CCUS as a Climate Mitigation Option

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Resources for the Future Seminar

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

May 24, 2017, Washington DC, USA

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

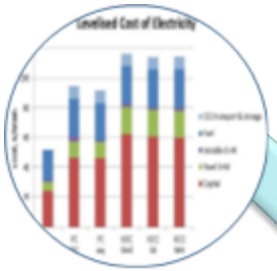
Members set strategic direction and technical programme

Ask

Universally recognised as independent technical organisation

What do we do?

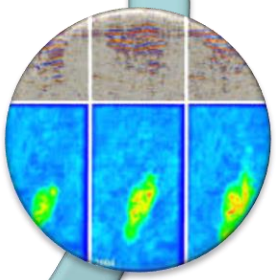
Our Core Activities Are:



Assess Mitigation Options – Focus our R&D CCS

Resource of 300+ reports

Facilitate technology implementation



Facilitate international co-operation

14 international research networks

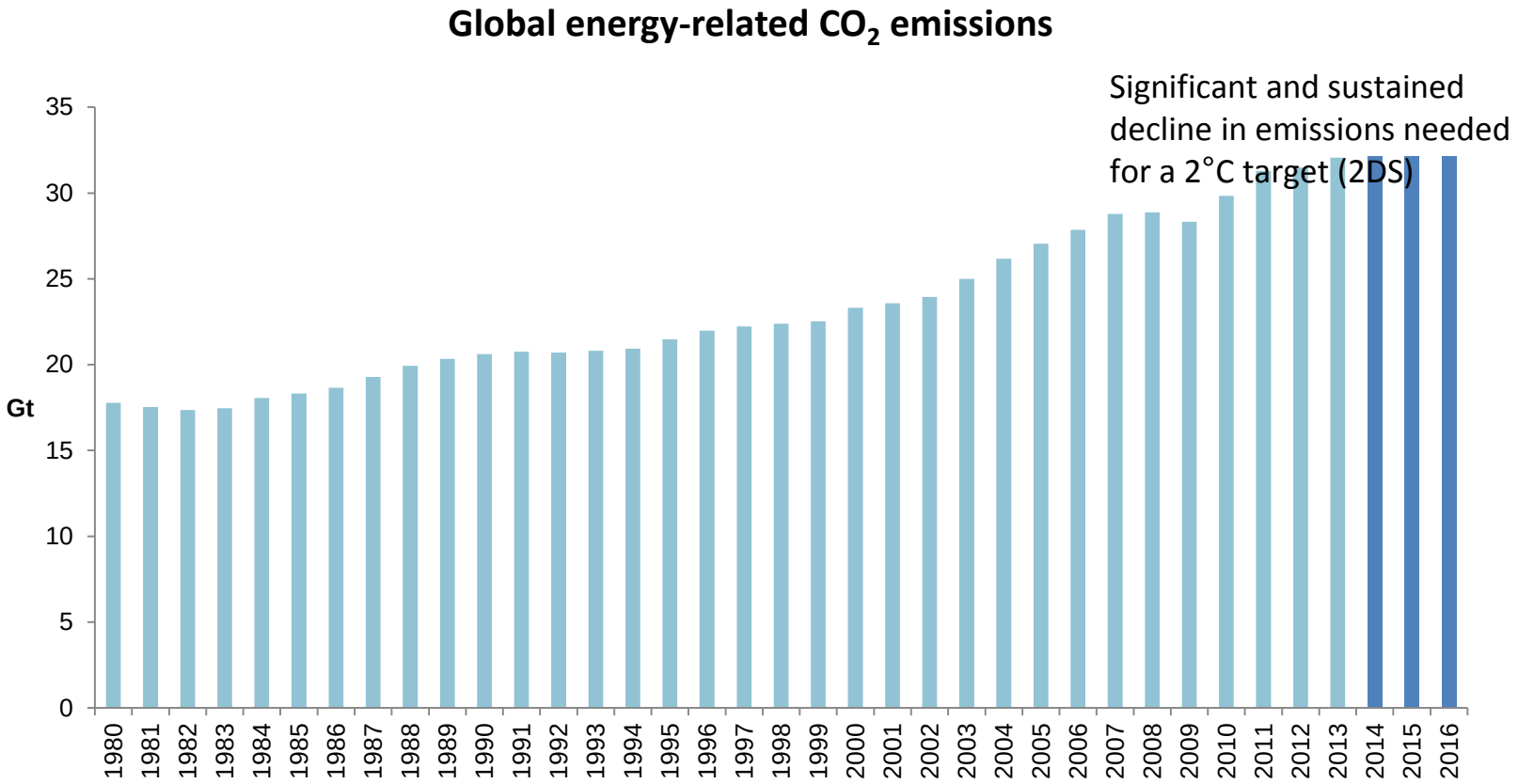
Disseminate our results as widely as possible

WMO Current Climate Status Report March 2017

- Levels of CO_2 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

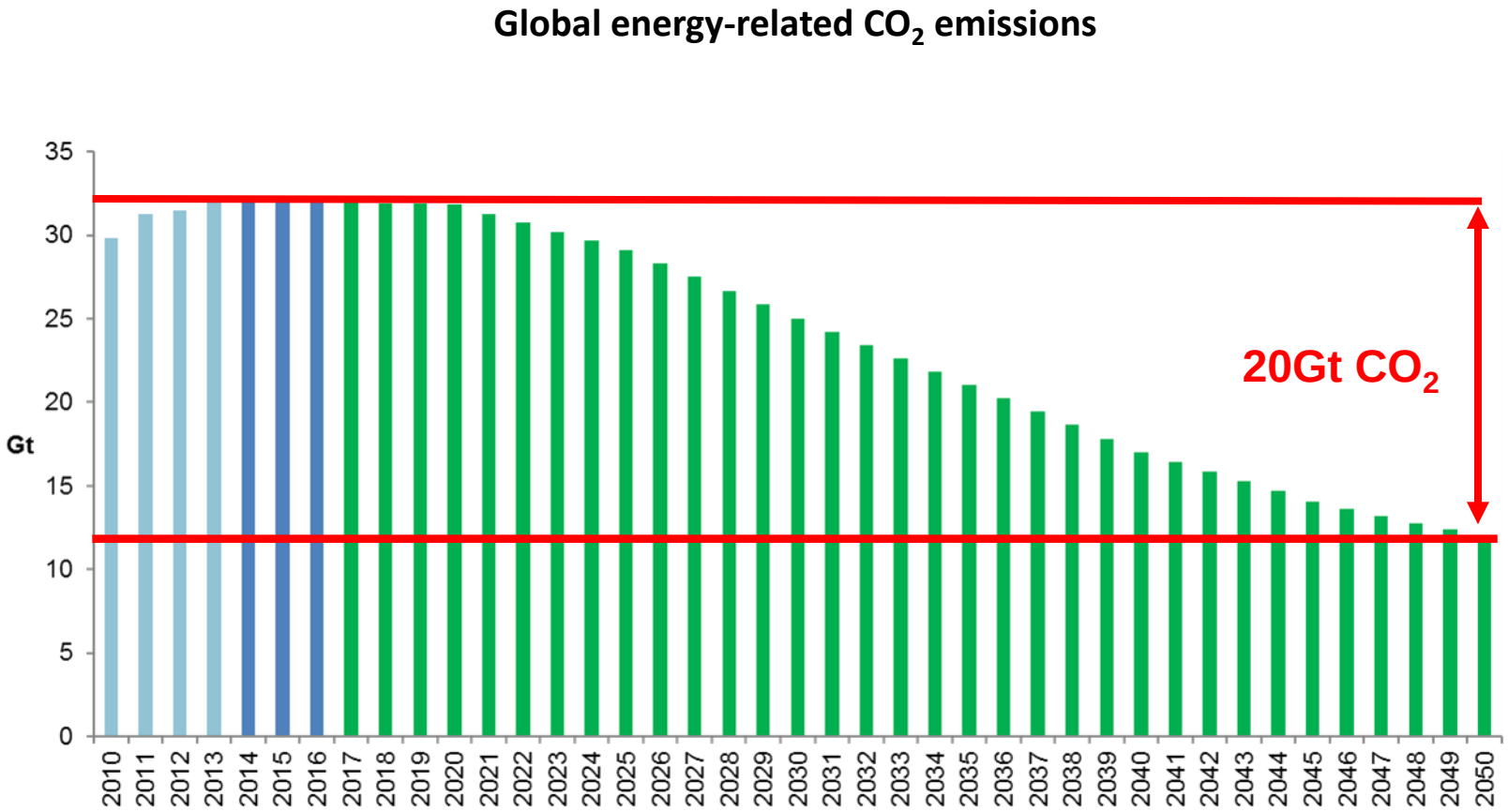
Global energy-related emissions flat for third year in a row



Three consecutive years of stable emissions alongside global GDP growth

17 March 2017

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

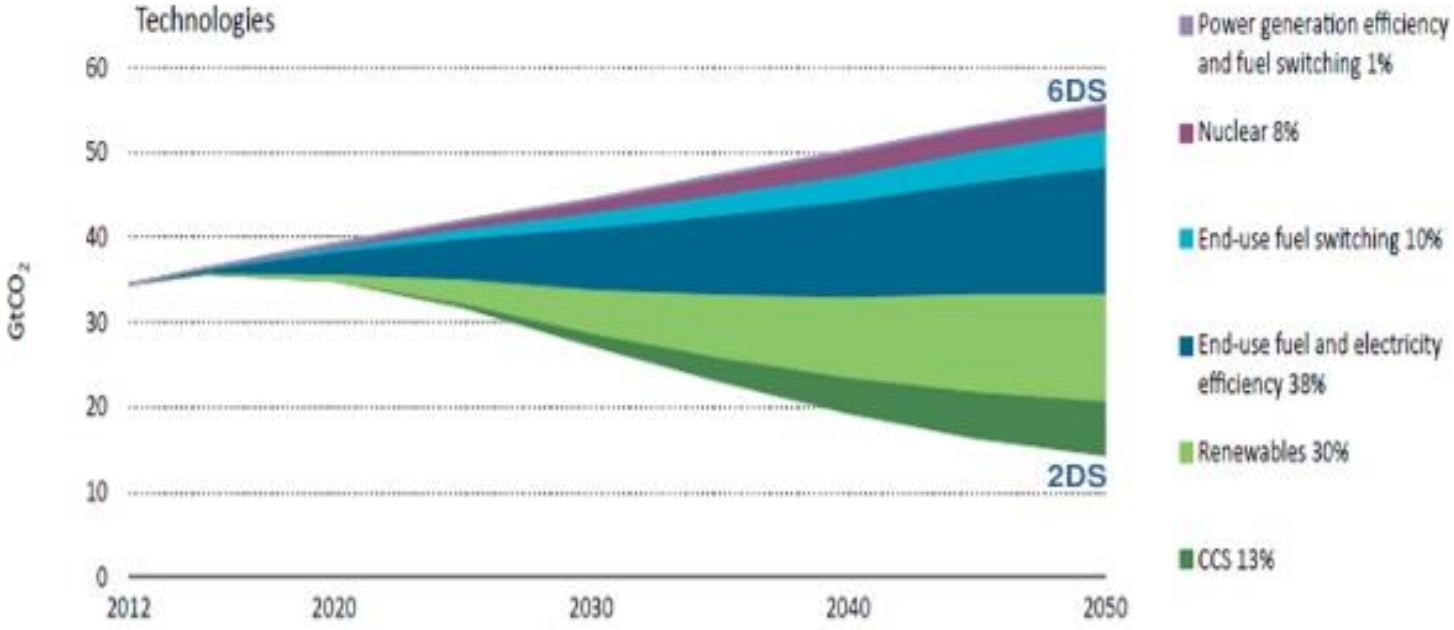


Significant and sustained decline in emissions needed for a 2°C target (2DS)

Technology mix for carbon emissions reduction in the 2DS

ETP 2015

Contribution of technology area to global cumulative CO2 reductions



Source: ETP 2015

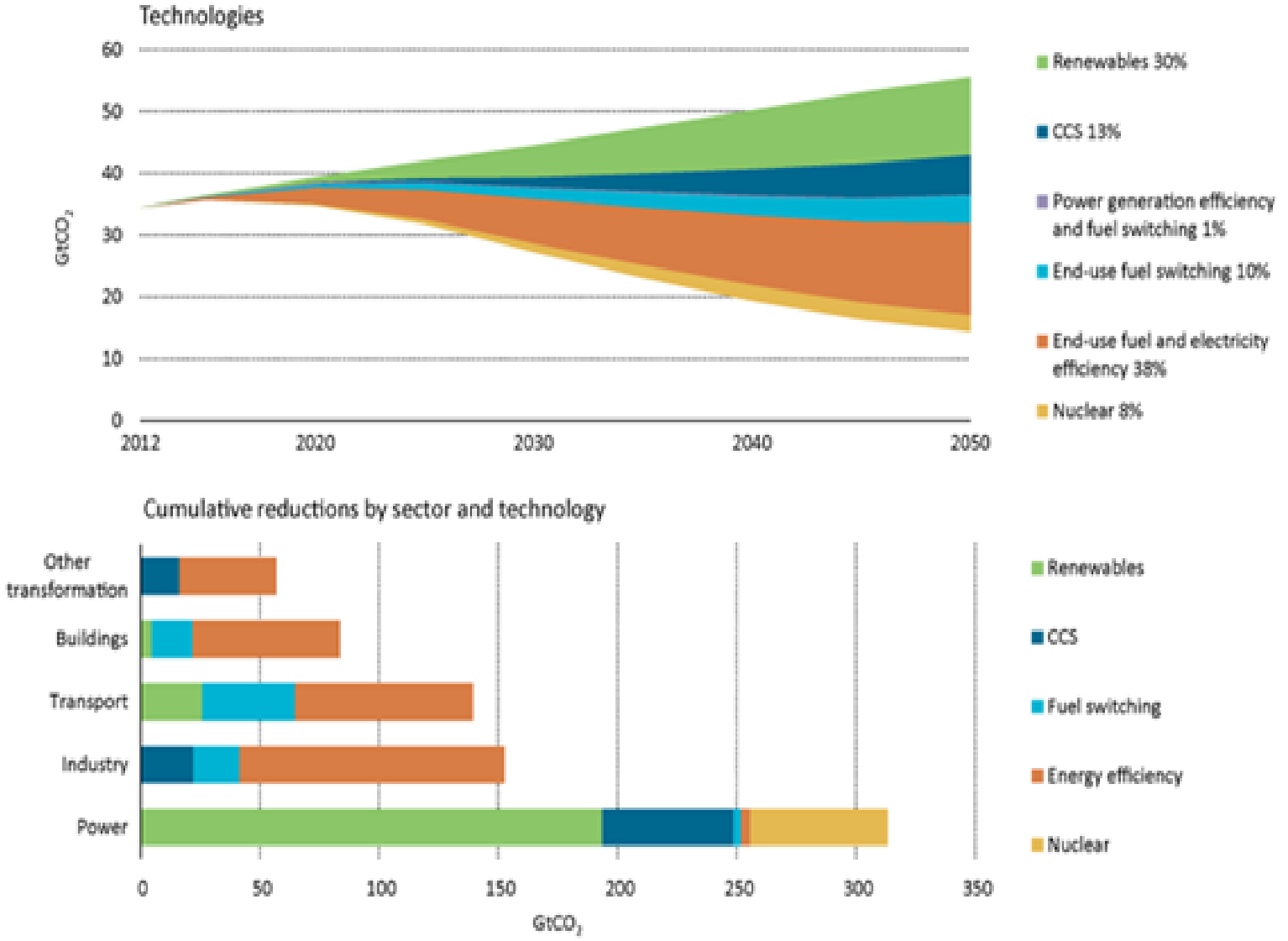
A portfolio-approach is needed for a least-cost low-carbon scenario

CCUS – a key climate policy option

- The IPCC AR5 indicated - CCS is a crucial technology to meet the 2^0C target
  - *Climate scenarios could not meet 2^0C without CCS*
  - *The costs of meeting the 2^0C 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 2^0C target.
- CCS is expected to be an even more crucial technology if we are to achieve below 2^0C target.

CCS – a key climate policy option (2)

- To go below 2^0C 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 - CO_2 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,
  - CO_2 capture capacity of ~ 8 Mtpa.
- 11 more large-scale CCS projects are in earlier stages of planning
  - CO_2 capture capacity of ~21 Mtpa.

Source: Global CCS institute

CCUS Deployment

Power Sector

- Boundary Dam – Canada
  - >1.3M captured
- NRG Parish (USA)
  - Largest capture unit to date
- Kemper County (USA)
  - Due on stream 2017
- OsakiCoolGen
  - IGCC unit operational
  - CO_2 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 CO_2
  - Financial support to demonstration projects
  - CO_2 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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