GLOBAL STATUS OF CCS

2020

JRO 38th Study Meeting

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CCS. VITAL TO ACHIEVE NET-ZERO

THE GLOBAL STATUS OF CCS

- In 2020, the pipeline of operational and under development CCS facilities continued to grow third year in a row.

- Number of countries, cities and companies committing to net-zero climate targets increased in 2020 despite the adversities faced, accelerating CCS development.

- Policy and funding support for CCS continued its momentum, most notably in the US, UK, Norway, EU, Japan and Australia.

- Three factors are enhancing the business case for CCS around the world:
  - Enhanced tax credit in the US
  - Hubs and clusters
  - Hydrogen, as the fuel of the future

- Despite the progress in 2020, to achieve net-zero emissions, CCS capacity must increase more than a hundredfold by 2050.

GLOBAL CCS FACILITIES UPDATE

MATURING INDUSTRY RESULTS IN UPDATED CLASSIFICATION SYSTEM

- New system introduced : classifies CCS facilities as ‘Commercial’ or ‘Pilot and Demonstration’.

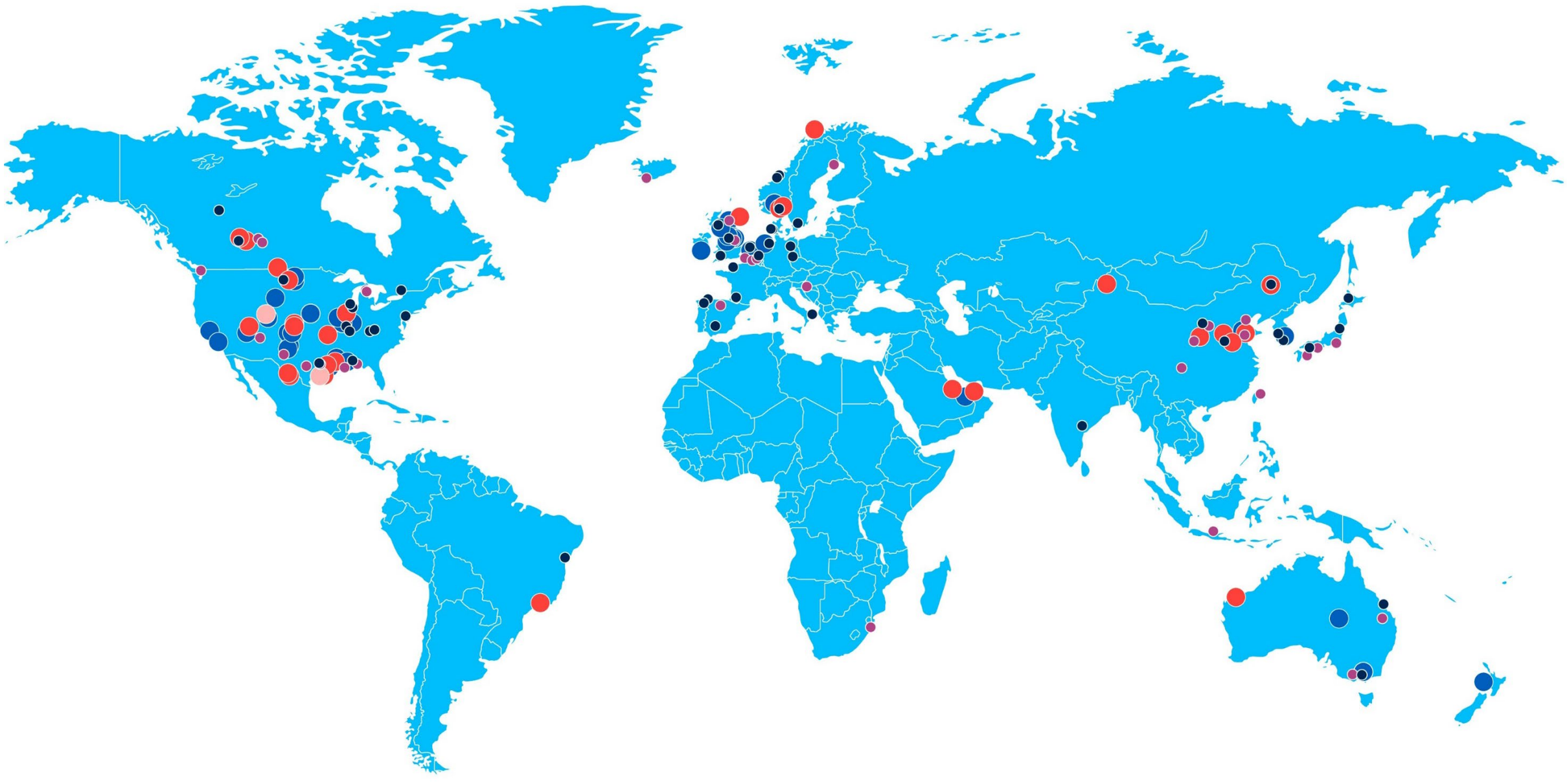
- 65 commercial CCS facilities operational or under development: 26 operating, three under construction, 34 under development, 2 with operations suspended.

- 17 totally new commercial facilities added in 2020; 12 of these are in the US.

- All facilities (operational and under development) have cumulative maximum capture capacity of around 115 million tonnes of CO_2 per annum.

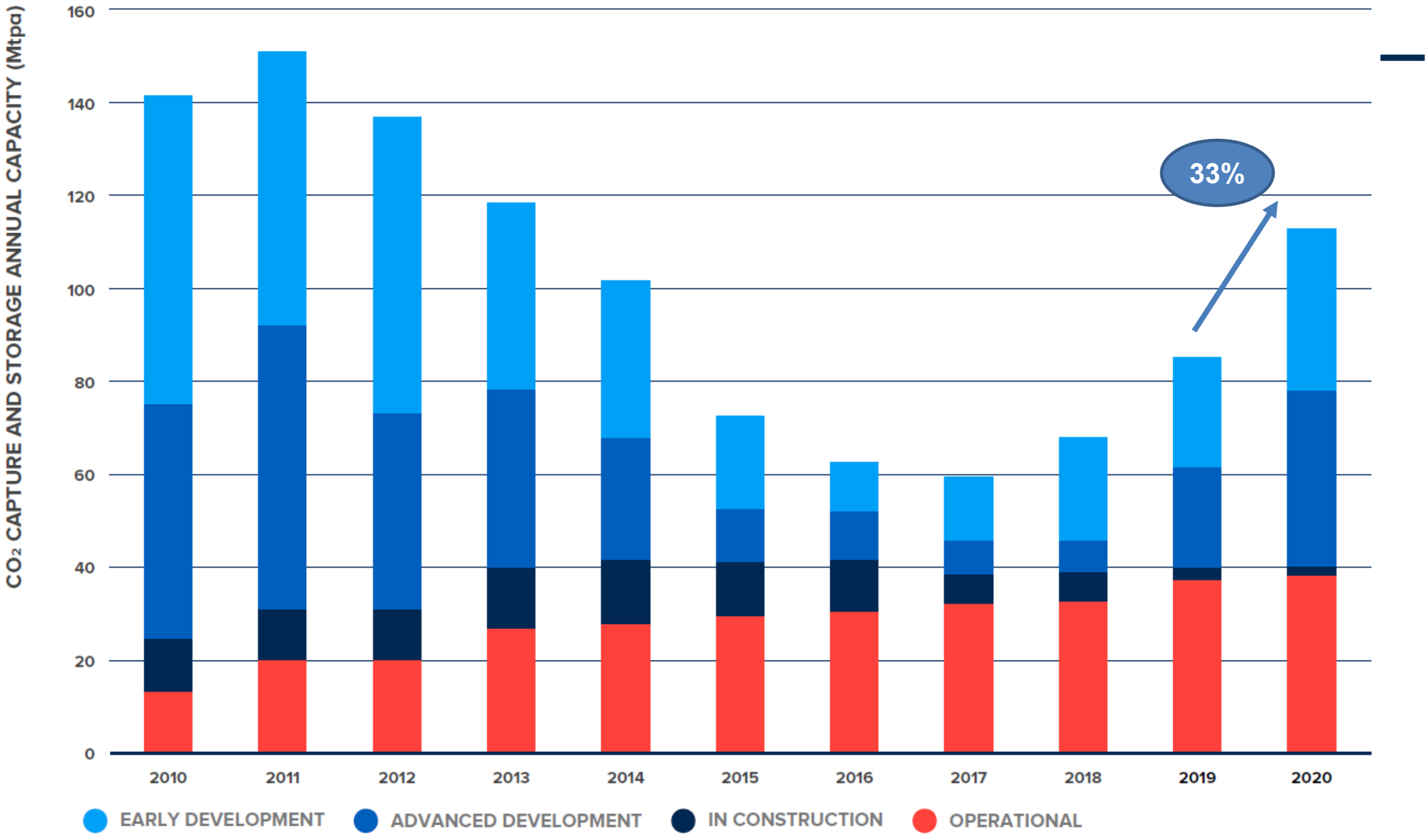
- Almost 40 million tonnes of CO_2 captured annually from 26 commercial CCS facilities currently in operation.

CCS FACILITIES: OPERATIONAL & VARIOUS STAGES OF DEVELOPMENT



- COMMERCIAL CCS FACILITIES IN OPERATION & CONSTRUCTION
- COMMERCIAL CCS FACILITIES IN DEVELOPMENT
- OPERATION SUSPENDED
- PILOT & DEMONSTRATION FACILITIES IN OPERATION & DEVELOPMENT
- PILOT & DEMONSTRATION FACILITIES COMPLETED

UPWARD MOMENTUM CONTINUES: COMMERCIAL CCS FACILITIES PIPELINE



THE CAPACITY OF FACILITIES WHERE OPERATION IS CURRENTLY SUSPENDED IS NOT INCLUDED IN THE 2020 DATA.

COMMERCIAL CCS FACILITIES IN VARIOUS POWER AND INDUSTRIAL APPLICATIONS

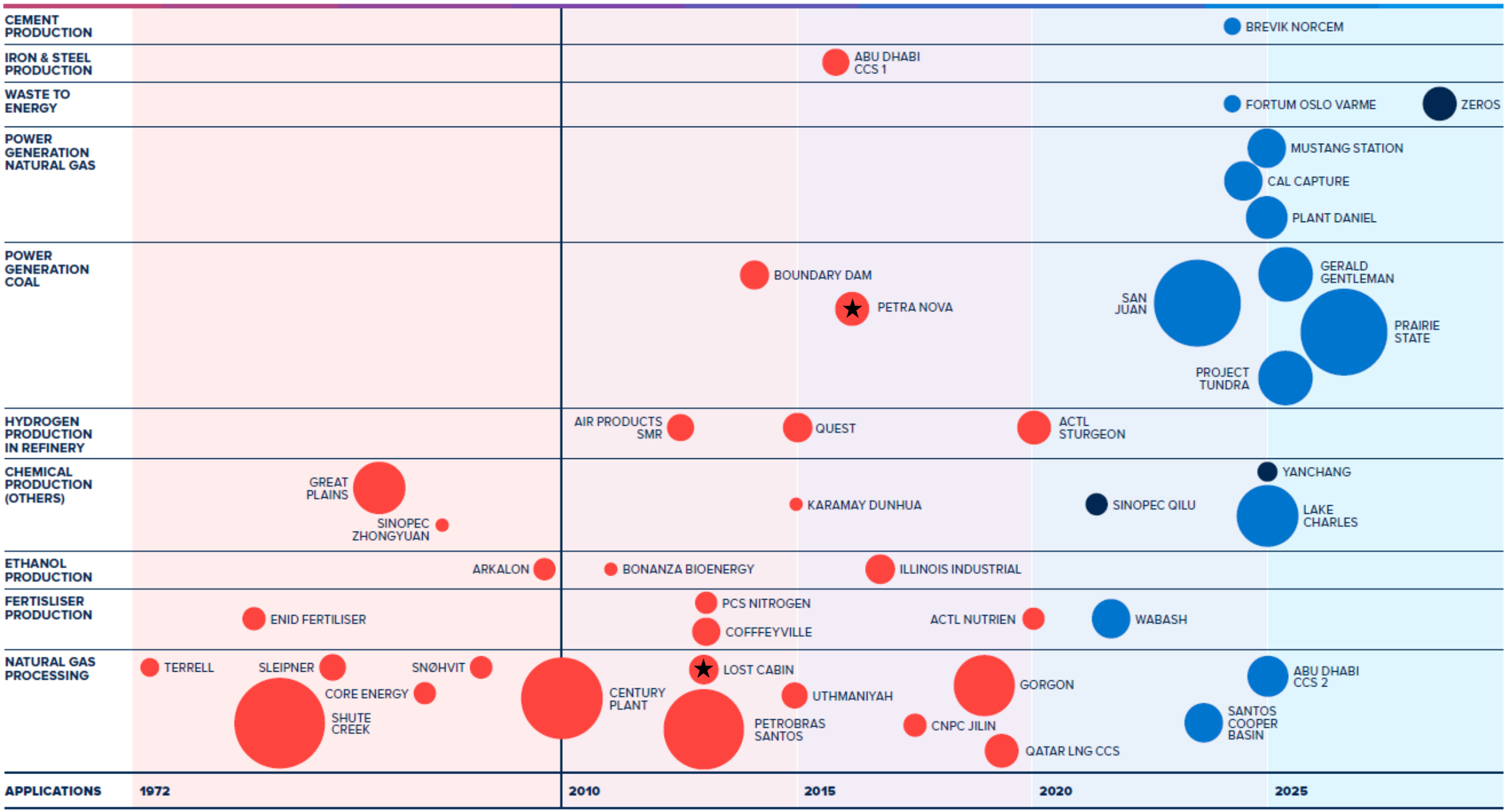


Chart indicates the primary industry type of each facility among various options.

- IN OPERATION
- IN CONSTRUCTION
- ADVANCED DEVELOPMENT
- ★ OPERATION SUSPENDED

Size of the circle is proportionate to the capture capacity of the facility.

- 0.2 Mtpa OF CO_2
- 1.0 Mtpa OF CO_2
- 5.0 Mtpa OF CO_2

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CCS HUBS

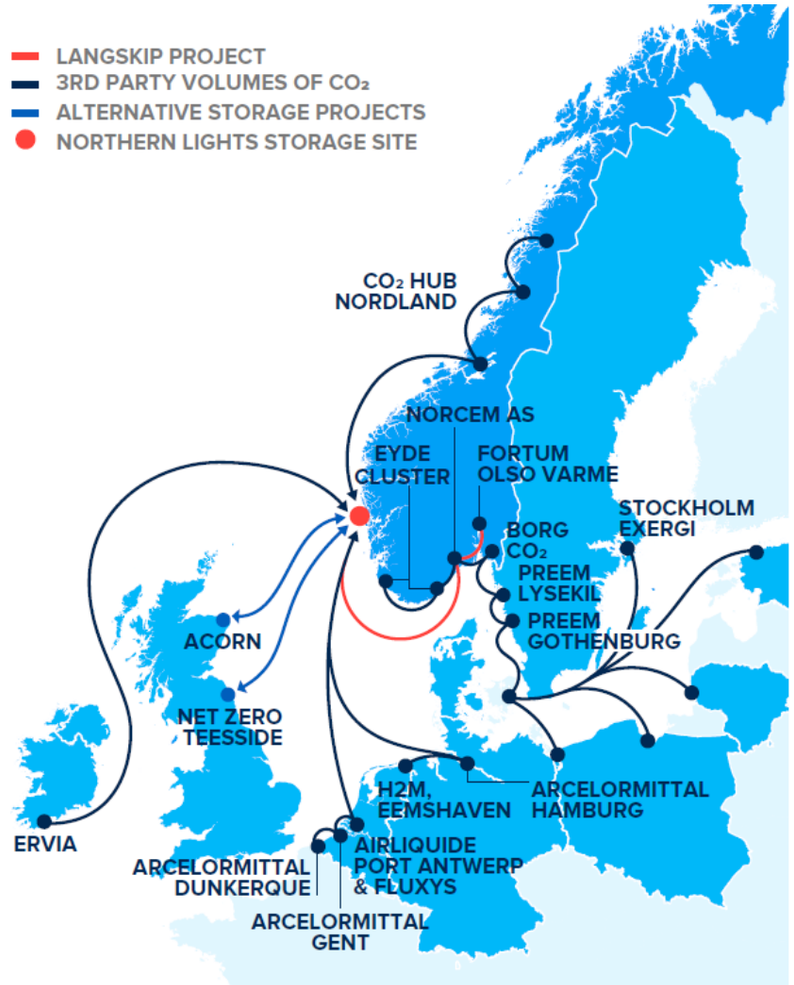
HUBS AND CLUSTERS ARE TAKING OFF GLOBALLY

- Multiple industrial point sources of CO_2 connected to a CO_2 transport and storage network.

- Access to large geological storage resources with the capacity to store CO_2 from industrial sources for decades.

- Economies of scale deliver lower unit-costs for CO_2 storage.

- Synergies between multiple CO_2 sources and the storage operator reduce cross chain risks and support commercial viability.



Northern Lights Project – Potential Sources Of CO_2

CCS HUBS AND CLUSTERS: OPERATING OR IN DEVELOPMENT

STORAGE TYPE

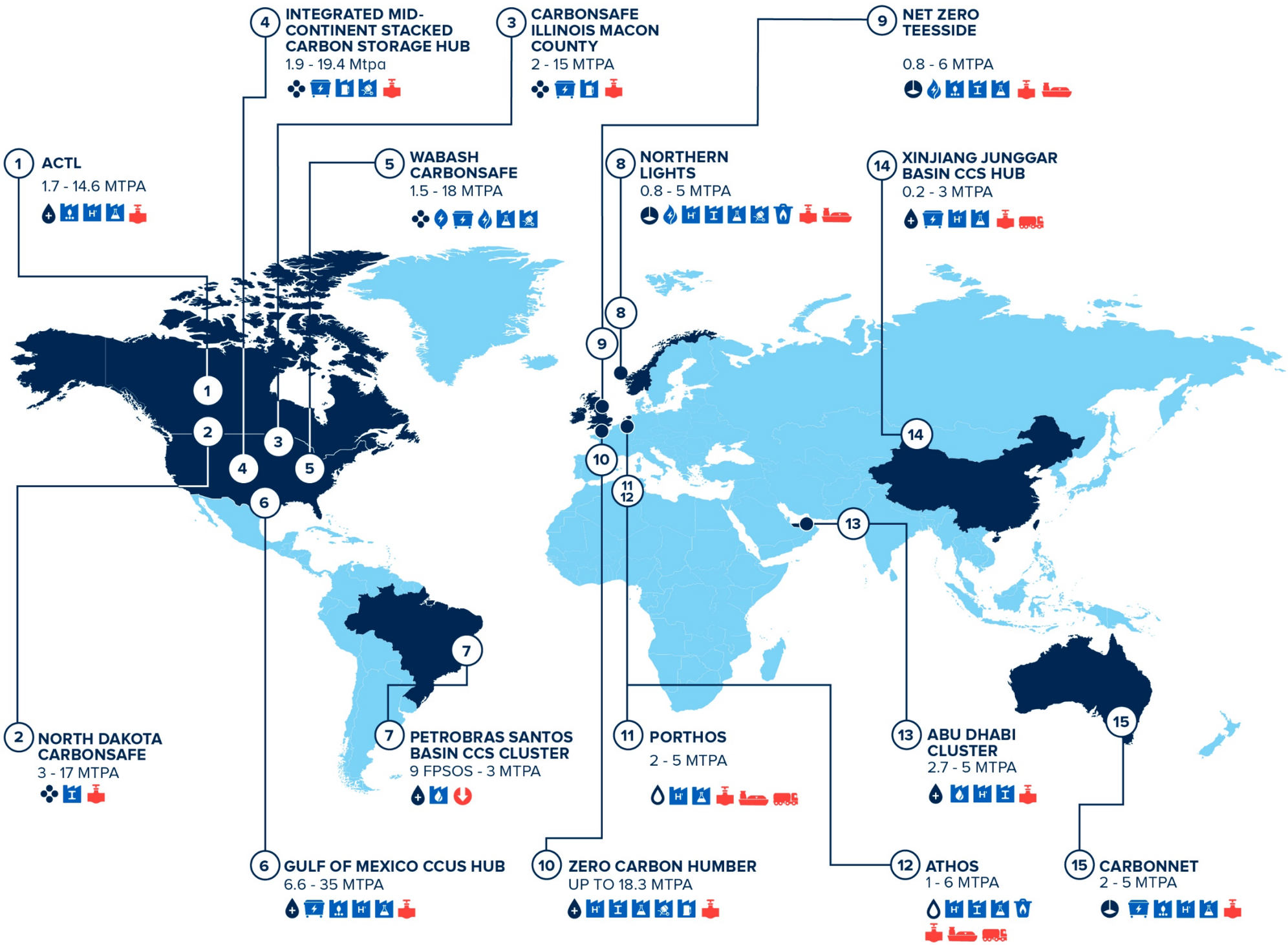
- DEEP SALINE FORMATIONS
- ENHANCED OIL RECOVERY
- DEPLETED OIL & GAS RESERVOIRS
- VARIOUS OPTIONS CONSIDERED

INDUSTRY SECTOR

- COAL FIRED POWER
- NATURAL GAS POWER
- NATURAL GAS PROCESSING
- FERTILISER PRODUCTION
- HYDROGEN PRODUCTION
- IRON & STEEL PRODUCTION
- CHEMICAL & PETROCHEMICAL PRODUCTION
- CEMENT PRODUCTION
- WASTE INCINERATION
- ETHANOL PRODUCTION
- BIOMASS POWER

DELIVERY

- PIPELINE
- SHIP
- ROAD
- DIRECT INJECTION



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AMERICAS

NEW PROJECTS AND POLICY PROGRESS IN THE REGION

- 12 new commercial CCS projects added to our database in the Americas in 2020. 36 commercial facilities operating or in development, plus two currently idled.

- US: New projects largely incentivised by 45Q tax credit and the California Low Carbon Fuel Standard (LCFS). U.S Congress allocated $217.8 million for CCUS development.

- Canada: Alberta Carbon Trunk Line began operating; a hub and cluster that saw over $550 million in provincial and federal funding.

- Brazil: Offshore projects in Brazil continue, capturing over 14M tonnes of CO_2 to date.

EUROPE

CCS MOMENTUM ACROSS EUROPE

- 14 commercial facilities in operation or various stages of development across Europe.

- First call for projects under the EU's €10 billion Innovation fund; expected to be a major source of funding for CCS acros the EU.

- The United Kingdom is set to establish the first net zero industrial cluster, with 1 billion pounds allocated to support CCS development.

- The Norwegian Government has moved forward with $1.8 billion investment to further CCS development.

ASIA PACIFIC

THE EMERGING POWERHOUSE FOR CCS DEPLOYMENT

- 10 CCS facilities in operation or in development across APAC countries.

- Regional collaboration between governments has boosted storage potential and knowledge.

- Singapore, Malaysia, and Australia have newly established CCS strategies.

- The Australian government has established a $50 million CCUS development fund.

JAPAN IN FOCUS

THE REGIONAL COLLABORATION ENGINE

- Japan announced a net-zero emissions target in October 2020.

- Japan has continued to be a strong supporter and promoter of CCUS in the region and is developing CCS technology both for domestic use and as an export industry.

- Japan is home to several CCUS demonstration projects, including Tomakomai, Mikawa and Osaki CoolGen projects

- In the region, Japan is leading collaboration with
  - Joint study on the development of high CO2 fields in Malaysia
  - Joint crediting mechanism (JCM) study for a CCS demonstration project in Indonesia

GULF COOPERATION STATES

GCC STATES EMERGING AS IMPORTANT FOR CCS DEVELOPMENT

- 3 CCS facilities in operation in the Gulf States, capturing 3.7 Mtpa of carbon dioxide.

- Circular carbon economy: CO_2 emissions are managed through a holistic approach to climate mitigation, including carbon removal.

- Saudi Arabia and the UAE have the largest emissions in the region, with power generation the biggest contributor.

CCS: VITAL TO NET-ZERO

SIGNIFICANT CCS POLICY VITAL TO ACHIEVE GLOBAL CLIMATE TARGETS

- To achieve net-zero emissions, CCS capacity must increase more than a hundredfold by 2050.

2,000+

LARGE-SCALE FACILITIES REQUIRED BY 2050

- Stronger policy to incentivise rapid CCS investment is overdue.

- Policy priorities include:
  - Creating conditions for investment
  - Facilitating development of CO_2 infrastructure
  - Clarifying key legal and regulatory issues

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The Global Status of CCS 2020 Report can be downloaded from
https://www.globalccsinstitute.com/rglobalstatusreport/