



GLOBAL  
CCS  
INSTITUTE



# CARBON CAPTURE AND STORAGE (CCS) OVERVIEW

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Cover image: Aerial view of Tomakomai CCS Demonstration carbon capture facilities located at Tomakomai City, Hokkaido, Japan. Image provided by JCCS.



# Agenda

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**The Global CCS Institute (GCCSI)**

**Carbon Capture and Storage (CCS) and CO<sub>2</sub>  
emission Reduction**

**The Current State of CCS**

**Obstacles to CCS Deployment**

**Changing the Narrative**



# **The Global CCS Institute (GCCSI)**



# The Global CCS Institute



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





# The Institute's Strategy

## [OUR VISION]

CCS is an integral part of a low emission future

## [OUR MISSION]

To accelerate the deployment and commercial viability of CCS globally

## [OUR STRATEGIC IMPERATIVES]

We're a Member led organisation  
We're a sensible, but bold, risk taker  
We're agile and we embrace change  
We're financially sustainable  
We expand & leverage the CCS community  
Our focus is on Valued & Impactful work

## [OUR IDENTITY]

We're recognised and sought out as the premier CCS body

MEMBER LED | CCS COMMUNITY | BOLD | IMPACTFUL | AGILE | SUSTAINABLE

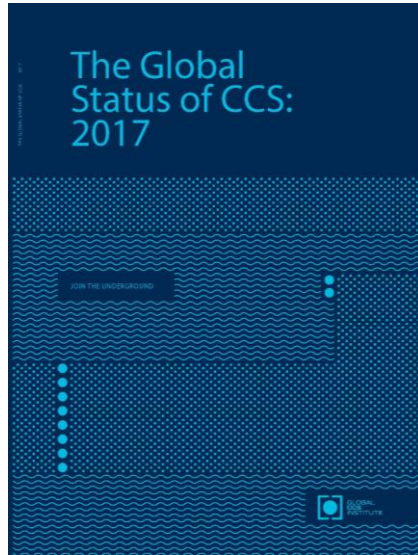


# Resources on the Ground



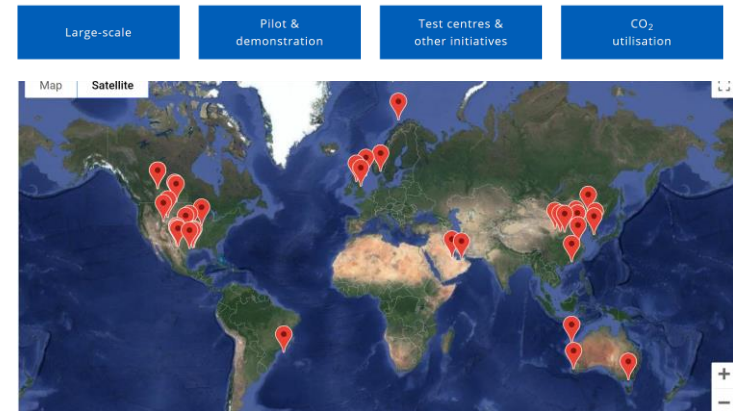


# Knowledge Resources



## Annual CCS Status Report

## CCS Facilities Database



## CO2RE Database



## Consulting Services





# Consulting Services

Fee for Service	Member Service
Applicability of Carbon Credits for CCS	Public Engagement at energy forum
Opportunities for Brown Coal in a Low-Carbon Economy	Critique of climate risk report
Transporting CO2 by Ship	Participate in CCS promotional video
Current State of CCS – Special Report to Government of Japan	Evaluate various monitoring techniques/protocols
Liability related to Off-Shore Storage of CO2	Provide input to CalEPA CCS protocol
Survey on CCS and ESG	Design and facilitate CCS conference

CREATING VALUE  
THROUGH  
KNOWLEDGE



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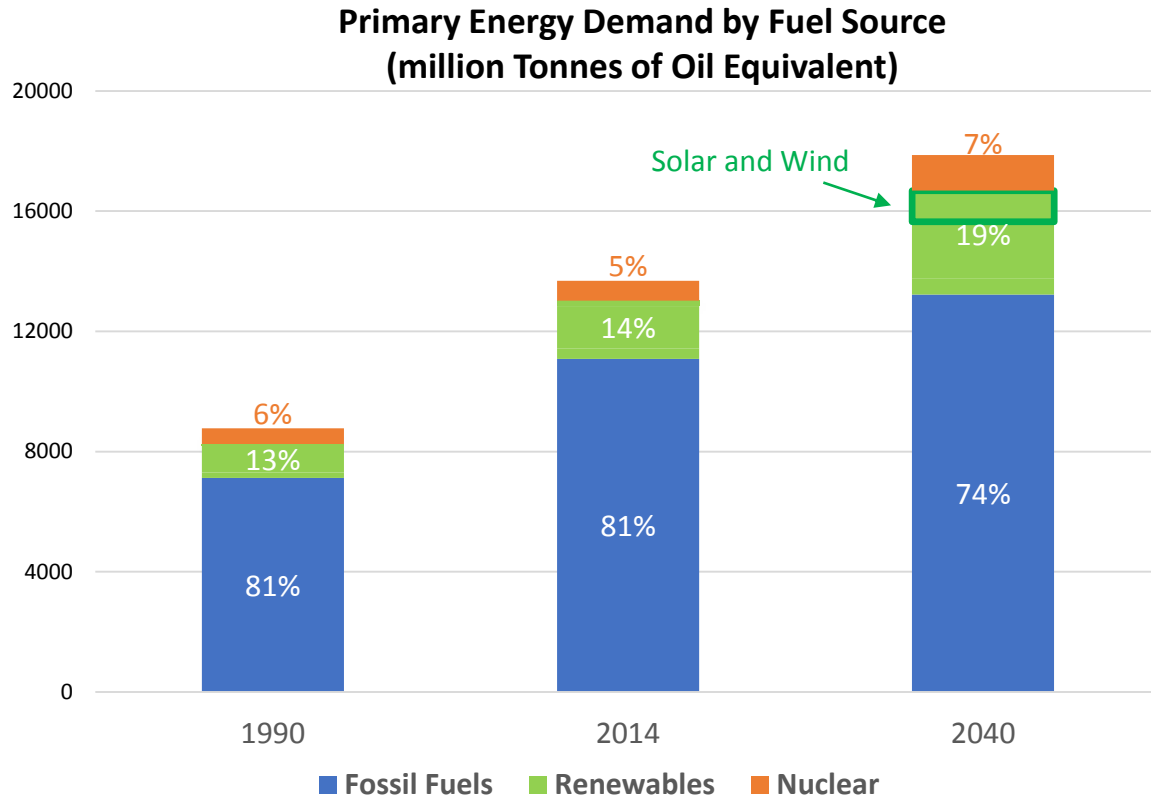


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## **CCS and CO<sub>2</sub> emission Reduction**



# Fossil fuel demand growing and reserves robust



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

**Fossil fuel proved reserves:**  
*~7 trillion barrels of oil equivalent*

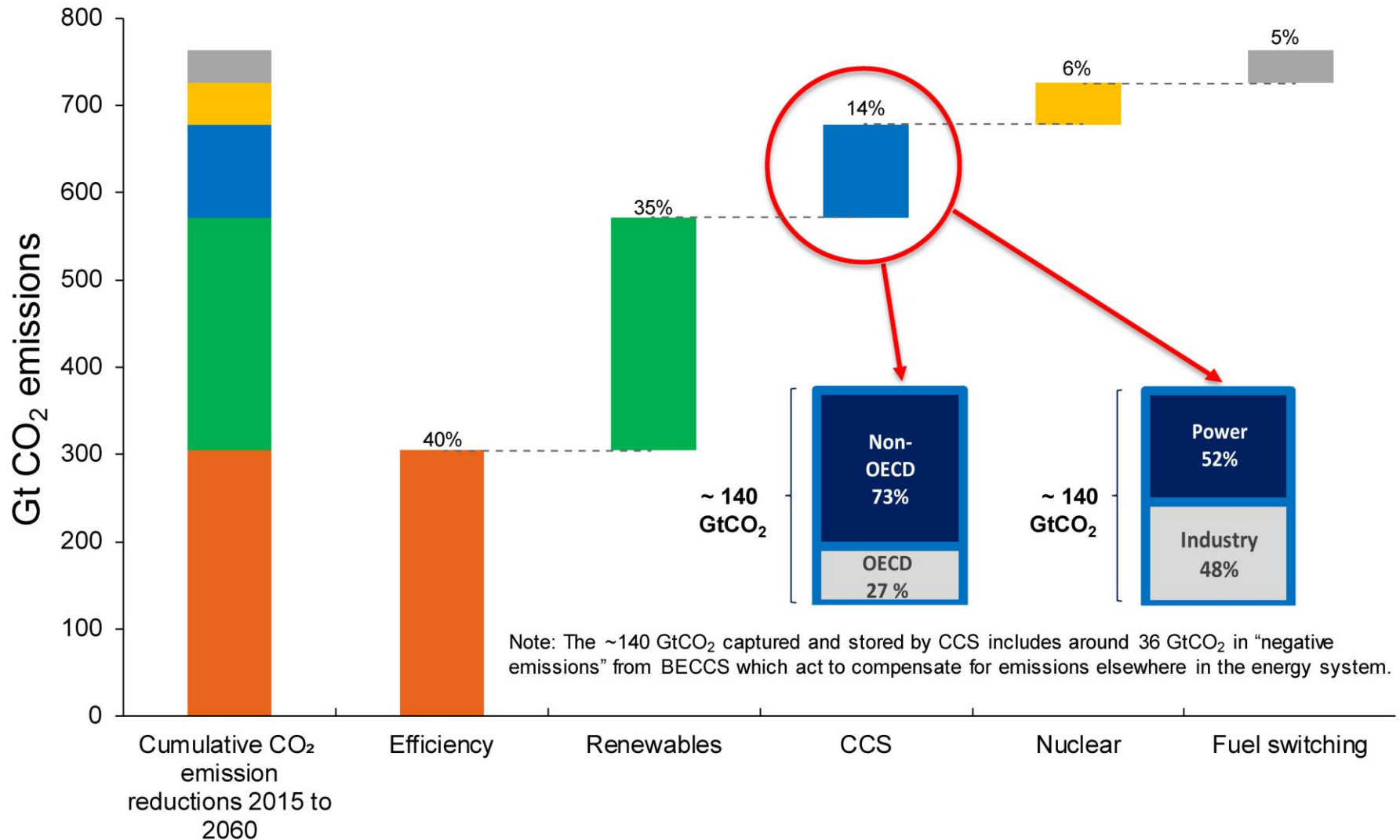
**Reserves to production ratio:**  
*~80 years*

Source: BP Statistical Review of World Energy 2017



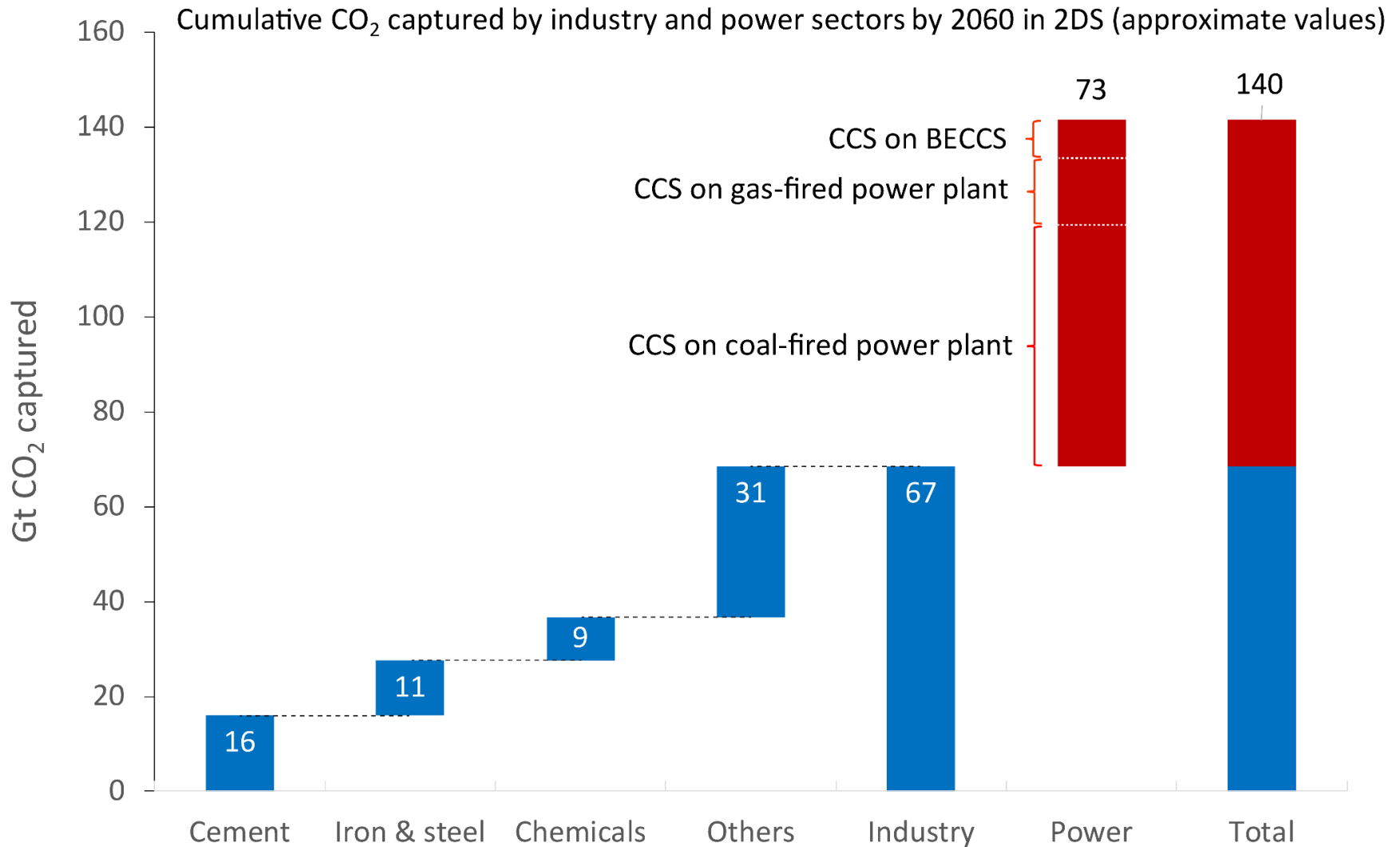
# CCS critical in portfolio of low-carbon technologies

CCS contributes 14% of cumulative reductions through 2060 in a 2DS world compared to 'current ambition' (Reference Scenario)



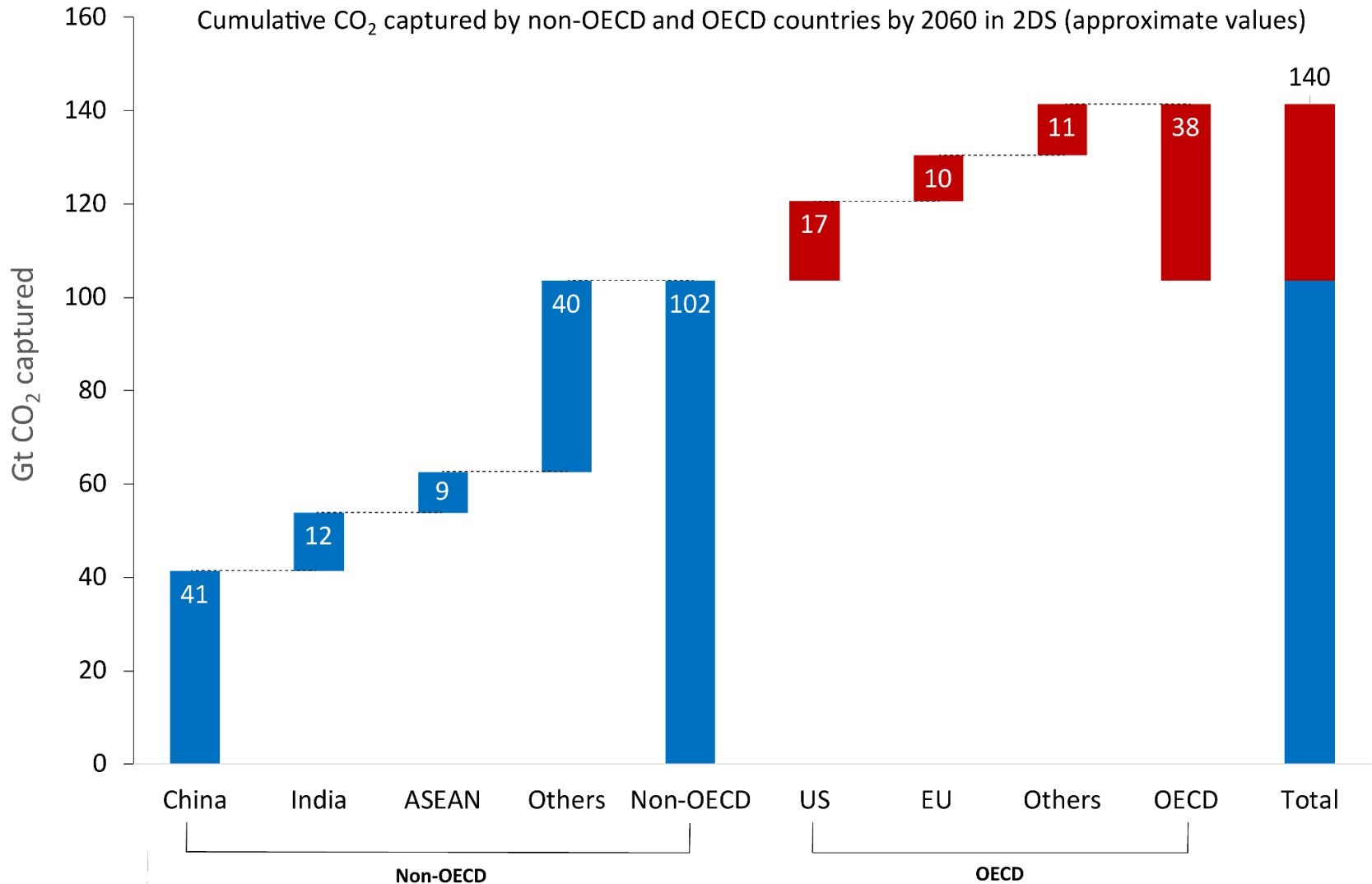


# CCS in industrial and power sectors in the 2DS





# CCS deployment by country in the 2DS

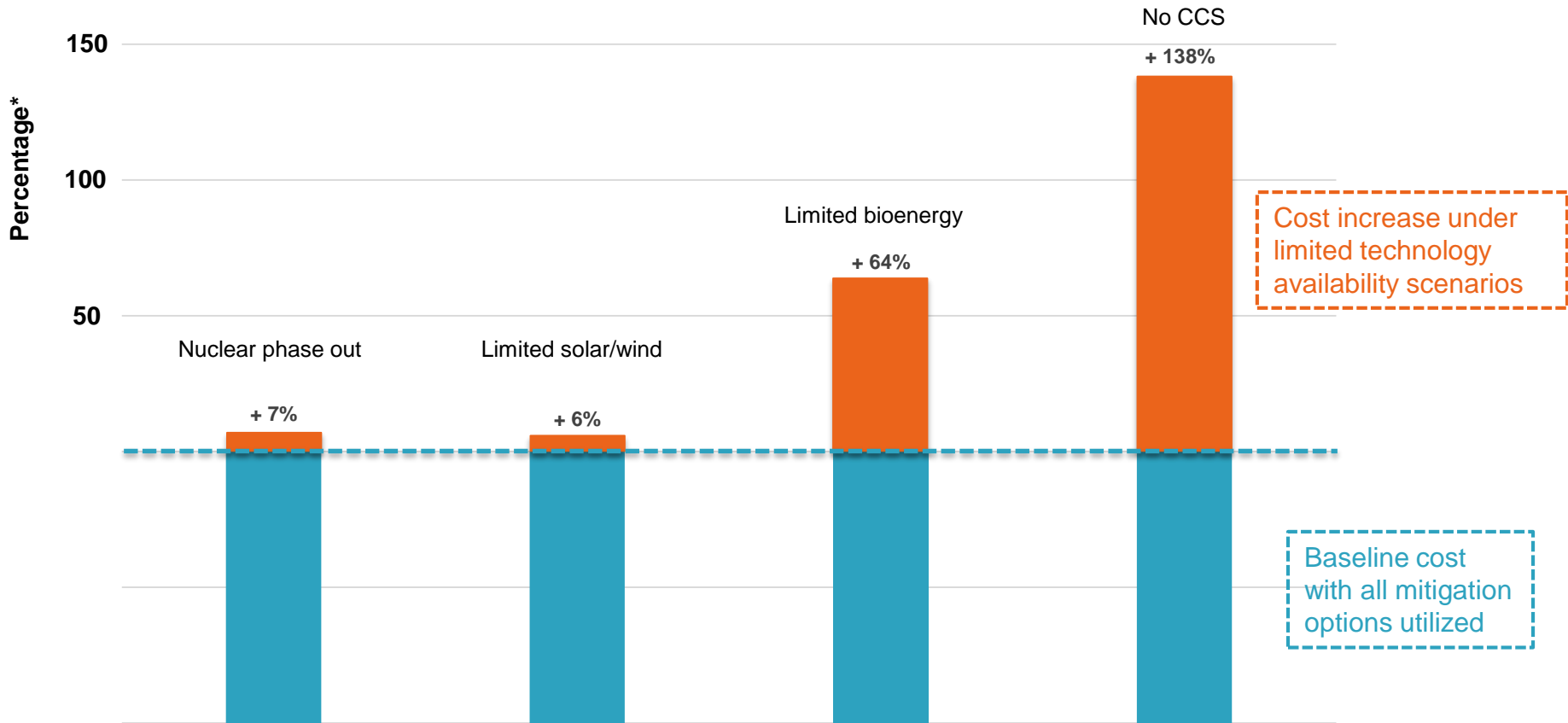


Source: data sourced from International Energy Agency (2017), Energy Technology Perspectives 2017, OECD/IEA, Paris





# Mitigation costs more than double without 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.



# **The Current State of CCS**

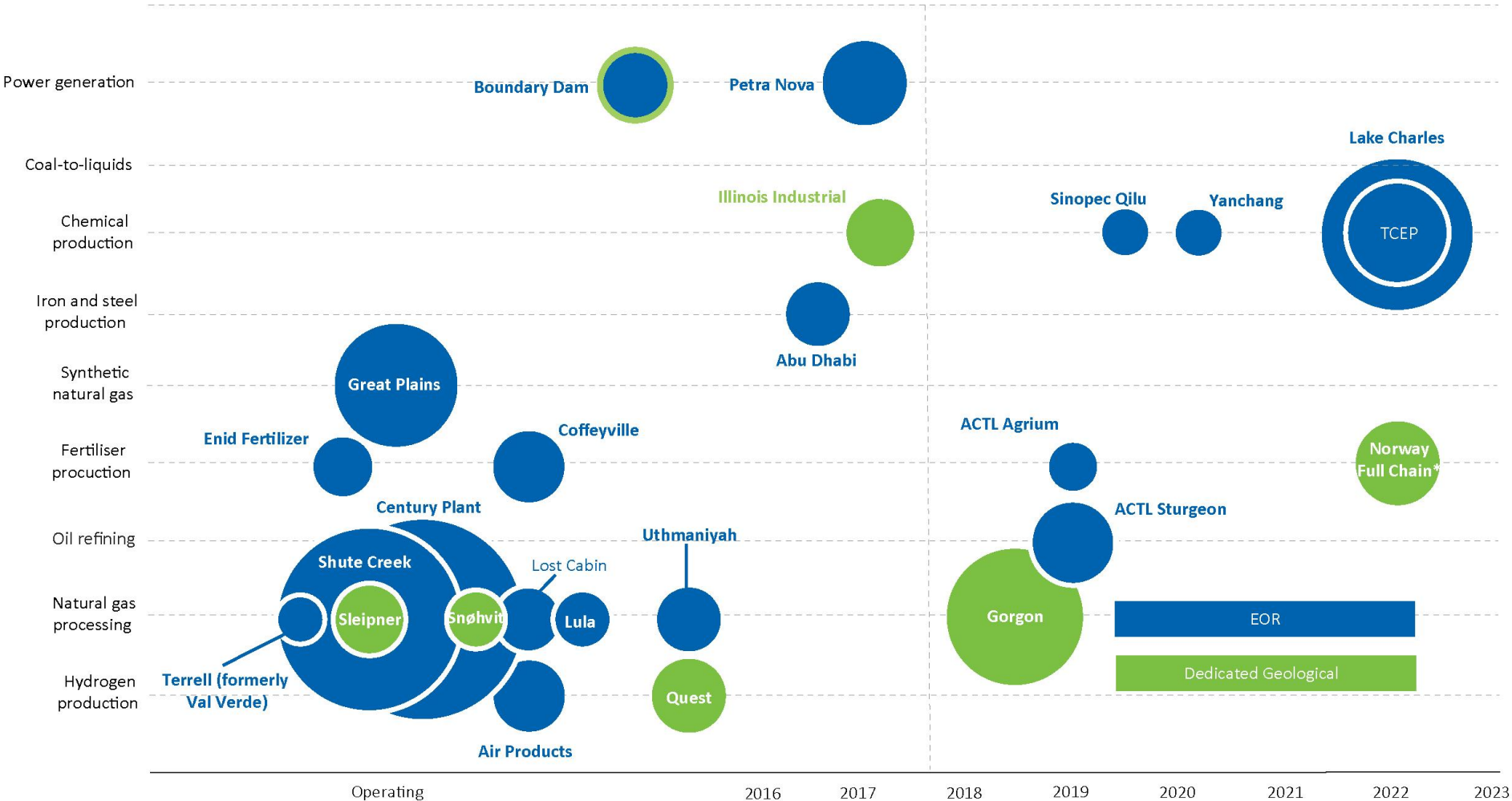


# 18 large-scale facilities in operation





# Carbon bubbles



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

\* Facilities in the Operating, In construction and Advanced development stages



# The CCS project pipeline is shifting

	Early development	Advanced development	Construction	Operating	Total
North America	-	2	2	12	16
China	6	-	2	-	8
Europe	2	1	-	2	5
Gulf Cooperation Council	-	-	-	2	2
Rest of World*	3	1	1	1	6
<b>Total</b>	<b>11</b>	<b>4</b>	<b>5</b>	<b>17</b>	<b>37</b>

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

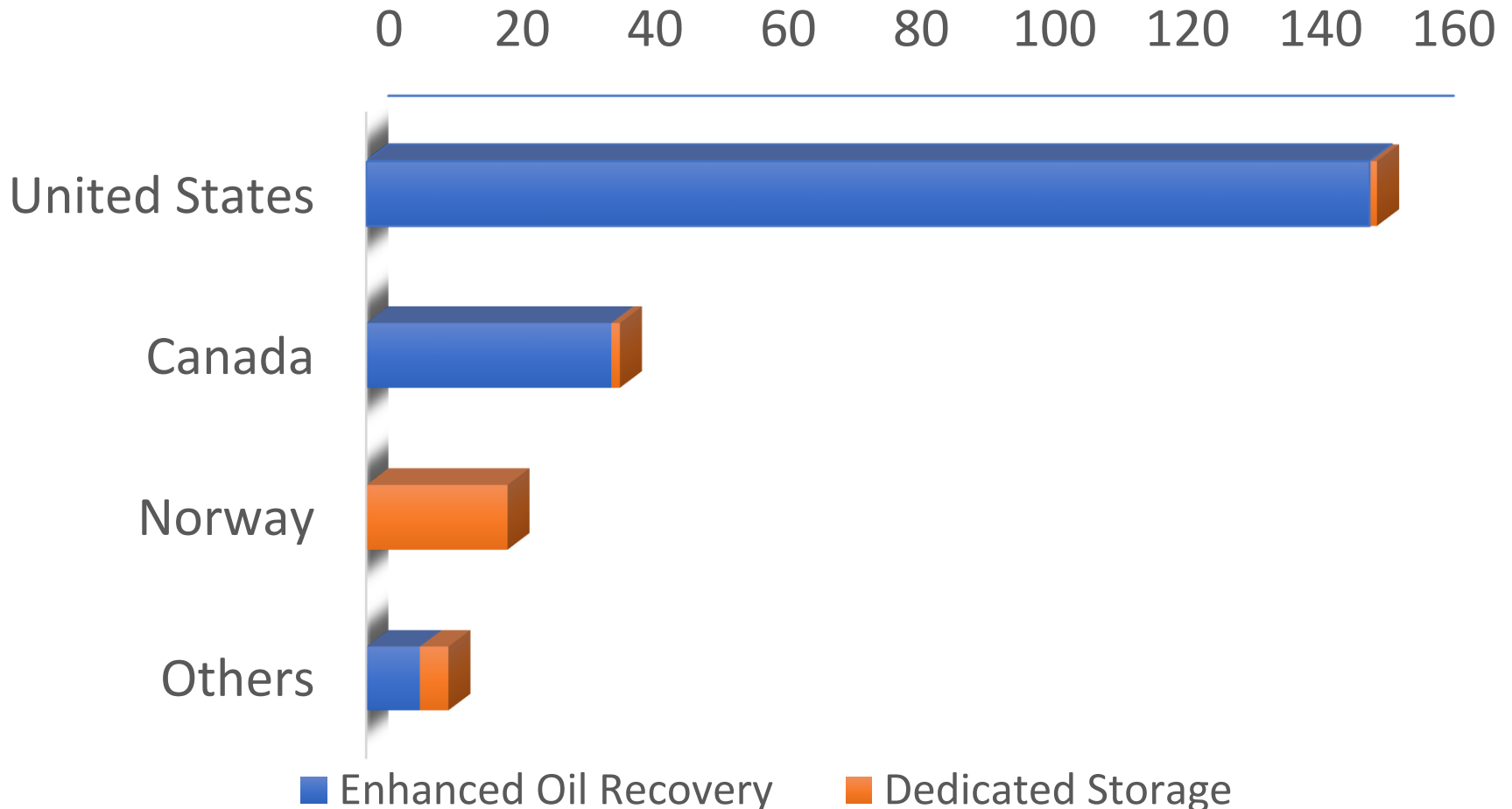
**North America dominates – 14 (of 21) facilities in operation or construction, China has most facilities in development, facility pipeline needs replenishment**





# Cumulative anthropogenic CO<sub>2</sub> injection

220 million tonnes CO<sub>2</sub> injected underground (approximate values)



**Note:** "Others" include Algeria, Brazil, China, Saudi Arabia, United Arab Emirates, Germany and France.

**Source:** Global CCS Institute estimates



# Key CCS Developments in North America





# The FUTURE Act – 45Q

## Level of credit available for different combinations of CO<sub>2</sub> sources and uses

IEA Analysis

Type of CO <sub>2</sub> storage/use	Minimum size of eligible carbon capture plant by type (ktCO <sub>2</sub> /yr)			Relevant level of tax credit in a given operational year (USD/tCO <sub>2</sub> )									
	Power plant	Other industrial facility	Direct air capture	2018	2019	2020	2021	2022	2023	2024	2025	2026	Later
	Dedicated geological storage	500	100	100	28	31	34	36	39	42	45	47	50
Storage via EOR	500	100	100	17	19	22	24	26	28	31	33	35	Index linked
Other utilisation processes <sup>1</sup>	25	25	25	17 <sup>2</sup>	19	22	24	26	28	31	33	35	Index linked

<sup>1</sup> each CO<sub>2</sub> source cannot be greater than 500 ktCO<sub>2</sub>/yr

<sup>2</sup> Any credit will only apply to the portion of the converted CO<sub>2</sub> that can be shown to reduce overall emissions



# Key CCS Developments in Europe





# Required scale-up is a monumental task

## The Last 25 Years

37 large-scale CCS facilities - combined CO<sub>2</sub> capture capacity of approximately 69 Mtpa\*:

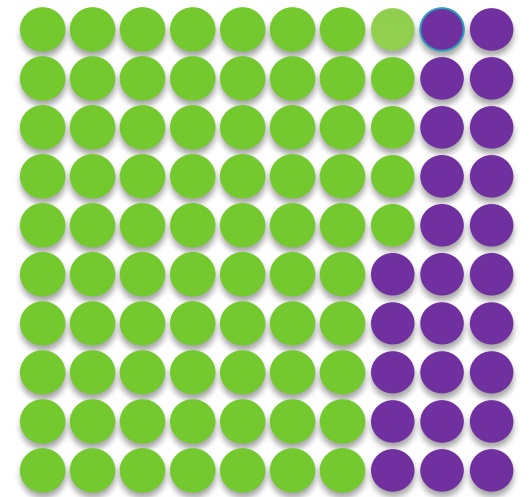
- 22 facilities in operation or construction (~37 Mtpa)
- 4 facilities in advanced development (~13 Mtpa)
- 11 facilities in earlier stages of development (~19 Mtpa)

37 Mtpa



## The Next 25 Years

3,800 Mtpa of CO<sub>2</sub> captured and stored by 2040 (IEA 2DS)\*\*



● Non-OECD ● OECD

\*Mtpa = million tonnes per annum

\*\*Source: International Energy Agency (2017), Energy Technology Perspectives 2017, OECD/IEA, Paris

Note: 2040 IEA 2DS data includes ~0.6 Mtpa “negative emissions” from BECCS





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# **Obstacles to CCS Deployment**



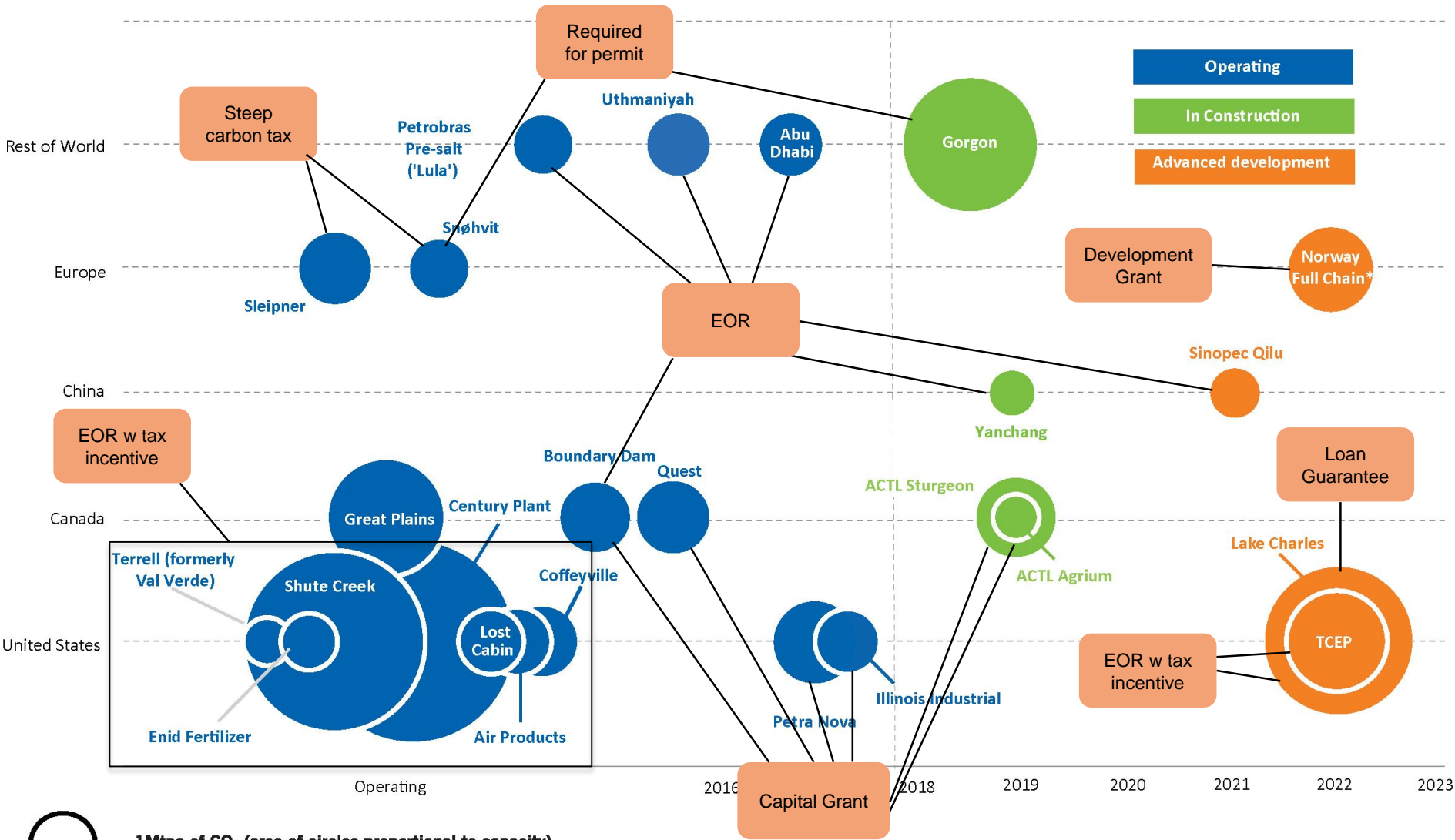
# Obstacles to Deployment

	#1 – Poor Project Economics	#2 – Perceptions, Risks, Uncertainties	#3 – Scale of Investment Required
Solutions	<b>Increase Income</b> – EOR, other CO2 markets, price premium for low-carbon energy, sell technology	Standards, knowledge sharing, research	Smaller projects, modularity
	<b>Reduce Capital Cost</b> – technology advances, subsidies/incentives, preferential financing	Communication, engagement	Industrial CCS
	<b>Reduce Operating Cost</b> – tax incentives, production tax credit	Guaranteed purchase of electricity, portfolio standards	Carbon utilization
	<b>Price/limit on carbon emissions</b> – Tax, cap/trade, emissions standards, permit requirement	Legislation, regulation	Loan guarantees

*Policy should focus on reducing or eliminating the barriers to private sector investment*



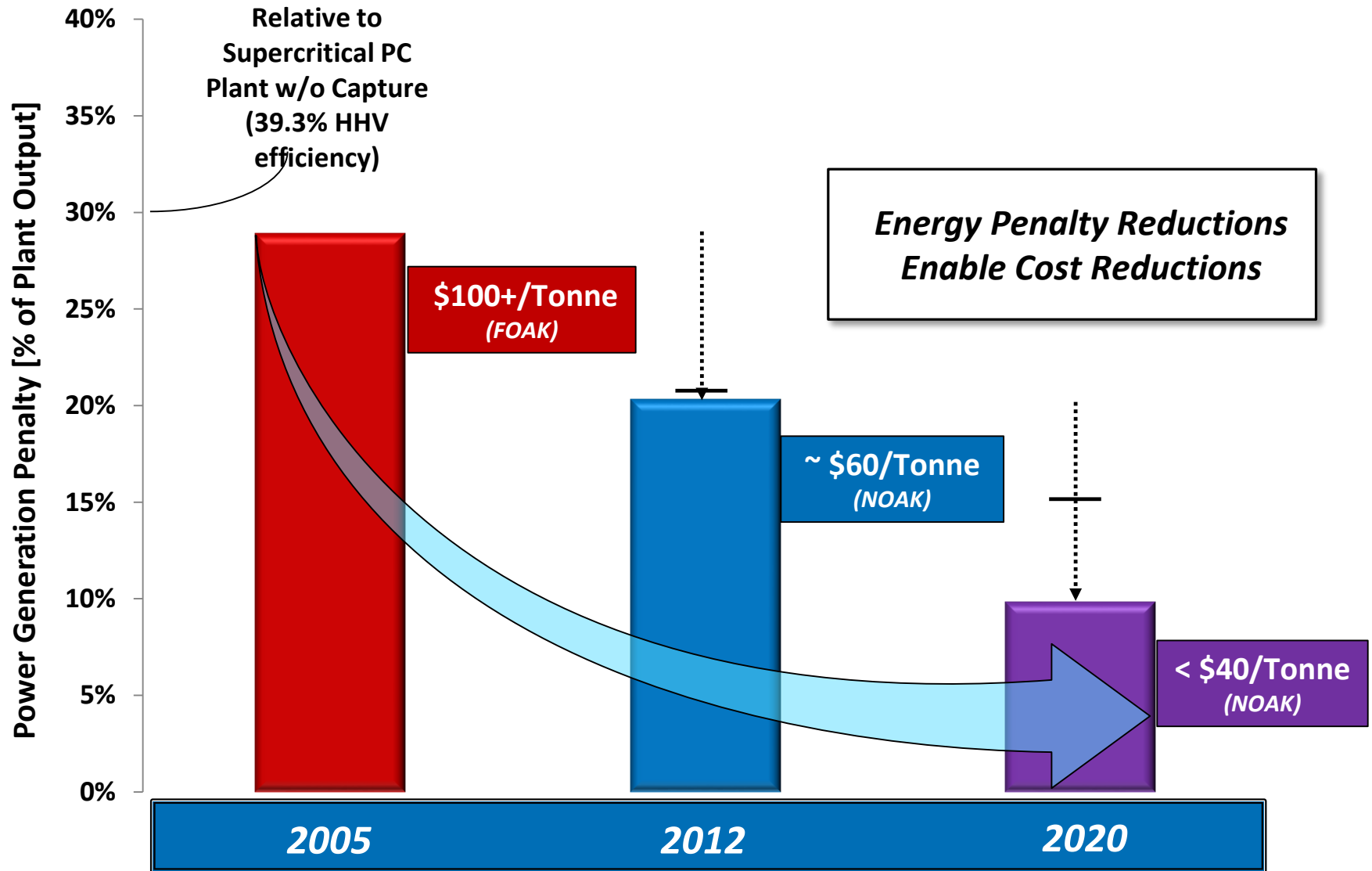
# Project Economics – policy measures that work



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



# Project Economics – technology advances



Note: HHV = Higher Heating value, FOAK = First of a Kind, NOAK = Nth of a Kind.

Source: Michael Matuszewski. "DOE/NETL CO<sub>2</sub> Capture R&D Program". 2014 NETL CO<sub>2</sub> Capture Technology Meeting



# Changing the Narrative





# The Current Narrative

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**E&E NEWS**

Will CCS Ever Work?

**HUFFPOST**

Donald Trump Promised 'Clean Coal,' But It Doesn't Exist

**The New York Times**

Companies Struggle to Make Carbon Capture Viable

**SCIENTIFIC AMERICAN**

*Carbon Capture May Be Too Expensive to Combat Climate Change*

**MORNING CONSULT**

Congress, White House Drag Feet on Support for Carbon Capture Expansion

**Bloomberg**

Will Trump Make This \$7 Billion Clean-Coal Plant Irrelevant?

**Forbes**

Carbon Capture: An Expensive Option For Reducing U.S. CO<sub>2</sub> Emissions

**Mashable**

Michael Bloomberg calls 'BS' on clean coal technology

**FINANCIAL TIMES**

Carbon capture and storage — too little, too late, too expensive



# The Language We Use

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*It is better to be understood  
than to be comprehensive*





# Congressional Survey – Does Carbon Capture Work?

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- **Language** – “CCS” is not an easily identified term
- **Cost** – widely held belief that CCS is too expensive
- **Climate change**
  - extends use of fossil fuel
  - Important option to address climate change
- **Safety** – risks not well understood



# Positive Language, Supported by Facts

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**P**roven

**A**ffordable

**V**ersatile

**E**ssential





# Proven

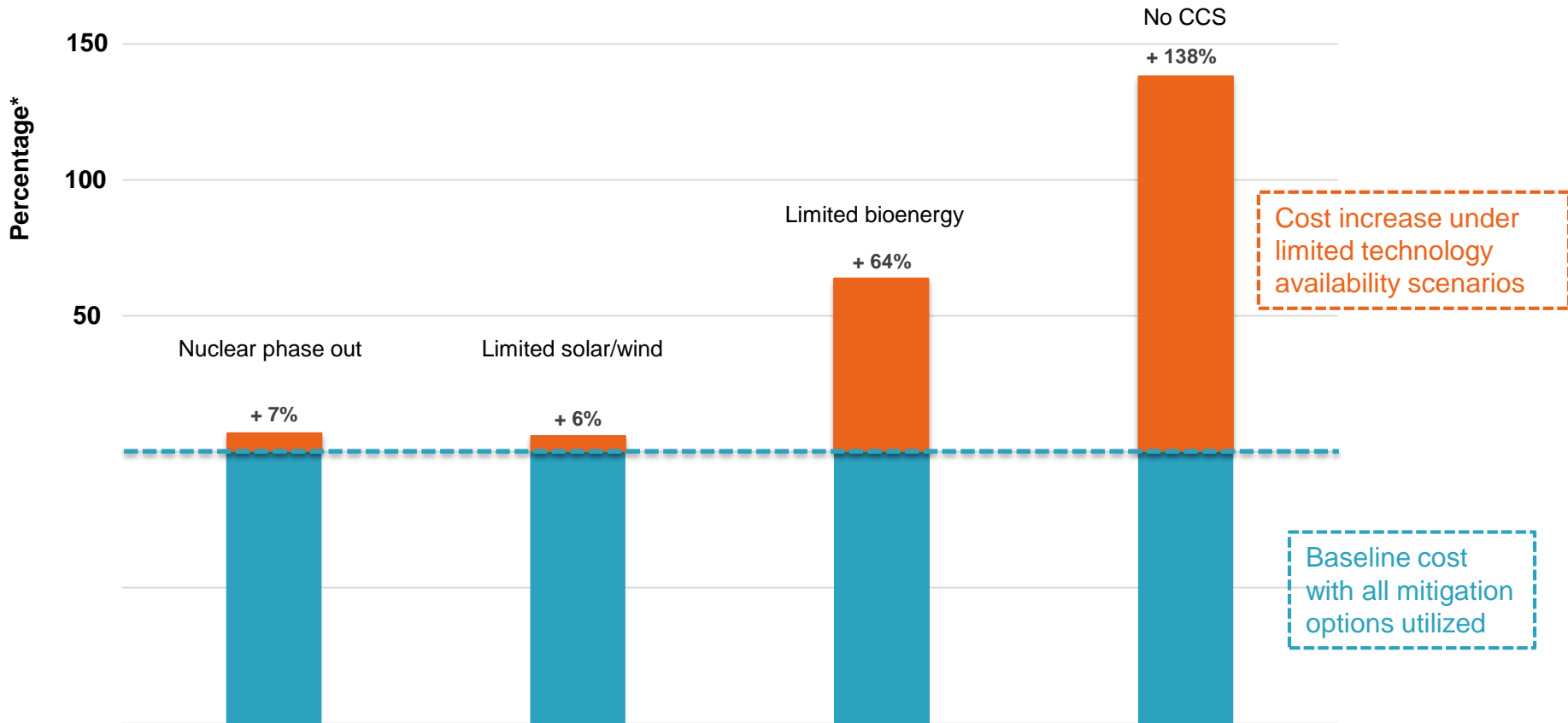
18 large-scale facilities  
37+ million tonnes/yr





# Affordable

Without CCS, cost of mitigation more than doubles



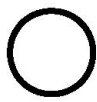
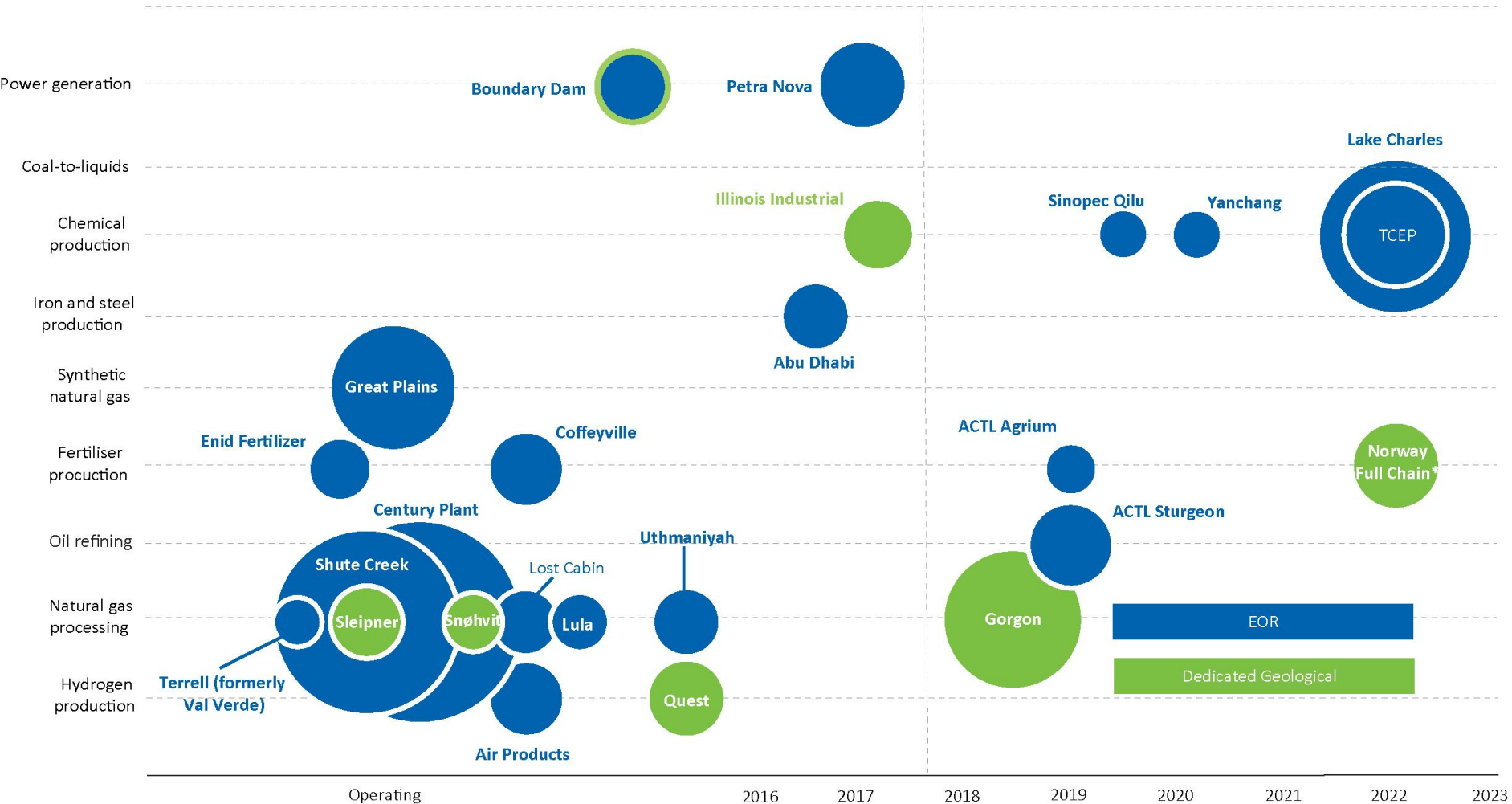
\*Percentage increase in total discounted mitigation costs (2015-2100) relative to default technology assumptions – median estimate

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



# Versatile

# CCS can be used across many industries



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

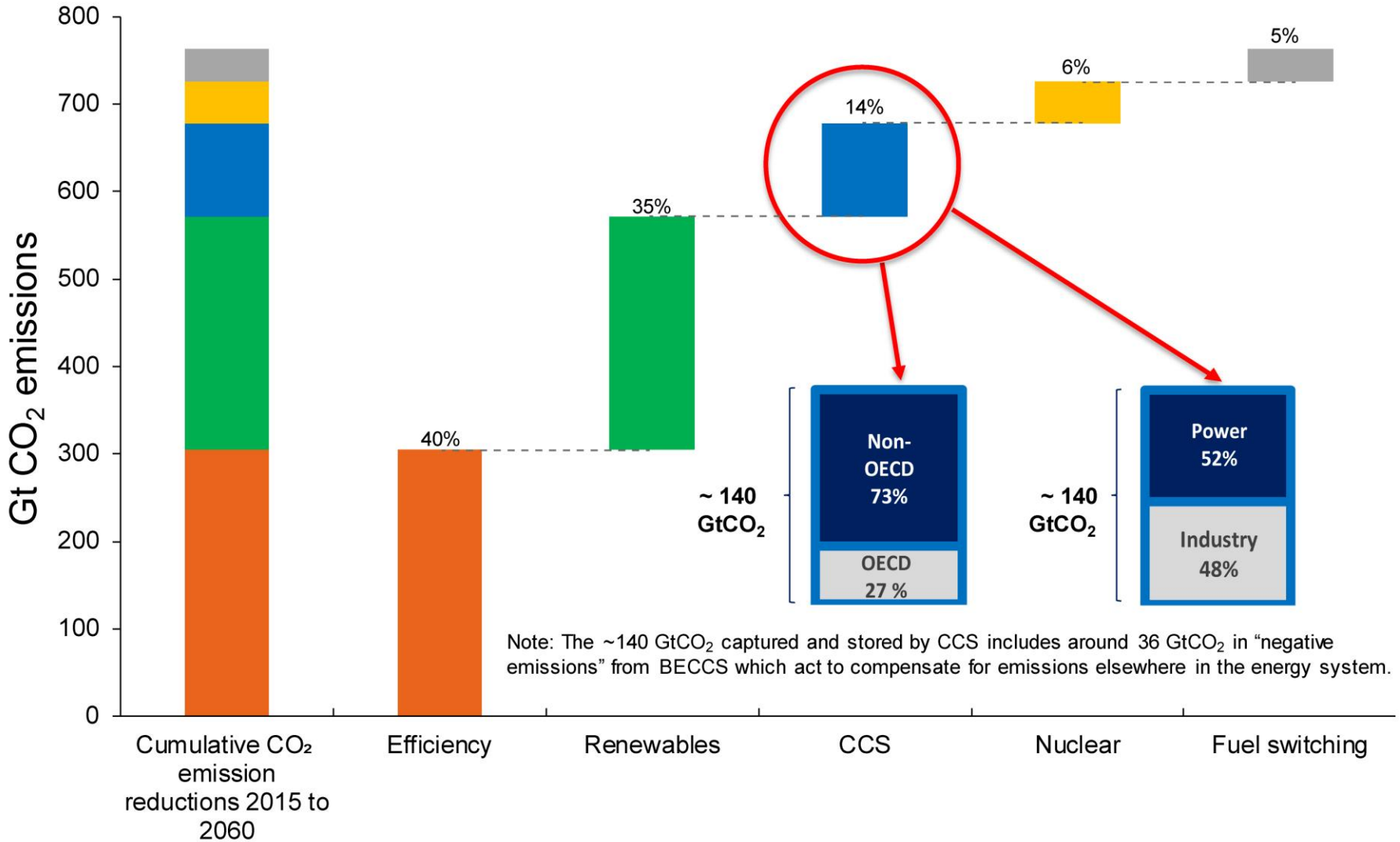
# Facilities in the Operating, In construction and Advanced development stages





# Essential

Numerous authorities say we can't achieve 2DS without it





## Key Messages

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1. Paris **climate change targets** cannot be reached without -CCS没有 CCS，巴黎协定2度目标将无法实现
2. CCS is the only **proven clean technology** capable of decarbonizing major industry-CCS技术是主要工业行业唯一能证明脱碳的清洁技术
3. CCS is creating a **new energy economy** of hydrogen production, bio-energy with CCS (BECCS), Direct Air Capture, and Carbon to Value representing a raft of CO<sub>2</sub> re-use applications-CCS正在创造一种新的氢能源经济、生物能源与CCS结合（BECS）、直接空气捕集以及代表了碳能产生价值的一系列CO<sub>2</sub>再利用
4. CCS is **creating jobs**, sustaining communities and strengthening nations-CCS正在创造就业、维持社区和使得国家强大
5. The storage of CO<sub>2</sub> is the **most effective option** available to reduce emissions and meet international climate change targets- CO<sub>2</sub>封存是减少排放和满足国际气候变化目标的最有效的选择

# BREAK THE CARBON CYCLE



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**JOIN THE UNDERGROUND**

**PARIS CLIMATE CHANGE TARGETS  
CANNOT BE MET WITHOUT CARBON CAPTURE AND STORAGE**