



CCUS as a Climate Mitigation Option

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Resources for the Future Seminar

Carbon Capture, Utilization, and Storage (CCUS): Status, Issues, Needs

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IEA Greenhouse Gas R&D



Part of the IEA ETN since 1991 –



What We
Are:



35 Members from 18 countries
plus OPEC, EU and CIAB



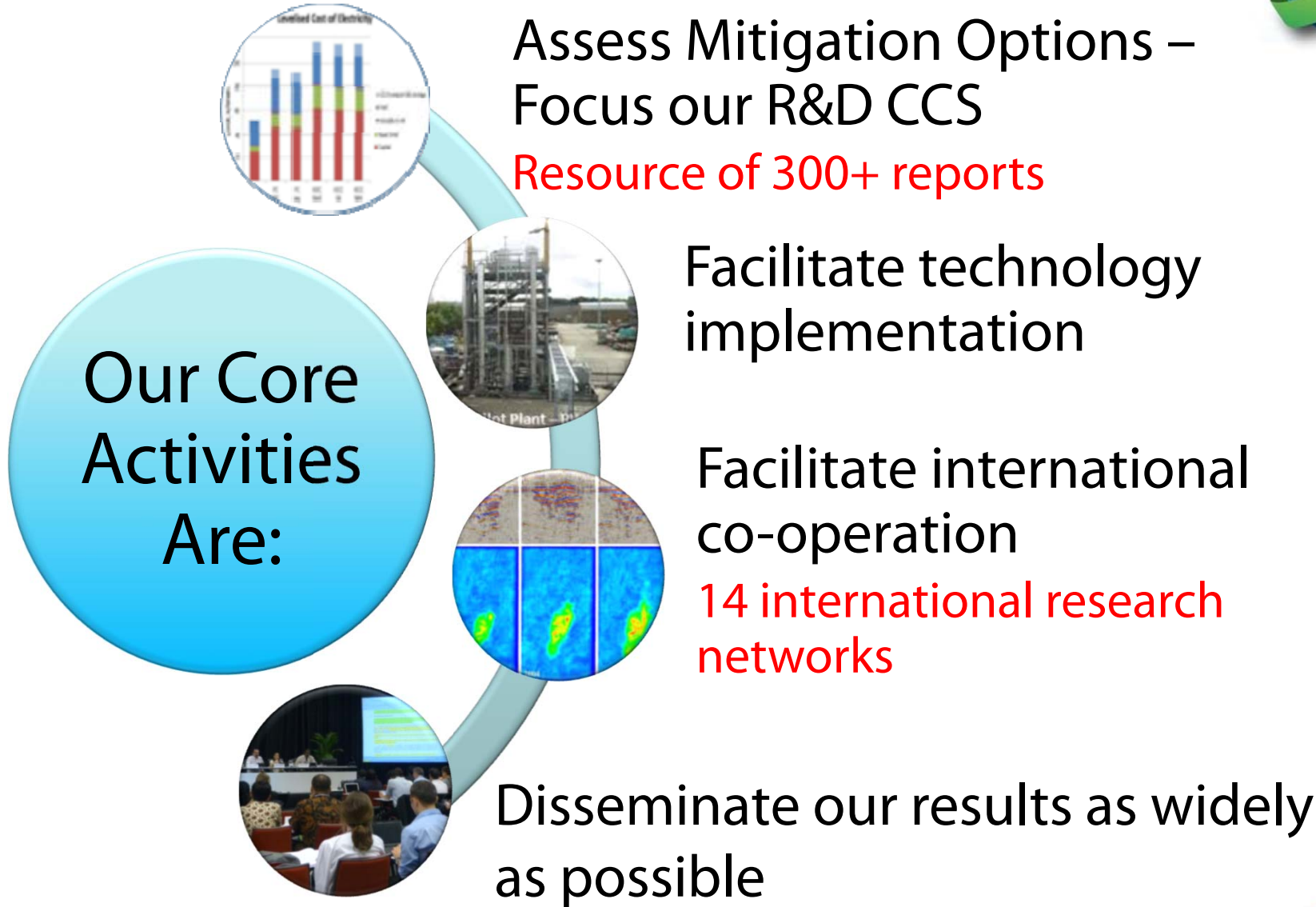
Members set strategic
direction and technical
programme



Universally recognised as
independent technical organisation



What do we do?



WMO Current Climate Status Report March 2017

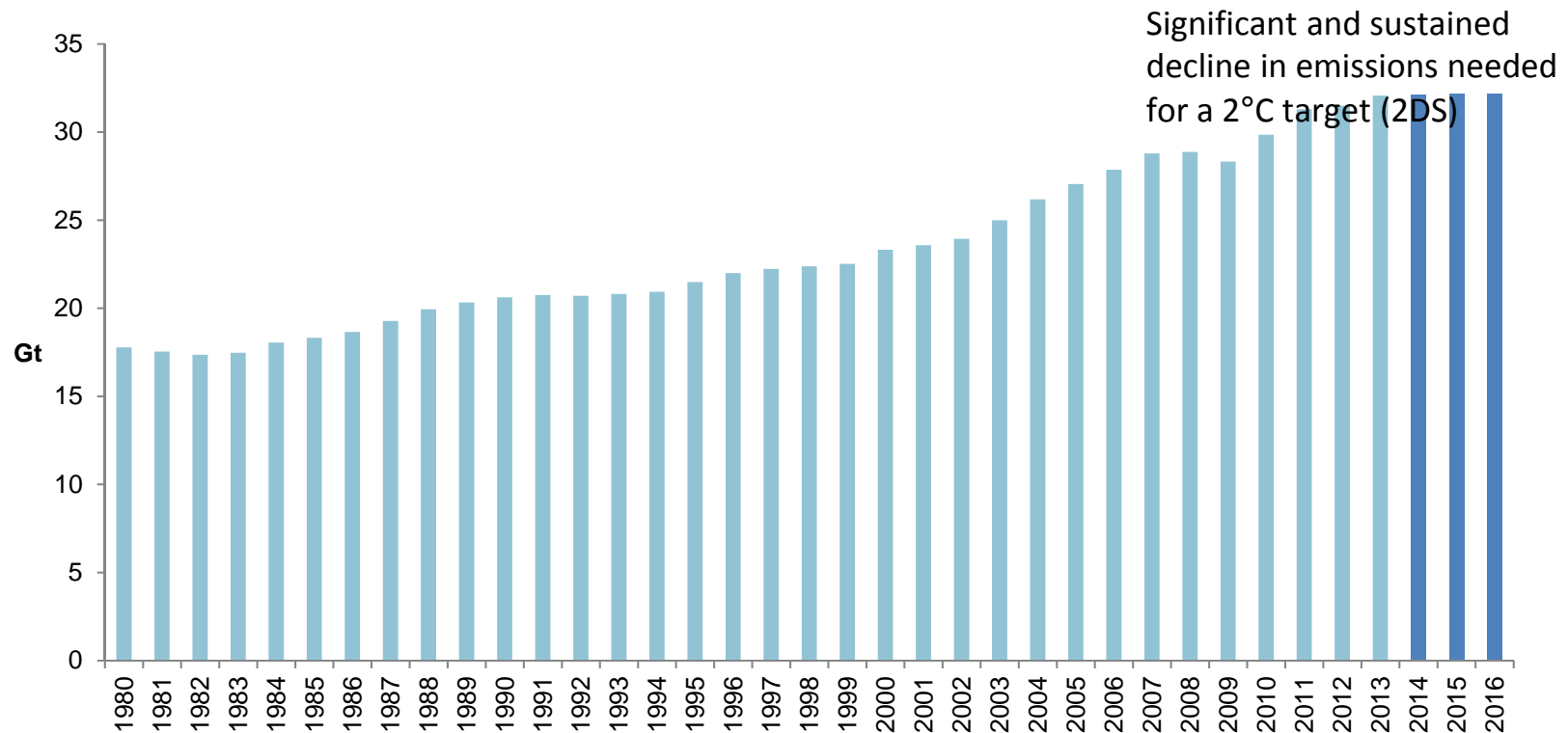


- Levels of CO₂ in the atmosphere reached a new high (>400ppm)
- 2016 was the warmest year on record
 - 1.1°C above the pre-industrial period, which is 0.06 °C above the previous record set in 2015.
- Globally averaged sea surface temperatures were also the warmest on record,
 - global sea levels continued to rise,
 - and Arctic sea-ice extent was well below average for most of the year.
- Conclusion: **“the influence of human activities on the climate system has become more and more evident”**

<https://public.wmo.int/en/media/press-release/climate-breaks-multiple-records-2016-global-impacts>

Global energy-related emissions flat for third year in a row

Global energy-related CO₂ emissions

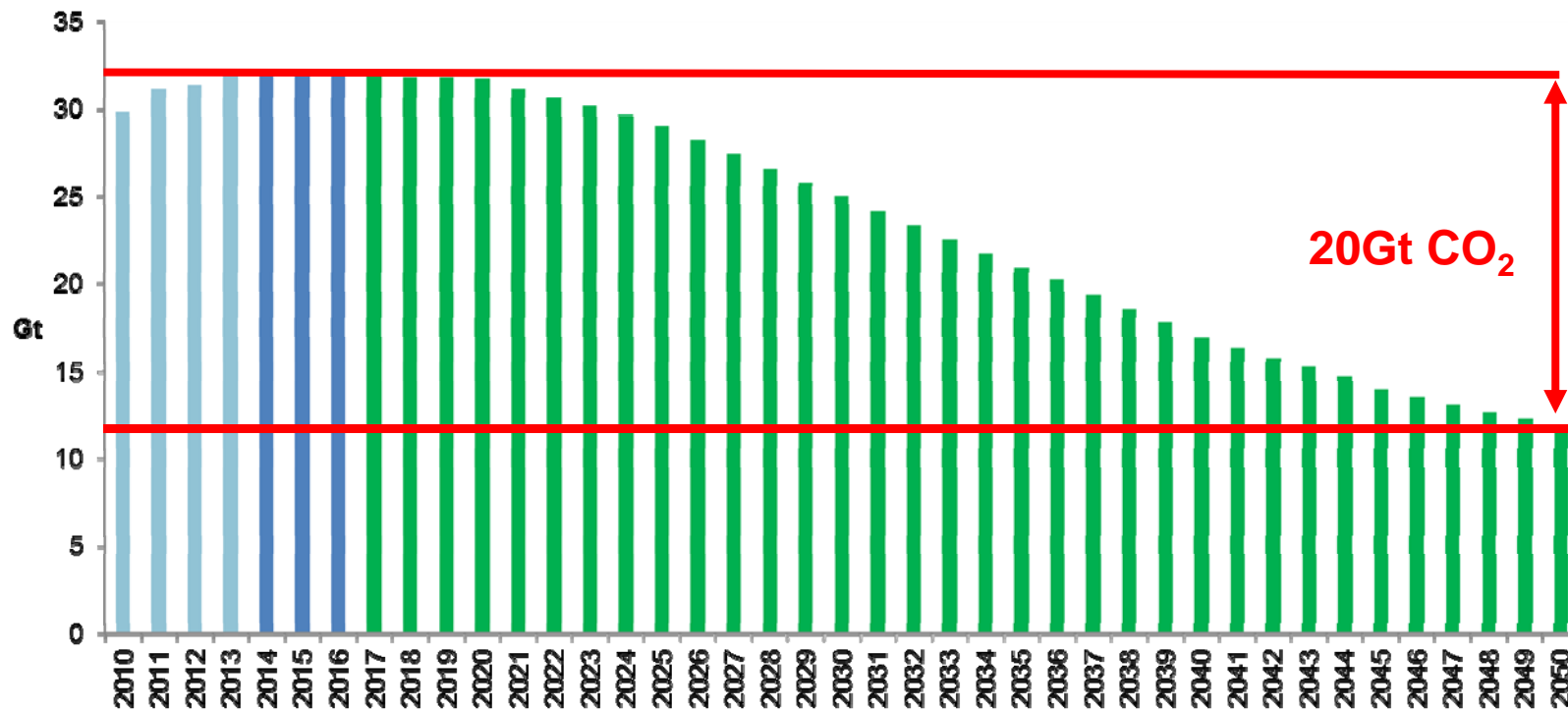


Three consecutive years of stable emissions alongside global GDP growth

17 March 2017

Global energy-related emissions flat for third year in a row

Global energy-related CO₂ emissions



Significant and sustained decline in emissions needed for a 2°C target (2DS)

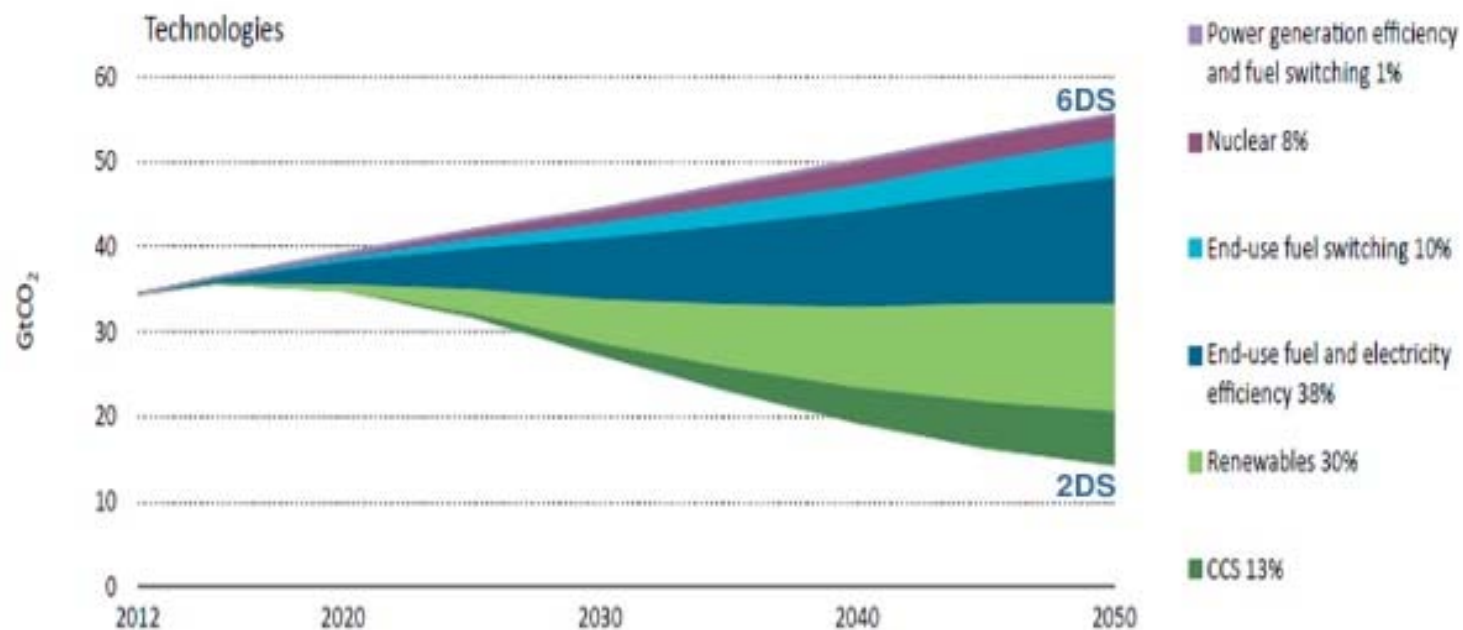
17 March 2017

Technology mix for carbon emissions reduction in the 2DS

ETP
2015



Contribution of technology area to global cumulative CO2 reductions



Source: ETP 2015

A portfolio-approach is needed for a least-cost low-carbon scenario

CCUS – a key climate policy option



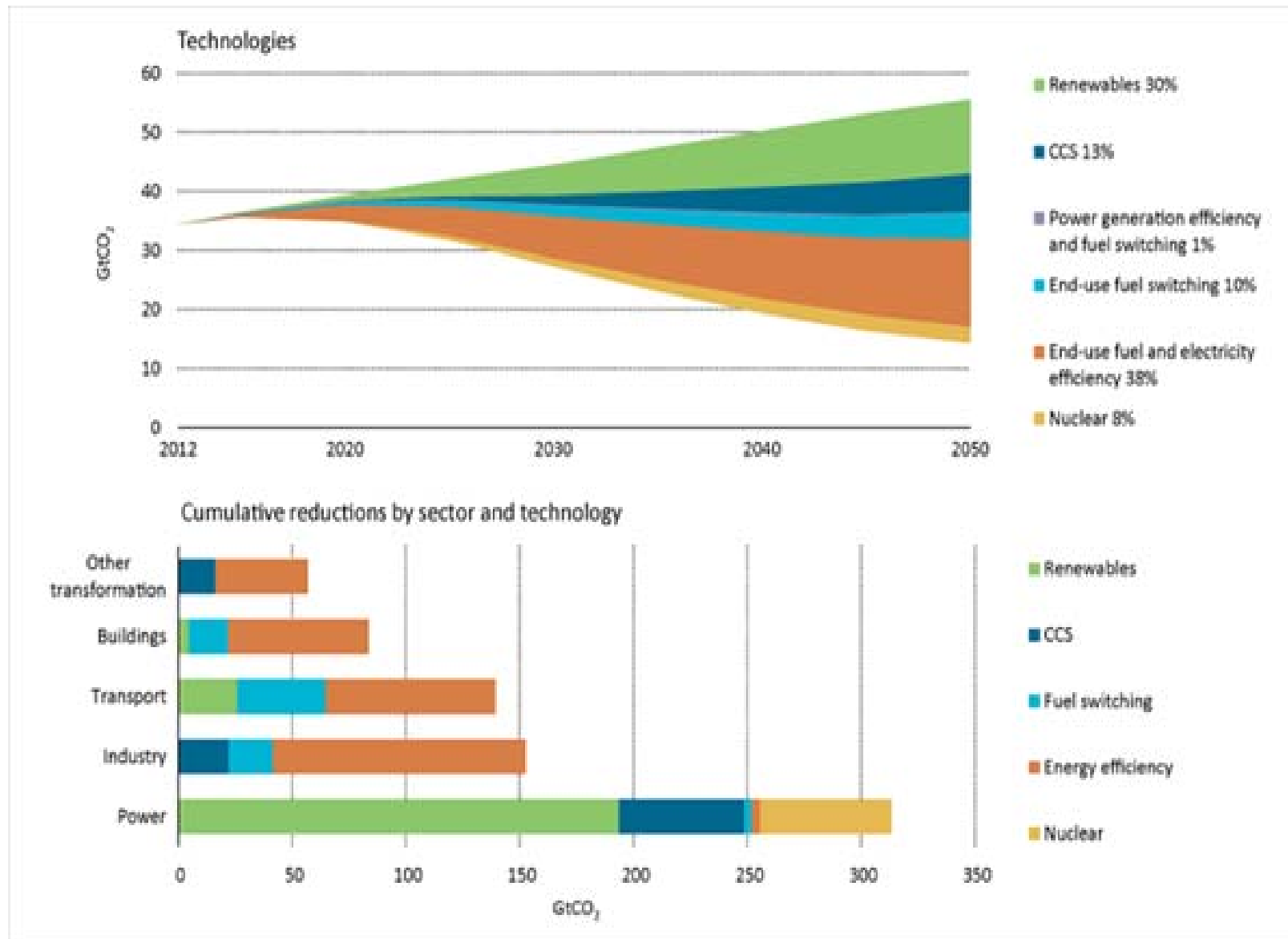
- The IPCC AR5 indicated - CCS is a crucial technology to meet the 2⁰C target
 - *Climate scenarios could not meet 2⁰C without CCS*
 - *The costs of meeting the 2⁰C will be 138% higher if CCS is not included as a mitigation option*
- Post Paris CCS “lowered” the target to limit temperature rise to below 2⁰C target.
- CCS is expected to be an even more crucial technology if we are to achieve below 2⁰C target.

CCS – a key climate policy option (2)

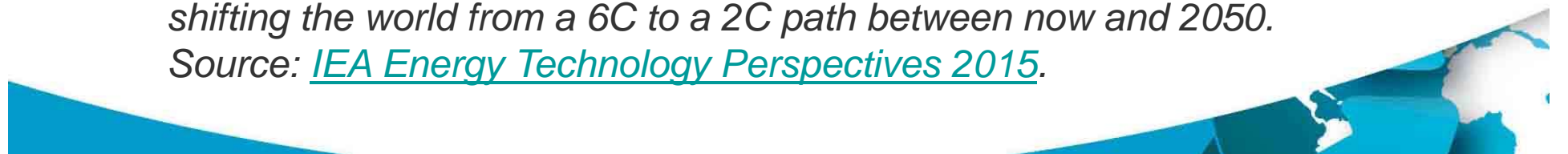


- To go below 2°C significant reductions in greenhouse gas emissions will be required in all sectors not just the power sector.
- CCS is a key technology to achieve deep emissions cuts in the industry sector.
- “Negative emission” technologies like BioCCS will likely need to be deployed from 2030 onwards.





The technologies and sectors making the largest contributions to shifting the world from a 6C to a 2C path between now and 2050.
Source: [IEA Energy Technology Perspectives 2015](#).



Current status of CCUS



- CCS technology is proven and in use around the world.
- 22 large-scale CCS projects in operation or under construction globally - CO₂ capture capacity of 40 Mtpa.
- 6 projects in construction as of March 2017
 - 3 projects to be operational in 2017 & 3 in 2018
- 5 more large-scale CCS projects at an advanced stage of development planning,
 - CO₂ capture capacity of ~ 8 Mtpa.
- 11 more large-scale CCS projects are in earlier stages of planning
 - CO₂ capture capacity of ~21 Mtpa.

Source: Global CCS institute

CCUS Deployment



Power Sector

- Boundary Dam – Canada
 - >1.3 captured
- NRG Parish (USA)
 - Largest capture unit to date
- Kemper County (USA)
 - Due on stream 2017
- OsakiCoolGen
 - IGCC unit operational
 - CO₂ capture 2018/19

Industry Sector's

- Natural gas processing
 - Sleipner -20 years
 - Lula, Brazil
- Hydrogen Production
 - Air Products (USA)
 - >3Mt captured
 - Quest (Canada)
 - >2Mt captured
- Steel manufacture
 - Emirates Steel now operational
- Bio-ethanol
 - IISD (USA)

Demonstration achievements



- CCS is a “proven” technology
- Growing confidence in CCS
 - It can do – “what it says on the tin”
- Growing number of capture vendors
 - Post combustion capture
 - Cansolv, Linde, MHI, Toshiba, Fluor
- Learning by doing
 - NOAK projects can be built at lower cost
- EOR gives financial support for early mover projects in regions

Role of CO₂- EOR (CCUS)



- North America
 - Provided price for CO₂
 - Financial support to demonstration projects
 - CO₂ pipeline infrastructure plus regulation
- CO₂-EOR developments
 - Offshore CO₂-EOR at Lula, Brazil
 - On-shore CO₂-EOR taking off in Gulf States
 - Pilot project in Saudi Arabia
 - Emirates Steel first mover project in UAE
 - China – first project (Yangcheng Petroleum) in 2019/2020



Next steps



- Progress in CCUS deployment has been significant and cost reductions observed from learning by doing
- Most early CCUS projects have required government support
 - Grants/loans for capital investment
 - Taxes, storage credits etc., towards operational costs
- Government support will still be needed to help drive down costs and/or make business model attractive to industry.
- Ultimately we need to create business models that allow projects to be self financing
 - No “one fits all solution”
- Knowledge transfer from early projects needed
- Proving the storage resource around world is essential
- Build infrastructure to support expanded deployment of CCUS.
- Further R&D to drive down costs





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