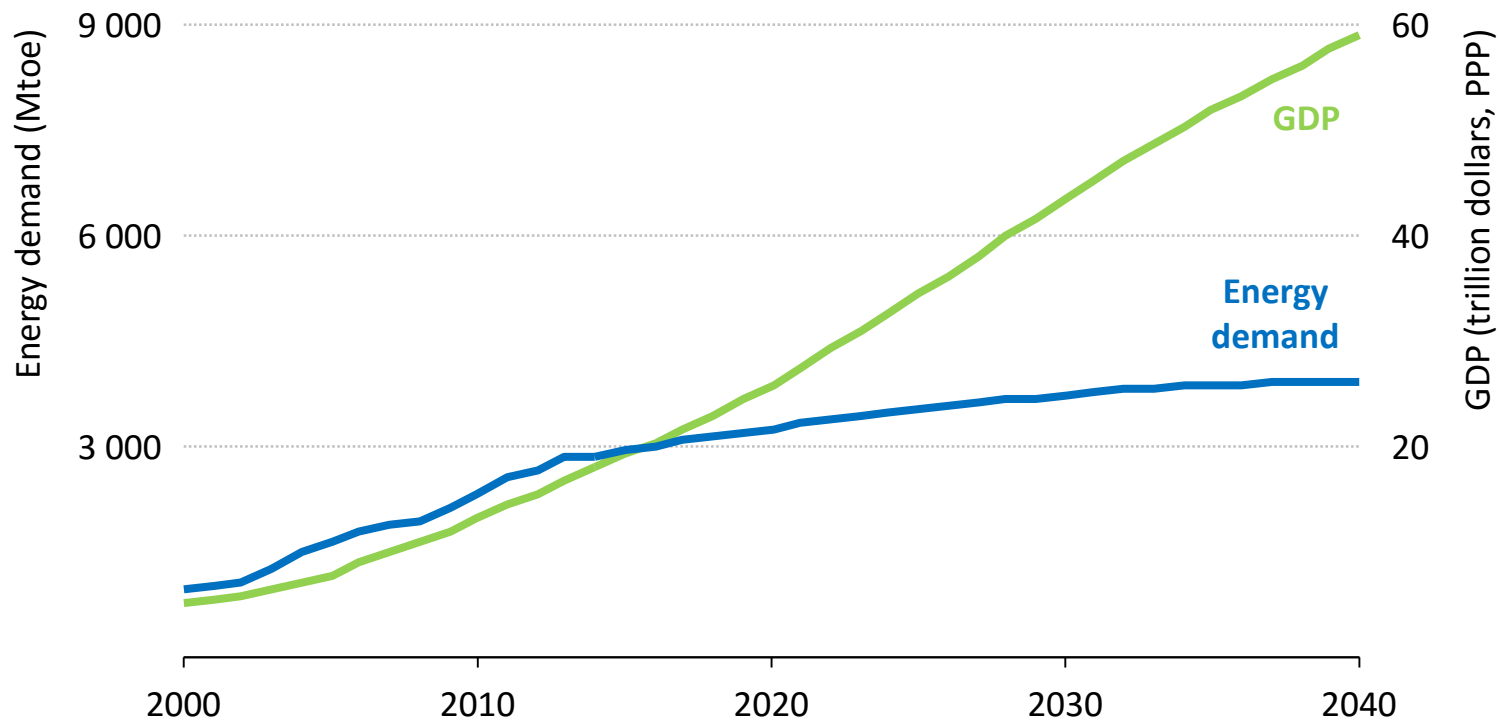
Primary Energy Demand, 2035 (Mtoe)



A new chapter in China's growth story



Energy demand in China

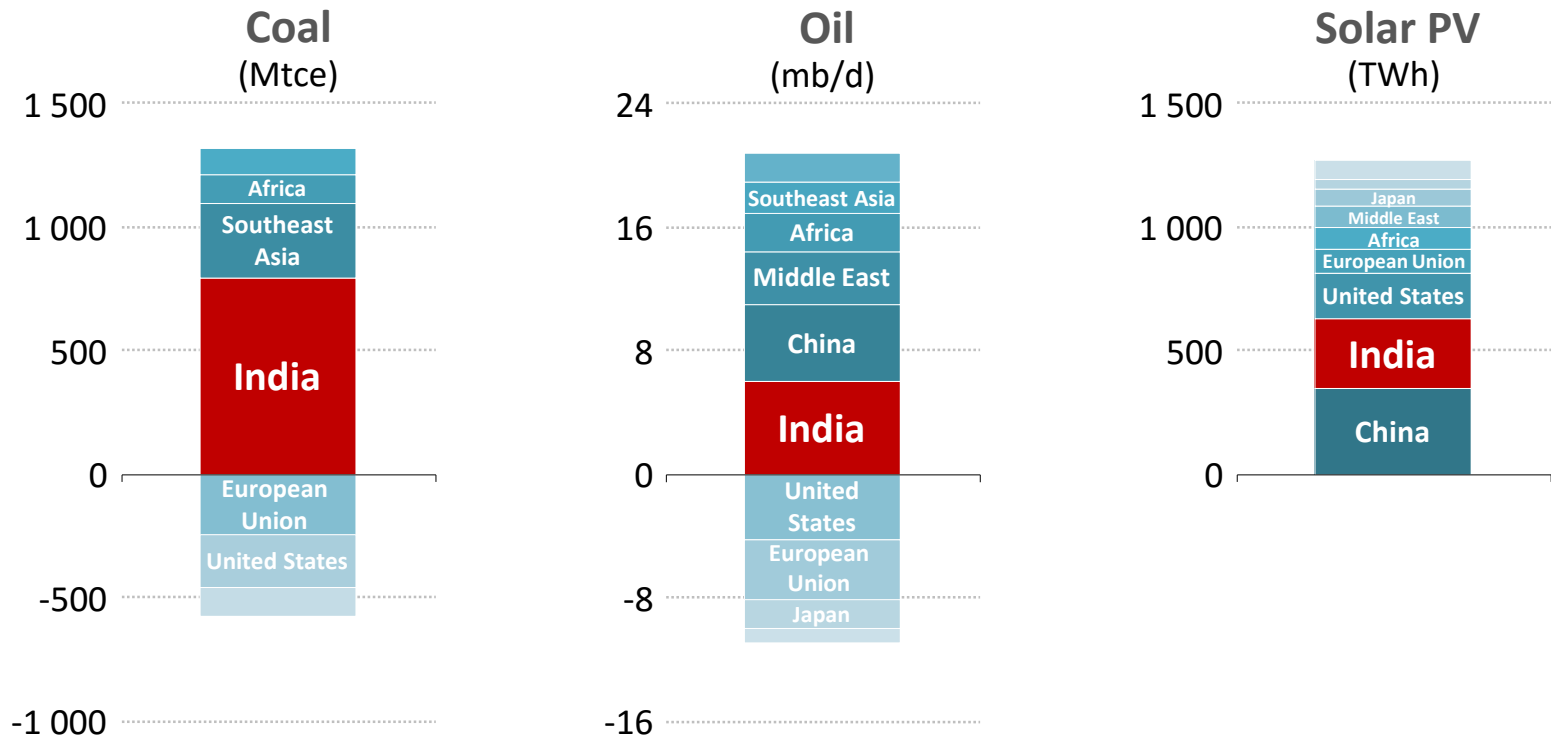


Along with energy efficiency, structural shifts in China's economy favouring expansion of services, mean less energy is required to generate economic growth

India moving to the centre of the world energy stage



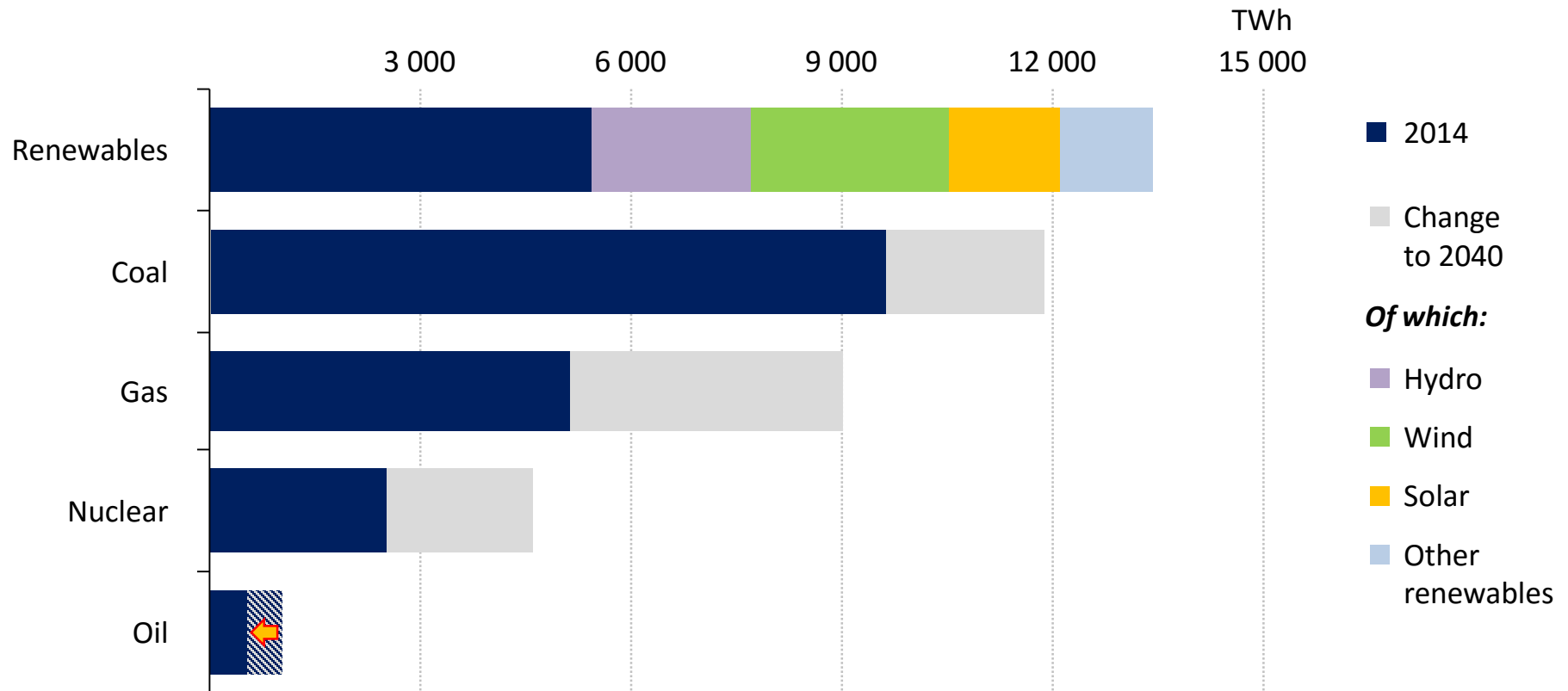
Change in demand for selected fuels, 2014-2040



New infrastructure, an expanding middle class & 600 million new electricity consumers mean a large rise in the energy required to fuel India's development

Power is leading the transformation of the energy system

Global electricity generation by source



Driven by continued policy support, renewables account for half of additional global generation, overtaking coal around 2030 to become the largest power source

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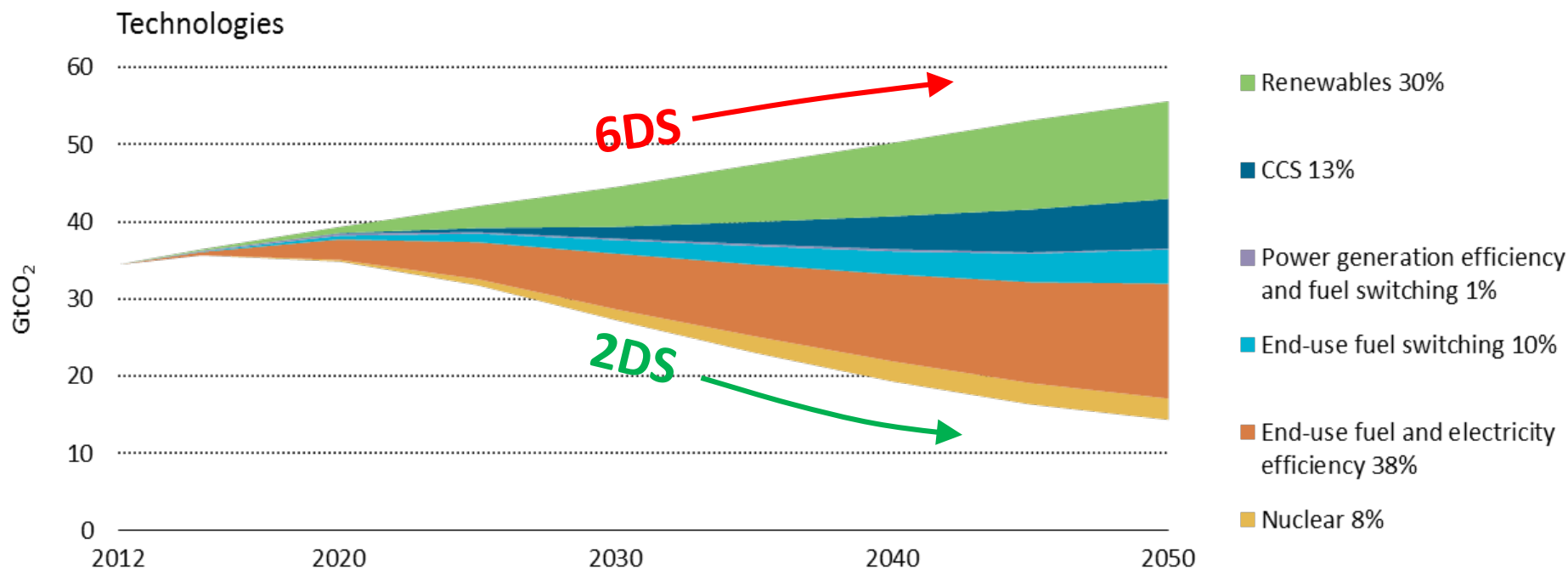
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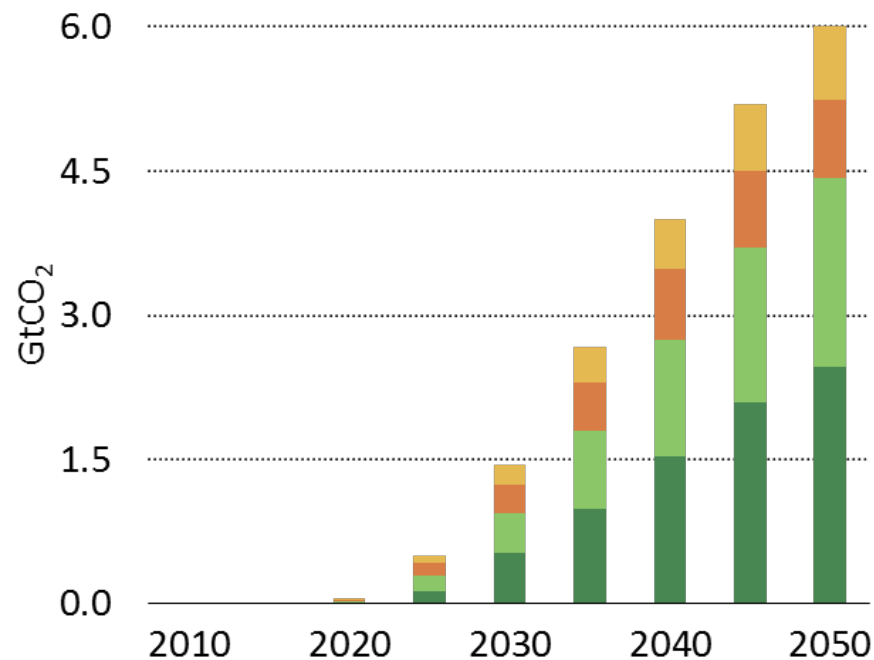
All technologies will be needed in a 2 degree world



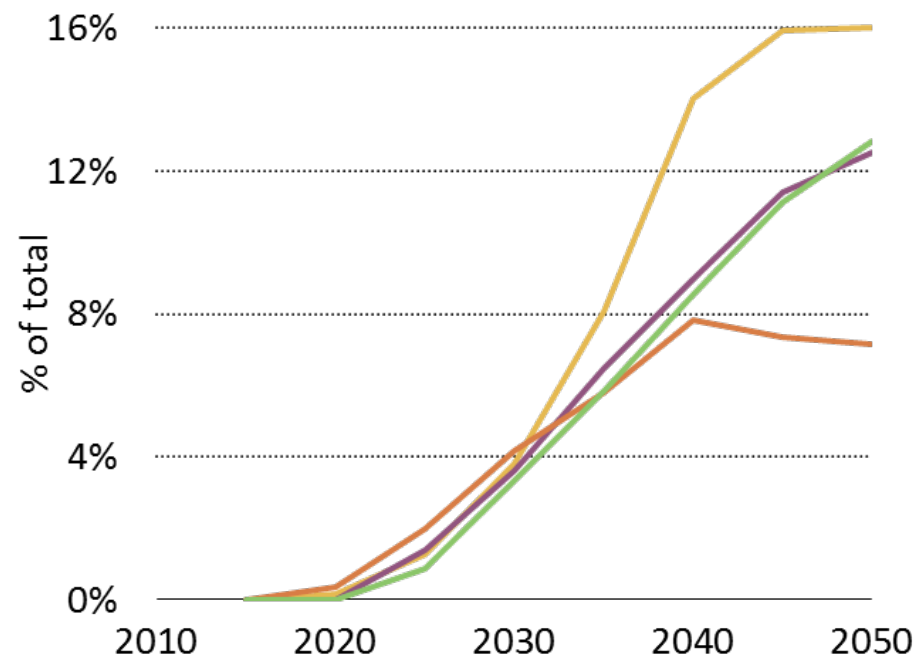
Percentages represent cumulative contributions to emissions reduction relative to 6DS

CCS in the 2DS

CO₂ captured and stored



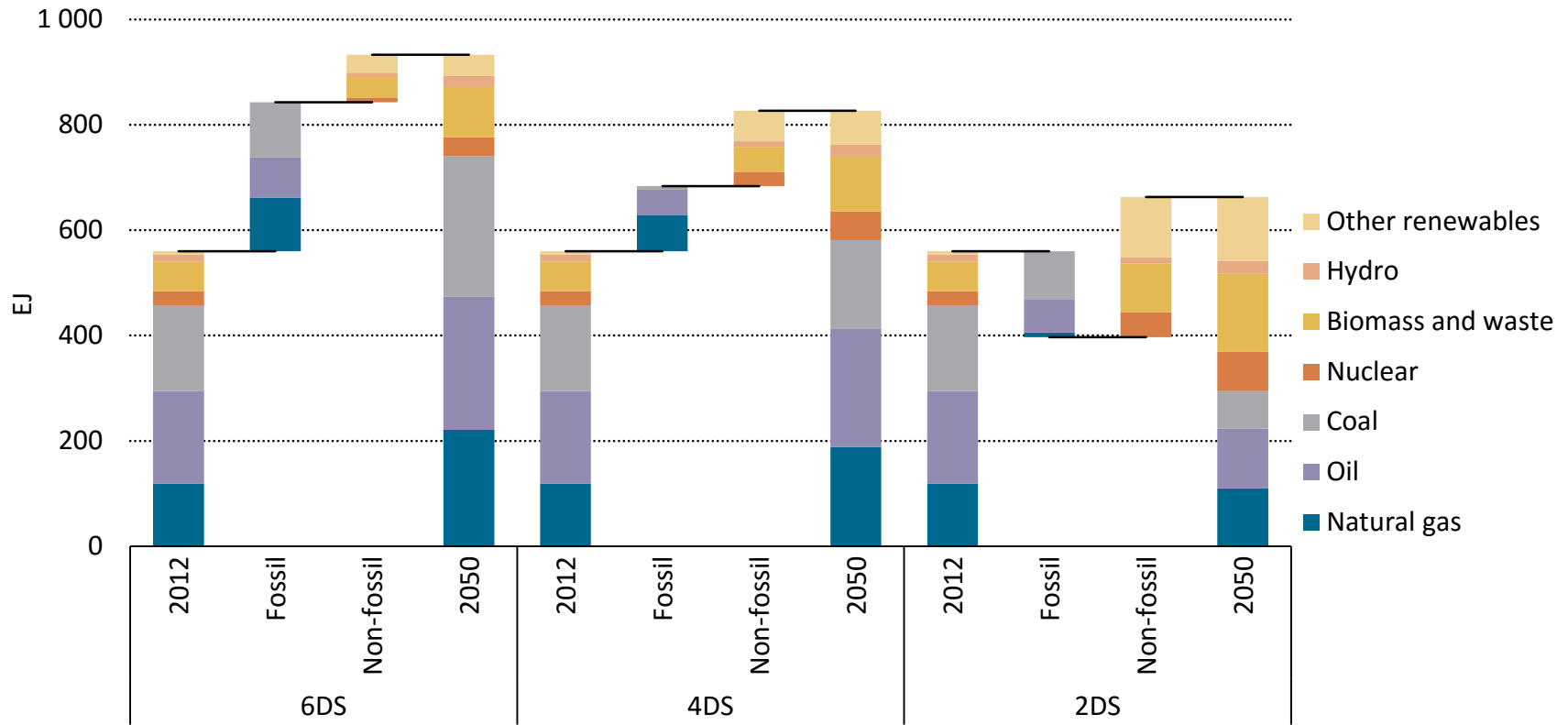
Electricity generation from CCS-equipped plants



Non-OECD Electricity sector Industrial applications OECD Americas OECD Asia Pacific
 OECD Electricity sector Industrial applications OECD Europe Non-OECD

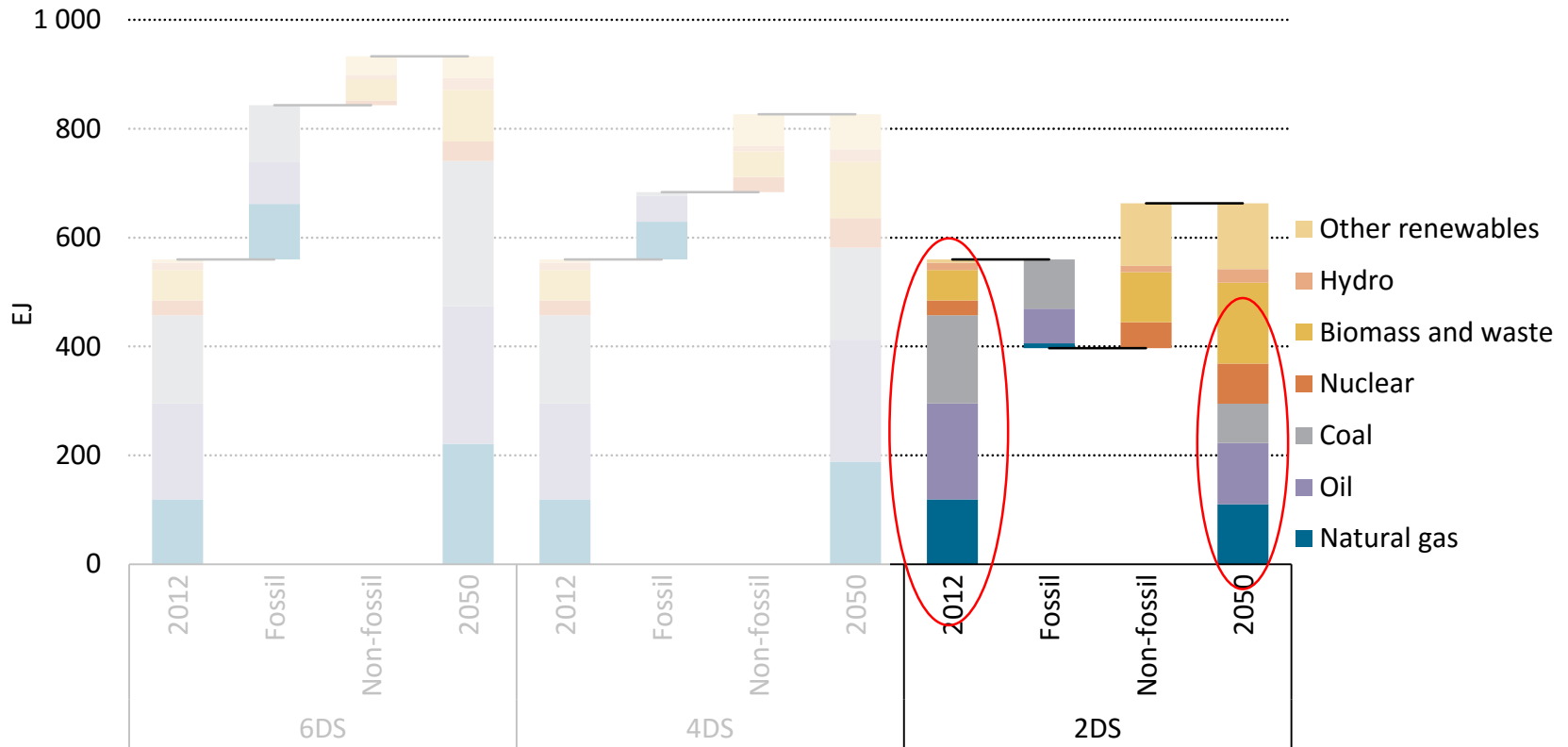
CCS is important in both electricity and industry.
Over ⅓ of CO₂ captured is in non-OECD countries.

Fossil fuels remain an important part of the energy mix...



...fossil fuels use is reduced but still has a **44% share in 2050** and are an important part of global energy supply in the 2DS

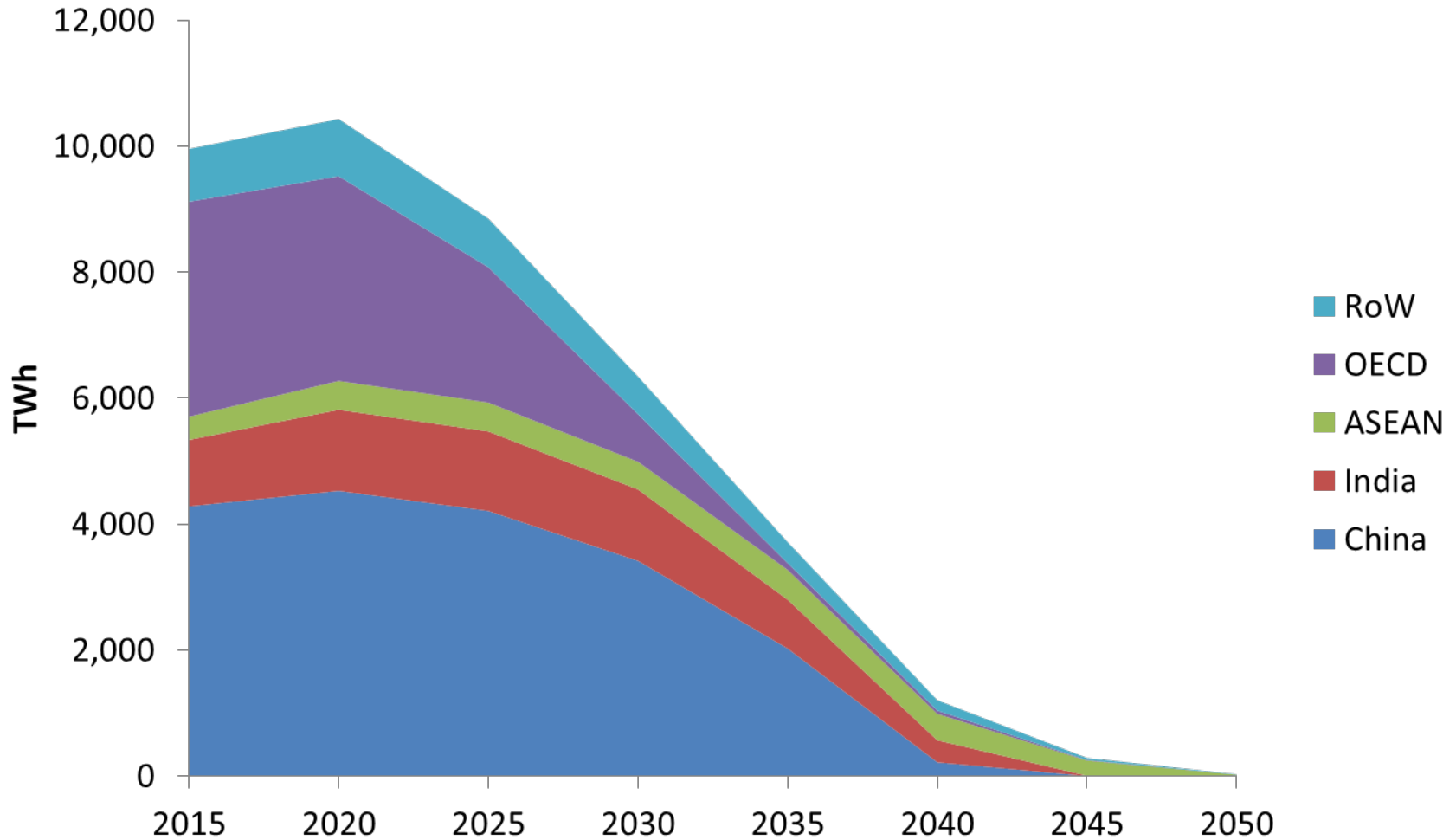
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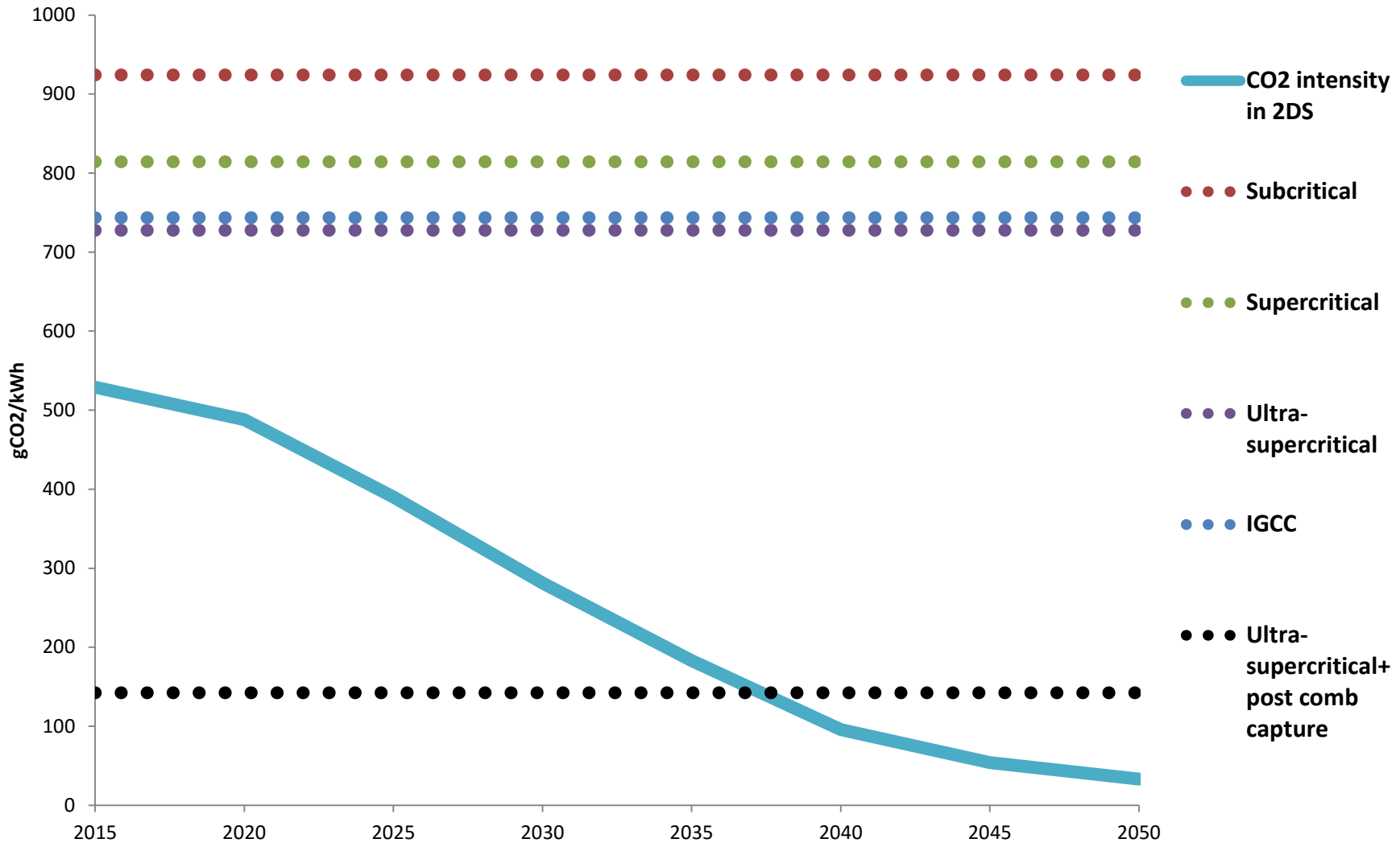
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But it is not business as usual...

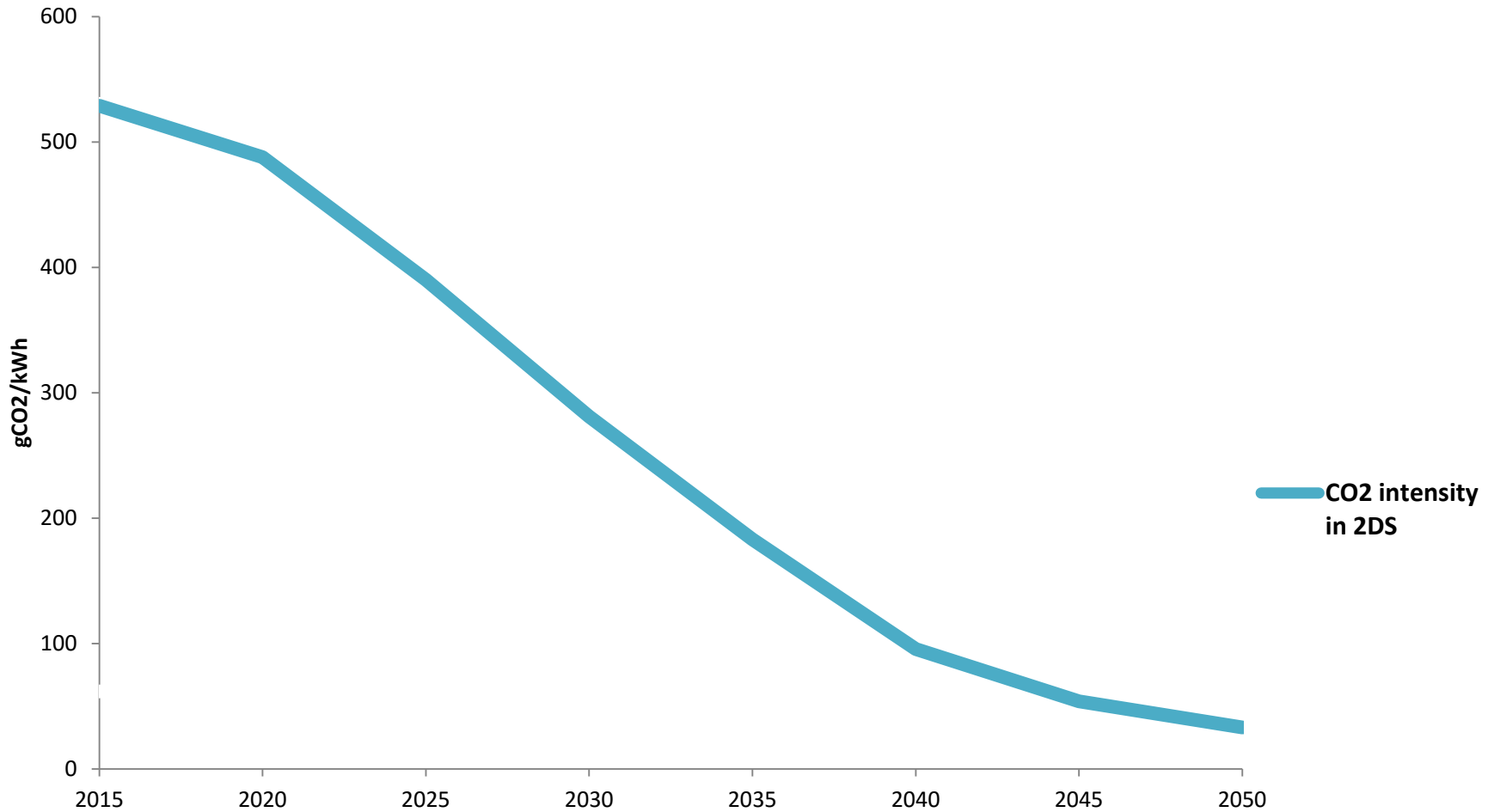
'Unabated' Global Coal Power Generation – 2DS



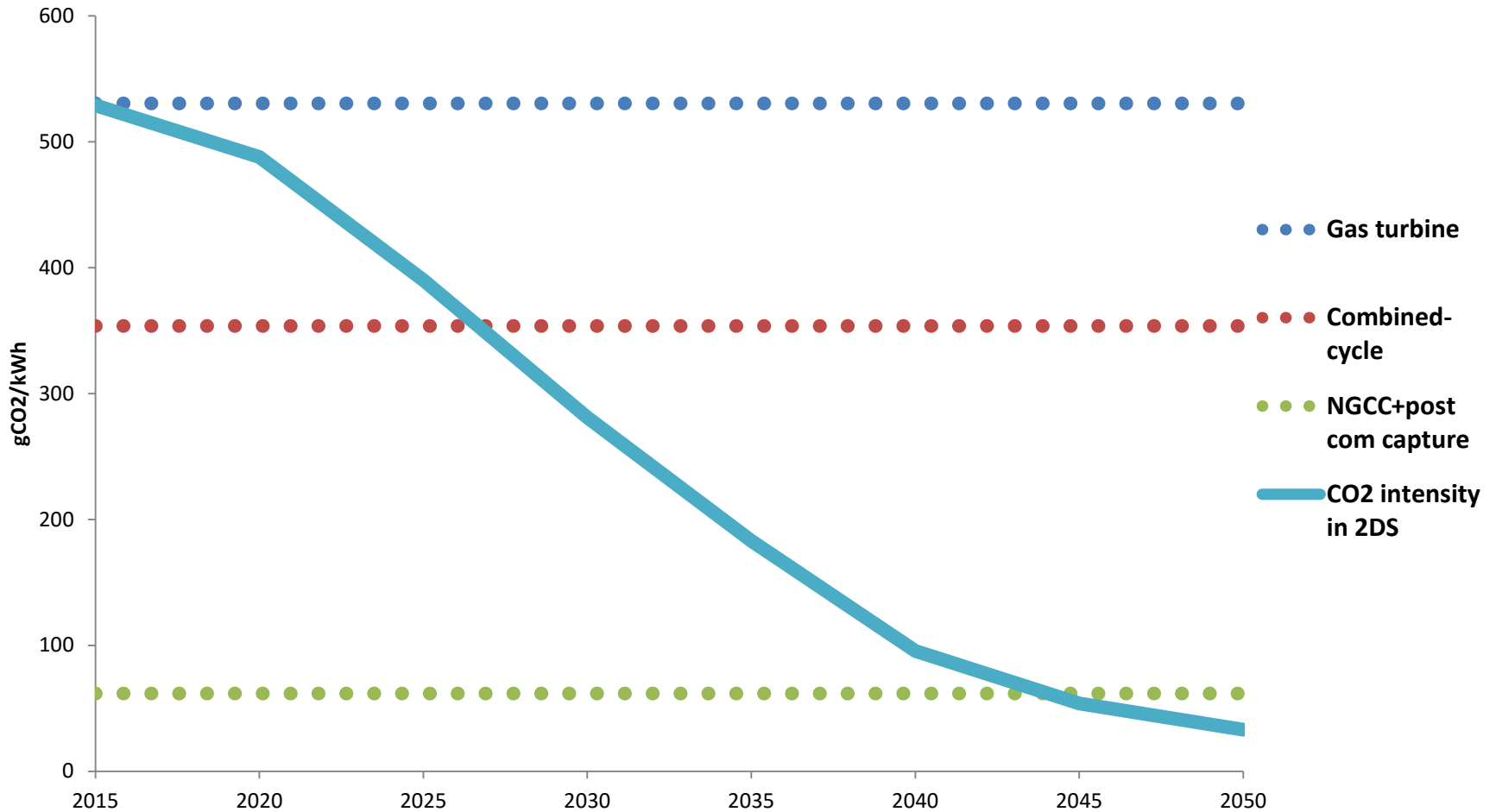
Coal: 'High efficient-low emissions'?



Gas: a transition or a destination?

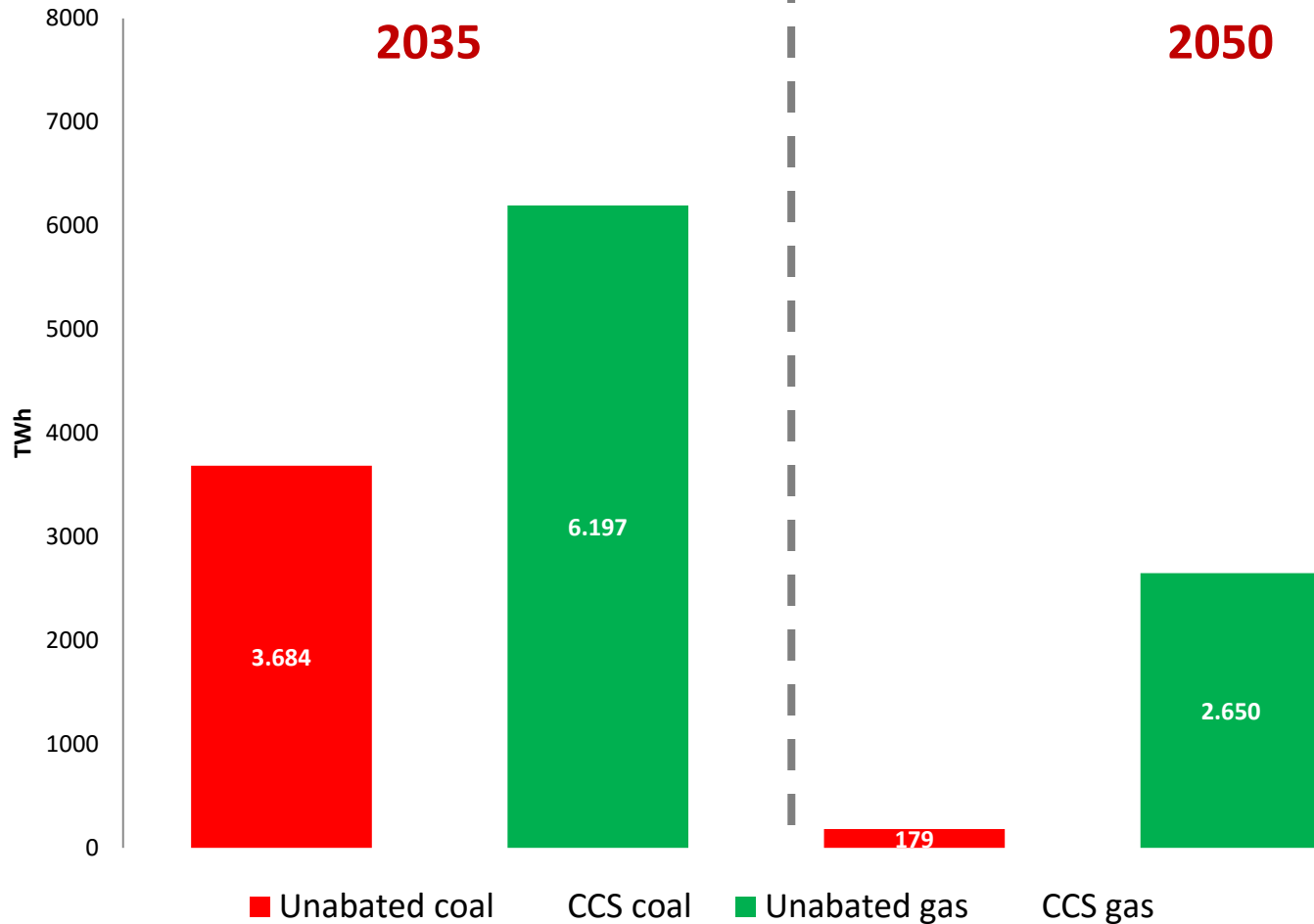


Gas: a transition or a destination?



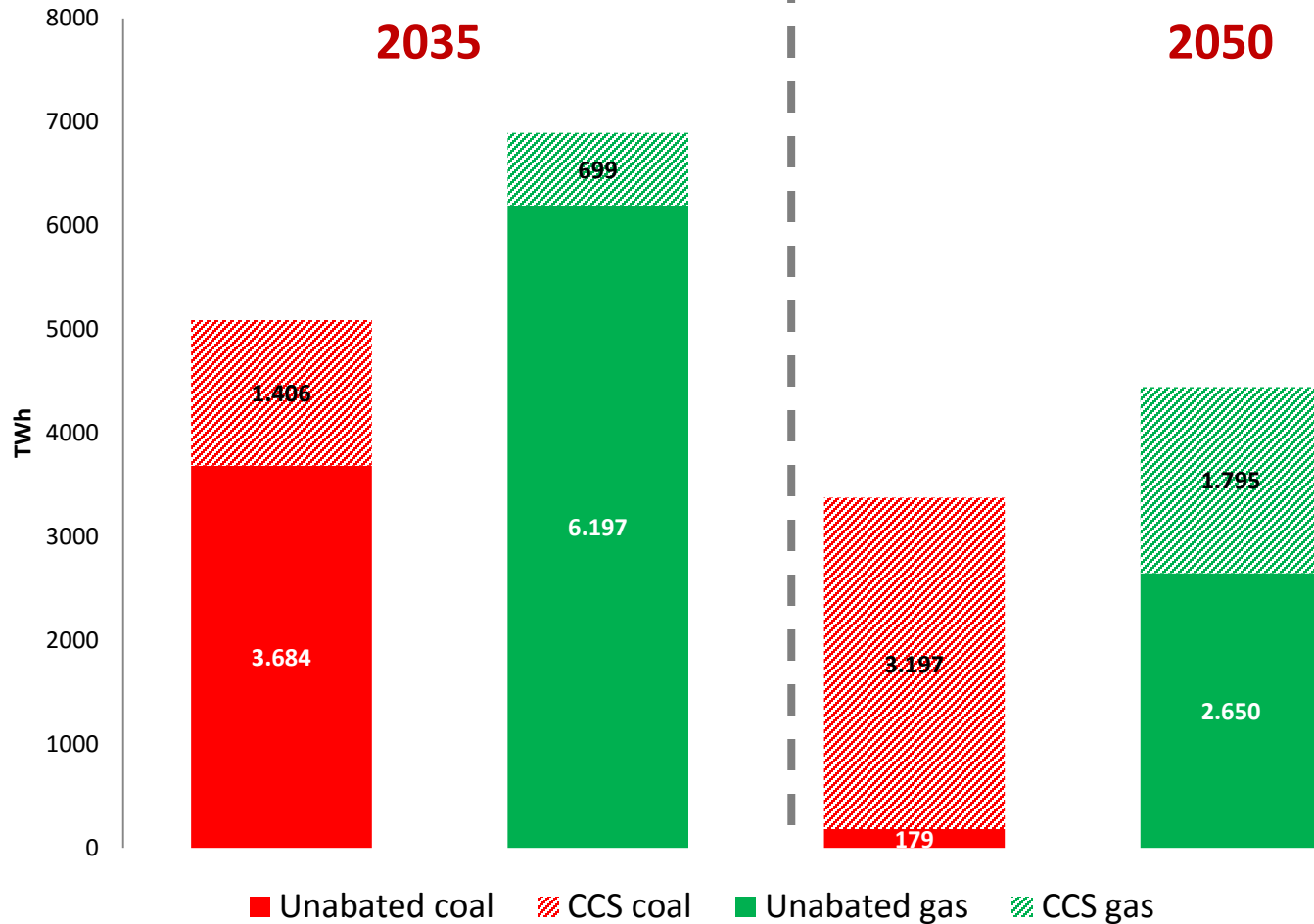
CCS underpins a future role for fossil fuels

Fossil-fuel power with CCS (2DS)

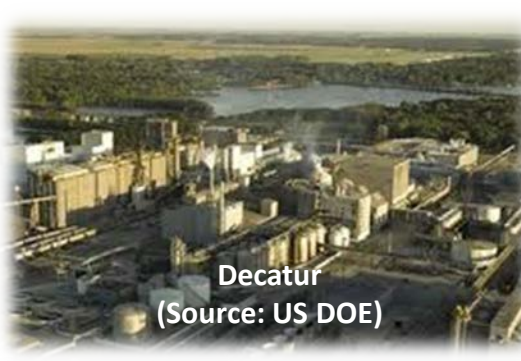


CCS underpins a future role for fossil fuels

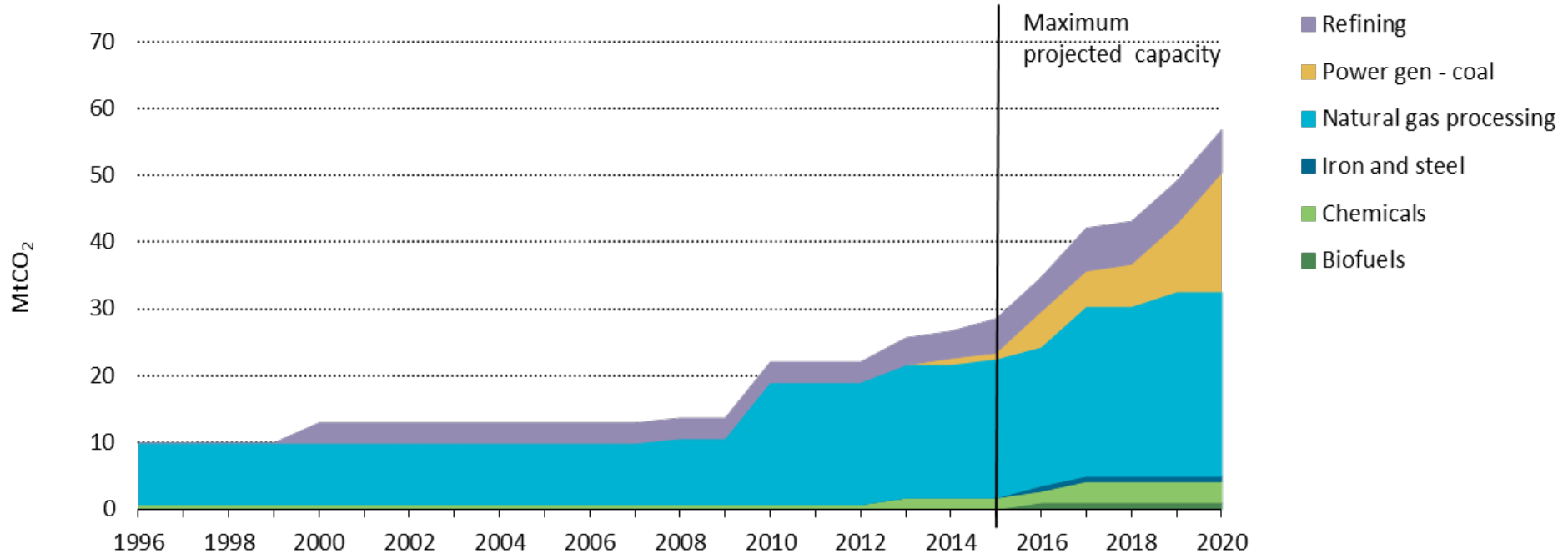
Fossil-fuel power with CCS (2DS)



CCS is up and running...

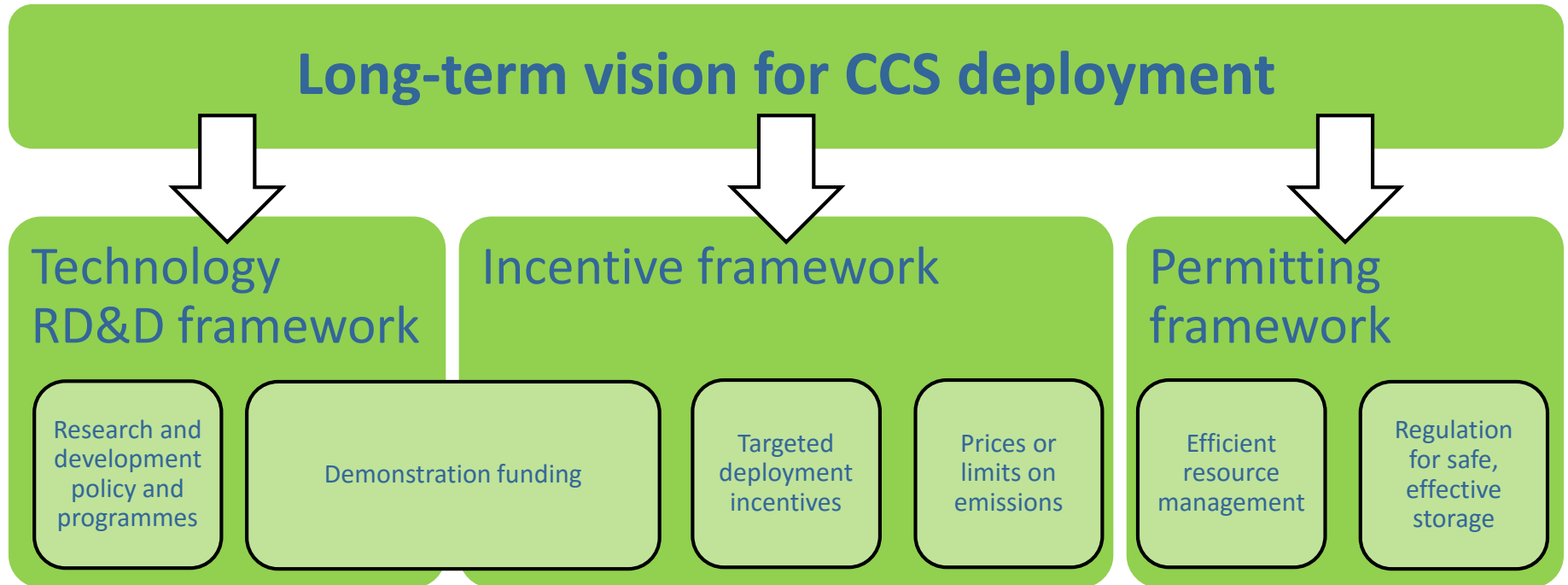


...but deployment must be accelerated



*The maximum capture capacity from all projects in the pipeline is **65 MtCO₂** a year – the 2DS calls for **500 MtCO₂** a year to be stored by 2025.*

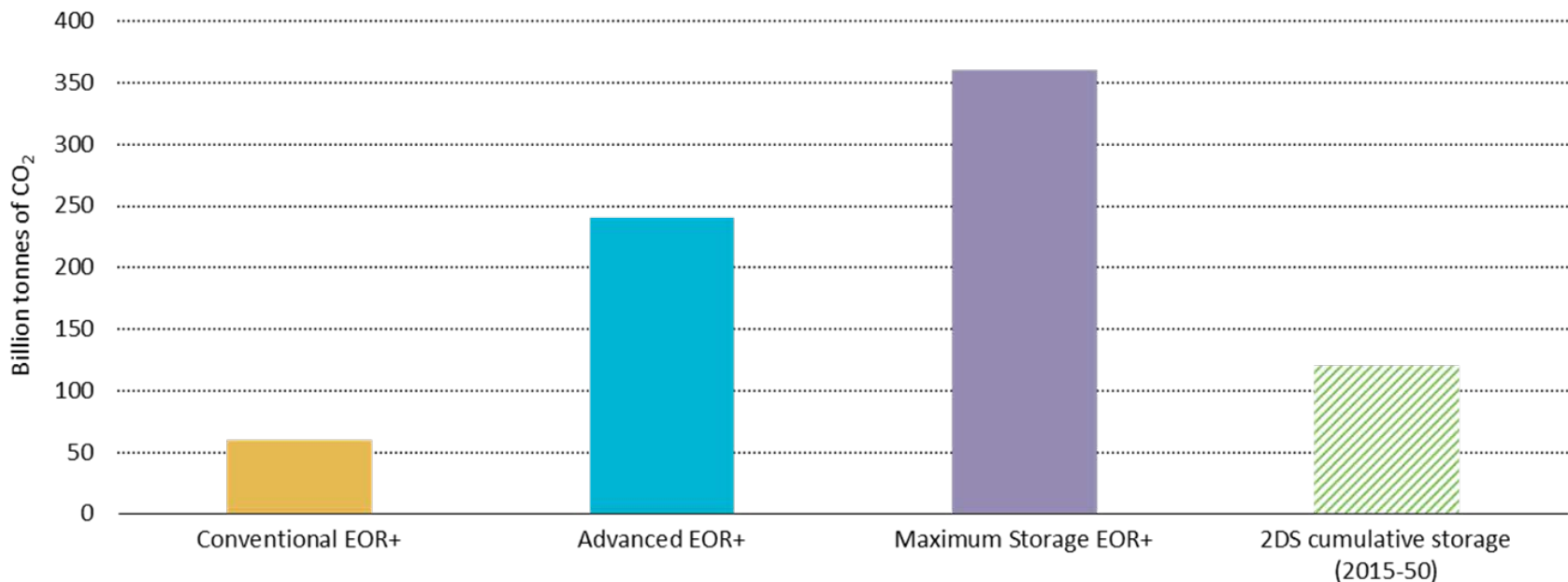
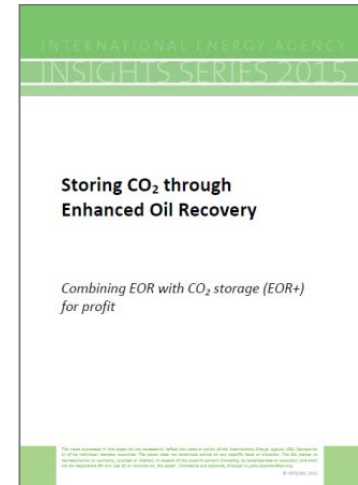
A supportive policy framework is essential...



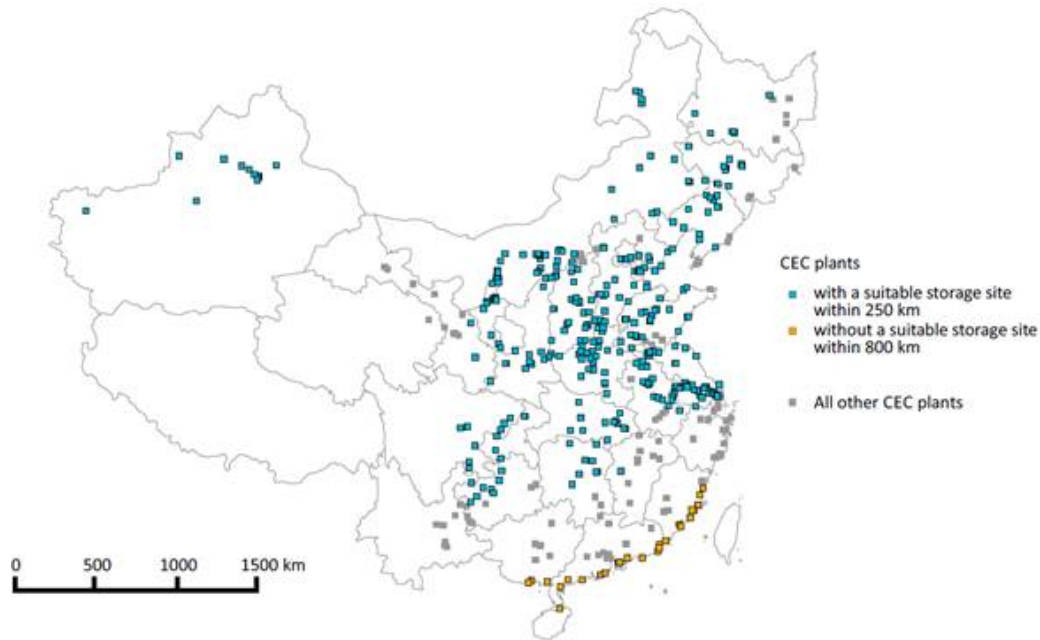
...but currently lacking in most jurisdictions

The potential of “EOR+”

- **Enormous potential for CO₂ storage through EOR**
 - Up to 3x the requirements of the IEA 2 degree scenario
- **Additional activities to transform EOR to permanent storage:**
 1. Additional site characterisation and risk assessment
 2. Additional measurement of venting and fugitive emissions
 3. Monitoring and enhanced field surveillance
 4. Changes to abandonment processes



The potential for China: retrofitting coal



- In 2020, China will have 330GW of coal-fired plant that is
 - larger than 600MW
 - younger than 15 years
 - within 250km of potential storage
- Strategy requires the development of significant storage resource in China

*Launch of IEA China Retrofit Report:
18 May, Beijing*

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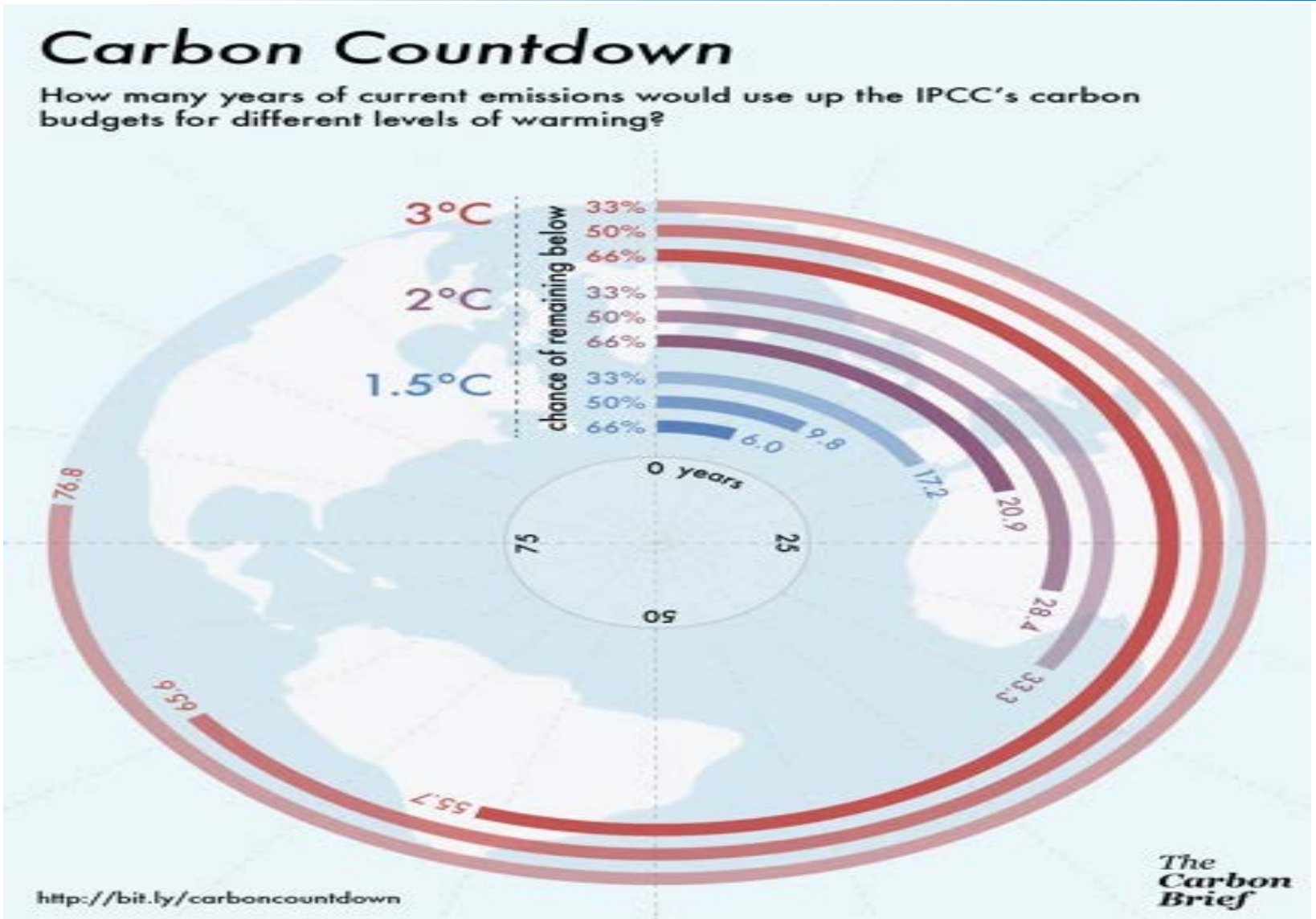
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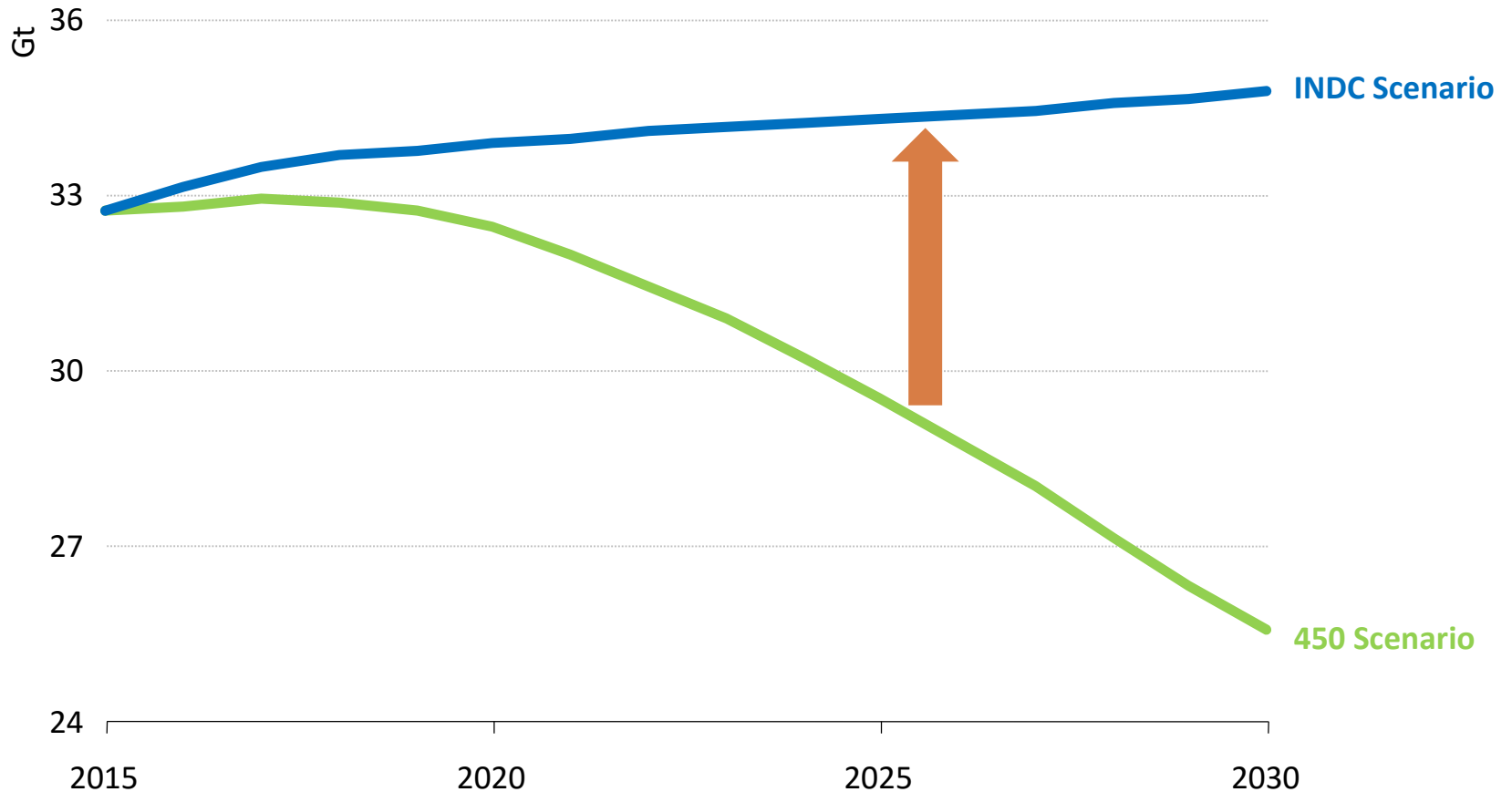
2015 Paris Agreement

- “Holding the increase in the global average temperature to **well below 2°C** above pre-industrial levels and to pursue efforts to limit the temperature increase **to 1.5°C** above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change;”
- “... Parties aim to reach global peaking of greenhouse gas emissions as soon as possible, recognizing that peaking will take longer for developing country Parties, and to undertake rapid reductions ... so as to achieve **a balance between anthropogenic emissions by sources and removals by sinks ... in the second half of this century ...**”

Not just ¼ more effort



(I)NDCs only take us part of the way...



(I)NDC above 2DS

Paris Agreement: implications for CCS

Many models could not achieve atmospheric concentration levels of about 450 ppm CO₂eq by 2100...under limited availability of key technologies, such as bioenergy, CCS, and their combination (IPCC, 2014)

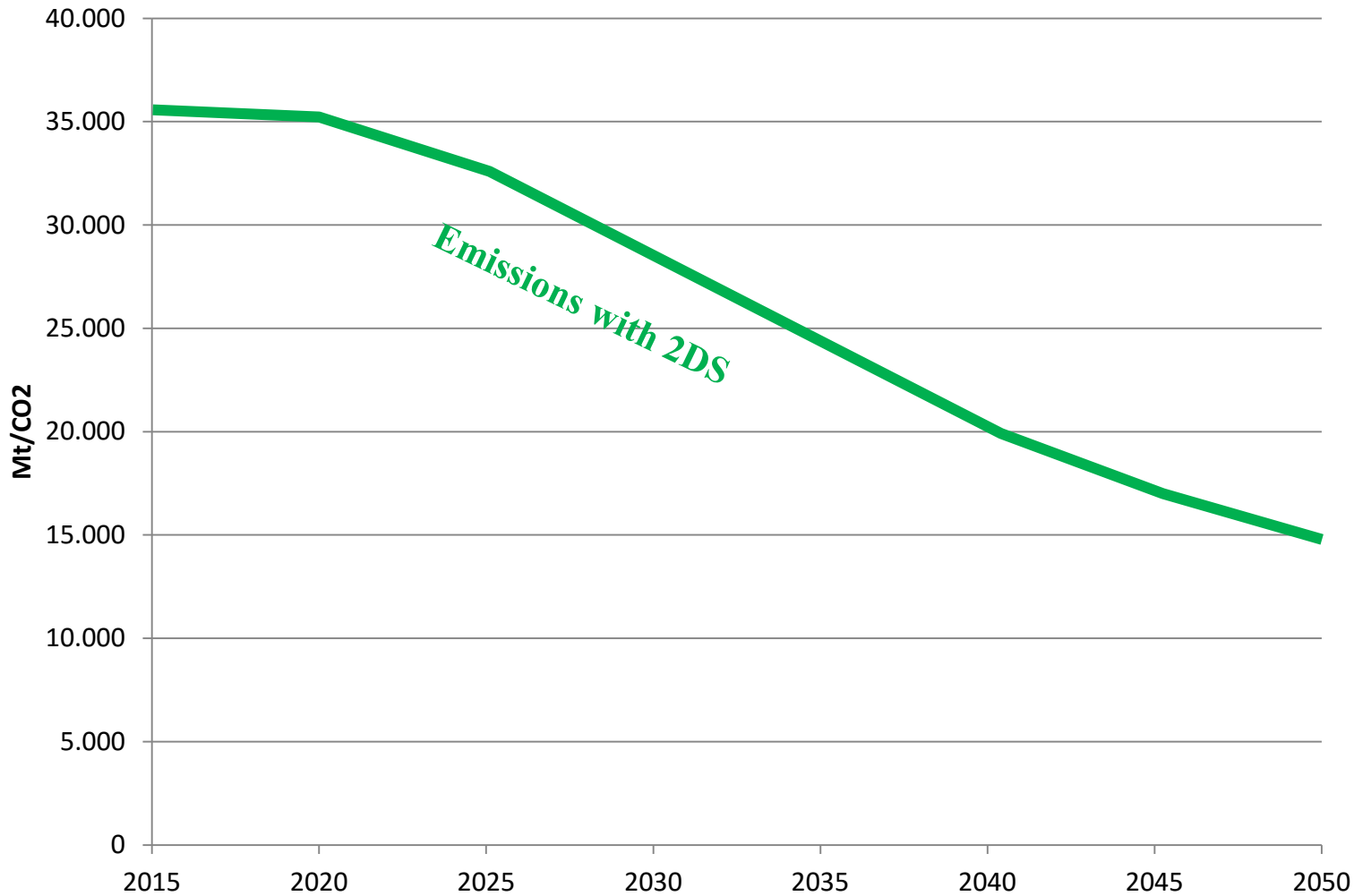
Getting to 'well below 2°C' and onwards to 1.5°C:

- Greater, faster deployment of CCS
- Greater emphasis on CCS in industry (where alternative solutions do not yet exist in many sectors)
- Negative emissions, sinks, and bio-CCS (BECCS)

...but are recent and current government policies compatible with this?

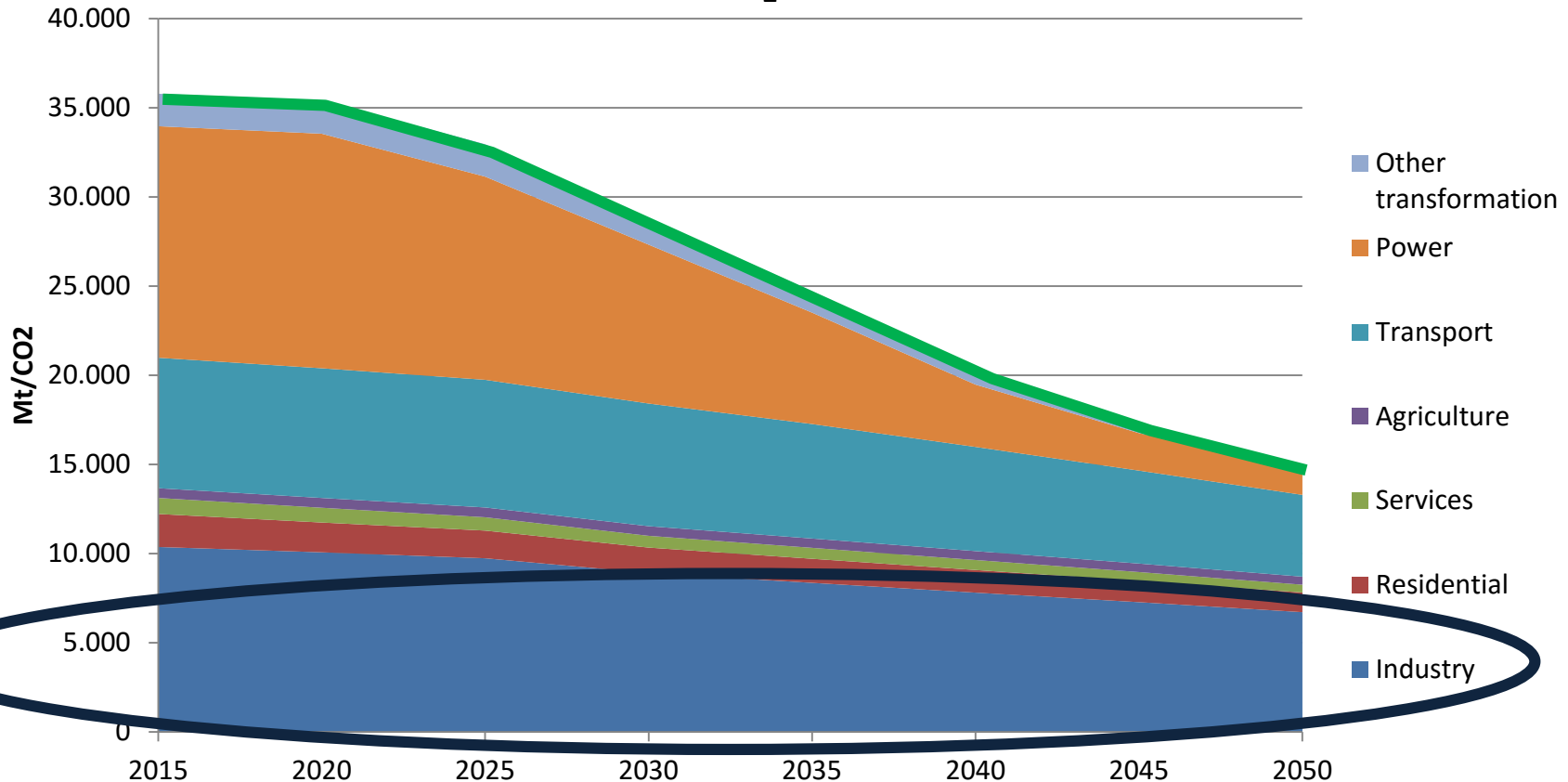
From 2 . . . to 'well below 2': Role for CCS on residual emissions

Remaining direct CO₂ emissions under 2DS



From 2 . . . to 'well below 2': Role for CCS on residual emissions

Remaining direct CO₂ emissions under 2DS



Despite 3Gt CO₂ captured and stored, 7Gt of CO₂ emissions **remain** from **industrial sources** in 2050 under 2DS.

How much more can CCS do in industrial applications under 'well below 2°'?

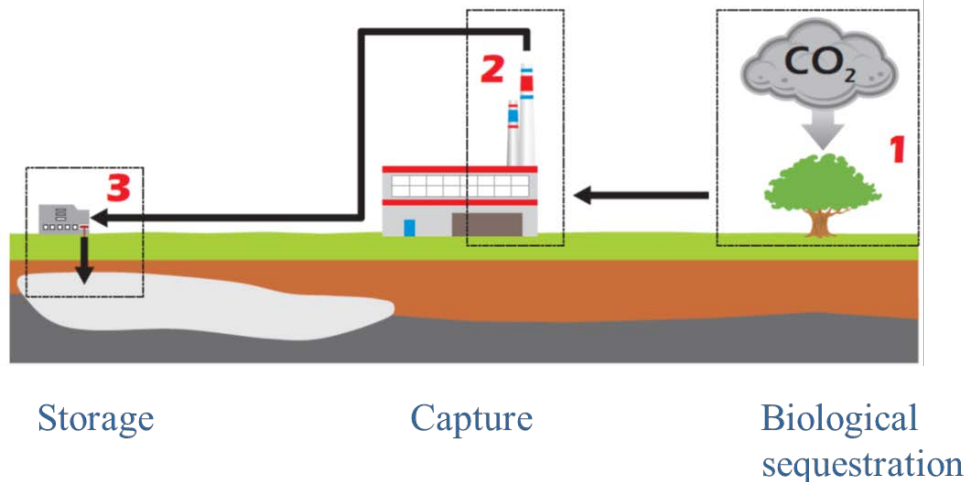
Industry-CCS: enabling clean products to tackle greater ambition

- CCS is a critical technology for many process industries with high specific emissions per tonne of product:
 - Steel: 1,9 – 2.1 tCO₂ / t of steel
 - Cement: 0.8tCO₂ / t of cement
- Applying CCS can enable clean products, with -50 to -80% CO₂ / t of cement or steel
- ...but: what would drive this?
 - Product standards & mandates
 - CO₂ price
 - Customer demand (to an extent)



Negative emissions: A greater role for BECCS?

- Combination of bioenergy with CCS can deliver net negative emissions and reduce atmospheric concentrations of CO₂
 - Can address ‘overshoot’ of carbon budgets in medium term
- But...not all BECCS is good BECCS
 - Sustainability of biomass – social and economic issues; competition with food production; loss of biodiversity; pressure on water resources etc
- Availability of geological storage will be critical!



Concluding Messages

- CCS will be an important part of the solution to climate change
- Fossil fuels will continue to play a role in the energy mix, particularly in non-OECD countries
- CCS is ready for deployment, but policy frameworks are lacking
- The Paris Agreement could be a game-changer for CCS

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Thank you!

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