

GLOBAL STATUS OF CCS: THE NEXT WAVE IS COMING

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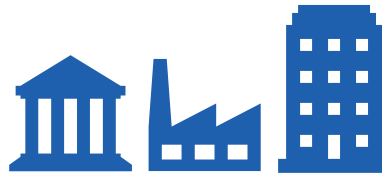
GLOBAL CCS
INSTITUTE

THE GLOBAL CCS INSTITUTE



International
think tank

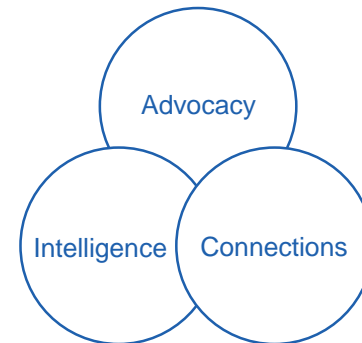
Backed by
governments,
businesses and NGOs



Mission: To accelerate
deployment of CCS

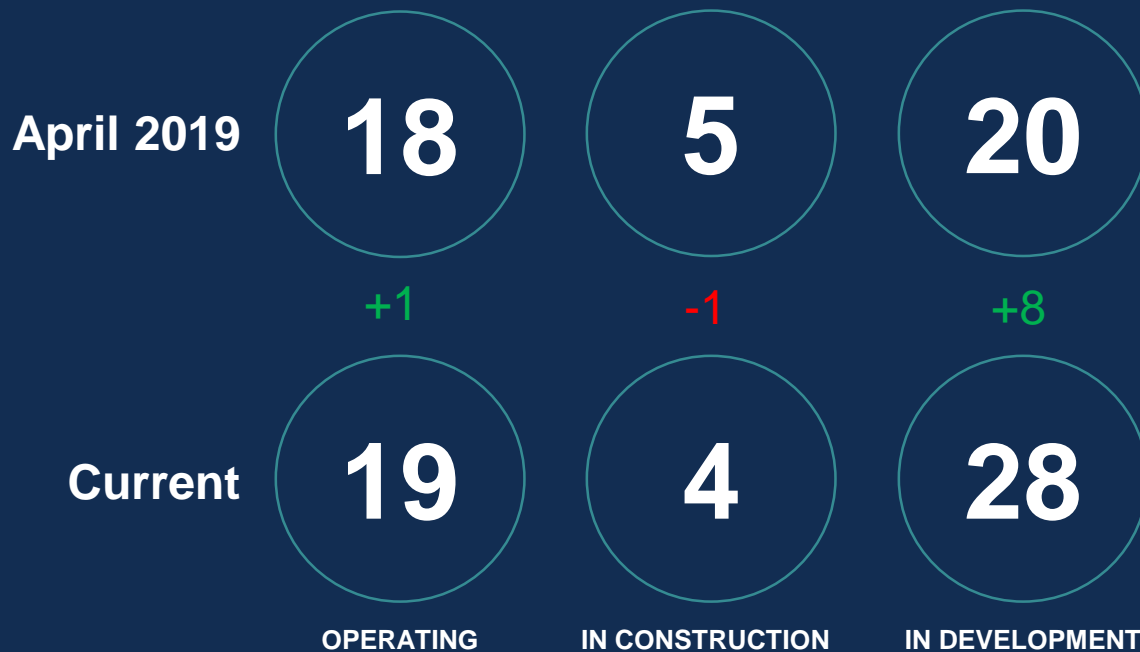
62 MEMBERS

7 locations



LARGE SCALE CCS FACILITIES

Recent developments

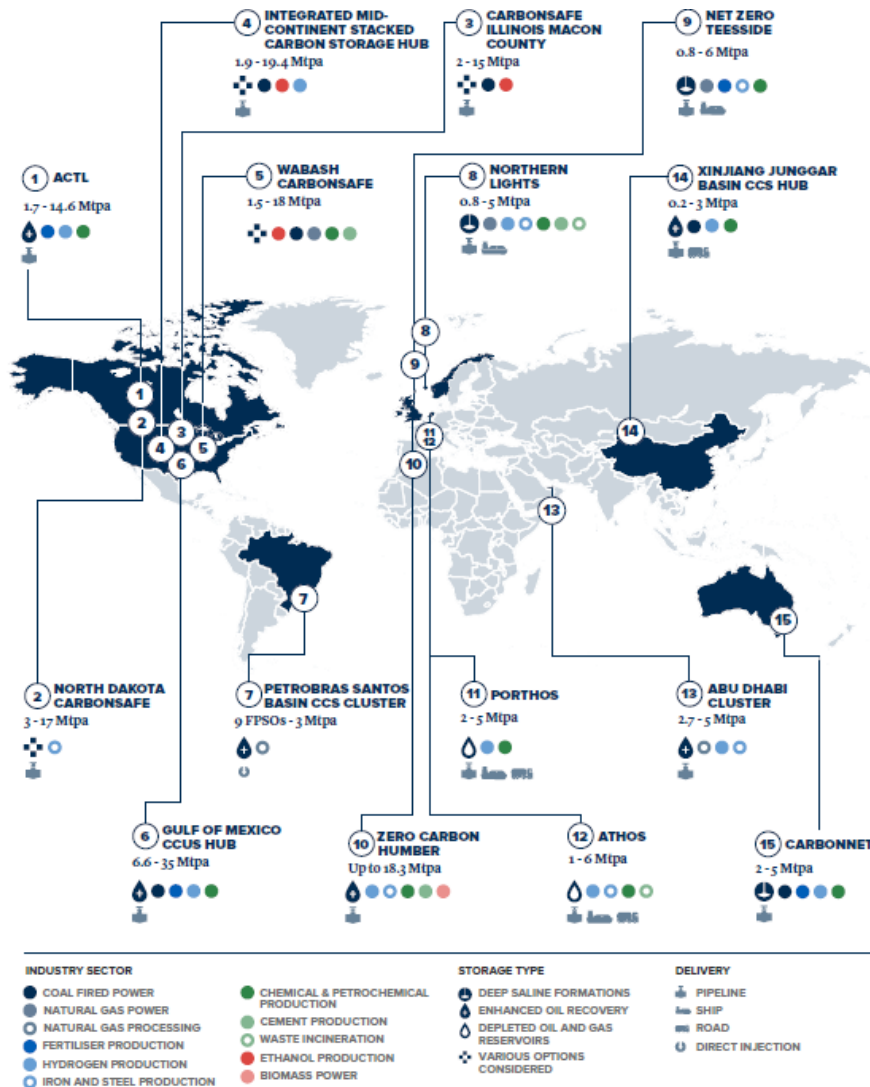


Facilities added

-  ABU DHABI CCS PHASE 2
-  CLEAN GAS PROJECT
-  WABASH
-  OXY AND WHITE ENERGY ETHANOL
-  PROJECT TUNDRA
-  DRY FORK
-  CARBONSAFE ILLINOIS
-  OXY AND CARBON ENGINEERING DAC
-  INTEGRATED MID-CONTINENT
-  ECO2S



NEXT WAVE OF CCS: HUBS & CLUSTERS



- Multiple industrial point sources of CO₂ connected to a CO₂ transport and storage network.
- Access to large geological storage resources with the capacity to store CO₂ from industrial sources for decades.
- Economies of scale deliver lower unit-costs for CO₂ storage.
- Synergies between multiple CO₂ sources and the storage operator reduce cross chain risks and support commercial viability.











Policies & project characteristics	 Carbon tax	 Tax credit or emissions credit	 Grant support	 Provision by government or SOE	 Regulatory requirement	 Enhanced oil recovery	 Low cost capture	 Low cost transport and storage	 Vertical integration
US									
Terrell						○	●	●	
Enid Fertiliser						○	●	●	
Shute Creek					●	○	●	●	
Century Plant		●				○	●		
Air Products SMR		●	○			○			
Coffeyville		●				○	●		
Lost Cabin		●				○	●		
Illinois Industrial		●	○				●	●	●
Petra Nova		●	○			○			
Great Plains						○	●		
Canada									
Boundary Dam			○	●	●	○		●	
Quest		●	○						●
ACTL Agrium			○			○	●		
ACTL Sturgeon			○			○	●		
Brazil									
Petrobras Santos				●		○	●	●	●
Norway						○			
Sleipner	●			●			●	●	●
Snohvit	●			●	●		●	●	●
UAE									
Abu Dhabi CCS				●		○		●	
Saudi Arabia									
Uthmaniyah				●		○	●	●	●
China									
CNPC Jilin				●		○	●	●	●
Sinopec Qilu*				●		○	●	●	
Yanchang*				●		○	●		
Australia									
Gorgon			○				●	●	●

FIGURE 6 CONDITIONS THAT ENABLED LARGE-SCALE FACILITIES
*In construction



Navigation controls including a mouse cursor, a hand icon, and zoom in (+) and zoom out (-) buttons. The zoom level is displayed as 54.5%.

WHO IS READY FOR CCS?

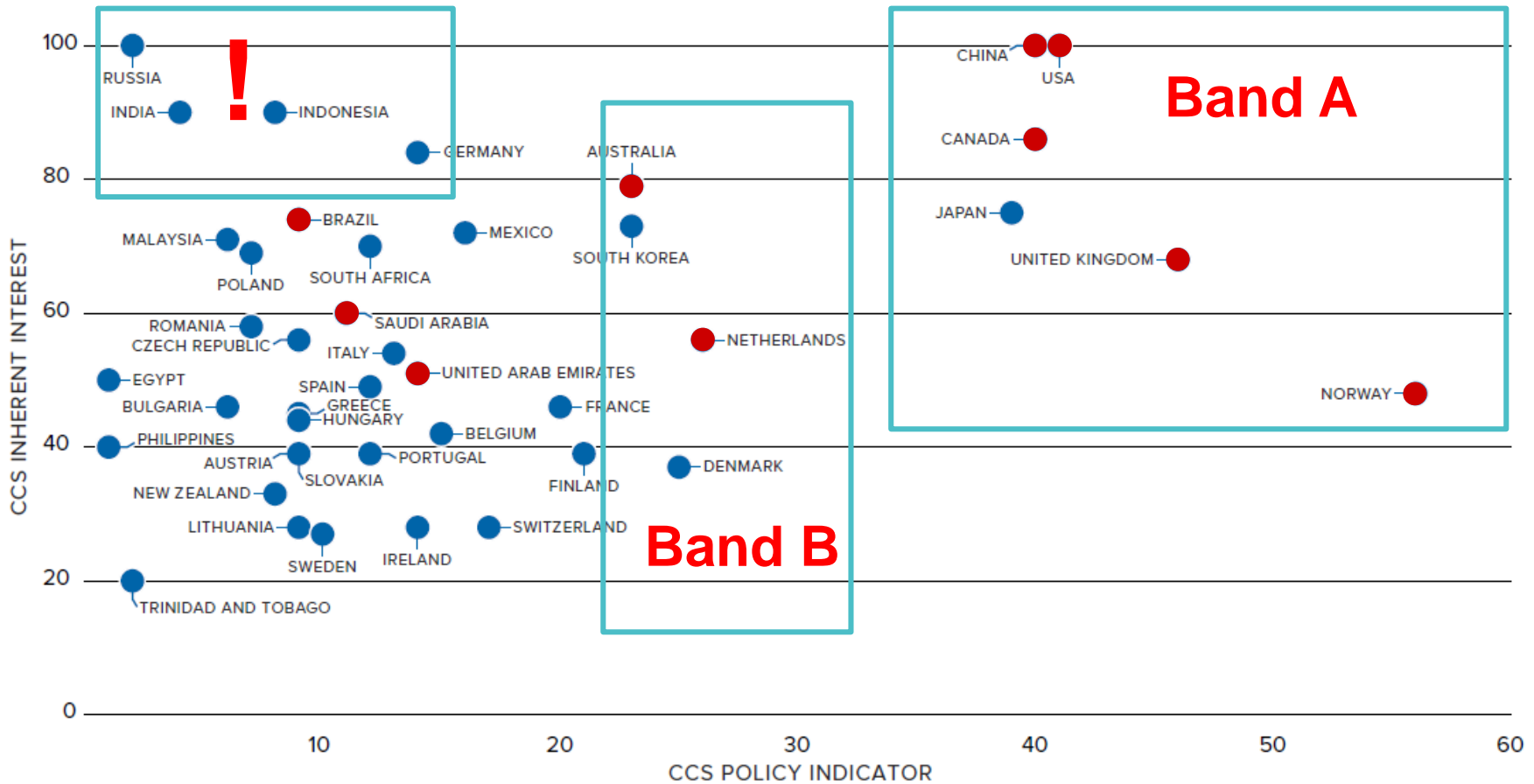


CCS READINESS INDEX

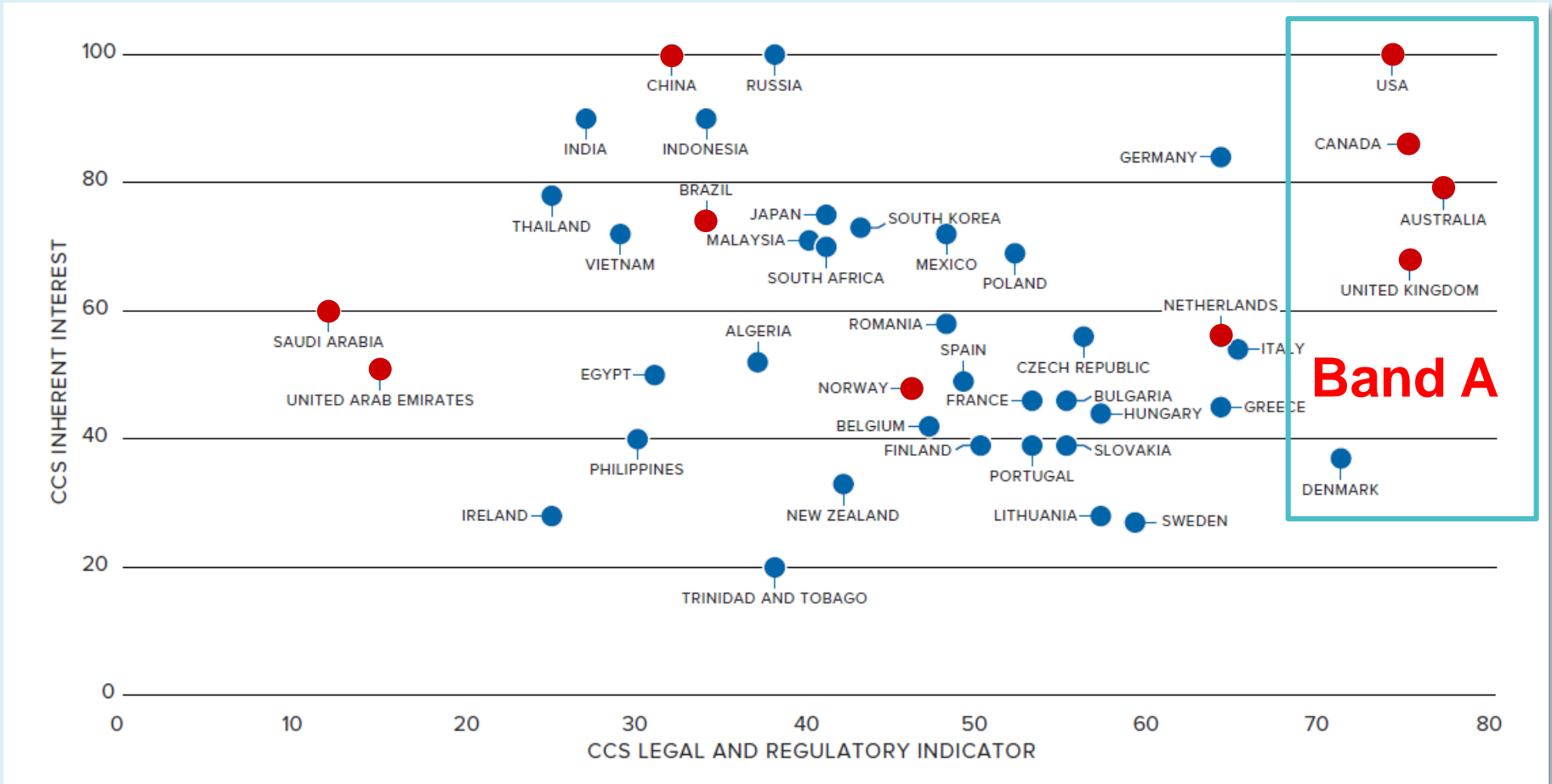
- Established in 2015
- Ranks over 50 countries:
 - Attractiveness for investment and deployment
 - Identifies leaders, fast followers
- Comprises four indicators:
 - Policy
 - Legal
 - Storage
 - Inherent CCS Interest



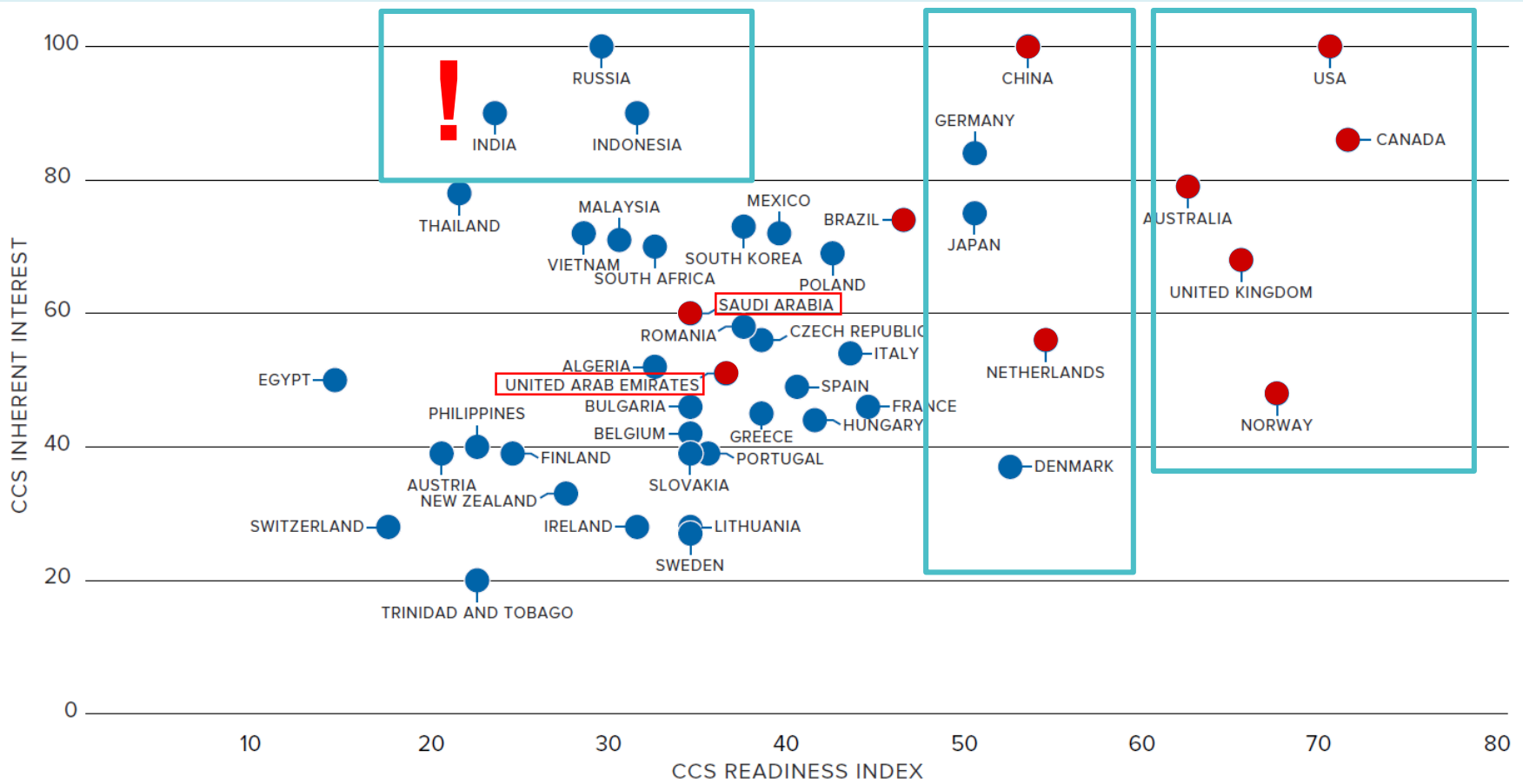
CCS POLICY INDICATOR



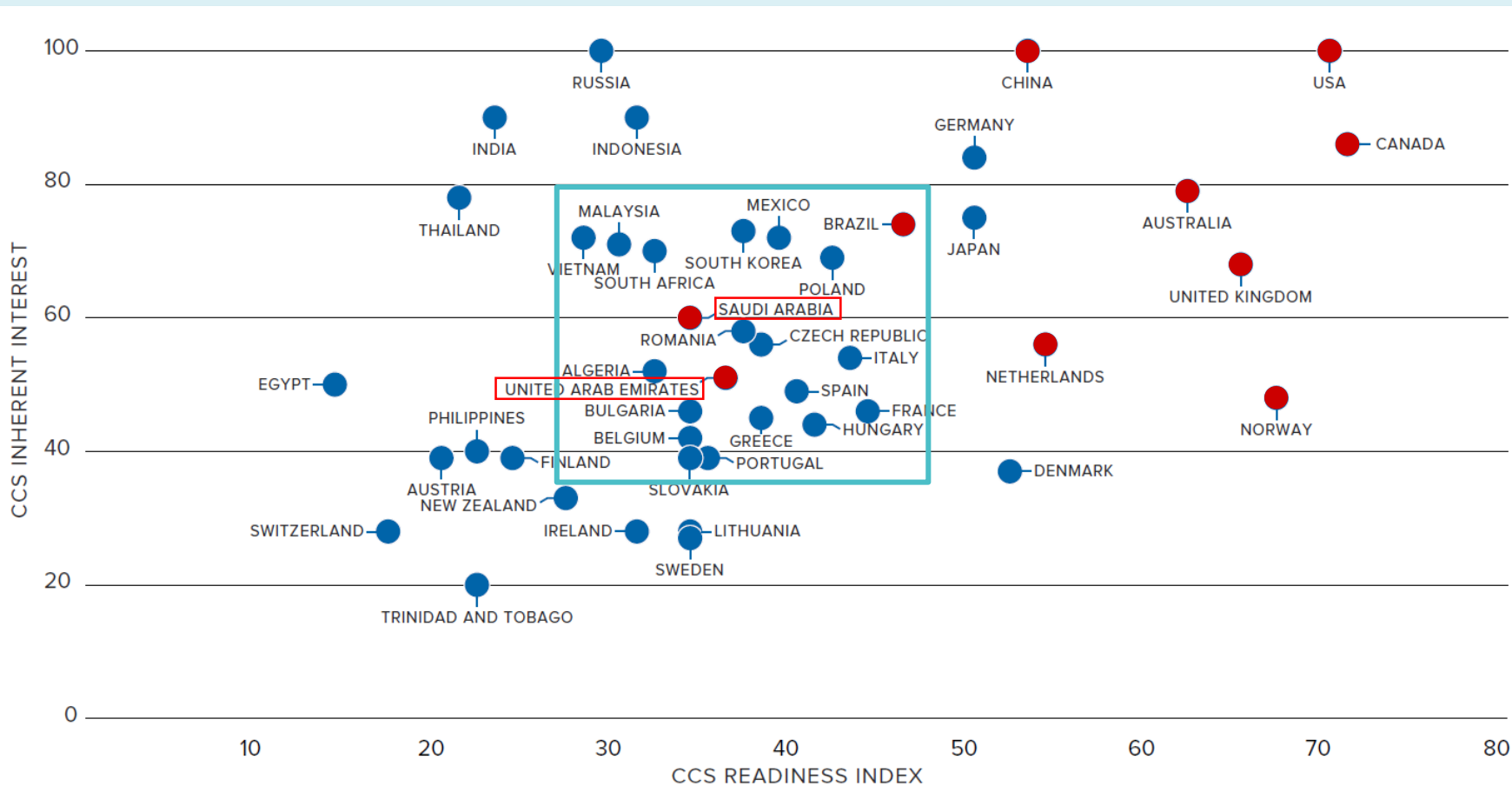
CCS LEGAL & REGULATORY INDICATOR



CCS READINESS INDEX



CCS READINESS INDEX



POLICY DEVELOPMENTS

Global

- Paris Accord – 10+ NDCs indicate CCS, Article 6
- Green Climate Fund – funding for CCUS projects
- ICAO – Carbon Offsetting and Reduction Scheme
- London Protocol amendment – bi-lateral agreements



AMERICAS

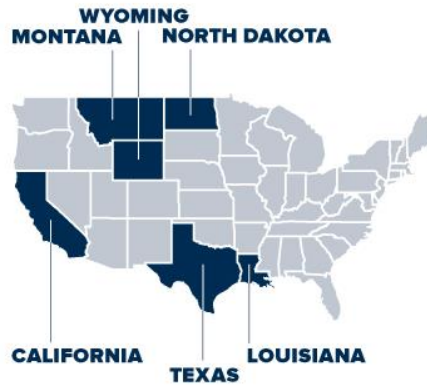
CCS FACILITIES IN THE AMERICAS

This region is home to **13 of the world's 19 large-scale operating CCS facilities.**



ACTIVE STATES

In the US, states that are active in CCS incentives and progression are: **California, Montana, Texas, North Dakota, Louisiana and Wyoming.**



CO₂ CAPTURE

These facilities combined capture **29.9 Million tonnes per annum (Mtpa) of CO₂.**

CO₂
29.9
Mtpa



NEW WAVE OF FACILITIES

In 2019 the Global CCS Institute added **8 new large-scale facilities** in the Americas to our database.

8 NEW FACILITIES



ADVANCING CCS

In this region, CCS deployment is supported by **strong policy frameworks, abundant geological storage, diverse stakeholder support and a wealth of private-sector experience**



REGIONAL DEVELOPMENTS

Clean Energy Ministerial held in Canada 2019. Canada invested \$25 million in Direct Air Capture (DAC).

\$25M INVESTED

Brazil stored >3 Mtpa CO₂. Stakeholder interest in advancing CCS use; in coal, natural gas power plants, ethanol sector.

>3 Mtpa CO₂

World Bank CCS Trust Fund funding **two CCS pilot projects in Mexico**; expected to proceed in early 2020.



US EMISSIONS PROFILE AND THE POTENTIAL FOR CCS TO MAKE A DIFFERENCE...

Power sector accounts for **28% of the US's greenhouse gas emissions.** In 2019, the Institute added three power plant retrofits to our Institute database. When operational will capture up to a further **10.3 Mtpa of CO₂.**

10.3 MtCO₂
ADDED CAPTURE CAPACITY FROM COAL RETROFIT



KEY US POLICY

Section 45Q of the Internal Revenue Code establishes tax credits for storage of CO₂.

Several CCS supportive bills were introduced in 2019 including the USE IT Act.

California's LCFS is a credit-based trading mechanism applies to CCS projects that lower the emissions intensity of fuels in the California market.

CO₂ STORAGE TAX CREDITS



EUROPE

CCS FACILITIES IN EUROPE

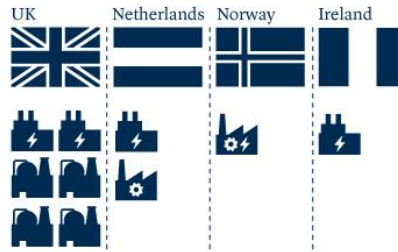
2 large scale CCS facilities in operation in Norway, capturing and storing 1.7 million tonnes per annum of CO₂.

1.7 Mtpa of CO₂



10 large scale CCS facilities in various stages of development (6 in the UK, 2 in the Netherlands, 1 in Norway, 1 Ireland). When operational, these facilities will capture:

20.8 Mtpa of CO₂



CCS facilities in operation and development across cement, power generation, waste-to-energy and hydrogen production.



FINANCE

The Innovation Fund; largest fund available for financing CCS in Europe - 10 billion euros are hoped to be made available**

€10B

POLICY

CCS is one of the seven building blocks in the European Commission's vision for a climate neutral Europe by 2050.



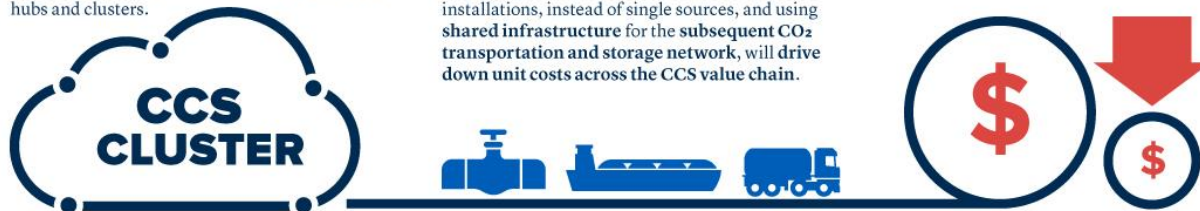
CCS contribution in strategy ranges from 52 to 606 MtCO₂ per year in 2050 — a strong case for CCS in supporting Europe's path to a climate neutral economy.



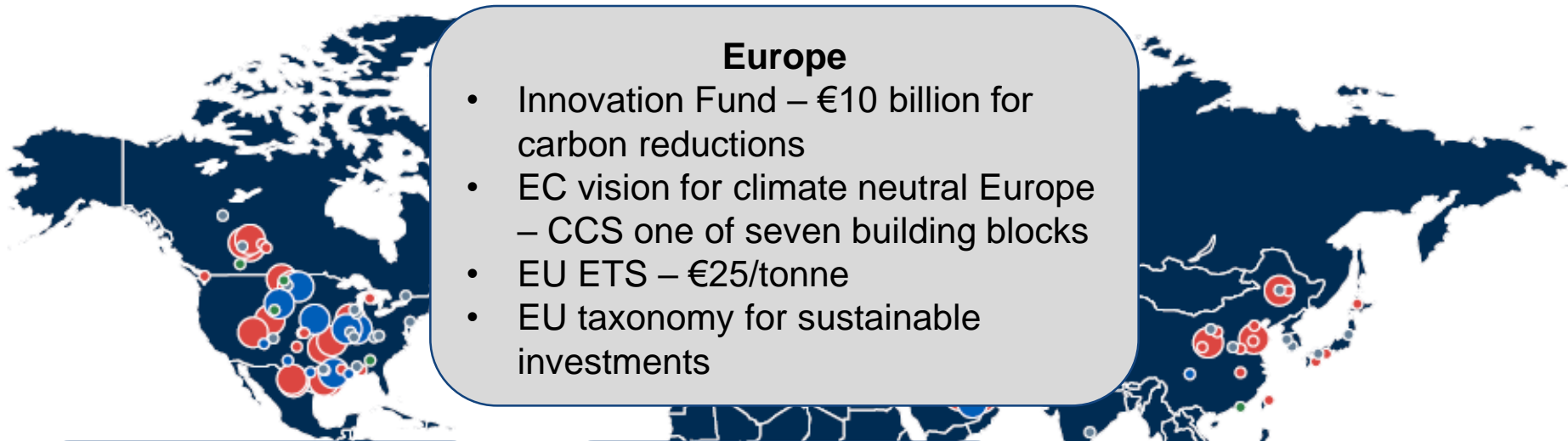
HUBS AND CLUSTERS

Most CCS projects in Europe are now planned as hubs and clusters.

Capturing CO₂ from clusters of industrial installations, instead of single sources, and using shared infrastructure for the subsequent CO₂ transportation and storage network, will drive down unit costs across the CCS value chain.



POLICY DEVELOPMENTS



Europe

- Innovation Fund – €10 billion for carbon reductions
- EC vision for climate neutral Europe – CCS one of seven building blocks
- EU ETS – €25/tonne
- EU taxonomy for sustainable investments

Norway

- Carbon tax – \$53/tonne
- Gassnova
- TCM
- Grant funding for full chain project – FID in Q3 2020

UK

- 80% GHG reduction by 2050
- Clean Growth Strategy – £100 million for CCUS
- CCUS Deployment Pathway – 2018
- Hydrogen

Netherlands

- 49% CO₂ reduction by 2030
- 20 MMT by CCUS

Germany

- Ban on storage
- Merkel: CCUS essential

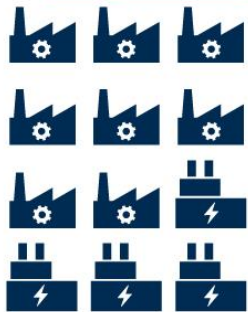


ASIA PACIFIC REGION

CCS

Region has **12 large-scale facilities** either operating or in various stages of development.

12



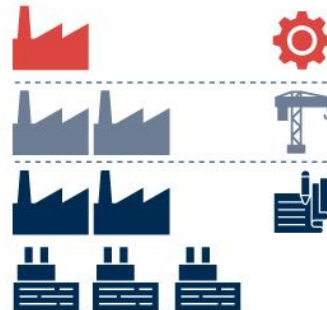
CHINA

China contributes almost one third of the world's CO₂ emissions.

China leads CCS activity across the Asia Pacific.



1 large-scale facility in operation, 2 in construction and 5 in early development.



In 2017, Asia Pacific region was responsible for **72 per cent of the world's coal consumption.**



Currently **352 GW** of coal fired power plants under construction or in planning.



Led by China and India, Asia Pacific economies also produce **more than half of the world's most emissions-intensive products**, such as steel and cement.



EMISSIONS PROFILE

Asia Pacific region is the source of just over **50%** of the world's total CO₂ emissions which is driven by fossil fuel reliance.



POLICY DEVELOPMENTS

China

- State-sponsored projects: 1 operating, 2 in construction, 7 in planning
- Numerous pilots and demonstrations
- Roadmap for CCUS in China, 2019
- CCUS in 5-year plans
- R&D - \$500 million
- ETS - 1700 power plants

Japan

- Deep R&D investment – NEDO, AIST, JCOAL, RITE
- Numerous testing and pilots
- Focus on capture technologies, partnerships with industry
- Tomokomai demo – METI
- Hydrogen Energy Supply Chain

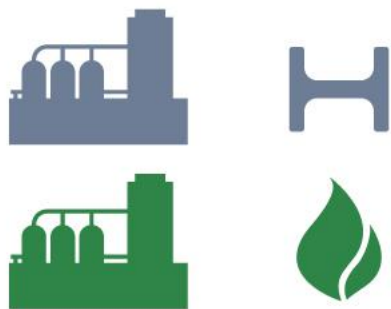
Australia

- Gorgon – CCS required
- Hydrogen Energy Supply Chain
- CarbonNet – offshore storage
- CO2 storage-enabling regs
- R&D – CO2CRC
- National Energy Guarantee



CCS CENTRAL ASIA & MIDDLE EAST

2 large scale CCS facilities in operation:
1 in iron and steel production and
1 in natural gas processing



OVERVIEW

Capturing **1.6 Mtpa** of CO₂



Region has vast and accessible underground storage potential of **5-30 Gigatonnes***



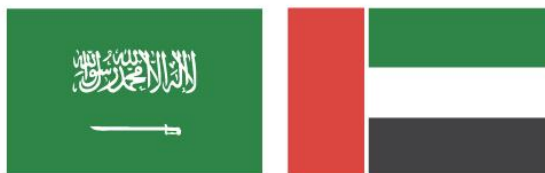
HYDROGEN OPPORTUNITY

Low carbon hydrogen production, from natural gas with CCS, in the Middle East is estimated to cost only **USD1.50/kg**



POLICY AND CCS MOVEMENT

Saudi Arabia and the United Arab Emirates both members of Mission Innovation and the Clean Energy Ministerial.



Both countries have committed to doubling public investment in clean energy research and development and are participating in the Clean Energy Ministerial's CCUS initiative.



CENTRAL ASIA

Rapidly increasing energy demands being driven by growing population, rising living standards and urbanisation that is largely met by fossil fuels.



THANK YOU

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