CCS as a Critical Part of the Carbon Budget

John Gale and Tim Dixon

IPICEA COP-20 side event

6 Dec 2014, Lima

BG GROUP

bp

CEZ GROUP

Chevron

TOTAL

REPSOL

ALSTOM

CIAB

EnBW

VATTENFALL

ExxonMobil

Evaluating technology options to mitigate greenhouse gas emissions

ieaghg

EPRI

JÜLICH

DOOSAN Doosan Babcock

Schlumberger

Statoil

PETROBRAS

INSTITUTO DE INVESTIGACIONES ELECTRICAS

JGC

RWE The energy to lead

Partner Organisations:

JCOAL Japan Coal Energy Center

ptrc Petroleum Technology Research Centre

CO2 GeoNet

carbon sequestration leadership forum

ETP 2014 – A choice of 3 futures

2DS

a vision of a **sustainable** energy system of reduced Greenhouse Gas (GHG) and CO_2 emissions

The 2°C Scenario

4DS

reflecting pledges by countries to cut emissions and boost energy efficiency

The 4°C Scenario

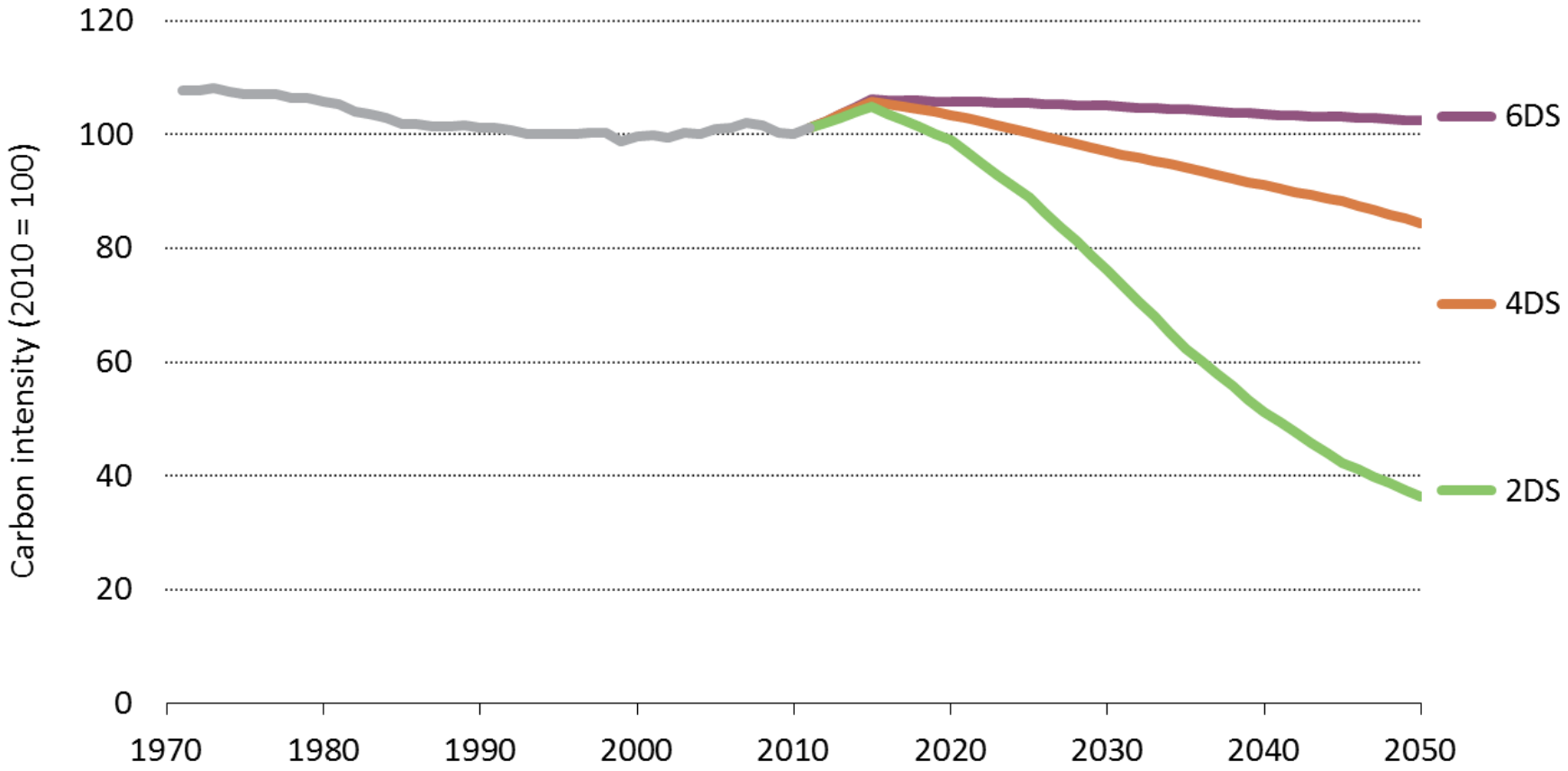
6DS

where the world is now heading with potentially **devastating** results

The 6°C Scenario

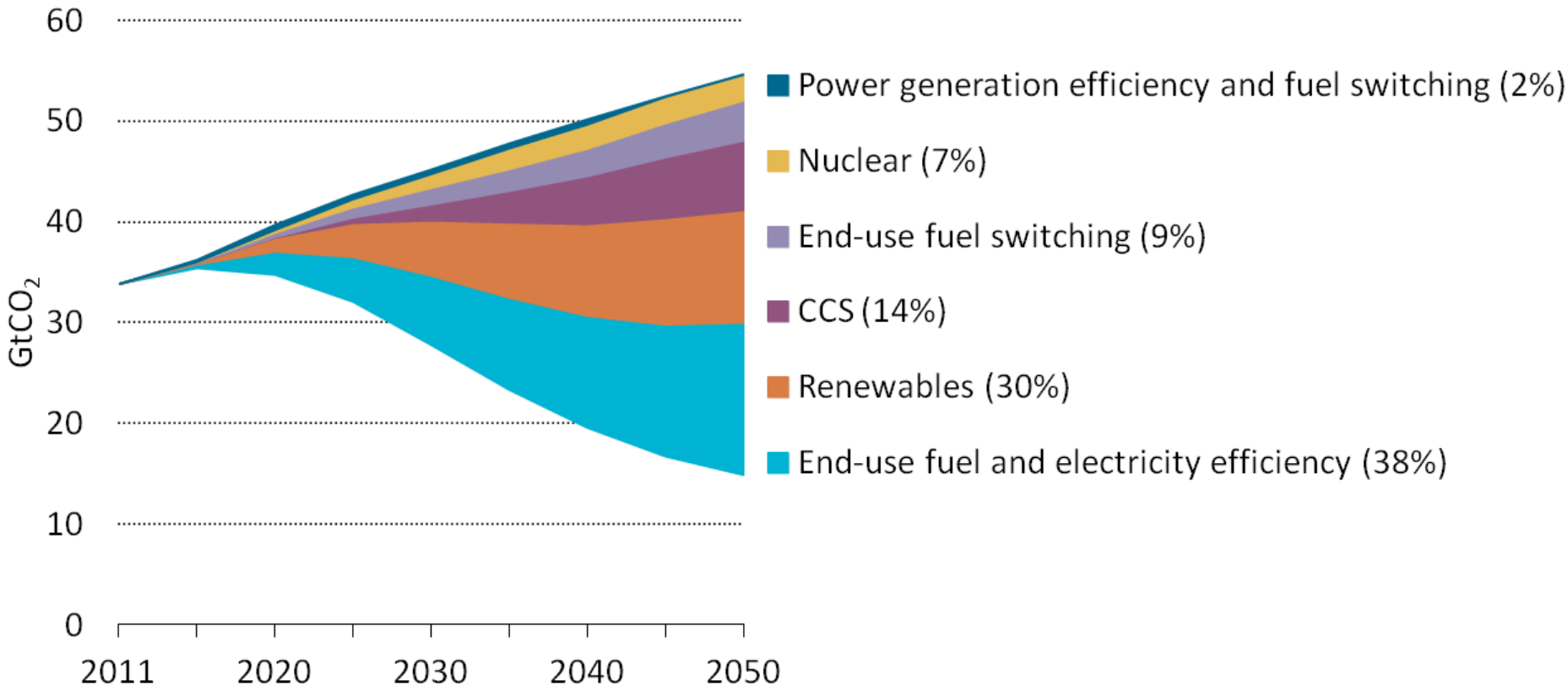
International Energy Agency

Carbon intensity of supply must fall rapidly



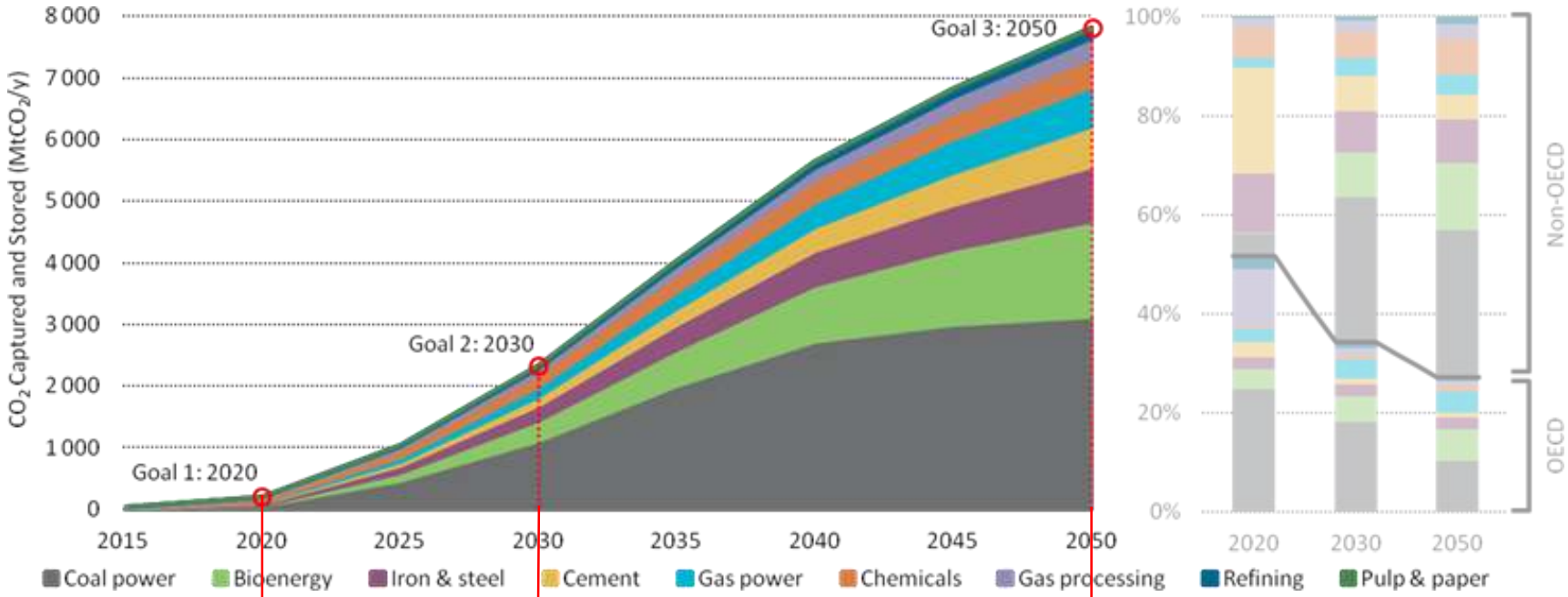
The 4DS and 2DS lead to dramatic reductions of the carbon-intensity index: by 15 points in the 4DS and by 64 points in the 2DS by 2050

A transformation of supply and use is needed



Carbon capture and storage (CCS) contributes 14% of total emissions reductions through 2050 relative to the 6DS

IEA vision: 120 Gt of CO_2 stored by 2050



Goal 1: 2020
Over 30 large projects in operation in power and across a range of industrial processes, storing 50 $MtCO_2$ per year.

Goal 2: 2030
Over 2 $GtCO_2$ is stored per year. CCS routinely used in power and certain industrial applications.

Goal 3: 2050
Over 7 $GtCO_2$ stored per year. CCS routinely used in all applicable power and industrial applications.

IPCC Fifth Assessment Report Synthesis Report

2nd November 2014
Copenhagen

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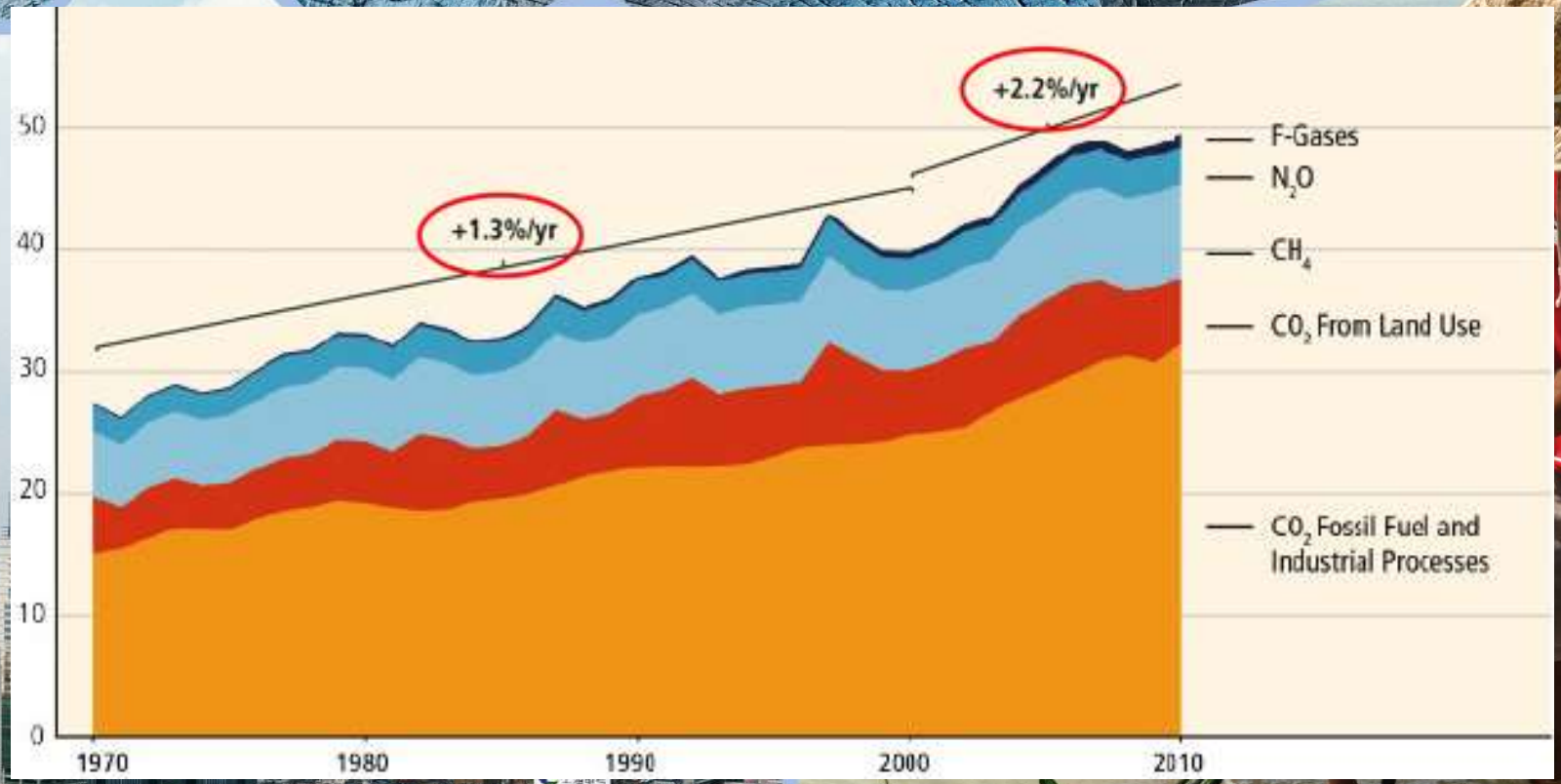
INTERGOVERNMENTAL PANEL ON climate change
WMO UNEP

GHG emissions growth between 2000 and 2010 has been larger than in the previous three decades



AR5 WGIII SPM

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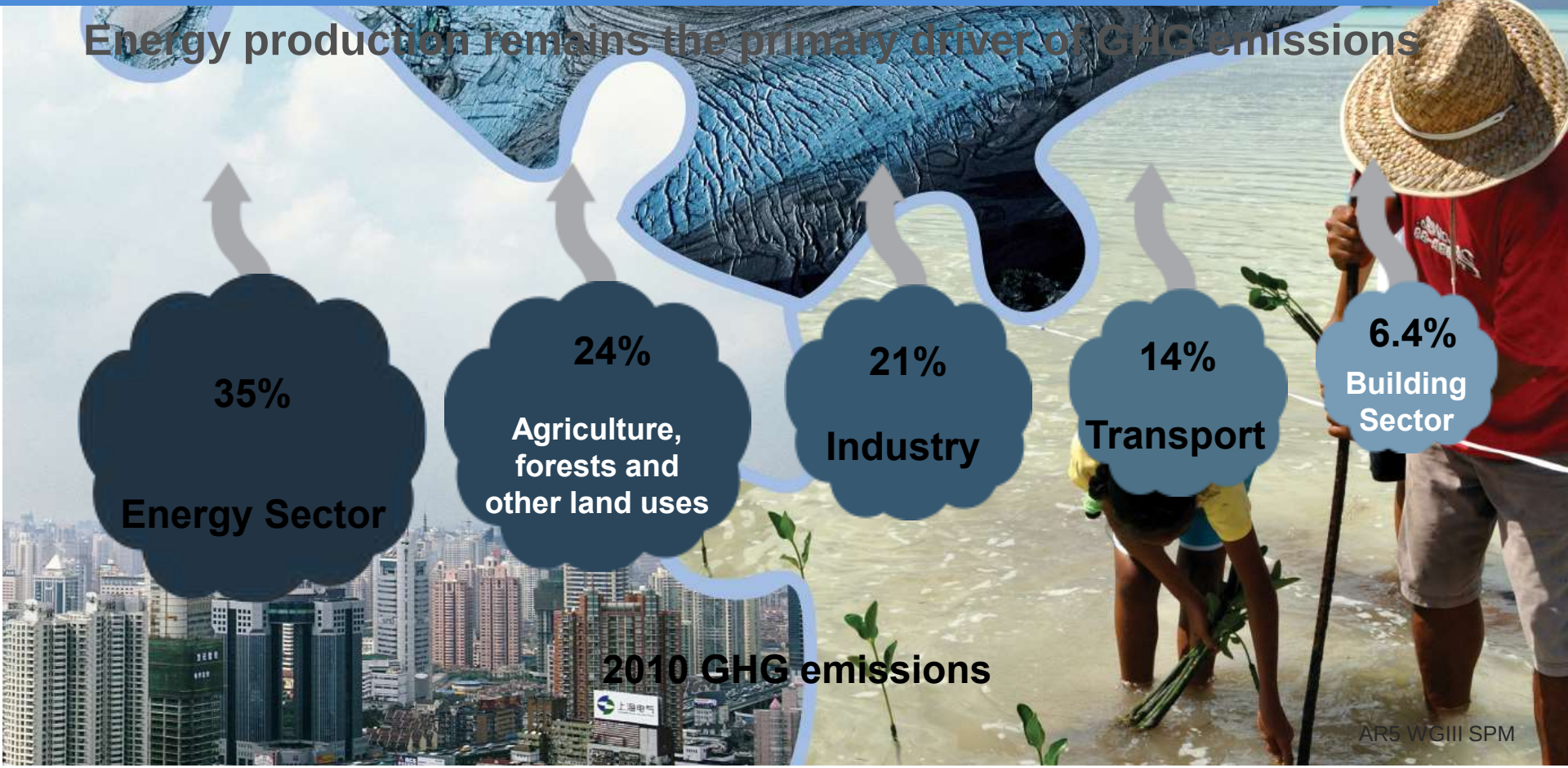
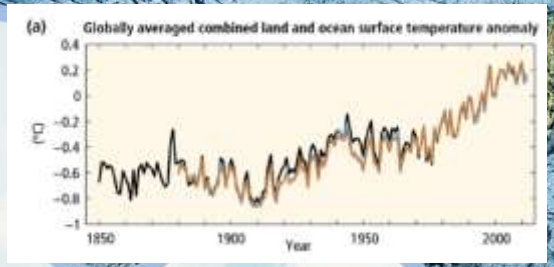
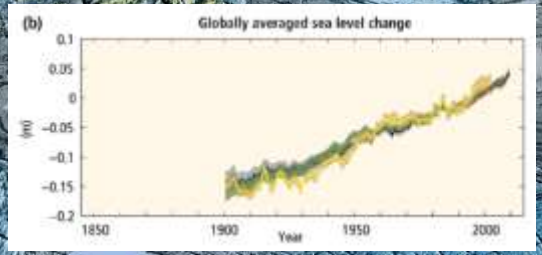
Sources of emissions

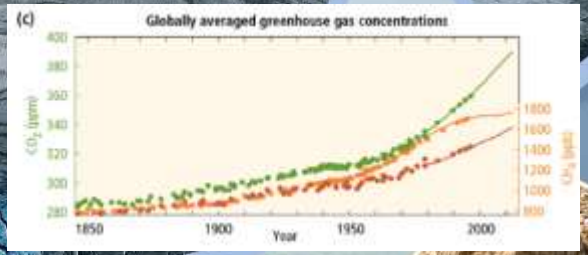
Energy production remains the primary driver of GHG emissions

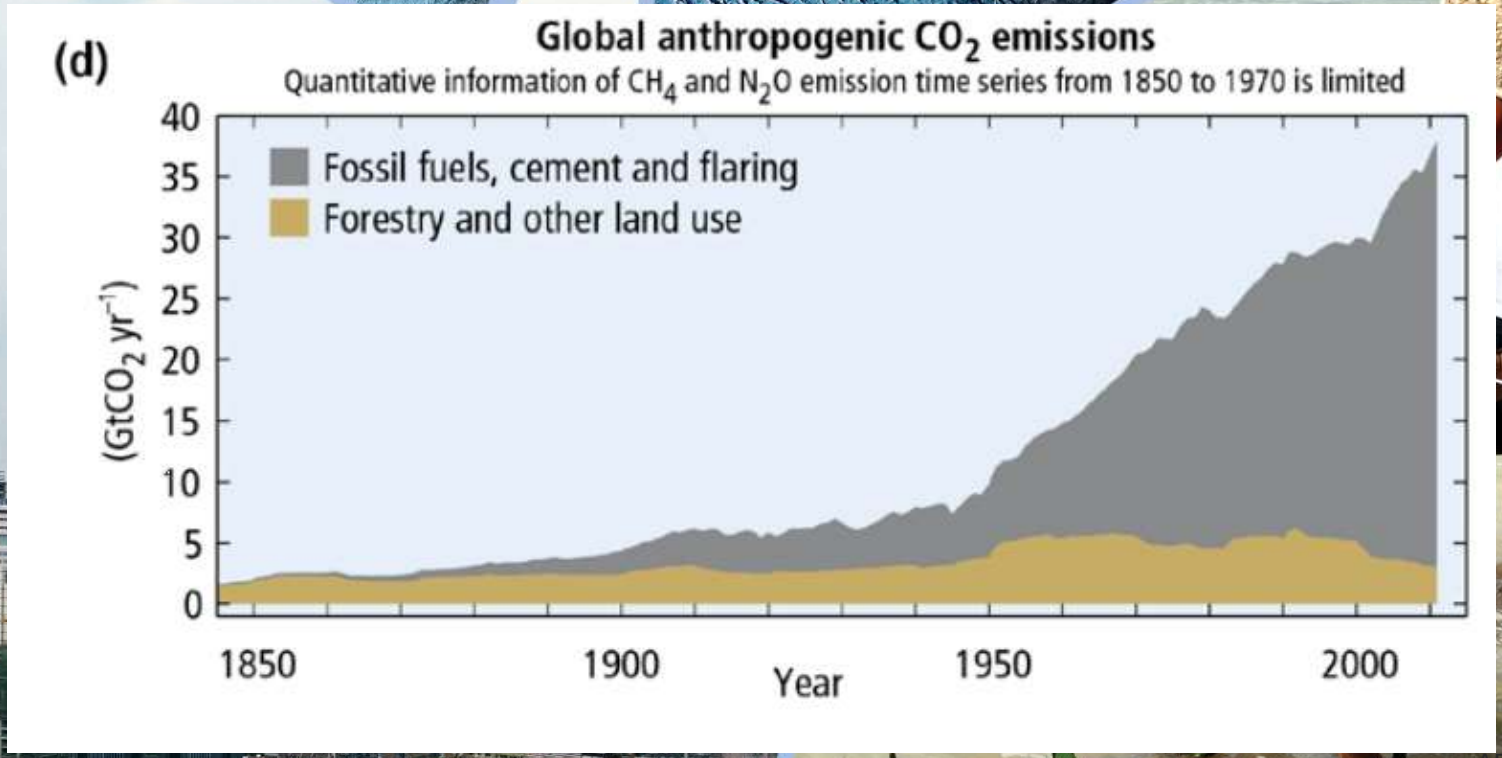


AR5 WGIII SPM









AR5 SYR SPM

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Mitigation Measures

More efficient use of energy

Greater use of low-carbon and no-carbon energy

- Many of these technologies exist today

Improved carbon sinks

- Reduced deforestation and improved forest management and planting of new forests
- Bio-energy with carbon capture and storage

Lifestyle and behavioural changes

AR5 WGIII SPM

IPCC AR5 SYR Table 3.2 (2014)

	Increase in total discounted mitigation costs in scenarios with limited availability of technologies			
	[% increase in total discounted mitigation costs (2015–2100) relative to default technology assumptions]			
2100 Concentration (ppm CO_2eq)	No CCS	Nuclear phase out	Limited Solar / Wind	Limited Bio-energy
450 (430–480)	138 (29–297) [N: 4]	7 (4–18) [N: 8]	6 (2–29) [N: 8]	64 (44–78) [N: 8]
500 (480–530)				
550 (530–580)	39 (18–78) [N: 11]	13 (2–23) [N: 10]	8 (5–15) [N: 10]	18 (4–66) [N: 12]
580–650				

IPCC AR5 and CCS

- Importance both for reducing emissions from fossil fuels and also for combining with bioenergy to take CO_2 out of the atmosphere (BECCS or BioCCS).
- Removing CCS from the mix will **increase** mitigation costs by **138%** - by far the highest increase from any of the technologies analysed (bioenergy, wind, solar, nuclear) - and may not be able to achieve 450ppm CO_{2eq} (+2C)
- ***"Note that many models cannot reach concentrations of about 450 ppm CO2eq by 2100 in the absence of CCS"*.**
- So we really do need CCS in the portfolio of low carbon energy technologies.
- CCS also has benefits for the fossil fuel producers - CCS would reduce the adverse effects of mitigation policies on the value of fossil fuel assets.

IPCC AR5 WGIII (Mitigation) Summary report

- Decarbonizing electricity generation is a key component of cost-effective mitig ation strategies
  - Decarbonization happens more rapidly in electricity generation than in the industry, buildings, and transport sectors
  - The share of low-carbon electricity supply (incl CCS) increases from 30% to more than 80 % by 2050,
  - Fossil fuel power generation without CCS is phased out by 2100.
- GHG emissions reduced significantly by:
  - Replacing average efficiency coal fired power plants with modern high efficiency natural gas plants or CHP
  - Proviso's
    - Natural gas is available
    - Emissions from extraction and supply are low or mitigated
  - Natural gas without CCS is a bridging technology

Energy Transition Case studies

USA

- Shale gas revolution changed energy dynamics
- New EPA rules for fossil fuel power plants
  - Unabated gas
  - Or partial capture on coal fired power plant
- Renewables increase
- Cheap coal to export

Germany

- High renewables penetration
- Nuclear phase out
- Gas has cost and security of supply issues
- Using unabated coal to balance grid demand and reduce costs to consumer
- CO2 emissions going back up

Energy Transition Case studies

China

- Coal dominant energy source for foreseeable future
- Pollution driving change not climate change
- Increasing use of renewables/nuclear and EE
- Shale gas won't take off for a decade or more
- Fossil fuel imports increasing – destabilising regional energy supplies

Japan

- Post Fukushima nuclear conundrum
- CO2 emissions rising through use of unabated coal
- Limited geological resources for CO2 storage
- Plans for more renewables/EE
- Coal lowest cost imported fossil fuel with stable supply

Thank you, any Questions?

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