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# GLOBAL OUTLOOK FOR CCUS

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CAGS Technical Workshop  
26 June 2017



# Large-scale CCS facilities



**17 large-scale facilities are operational; more to come**



# 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
<b>Total</b>	<b>11</b>	<b>7</b>	<b>5</b>	<b>17</b>	<b>40</b>

\* 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**





# Large-scale CCS facilities by region or country

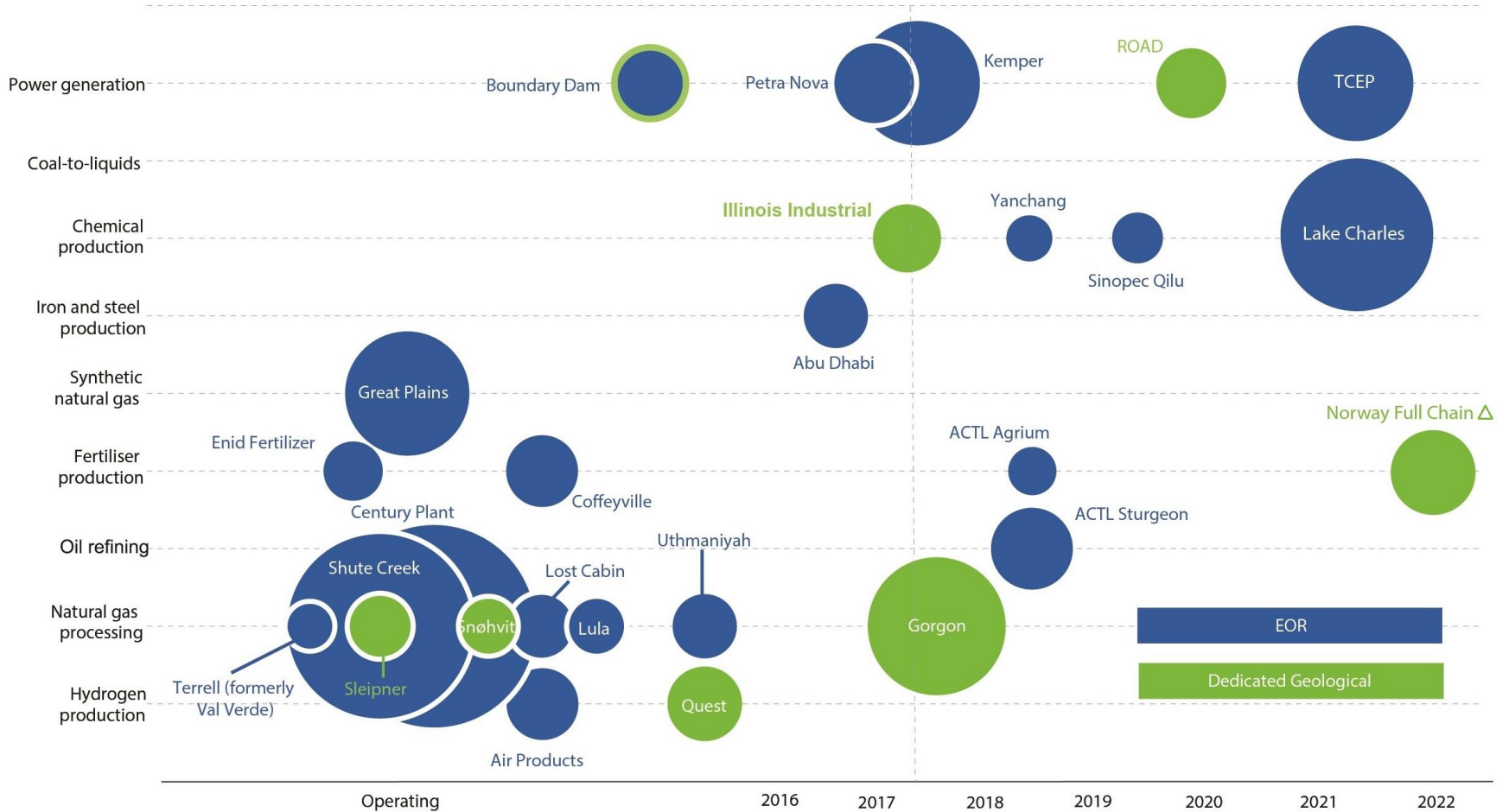
	Early planning	Advanced planning	Construction	Operation	Total
North America			3	12	18
<b>China</b>			<b>1</b>	-	<b>8</b>




**Yanchang CCS launch places CCS in China to front of world news**



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



 = 1Mtpa of CO<sub>2</sub> (area of circles proportional to capacity)

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

Δ Feasibility studies assessed the possibility of CO<sub>2</sub> capture and storage from ammonia production, from cement production and from waste-to-energy sources



# CCS Facilities – industry: the oldest



Source: Oxy

## Terrell Natural Gas Processing Plant (1972)

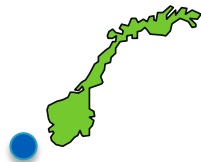


- Capture: Natural gas separation
- Storage: CO<sub>2</sub>-EOR
  - ~0.4 - 0.5 MTPA
  - Texas oil fields



Source: Statoil

## Sleipner (1996)



- Capture: Natural gas separation (amine)
  - Fields: <2-9%
- Storage: Dedicated
  - ~1 MTPA
  - Utsira Formation





## CCS Facilities – industry (2)



Source: Chevron Australia Pty Ltd

### Gorgon CO<sub>2</sub> Injection Project (2017/18)

- Capture: Industrial, natural gas processing
  - Gas fields: 1-14% CO<sub>2</sub>
- Storage: Dedicated
  - 3.4 and 4.0 MTPA CO<sub>2</sub>



Source: ESI

### Abu Dhabi CCS (2016)

- Capture: Emirates Steel Industries Factory
  - By-product of their direct reduced iron-making
- Storage: CO<sub>2</sub>-EOR
  - 0.8 MTPA; ADNOC Rumaiha oilfield



Source: PETROBAS

### Santos Basin Pre-Salt Oil Field CCS (2013)

- Capture: Natural gas separation (membrane)
  - Fields: 8-15%
- Storage: CO<sub>2</sub>-EOR (primary recovery)
  - ~1 MTPA; Lula and Sapinhoá oil fields





# 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<sub>2</sub>-EOR
  - Yanchang oil fields, 0.41 MTPA CO<sub>2</sub>



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 Facilities – power



## Petra Nova Carbon Capture (2017)

- Capture: Sub-bituminous coal-fired
  - Post combustion (Amine); retrofit
- Storage: CO<sub>2</sub>-EOR
  - ~1.4 MTPA; West Ranch oil field
  - 9 injection, 16 production wells



## Boundary Dam (2014)

- Operational: capture since 2015
- Capture: brown coal-fired
  - Post-combustion (Amine); retrofit
- Storage: CO<sub>2</sub>-EOR / Dedicated
  - 1 MTPA; Weyburn Oil field





# CCS is real, CCS is needed

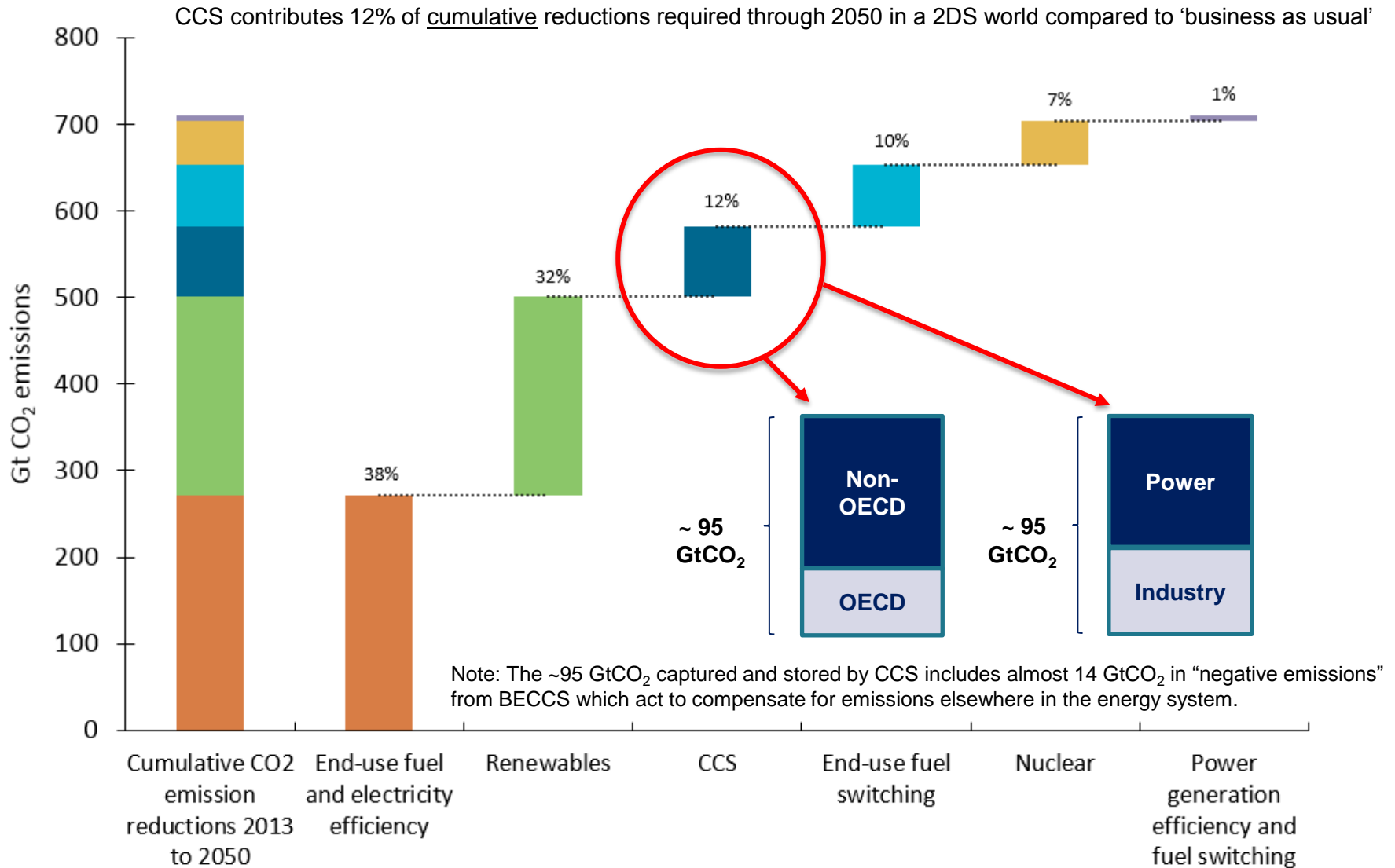
**Current operating and facilities under construction have around 40 Mtpa of CO<sub>2</sub> capture capacity**







# CCS is critical in a portfolio of low-carbon technologies



Source: IEA, Energy Technology Perspectives (2016)





# Challenge & Opportunity

## Global Status of CCS

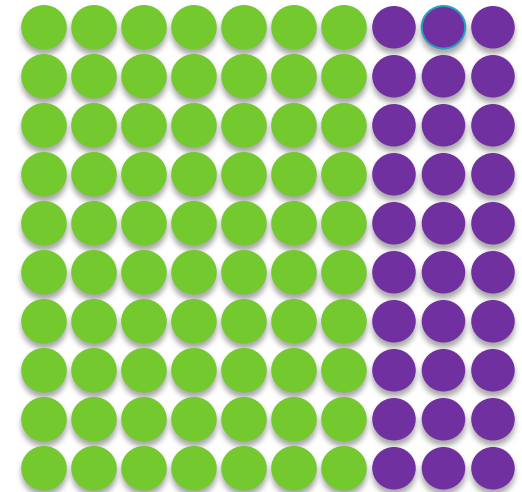
40 large-scale CCS projects - combined capture capacity of approximately 71 Mtpa\*:

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

40 Mtpa



**~4,000 Mtpa of CO<sub>2</sub> captured by CCS by 2040**  
(IEA 450 Scenario)\*\*



● Non-OECD ● OECD

\*Mtpa = million tonnes per annum

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



# Capture: Major infrastructure

CO<sub>2</sub> compressor unit (after absorption capture)



Gorgon Project- CO<sub>2</sub> injection rate of 3-4 Mtpa



# Pipeline engineering: a mature industry

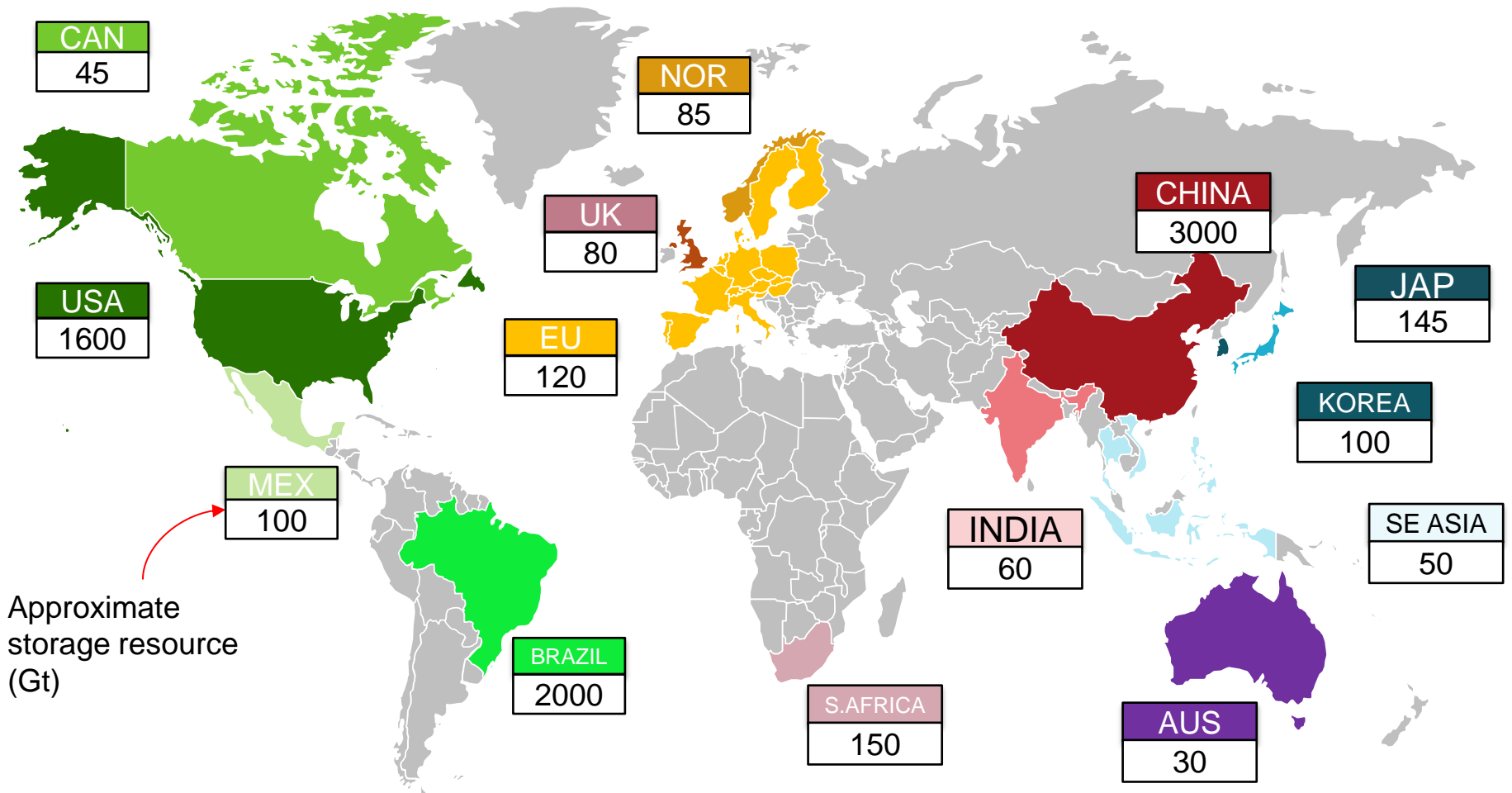


**CO<sub>2</sub> Pipeline Network in the USA**





# Substantial storage resources are present in most key regions of the world, sufficient to enable CCS

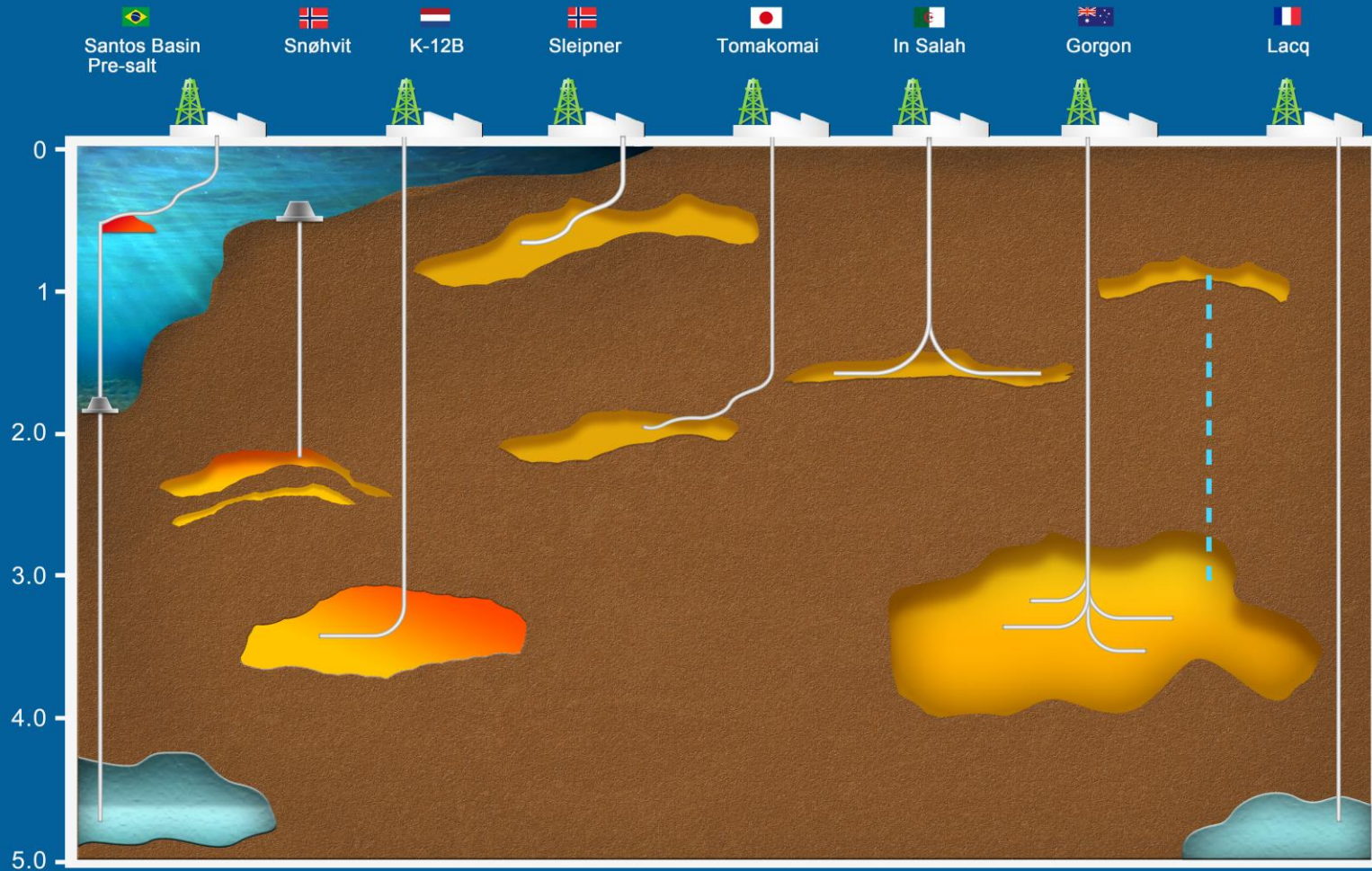


Approximate  
storage resource  
(Gt)

Values from various public sources of information, including national to basin-scale studies to assessments of depleted oil and gas fields only. SE Asia only includes Indonesia (South Sumatra), Philippines, Thailand, Viet Nam.

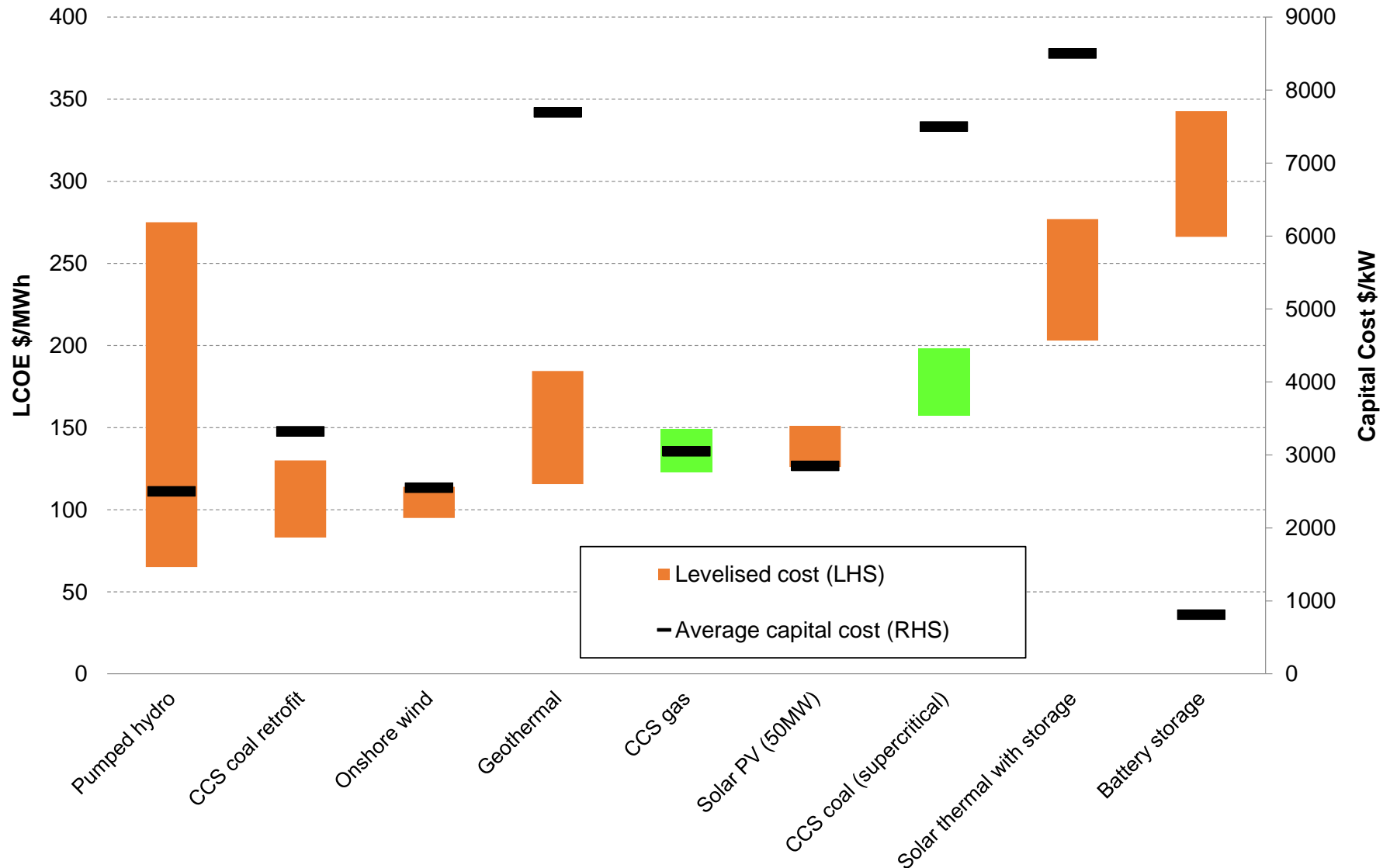


# Storage across wide range of environments and injection strategies





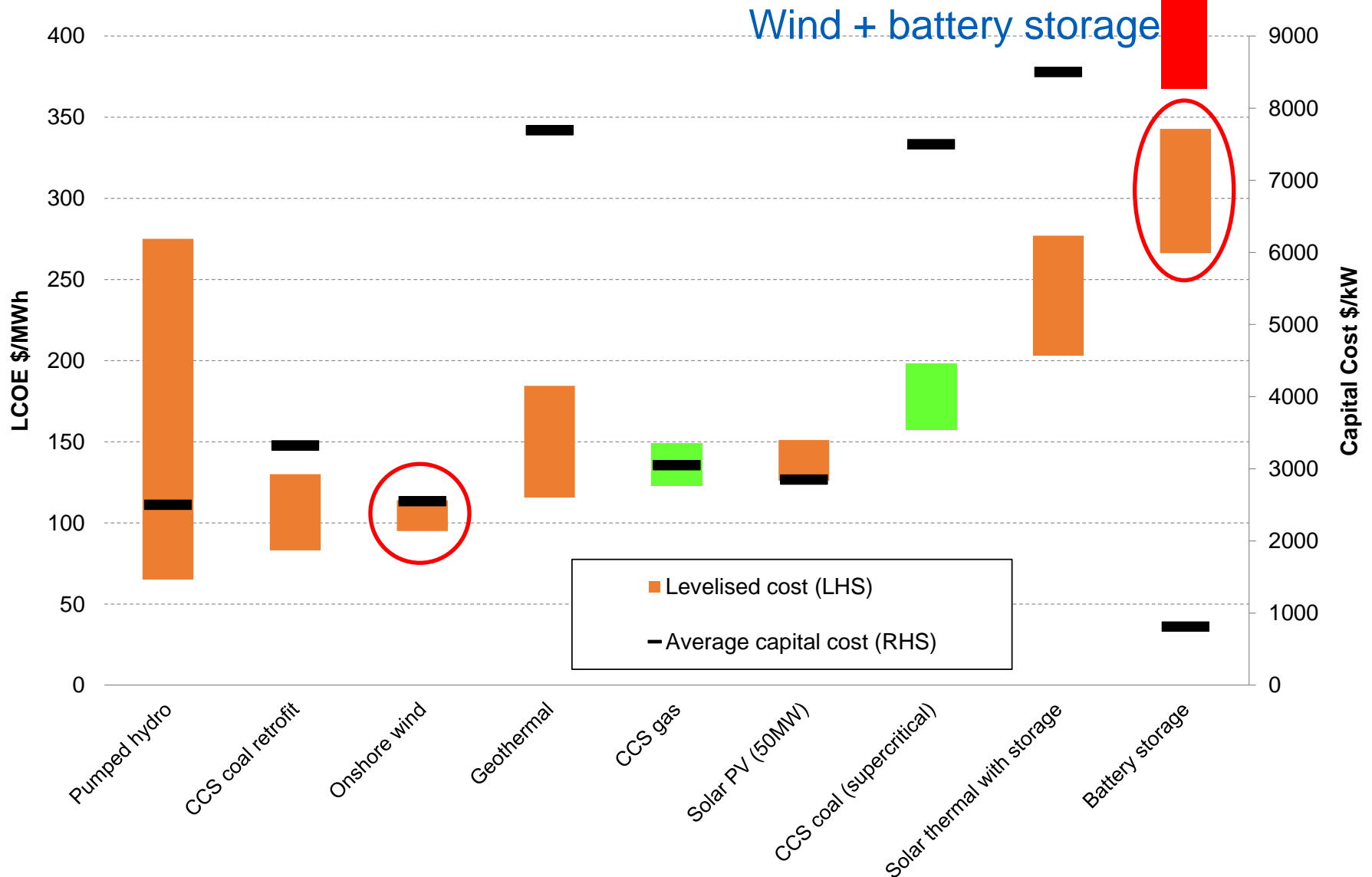
# CCS is competitive with other low emission technologies







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





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95 Gt | IEA CCS contribution  
2015-2050

*which means*

6 Gtpa | IEA CCS per annum  
contribution in 2050

*which equals*

120 TCF

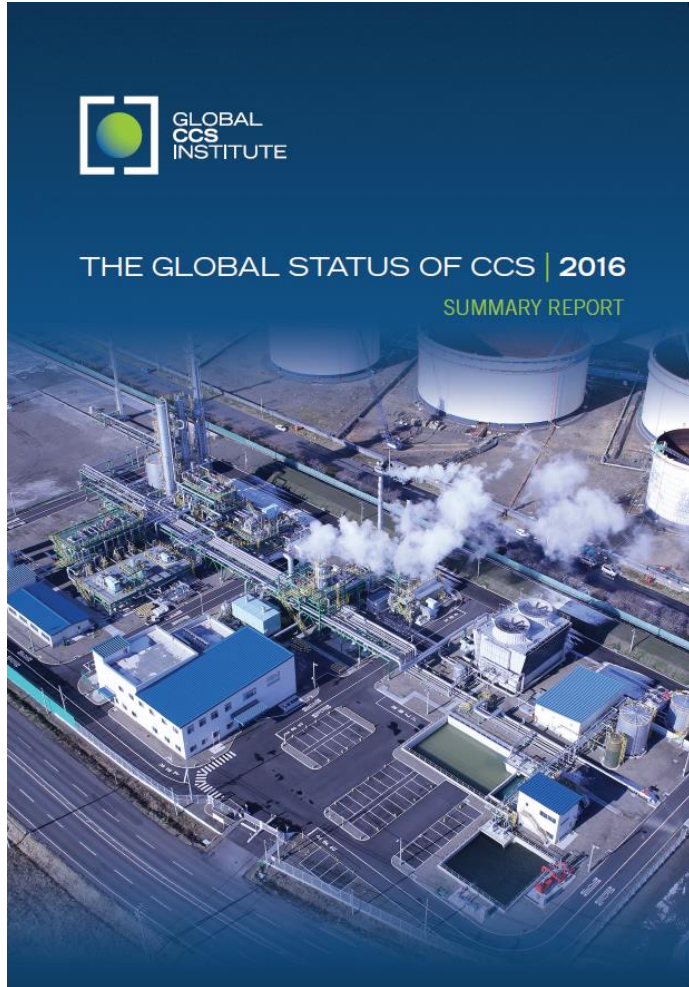
*in 2013 we used*

115 TCF | IEA WEO 2013  
natural gas consumption

Some BIG  
numbers...



# For more information



The Institute's key publication

Summary Report, Key Findings and other advocacy materials can be found at:

[status.globalccsinstitute.com](https://status.globalccsinstitute.com)

Full report is available online at the Institute's Members' Portal.



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