GLOBAL CCS INSTITUTE

GLOBAL OUTLOOK FOR CCUS

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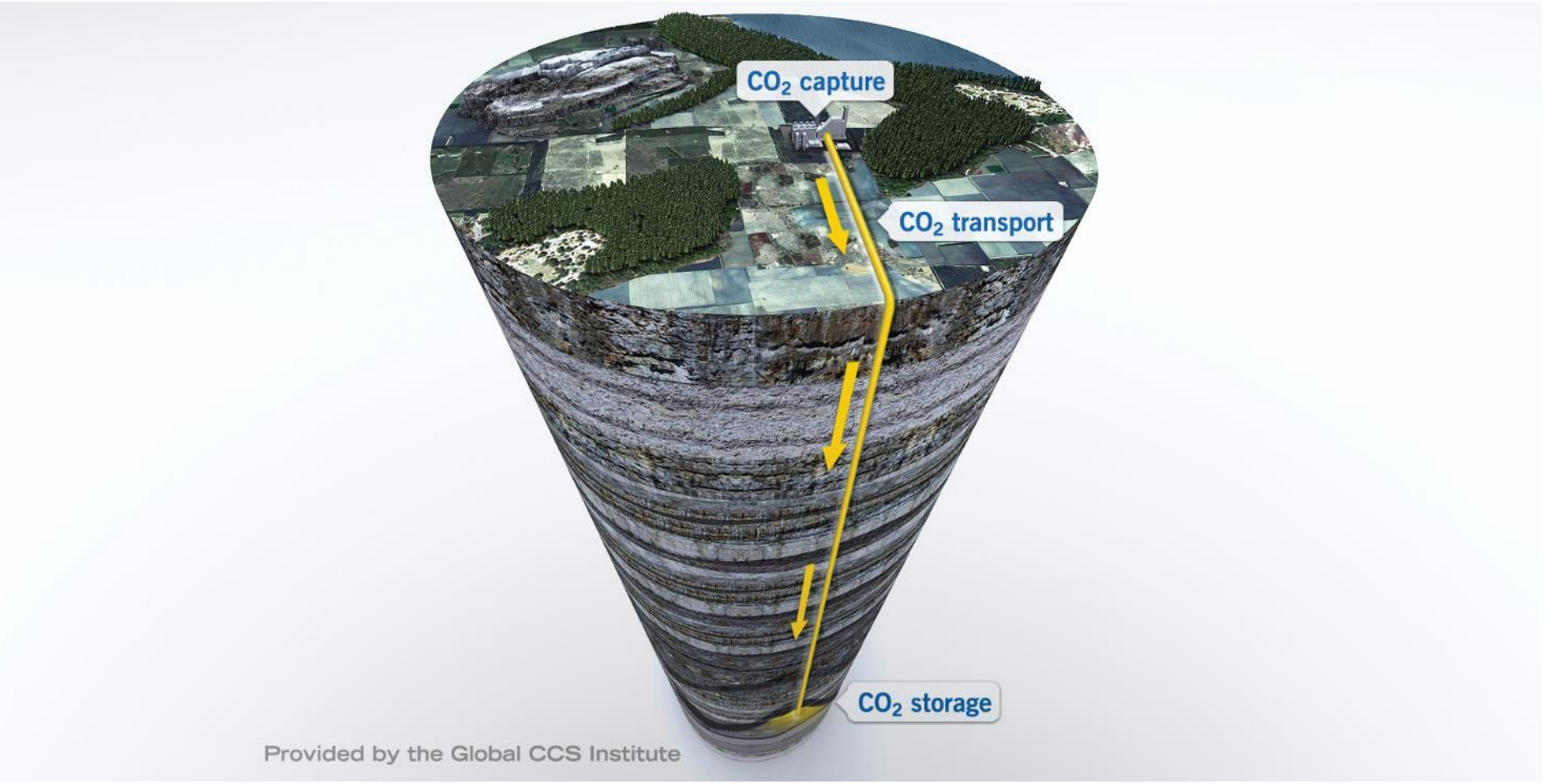
Global CCS Institute

CAGS Technical Workshop
26 June 2017

CARBON CAPTURE AND STORAGE



Capture: Major infrastructure

CO_2 compressor unit (after absorption capture)

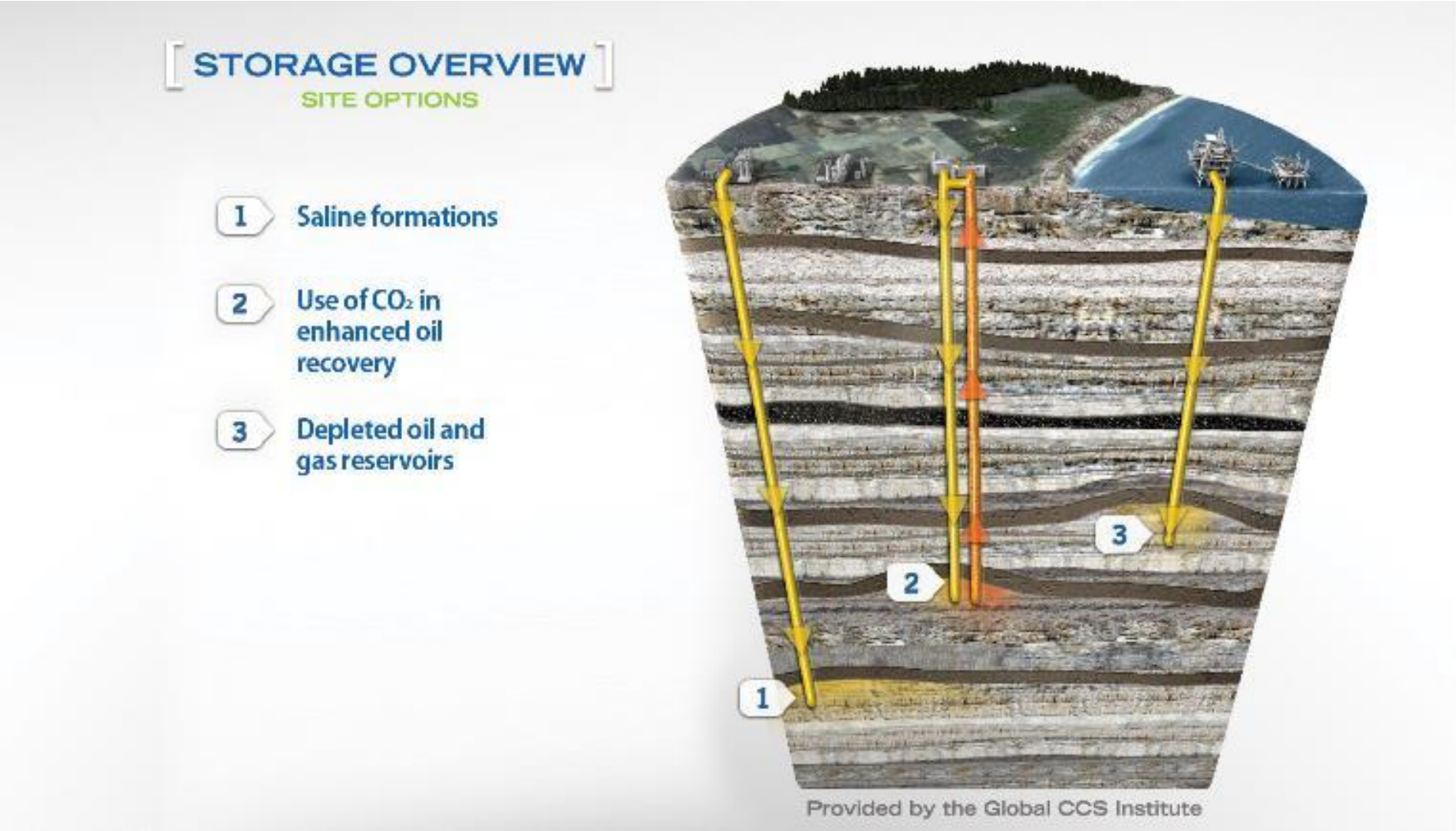
Gorgon Project- CO_2 injection rate of 3-4 Mtpa

Pipeline engineering: a mature industry

Source: DoE/NETL(2013)

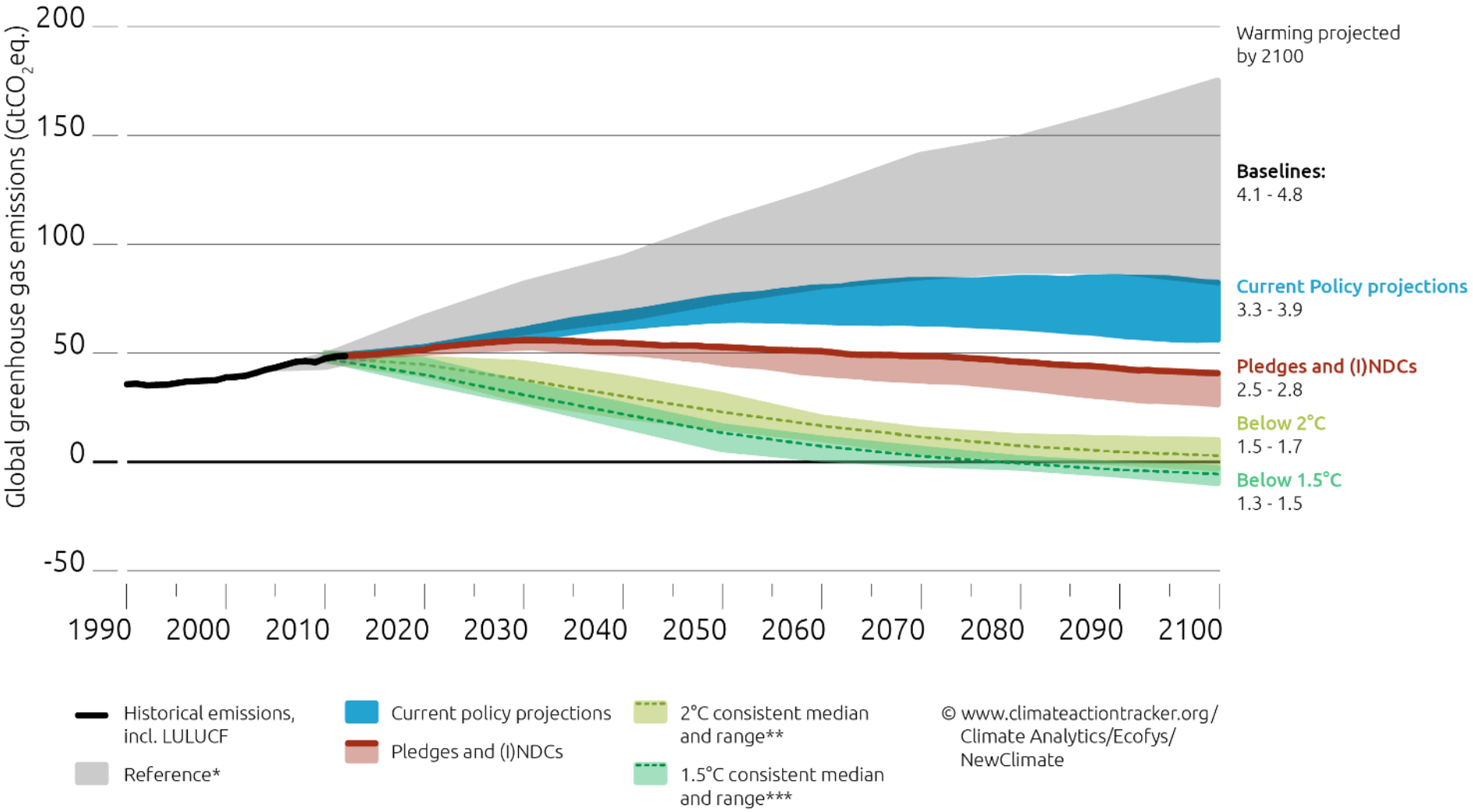
CO_2 Pipeline Network in the USA

Storage: 40 years of knowledge



CCS: THE INCONVENIENT TRUTH

Paris commitments: currently on track for +3ºC

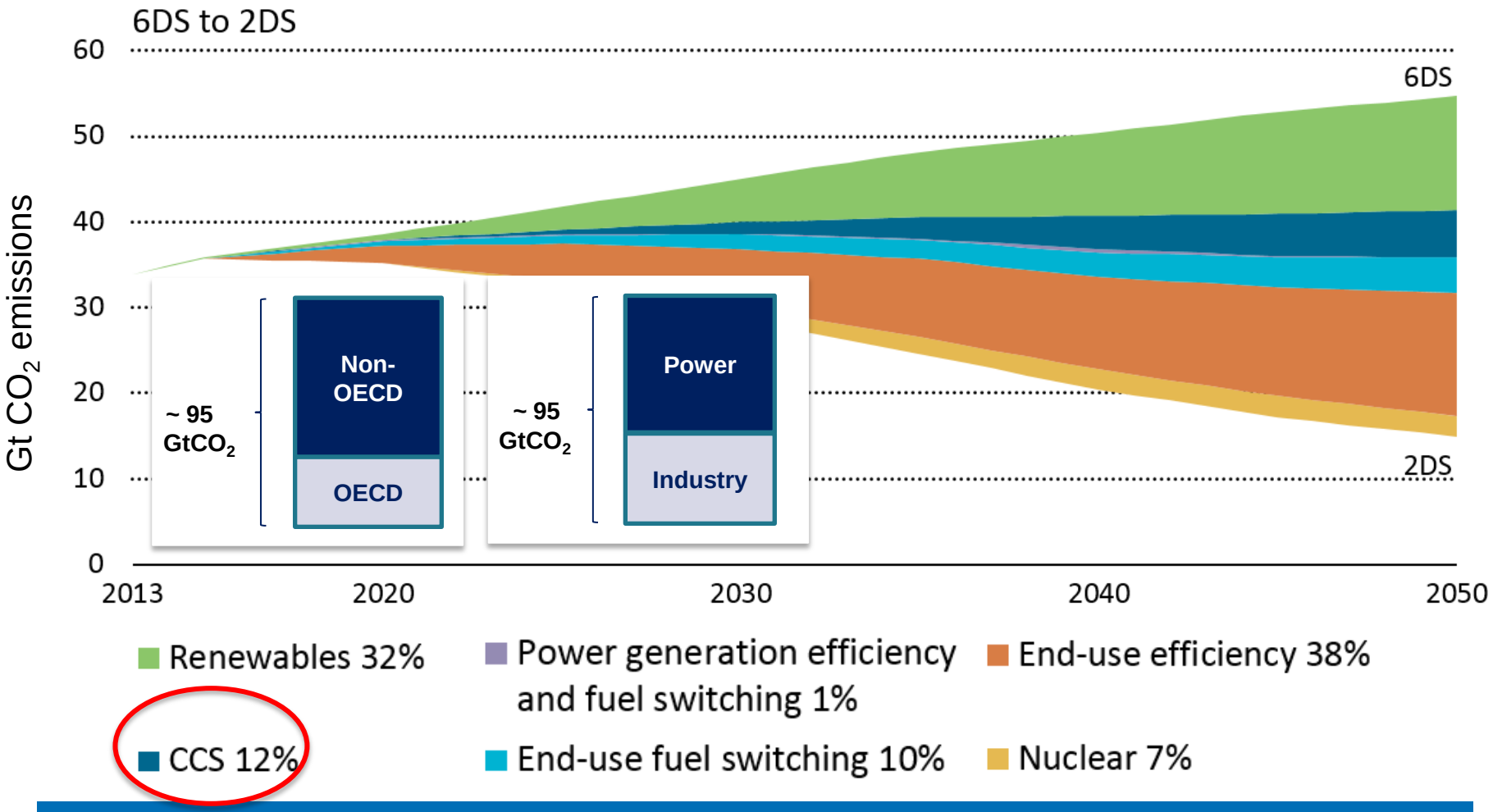


Source: Climate Action Tracker (2017)

CoP21: Need for CCS will become more visible

- **CoP21 was a significant step forwards:**
  - 195 countries agreed a higher level of ambition; limiting global warming to1.5 - 2^{o}C
  - Established bottom-up architecture for emission reduction targets allowing nations to determine their national contributions
  - Established a process of regular (5 yearly) reviews of national emission reduction targets and an expectation that targets will become more stringent

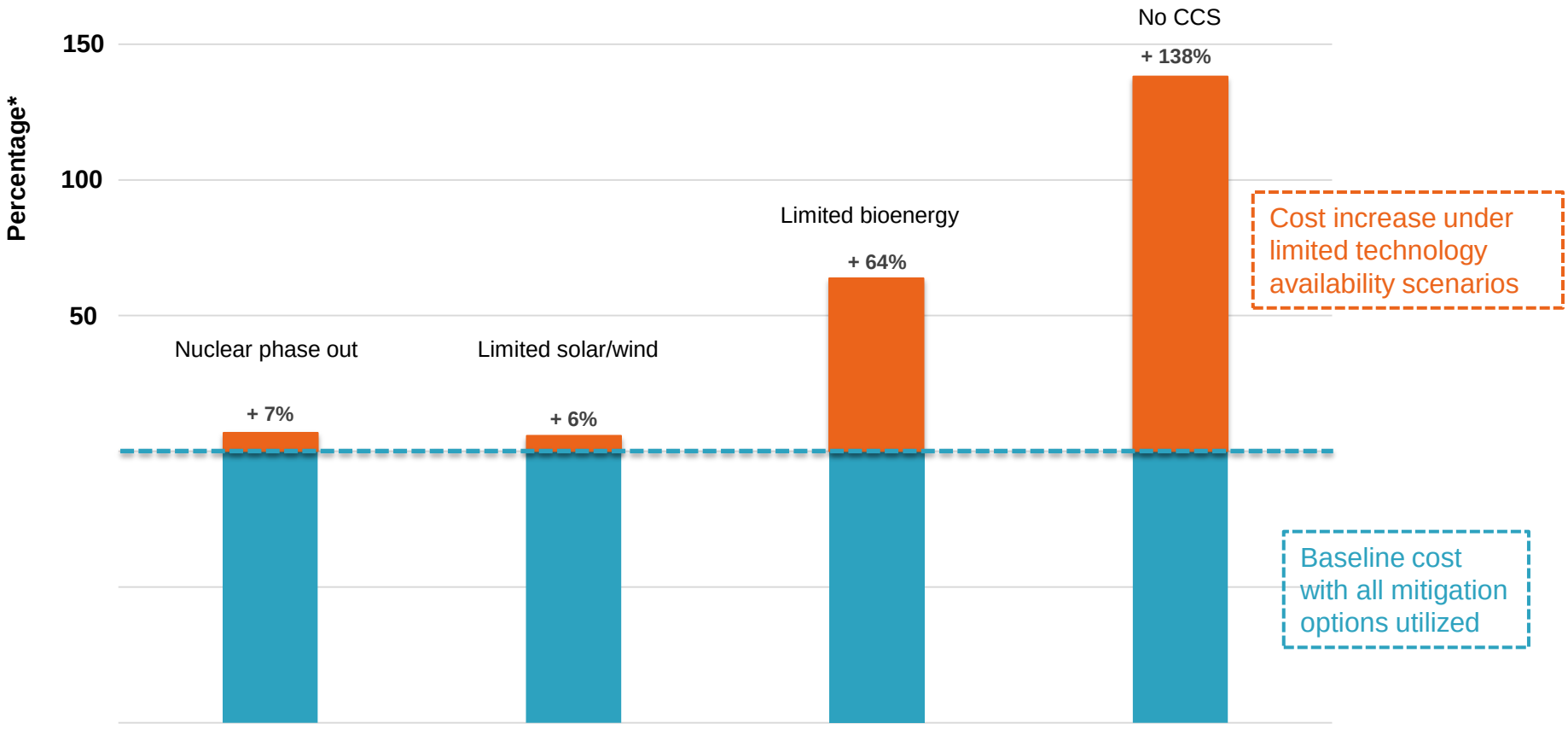
CCS is a vital element of a low-carbon energy future



A transformation in how we generate and use energy is needed

Source: IEA Energy Technology Perspectives (2016)

Mitigation costs more than double in scenarios with limited availability of CCS

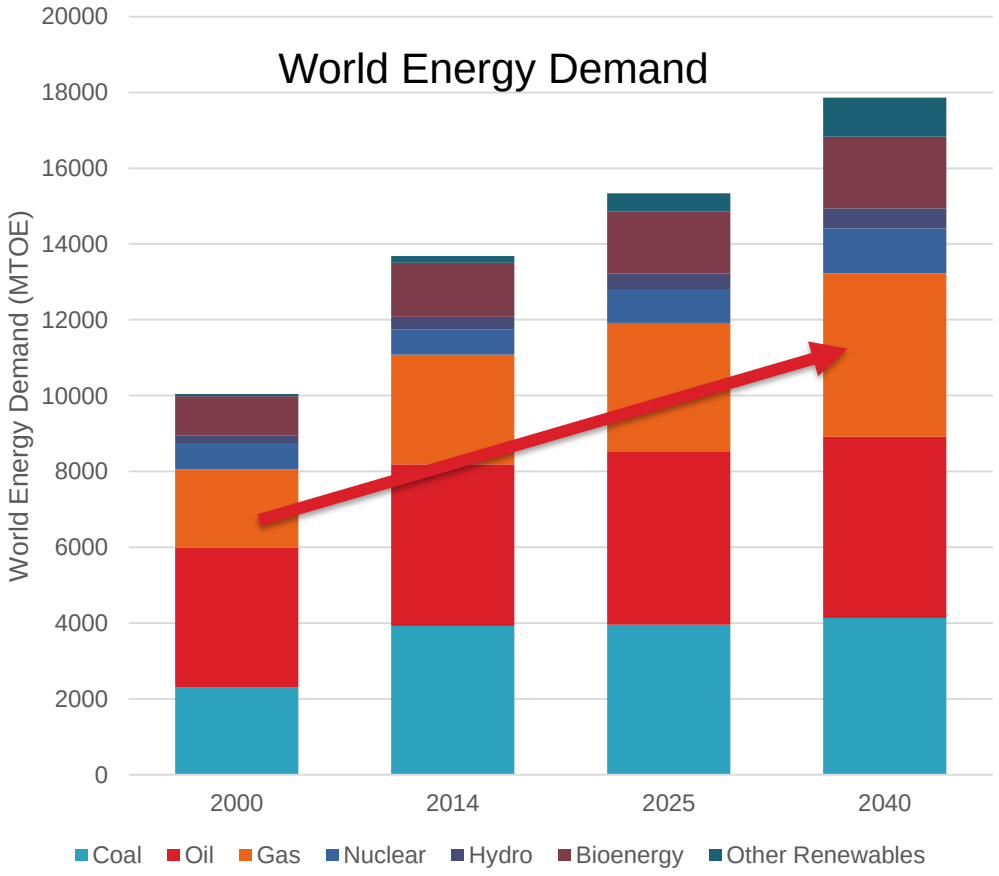


*Percentage increase in total discounted mitigation costs (2015-2100) relative to default technology assumptions – median estimate

Source: *IPCC Fifth Assessment Synthesis Report, Summary for Policymakers, November 2014.*

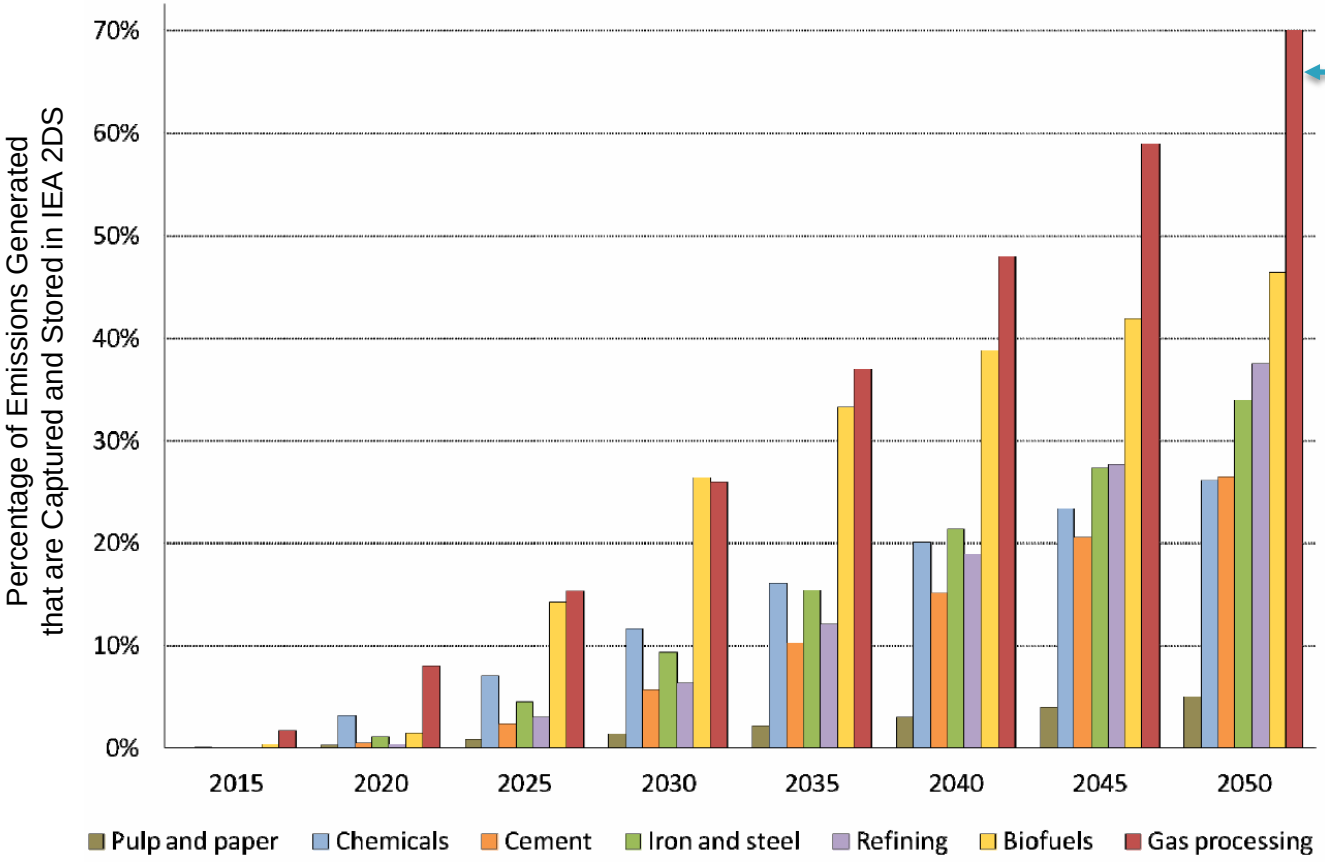
Fossil fuel demand growing & reserves robust

Fossil Fuel Share	80%	81%	78%	74%



Source: *IEA World Energy Outlook,* 2016 (New policies scenario)

Industrial emissions: CCS is only viable option



Source: *IEA Global Action to Advance CCS; 2013*

70% of CO_2 emissions from gas processing must be captured and stored by 2050 in the IEA 2 Degree Celsius Scenario

Currently, in most high emission industries there are no cost-effective and technically viable method to reduce emissions, apart from CCS

STATUS OF CCS: 2017

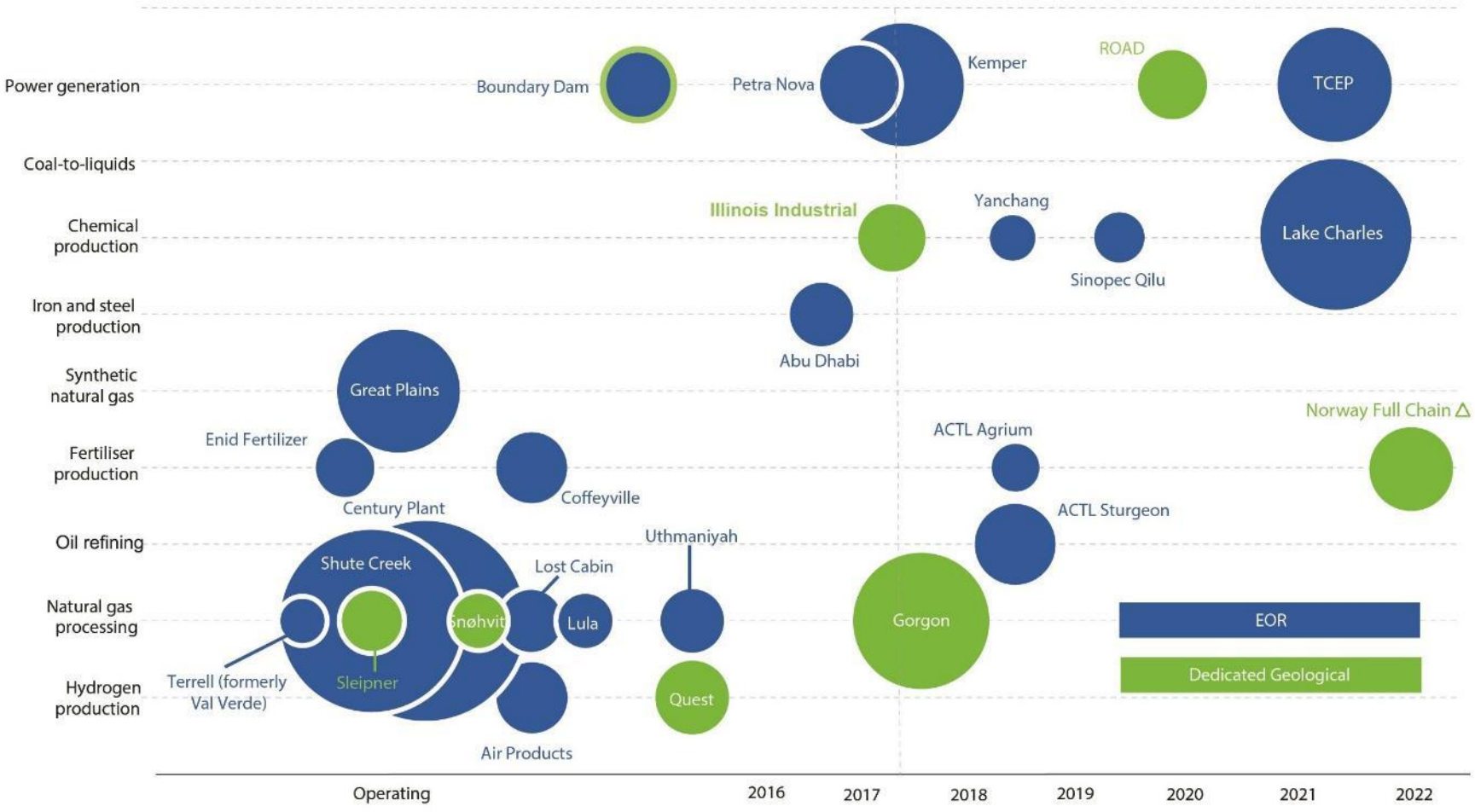
Large-scale CCS facilities by region or country

	Early planning	Advanced planning	Construction	Operation	Total
North America	1	2	3	12	18
China	5	2	1	-	8
Europe	2	2	-	2	6
Gulf Cooperation Council	-	-	-	2	2
Rest of World*	3	1	1	1	6
Total	11	7	5	17	40

** Includes facilities in Australia, Brazil and South Korea.*

North America dominates – 15 (of 22) facilities in operation or construction, China has most facilities in planning

Actual and expected operation dates up to 2022 for large-scale CCS projects by industry and storage type*



*** Includes projects in the Operate, Execute and Define stages**

Δ Feasibility studies assessed the possibility of CO_2 capture and storage from ammonia production, from cement production and from waste-to-energy sources

CCS Facilities – power, industry

Source: NRG

Petra Nova Carbon Capture (2017)

- Capture: Sub-bituminous coal-fired
  - Post combustion (Amine); retrofit
- Storage: CO_2-EOR
  - ~1.4 MTPA; West Ranch oil field

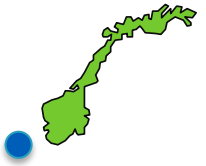

Source: Chevron Australia Pty Ltd

Gorgon CO_2 Injection Project (2017/18)

- Capture: Industrial, natural gas processing
  - Gas fields: 1-14% CO_2
- Storage: Dedicated
  - 3.4 and 4.0 MTPA CO_2


Source: Statoil

Sleipner (1996)



- Capture: Industrial, natural gas processing
  - Fields: <2-9%
- Storage: Dedicated
  - ~1 MTPA
  - Utsira Formation

CCS Facilities – next generation industries


Source: Yanchang Petroleum

Coal-to-X

Yanchang CCS Project (2018; pilot)

- Capture: Industrial gasification
  - Coal-to-chemical, Coal-to-liquids
- Storage: CO_2-EOR
  - Yanchang oil fields, 0.41 MTPA CO_2


Source: JapanCCS

Hydrogen

Tomakomai CCS Demonstration (2016)

- Capture: Hydrogen production (Amine)
- Dedicated geological storage
  - Onshore-offshore storage
  - 100,000 TPA


Source: Illinois Decatur ADM

BioEnergy - CCS

Illinois Industrial CCS Project (2017)

- Capture: Fermentation, Corn-to-ethanol plant
- Storage: Dedicated
  - ~ 1 MTPA

CCS is real, CCS is needed



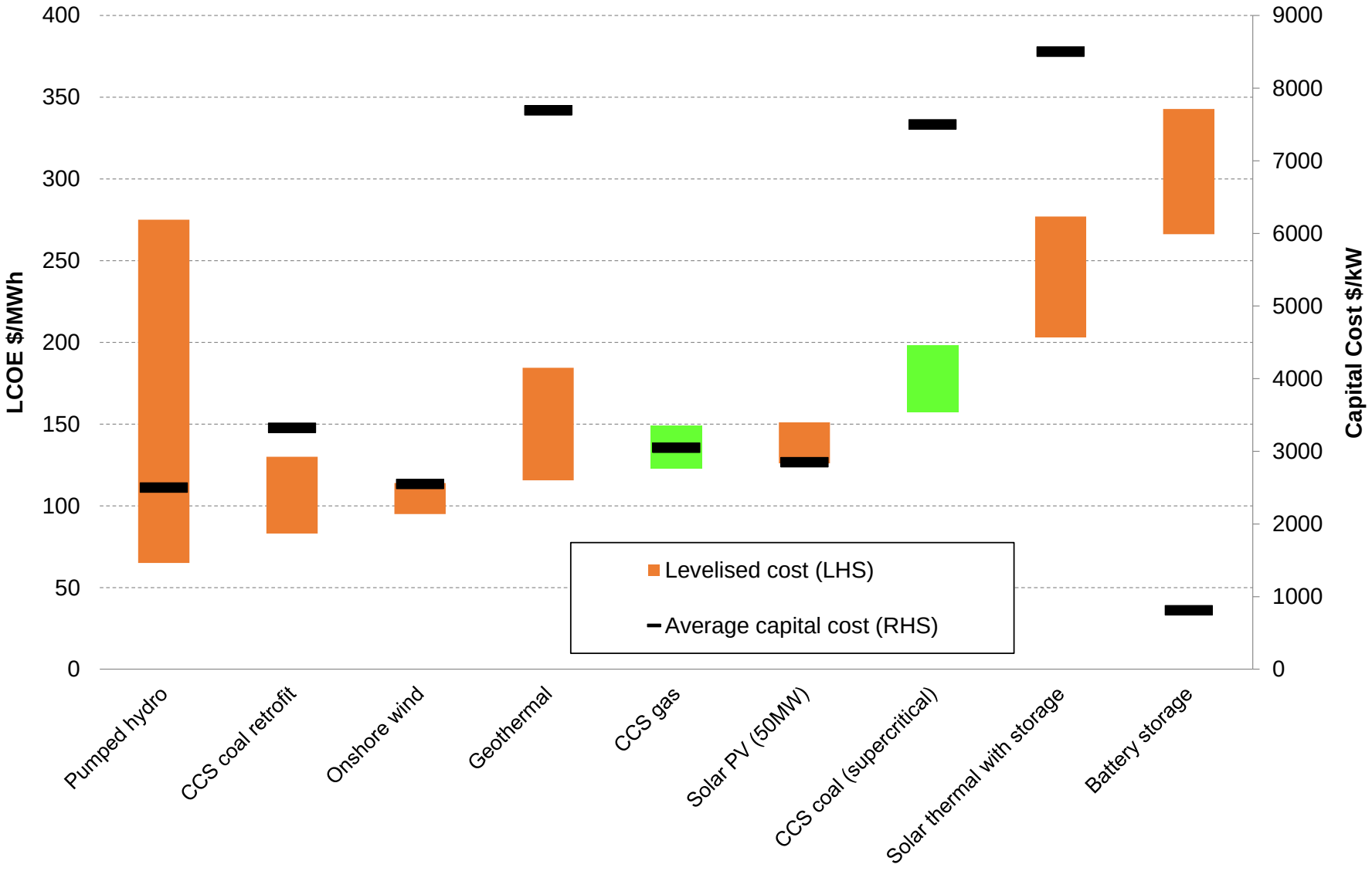

Current operating and facilities under construction have around 40 Mtpa of CO_2 capture capacity







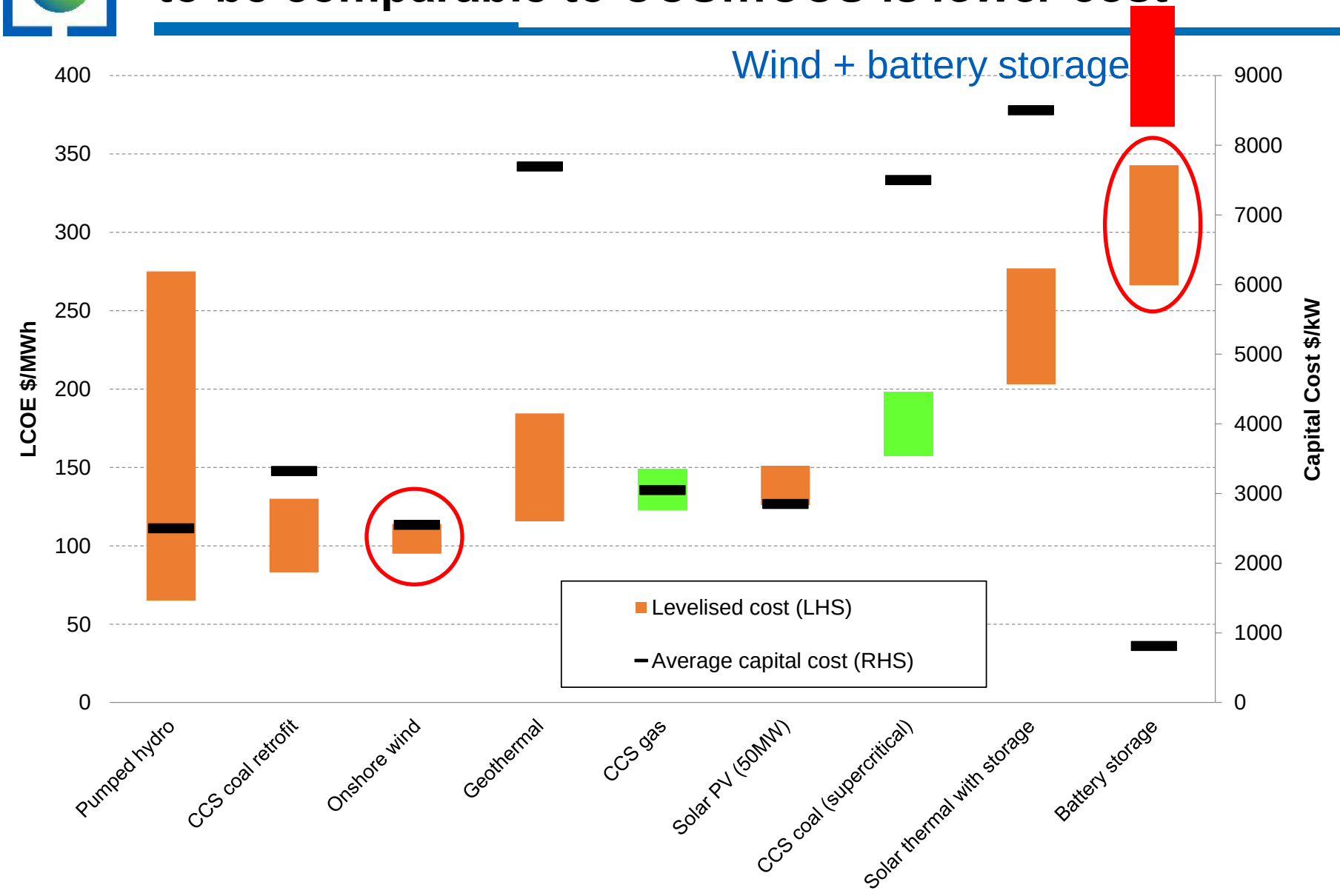

CCS is competitive with other low emission technologies



Sources: CO2CRC, 2015; MEI/Arup, 2014; Lazard, 2014.

Note: These costs are for Australia

Intermittent renewables also require energy storage to be comparable to CCS…CCS is *lower* cost



Sources: CO2CRC, 2015; MEI/Arup, 2014; Lazard, 2014.

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Challenge & Opportunity

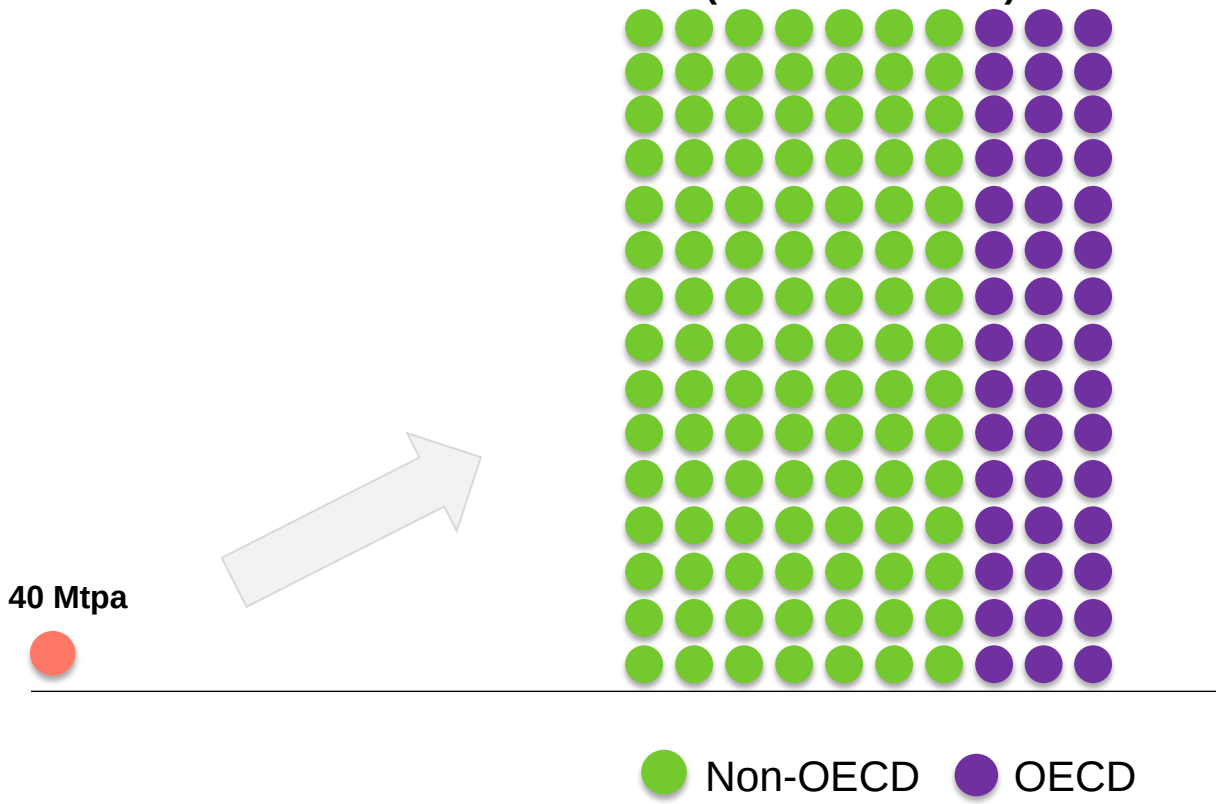
Global Status of CCS (June 2017)

40 large-scale CCS projects - combined capture capacity of approximately 71 Mtpa*:

- 22 projects in operation or construction (**40 Mtpa**)
- 6 projects in advanced planning (6 Mtpa)
- 12 projects in earlier stages of planning (25 Mtpa)

*Mtpa = million tonnes per annum

~6,000 Mtpa of CO_2 captured by CCS by 2050 (IEA 2D Scenario)**



****Source**: *IEA, Energy Technology Perspectives (2016).*

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Some BIG numbers…

95 Gt | IEA CCS contribution **2015-2050**

which means

6 Gtpa | IEA CCS per annum contribution in **2050**

which equals

120 TCF

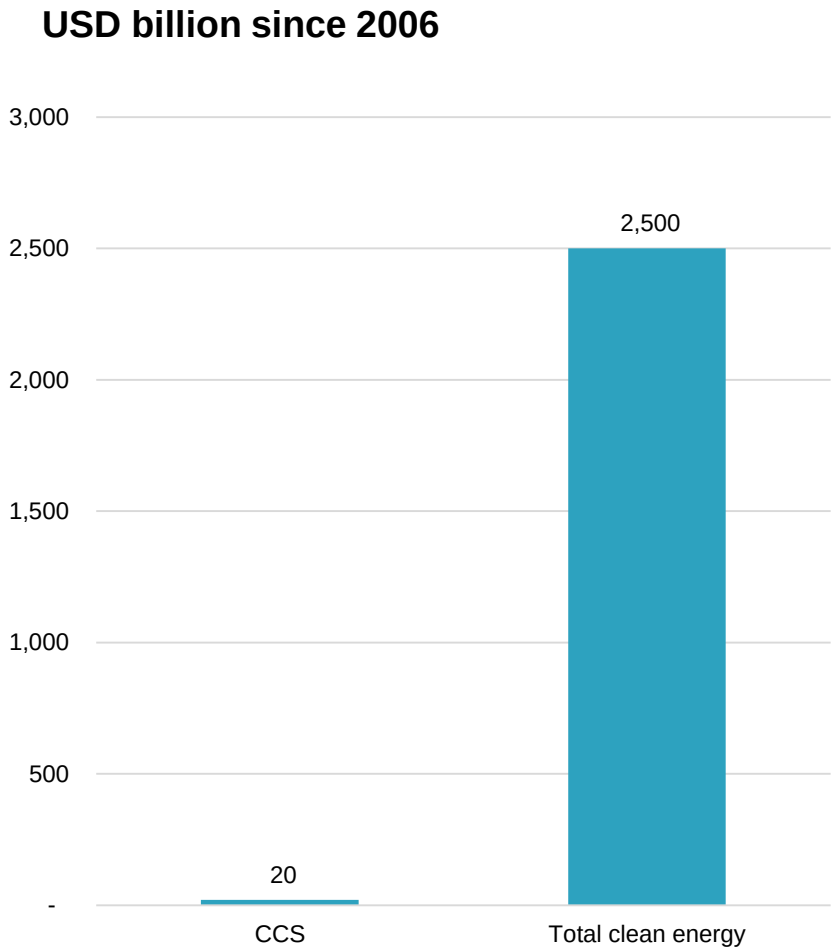
in 2013 we used

115 TCF | IEA WEO 2013 **natural gas consumption**

HOW CAN WE GET THERE?

Strong policy drives investment – CCS must be afforded 'policy parity'

- Scale of renewables investment is instructive
- CCS has not enjoyed commensurate policy support
- Enhanced oil recovery has provided impetus in North America
- Policy parity is essential
- How do we get CCS onto a similar curve?



Data source: **IEA 2015 "Tracking Clean Energy Progress". Bloomberg New Energy Finance "Clean Energy Investment By the Numbers – End of Year 2015" fact pack.**

Advocacy: International influence

Unparalleled access to international decision-making

- Advocating for CCS policy support in important multilateral agreements and platforms
- The primary channel of influence for CCS in the United Nations Framework Convention on Climate Change
- Knowledge of international CCS funding programs
- Influencing CCS design via the International Standards Organisation (ISO)

Accredited Observer

UNFCCC
Green Climate Fund
Intergovernmental Panel on Climate Change

Member

Climate Technology Centre and Network
United Nations Global Compact

Participant

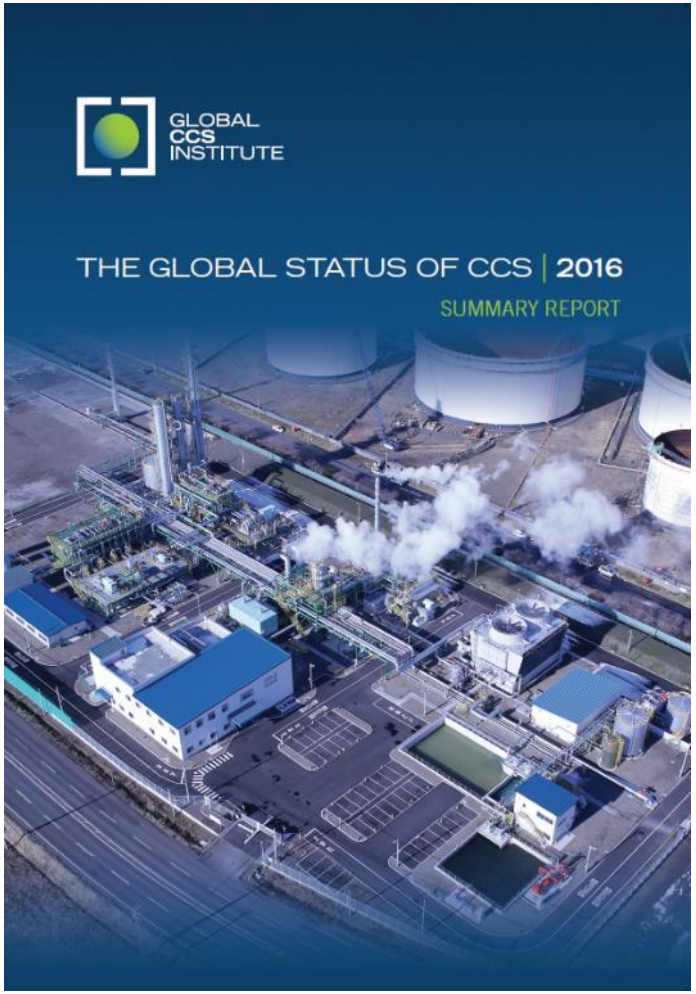
Carbon Sequestration Leadership Forum
Clean Energy Ministerial
North American Energy Tri-Lateral

Paris Agreement

Photograph: Francois Mori/AP (Guardian 2016)

- Countries must be further encouraged to include CCS in the next wave of NDCs (access to affordable finance for projects may depend on it)
- CCS needs higher representation in developing country TNAs
- 10 countries cite CCS in INDCs – represents a third of global emissions
  - Adding those countries that we know to have an active interest in CCS, but who have not cited CCS in their NDCs, could represent > 65% of global emissions

Advocacy: Status and the underground



The Institute's key publication can be found at:

status.globalccsinstitute.com

The Global CCS Institute

Our Vision for CCS:
CCS is an integral part of a low-carbon future

- We are an international membership organisation.
- Offices in Washington DC, Brussels, Beijing and Tokyo. Headquarters in Melbourne.
- Our diverse international membership consists of:
  - governments,
  - global corporations,
  - small companies,
  - research bodies, and
  - non-government organisations.
- Specialist expertise covers the CCS/CCUS chain.

Key Messages from the Global CCS Institute

CCS is a vital component of a low-carbon future.

CCS is established and already reducing emissions.

Strong policy support is required globally.

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