

2013

2015

2020

2025

2030

2035

2040

2045

2050



IEA CCS Activities

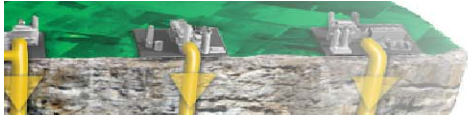
CSLF Policy Group - 03 November 2015

Tristan Stanley

CCS Unit

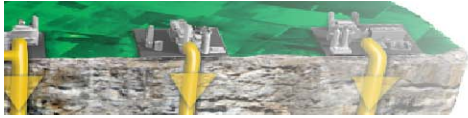
IEA

 Carbon capture and storage



My remarks

1. ETP 2015: The role of CCS
2. Storage CO₂ through enhanced oil recovery (EOR)
3. Upcoming work...

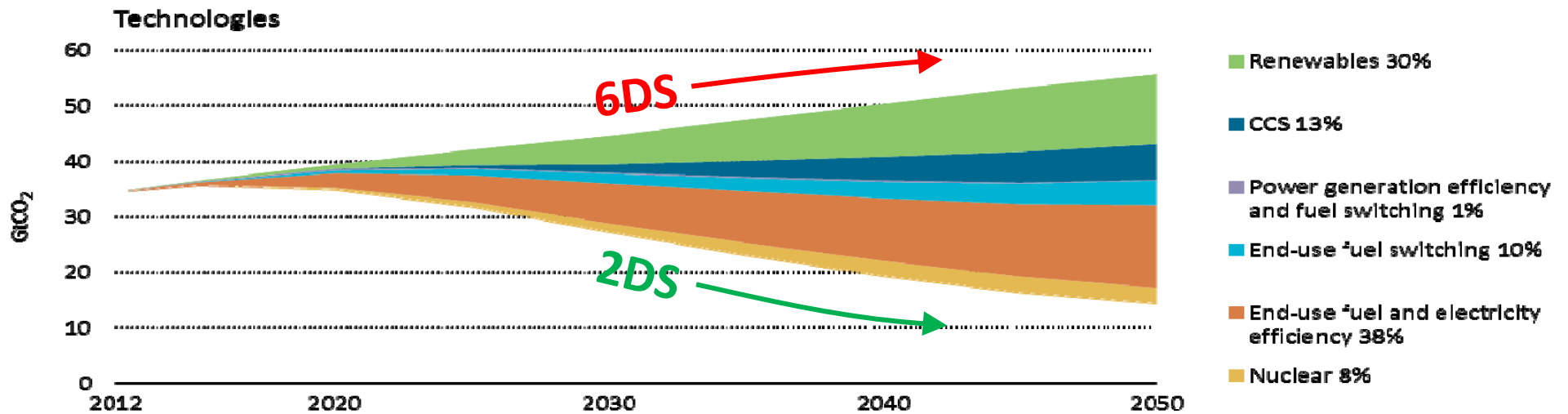


My remarks

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A portfolio of technologies is required to get from here to there

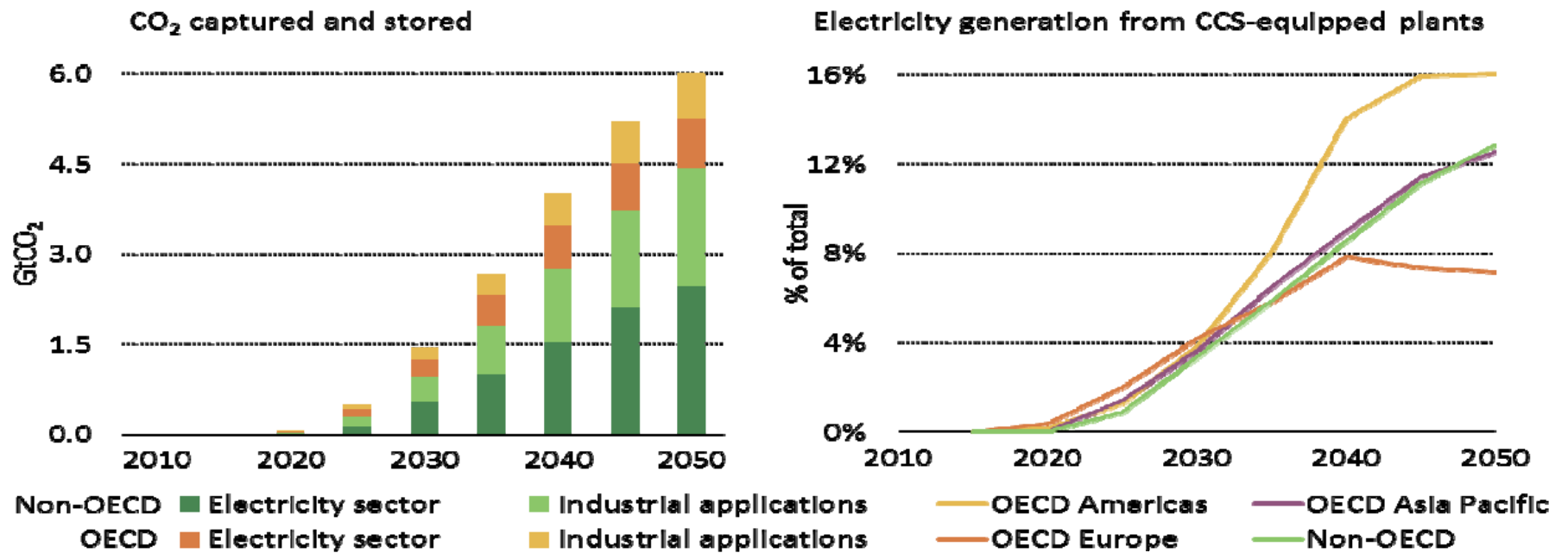
ETP 2015



Percentages represent cumulative contributions to emissions reduction relative to 6DS

CCS takes off after 2025 in the 2DS

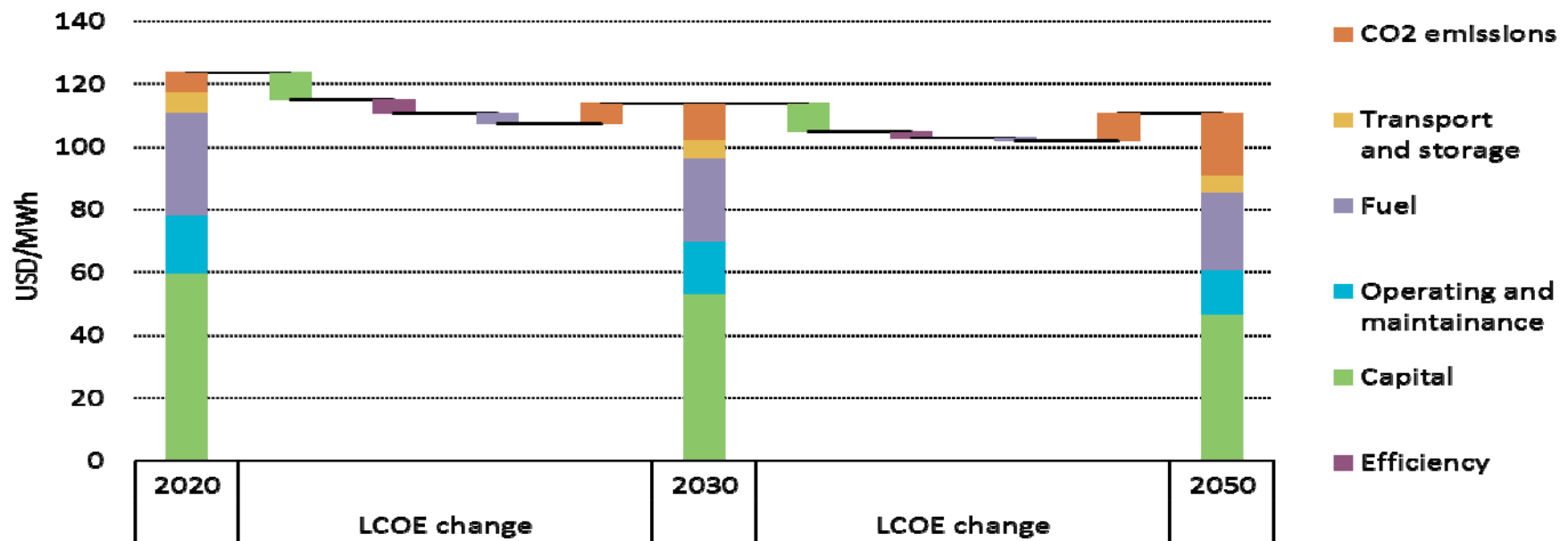
ETP
2015



CCS is important in both electricity and industry; over two-thirds of total CO₂ captured and stored is in non-OECD countries

LCOE of CCS-equipped coal power plants falls in 2DS

ETP
2015

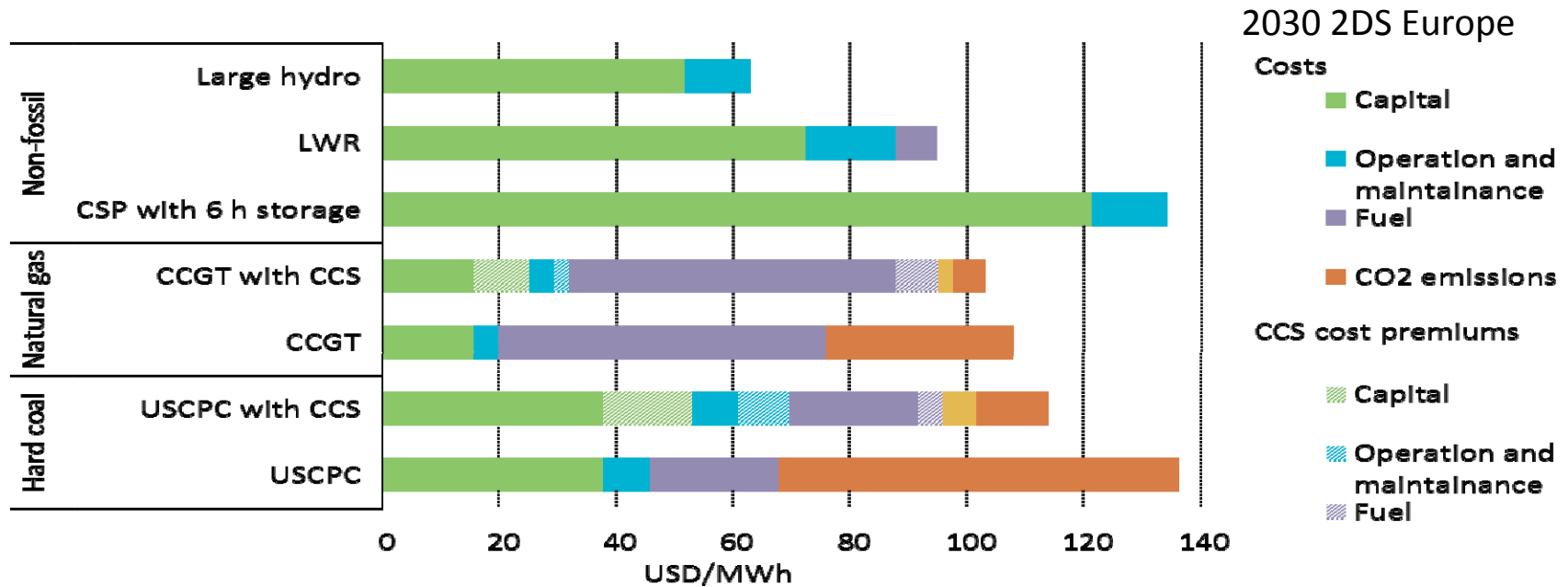


There is a critical reduction in LCOE of CCS across the ETP period

Note: today's first-of-a-kind costs are much higher than 2020 costs

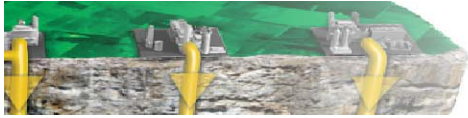
For power, CCS becomes competitive with other dispatchable options

ETP
2015



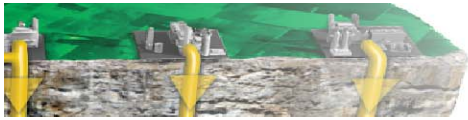
Innovation, falling fuel prices and rising CO₂ prices reduce costs of CCS-equipped power plants in the 2DS

1. In the 2DS, 5 - 6 GtCO₂/yr are captured and stored by 2050 in all sectors
2. CCS deployment has begun in “sweet spots”
3. “Learning-by-doing” is now also under way for CCS in power generation



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CO₂ is produced alongside the oil and re-injected

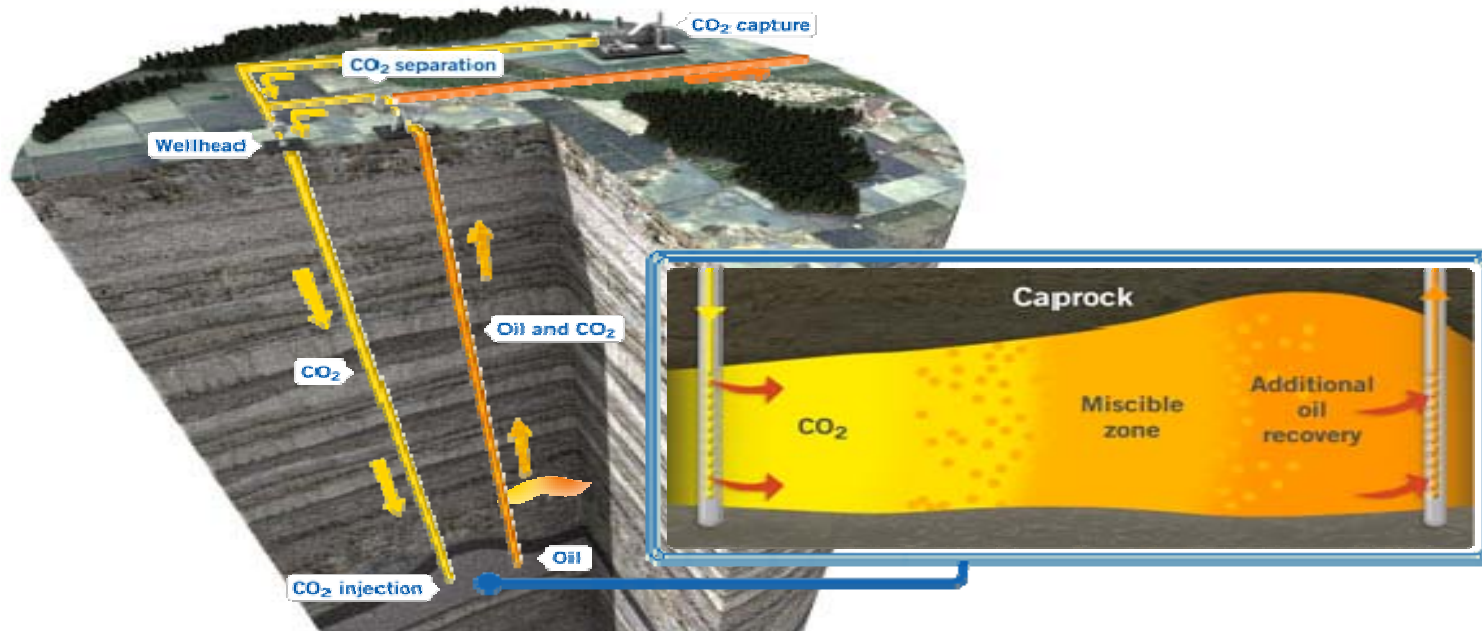
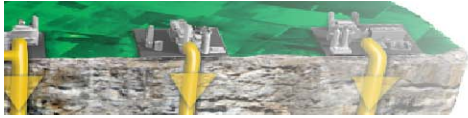
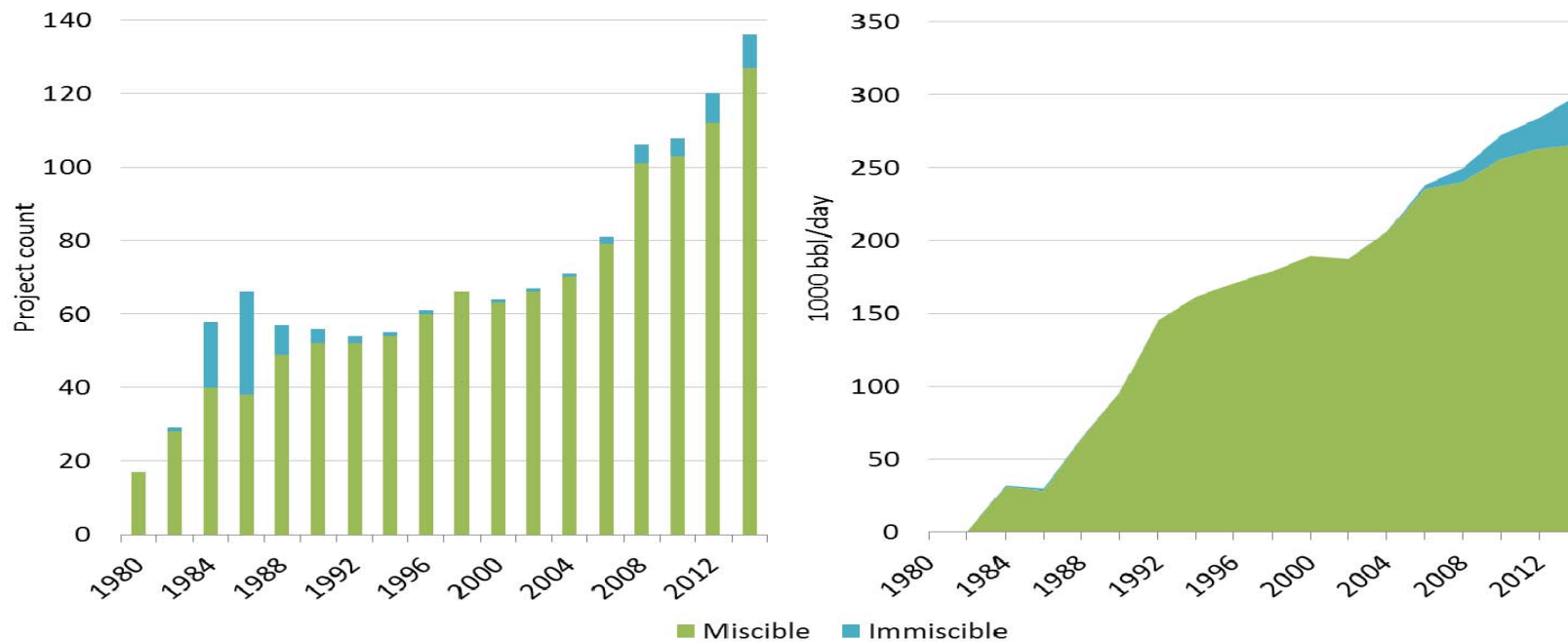


Image: Global CCS Institute

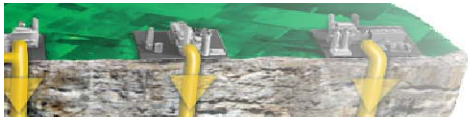


An upwards trend for US miscible projects and production from CO₂-EOR



KACST-TIC CCS Training Course

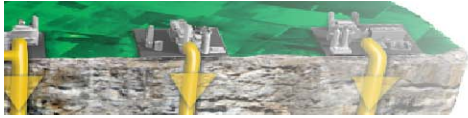
Data: Moritis, 2010



3 EOR operational models

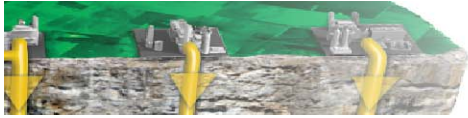
Scenario	Incremental recovery % OOIP	Utilisation tCO ₂ /bbl
Conventional EOR+	6.5	0.3
Advanced EOR+	13	0.6
Maximum Storage EOR+	13	0.9

CO₂ supply prices should be sensitive to climate policy.
Ceteris paribus, lower cost CO₂ should translate into higher utilisation rates and higher incremental recovery

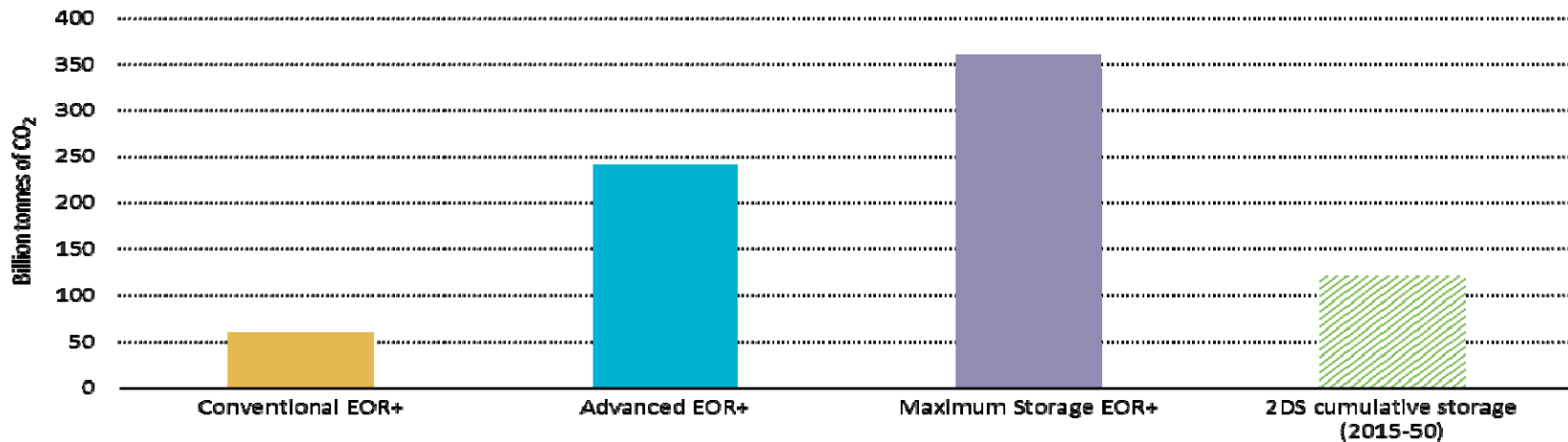


Shifting from EOR to EOR+

- **Additional site characterisation and risk assessment** to collect information on overlying cap-rock and geological formations, as well as abandoned wellbores, to assess the potential for leakage of CO₂ from the reservoir.
- **Additional measurement of venting and fugitive emissions** from surface processing equipment.
- **Monitoring and enhanced field surveillance** aimed at identifying and, if necessary, estimating leakage rates from the site to assess whether the reservoir behaves as anticipated.
- **Changes to abandonment processes** that help guarantee long-term containment of injected CO₂, such as plugging and removal of the uppermost components of wells so they can withstand the corrosive effects of CO₂-water mixtures.

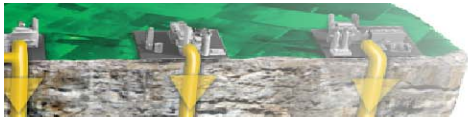


Large technical potential for storage

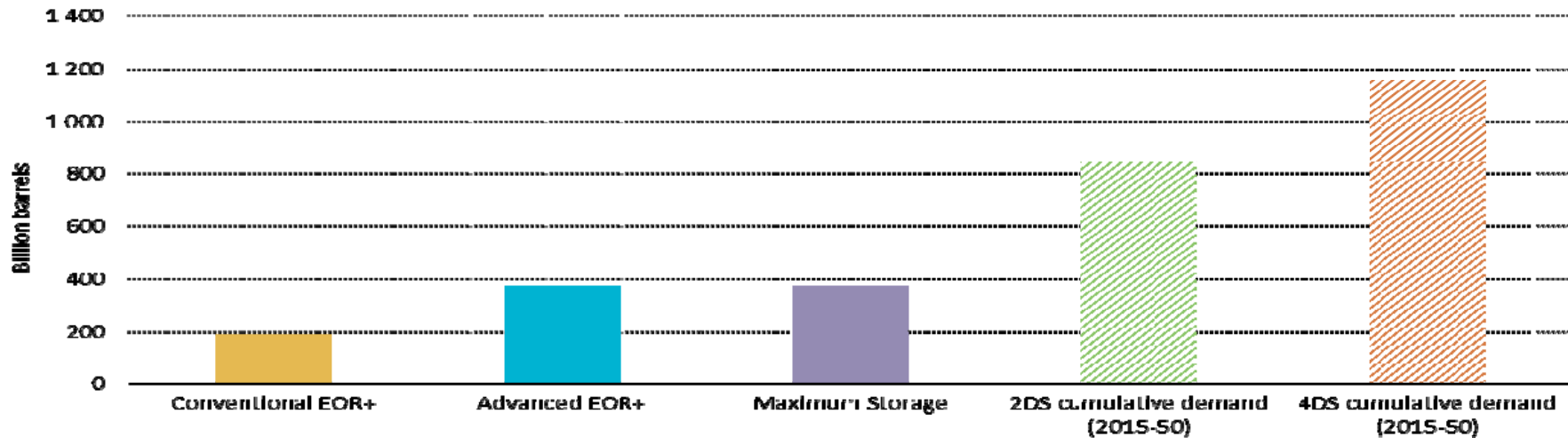


There is the technical potential for around half of the storage in the 2DS to come from Conventional EOR+...

... and more than twice the needed capacity through Advanced EOR+

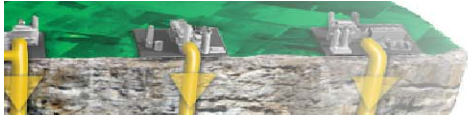


Potential for incremental production is equally large

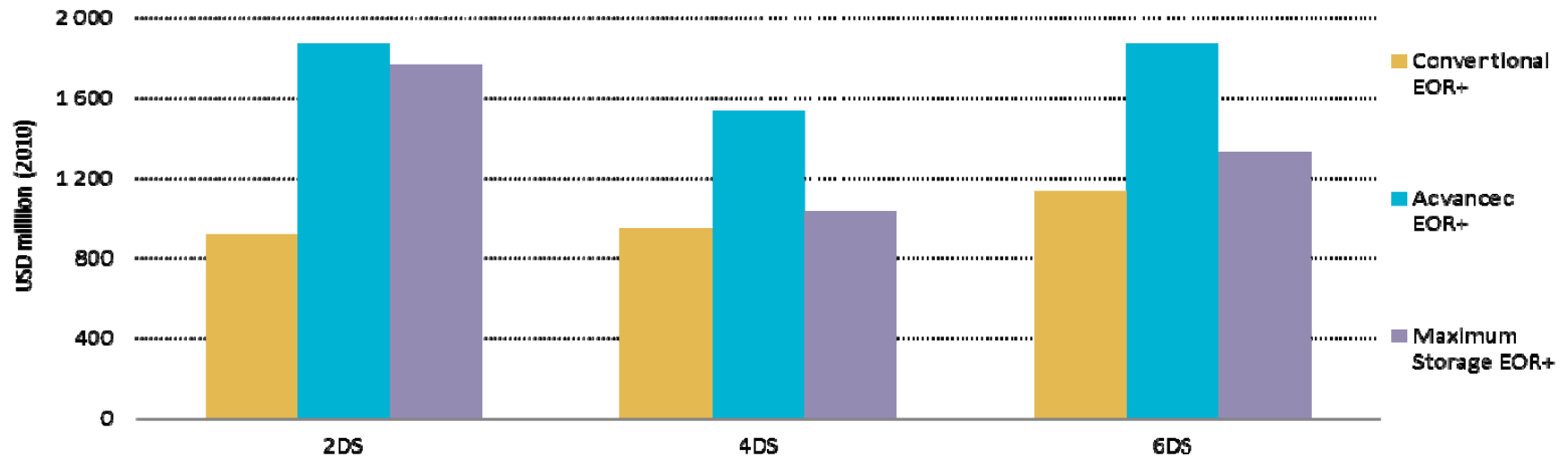


Technical potential for large incremental oil production under Advanced and Maximum Storage EOR+...

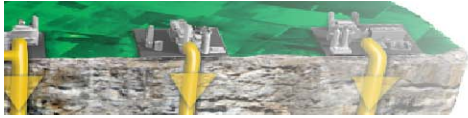
... large proportion of oil demand under the 2DS



The NPV of Advanced EOR+ comes out ahead under all ETP scenarios



Under lower (and possibly –ve) CO₂ supply prices and increased oil production, the Advanced EOR+ approach has the highest NPV in all ETP scenarios

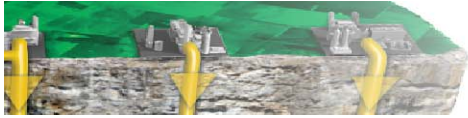


Life cycle emissions are good news, but...

- On an LCA basis, both Advanced EOR+ and Maximum Storage EOR+, the picture is positive (negative?) – emissions are lower
- and even for Conventional EOR+, emissions reductions can be achieved if >50% of incremental oil displaces existing production

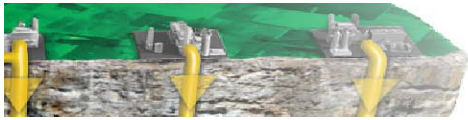
However...

- In many places, we will need to establish an EOR industry before pursuing EOR+
- and in places where there is an existing industry, there can be legal issues around introducing EOR+



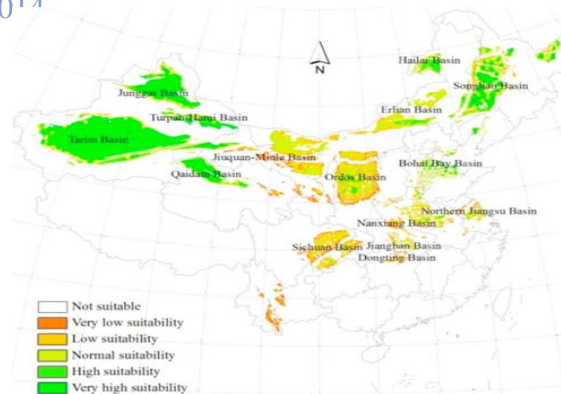
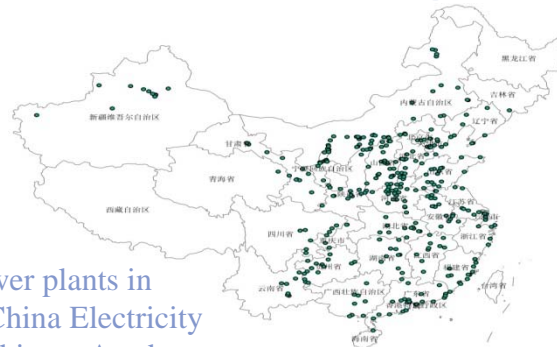
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Retrofitting CCS on coal-power in China

Coal-fired power plants in China. From China Electricity Council and Chinese Academy of Sciences, 20¹⁴

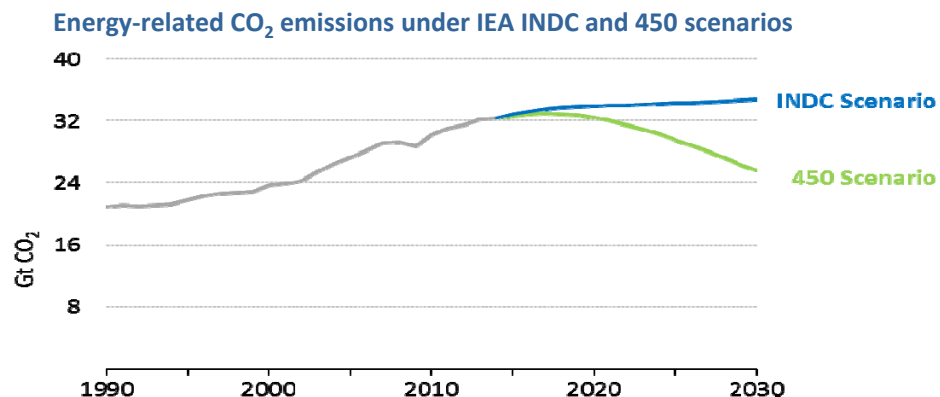


China's CO₂ storage. Wei et al., 2013

- China's coal-fired power sector: Nr. 1 emitter in the world with 4Gt CO₂ per year (USA: 2Gtpa in 2012)
- In 2020, China will have 330GW of coal-fired plant that is
 - larger than 600MW
 - younger than 15 years
- 375GW of current plant within 250km of potential storage
- Refurbishing an existing plant and adding CCS can be a relatively inexpensive way to get low-emissions power without losing a capital asset
- Strategy requires the development of significant storage resource in China

Energy & climate change – COP21

- A major milestone in efforts to combat climate change is fast approaching – COP21 in Paris in December 2015
- Momentum is building:
 - Historic US-China joint announcement; EU 2030 targets agreed etc.
 - 128 INDCs submitted, covering 150+ countries and 90% of energy-related greenhouse gases
 - Energy-sector CO₂ emissions slow down significantly if INDCs implemented



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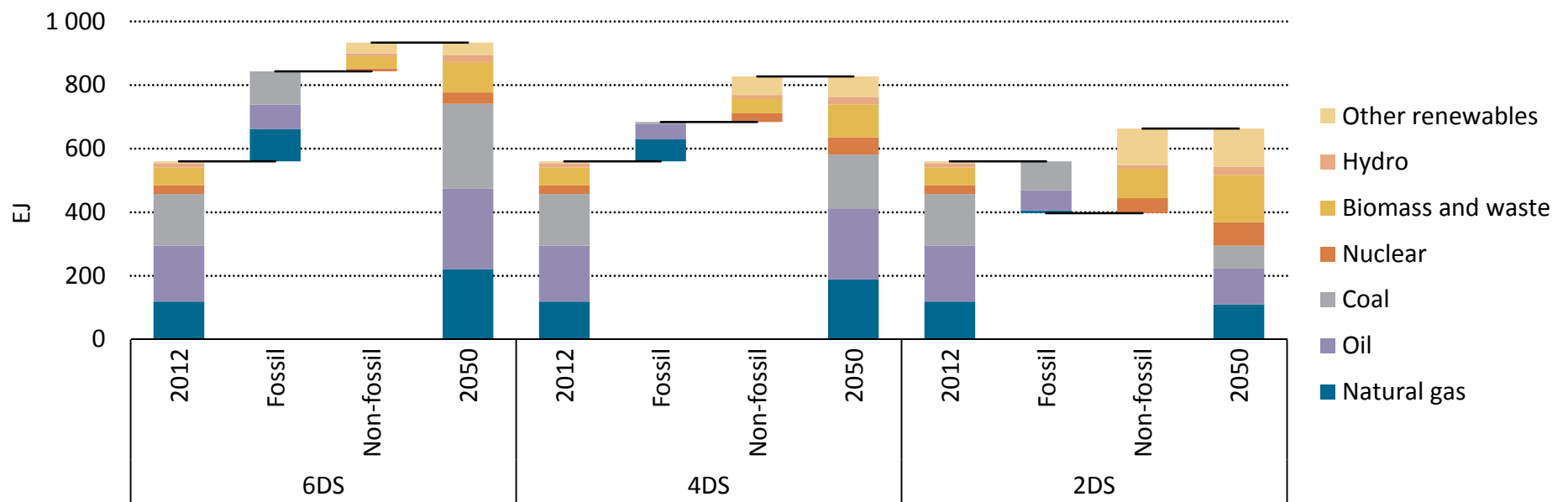
2050



Thank you!

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Reduced dependency on fossil fuels... ETP 2015



...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