

グローバルCCSインスティテュート日本事務所主催 公開ウェビナー

「なぜ世界はCCSが必要なのか？ – 世界のCCSの動向とその課題」

講演者:

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Chris Consoli



CCS: ROLE, STATUS & DRIVERS

PRESENTERS:

- **CHRIS CONSOLI**, SENIOR CONSULTANT – STORAGE, GLOBAL
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- **IAN HAVERCROFT**, SENIOR CONSULTANT – LEGAL & REGULATORY,
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WHAT IS CCS?

CAPTURE

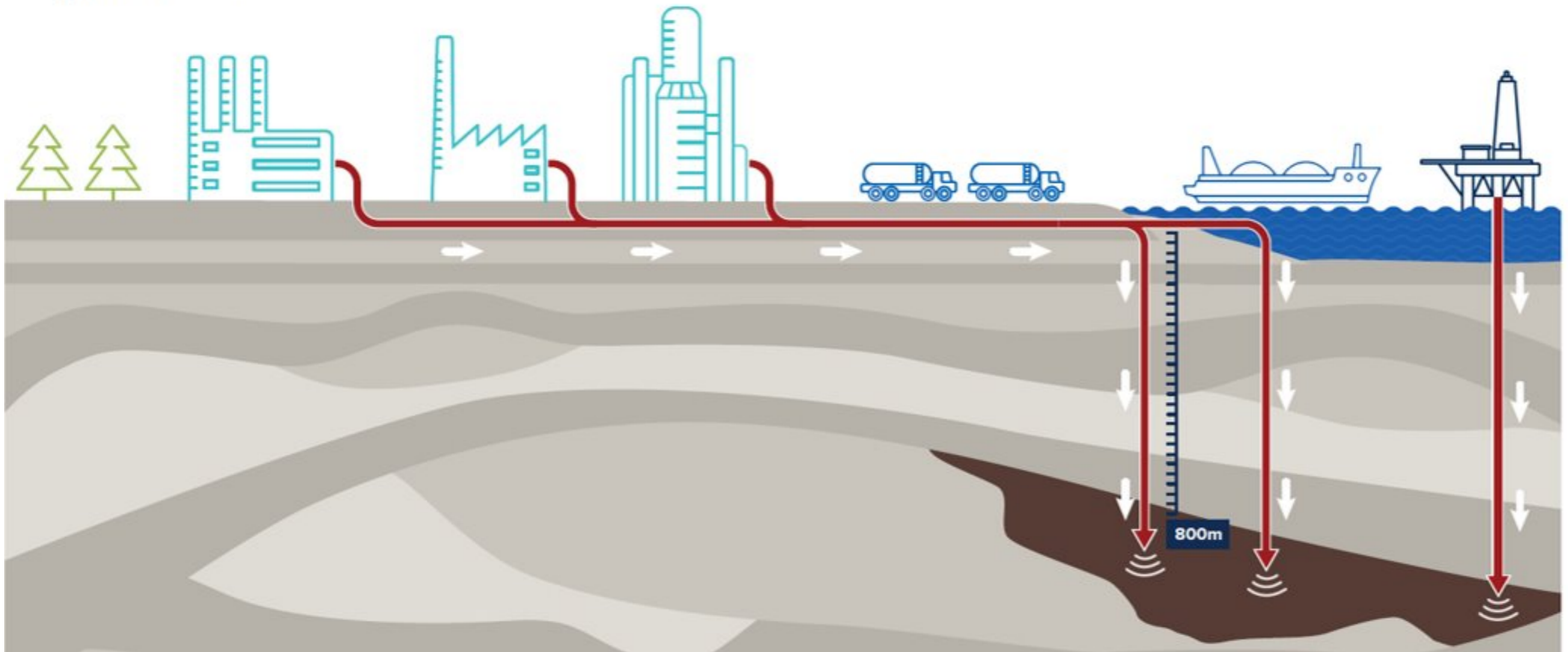
Capture involves the separation of CO₂ from other gases produced at large industrial process facilities such as coal and natural-gas-fired power plants, steel mills, cement plants and refineries.

TRANSPORT

Once separated, the CO₂ is compressed and transported via pipelines, trucks, ships or other methods to a suitable site for geological storage.

STORAGE

CO₂ is injected onshore or offshore into deep underground rock formations at depths of 800m or more.



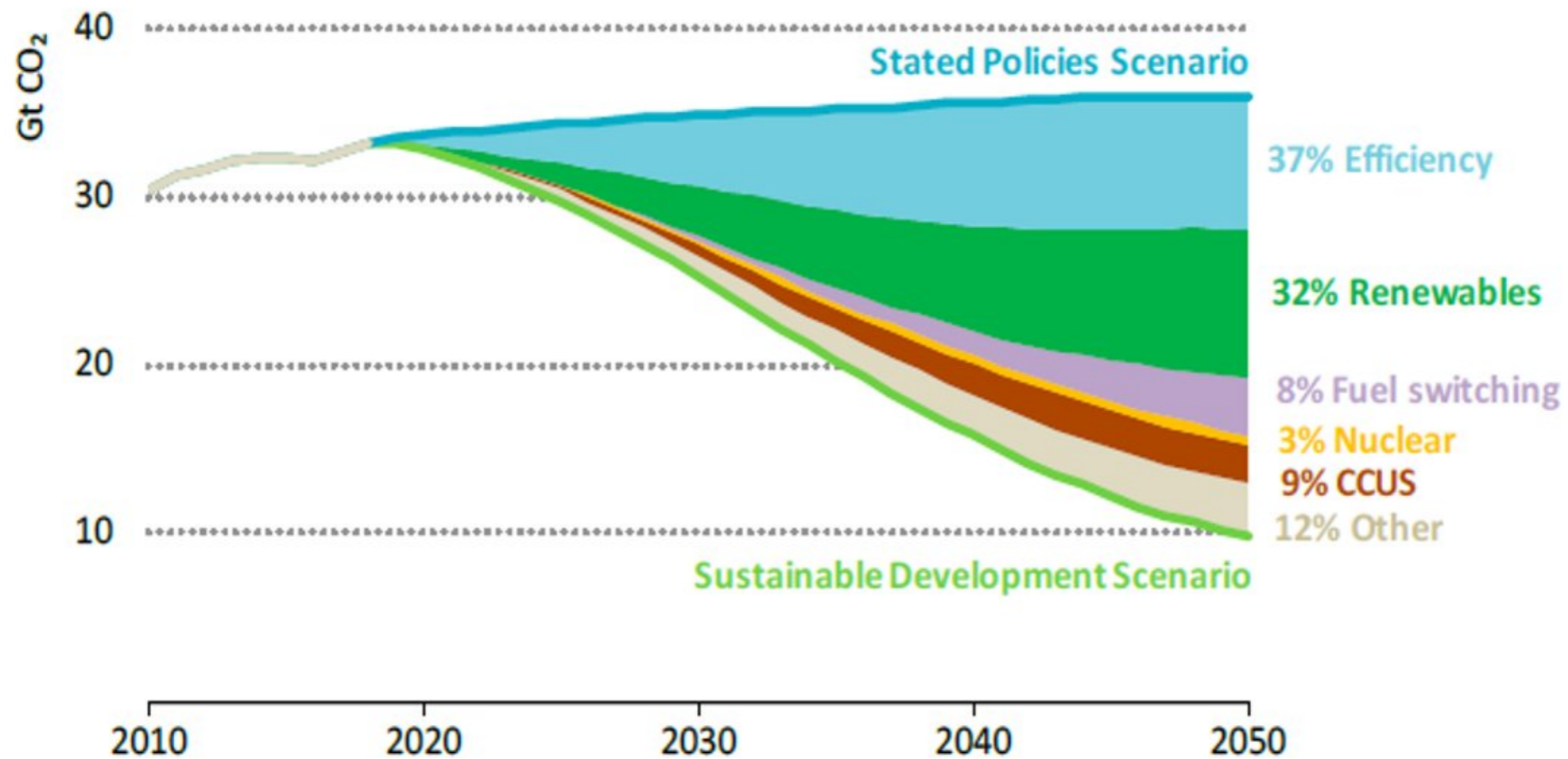
MEETING CLIMATE CHANGE TARGETS

- CCS is vital to reduce emissions to net-zero by mid-century and achieve global climate change targets.
- CCS technologies are proven, have been in operation since 1970s.
- Over 260 Mt of anthropogenic CO₂ has been captured and stored to date.
- CCS is versatile in its application; mitigates emissions as well as removes CO₂ from atmosphere.
- Most proposed models require a substantial volume of CO₂ to be captured, transported and stored annually.

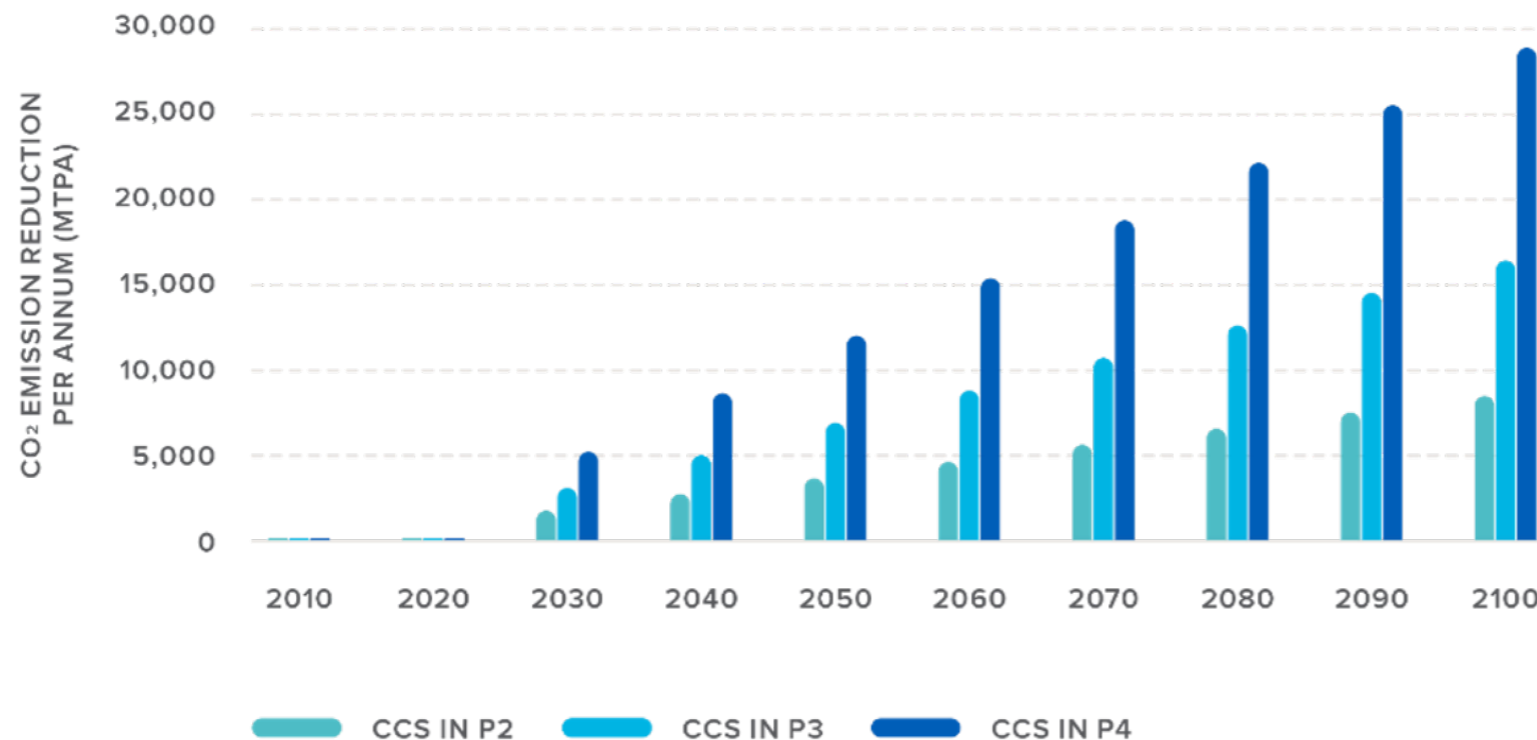


CCS IS ESSENTIAL - IEA WEO 2019 REPORT

- 66% chance of $T \leq 1.8$ degrees C
- Limited negative emissions
- Average 1.5Gtpa CO₂ captured 2019-2050
- 2.8Gt CO₂ captured in 2050, capture split almost equally between power and industry



CCS IS ESSENTIAL - IPCC SR15 REPORT



- Almost all scenarios required CCS
- 3 of 4 Illustrative Pathways required 348Gt to 1,218Gt CO2 to be stored this century.

P2: A SUSTAINABILITY-ORIENTED SCENARIO

P3: A MIDDLE-OF-THE-ROAD SCENARIO

P4: A RESOURCE-AND ENERGY-INTENSIVE SCENARIO

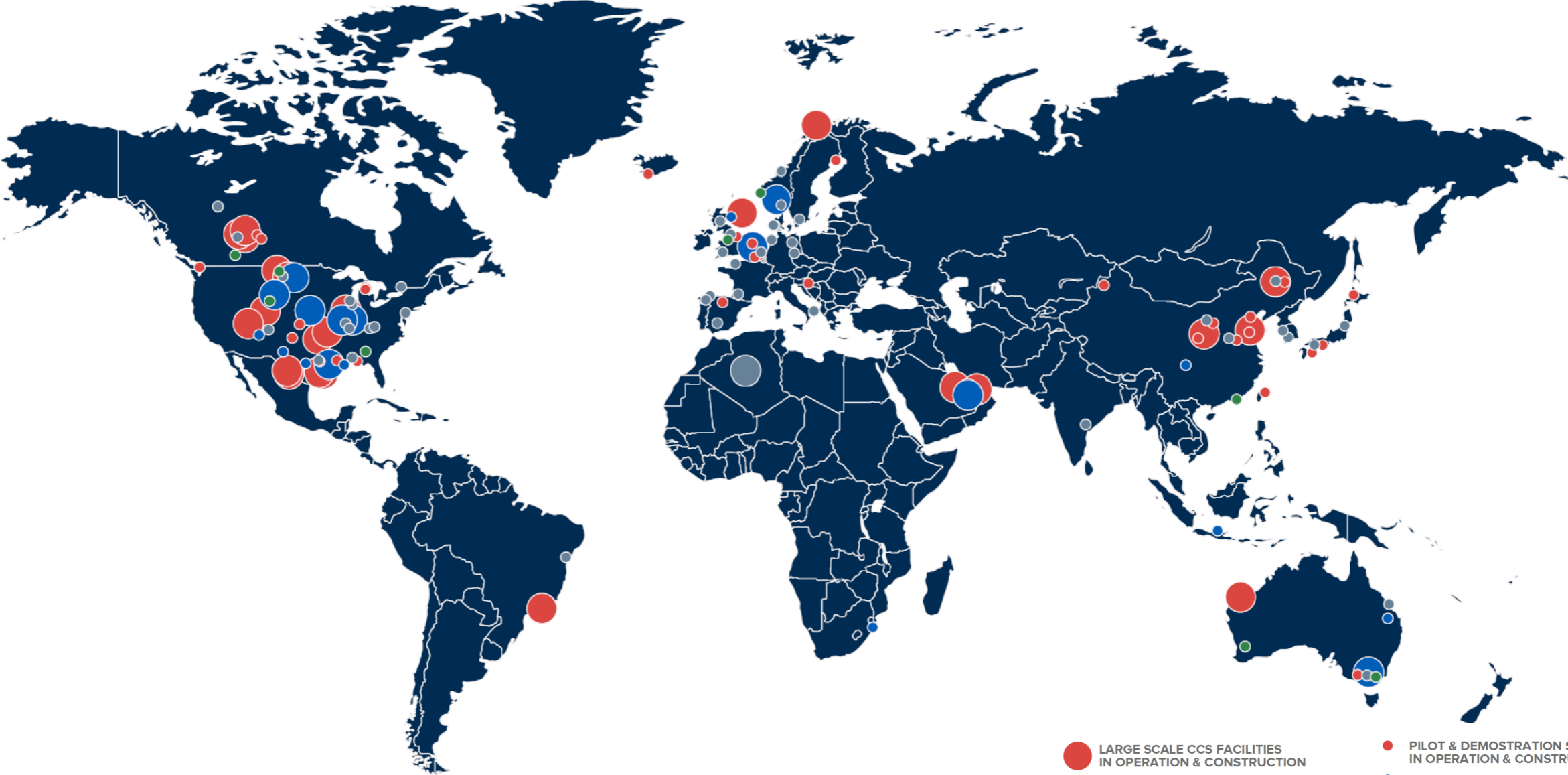


CURRENT STATUS OF CCS



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CURRENT CCS FACILITIES AROUND THE WORLD



- LARGE SCALE CCS FACILITIES IN OPERATION & CONSTRUCTION
 - LARGE SCALE CCS FACILITIES IN ADVANCED DEVELOPMENT
 - LARGE SCALE CCS FACILITIES COMPLETED
 - PILOT & DEMONSTRATION SCALE FACILITY IN OPERATION & CONSTRUCTION
 - PILOT & DEMONSTRATION SCALE FACILITY IN ADVANCED DEVELOPMENT
 - PILOT & DEMONSTRATION SCALE FACILITY COMPLETED
 - TEST CENTRE
- LARGE SCALE = >400,000 TONNES OF CO₂ CAPTURED PER ANNUM

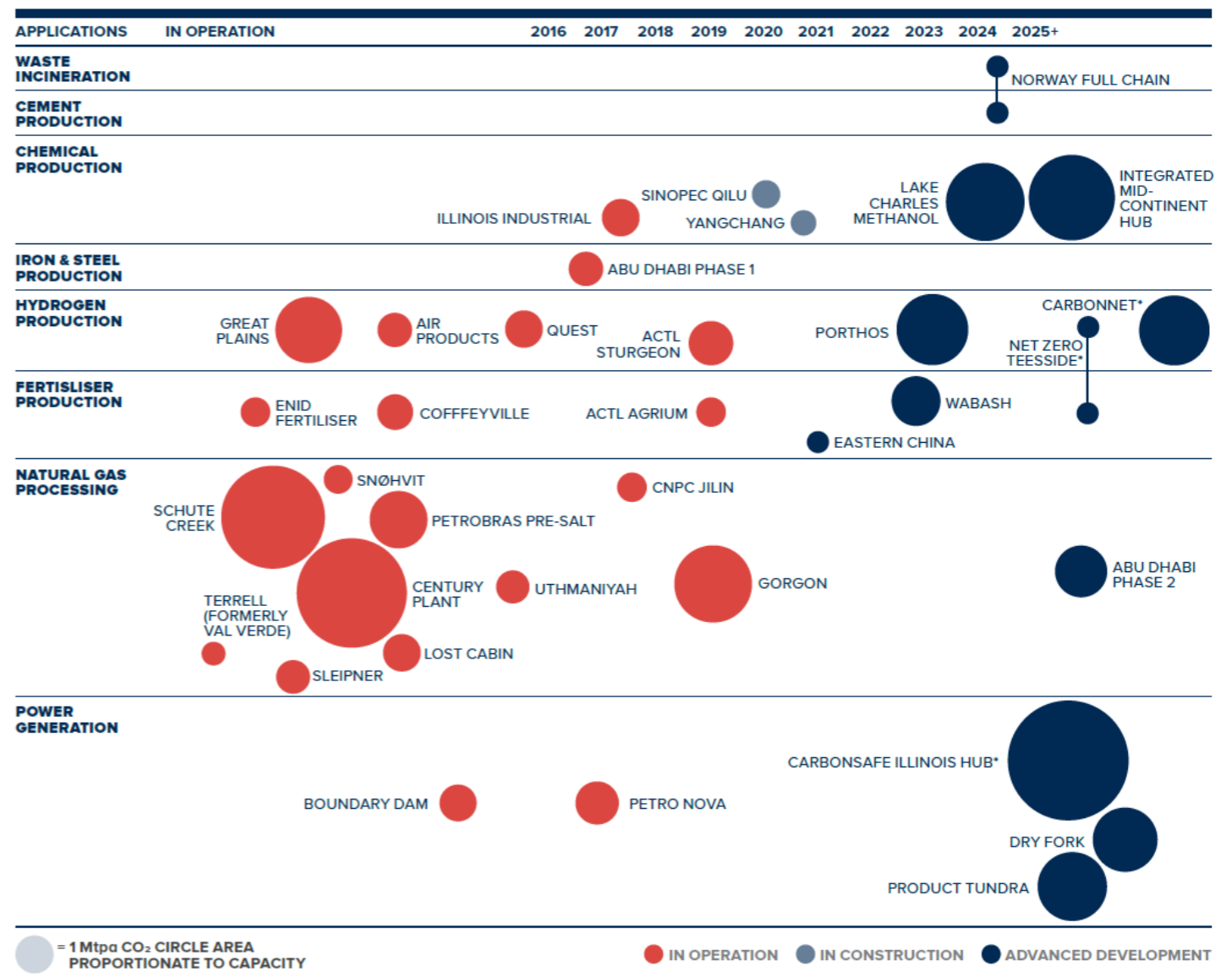


CCS PROJECT PIPELINE IS REPLENISHING

In 2019

- Total large scale CCS Project pipeline increased by 8 to 51
 - 10 new projects added
 - 2 removed
- Gorgon commenced operation bringing the number of large scale operating facilities to 19
- ACTL Sturgeon and ACTL Agrium facilities expected to commence operations very soon

Projects in “Advanced Development” Stage, or more advanced

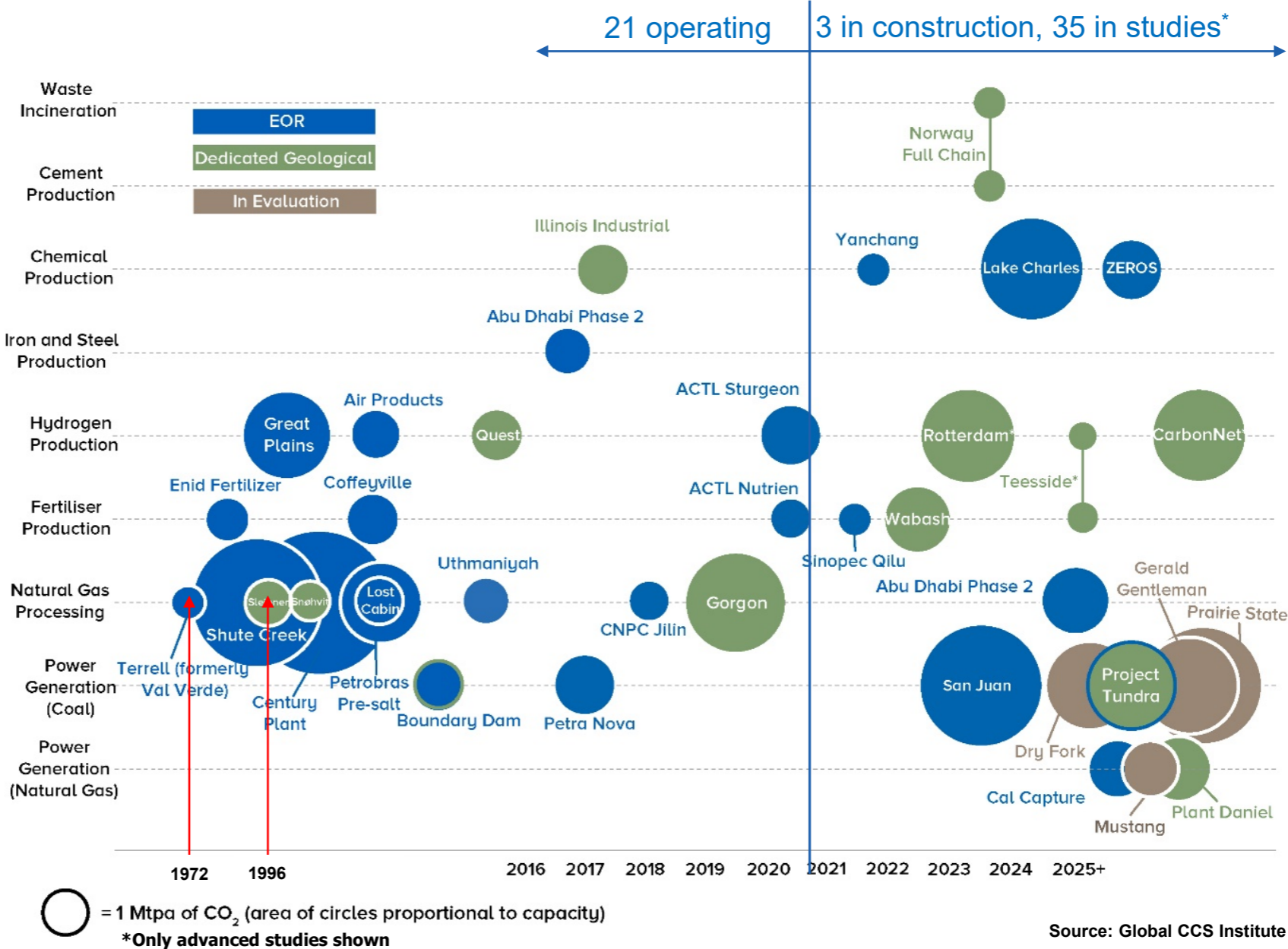


LARGE CCS FACILITIES – STORAGE

EOR since 1972

Dedicated CO₂ storage since 1996

260Mt anthropogenic CO₂ stored to date



CCS FACILITIES - INDUSTRY

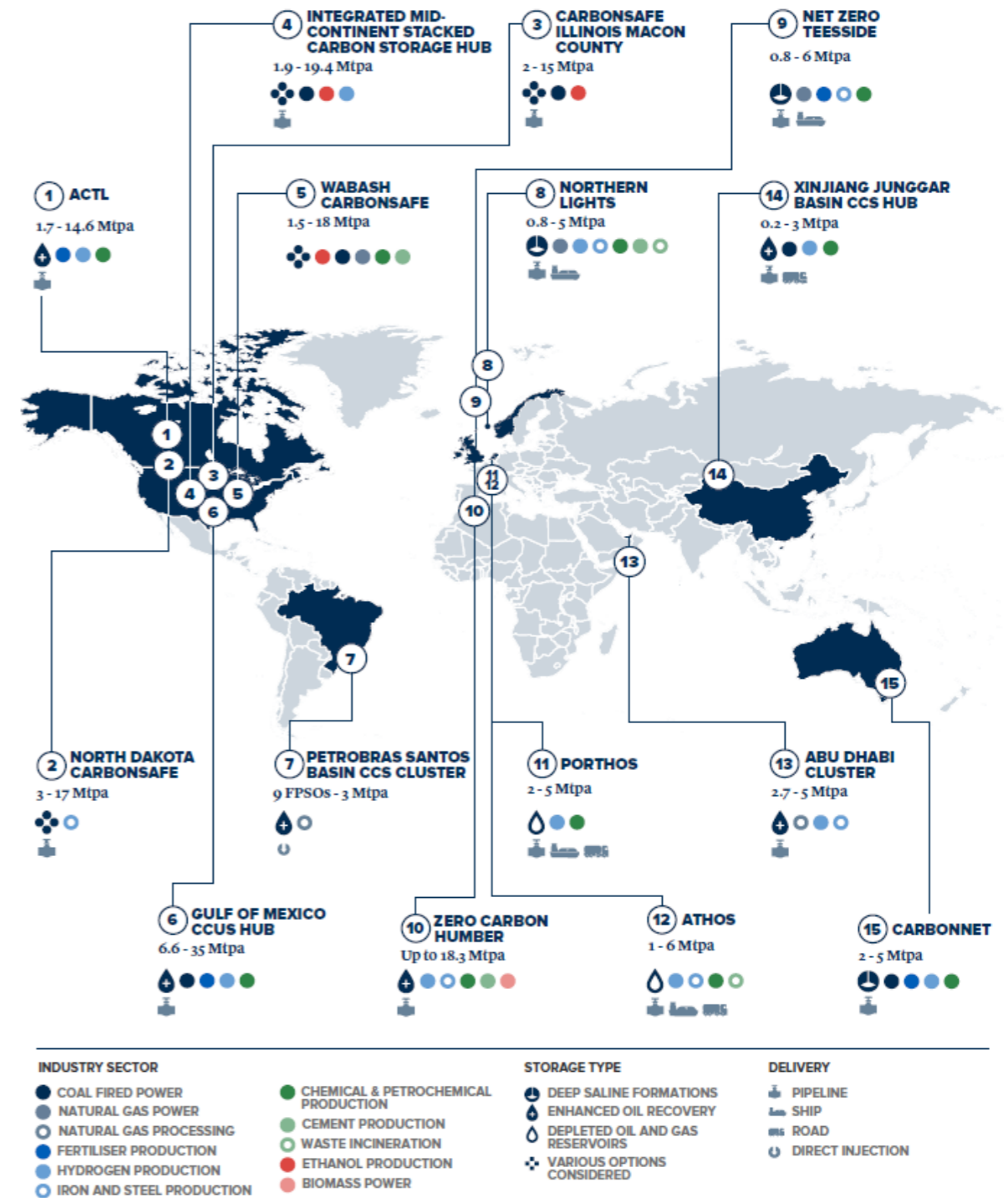
LARGE SCALE CCS FACILITIES BY APPLICATION					
	IN OPERATION	IN CONSTRUCTION	ADVANCED DEVELOPMENT	EARLY DEVELOPMENT	TOTAL
WASTE INCINERATION		●	●		2
CEMENT PRODUCTION			●	●	2
CHEMICAL PRODUCTION		●●	●●	●	5
IRON & STEEL PRODUCTION	●				1
HYDROGEN PRODUCTION	●●●●		●●	●●●	9
NATURAL GAS PROCESSING	●●●●●●●●●●		●		11
POWER GENERATION (COAL)	●●		●●●●●	●●●●	11
POWER GENERATION (NAT. GAS)			●●●●	●●●	7
ETHANOL PRODUCTION	●			●	2
FERTILISER PRODUCTION	●●●			●●	5
OTHER/IN EVALUATION				●●●●	4
TOTAL	21	3	16	19	59

Source: Global CCS Institute



CCS HUBS

- Economies of scale
- Commercial synergies
- Reduce cross-chain risk
- Create low-emission industrial precincts
- *Just transition* for communities that rely on high-emission industries
- Lowest cost opportunities US\$15-25/tonne CO₂ for high concentration CO₂ gas streams
 - Natural gas processing
 - Bioethanol production
 - Various chemical processes



Source: Global CCS Institute



STORAGE



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CO₂ STORAGE IS PROVEN

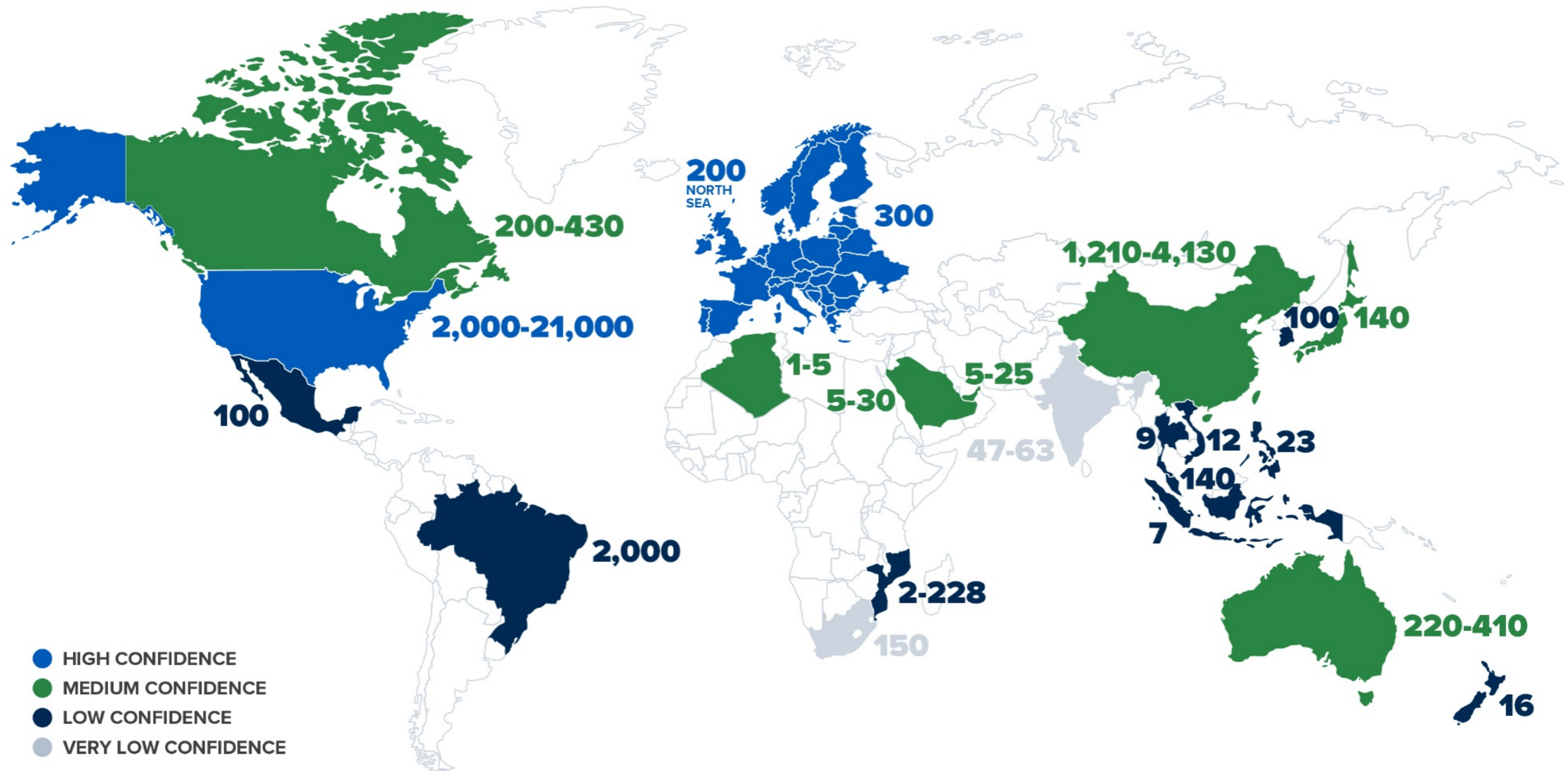
STORAGE IS HAPPENING!

- Over 260 million tonnes of anthropogenic CO₂ has been successfully injected underground
- The process of storing CO₂ in underground rock formations is well-understood, safe and permanent
- Monitoring technologies, refined from hydrocarbon and hydrogeology industries are available

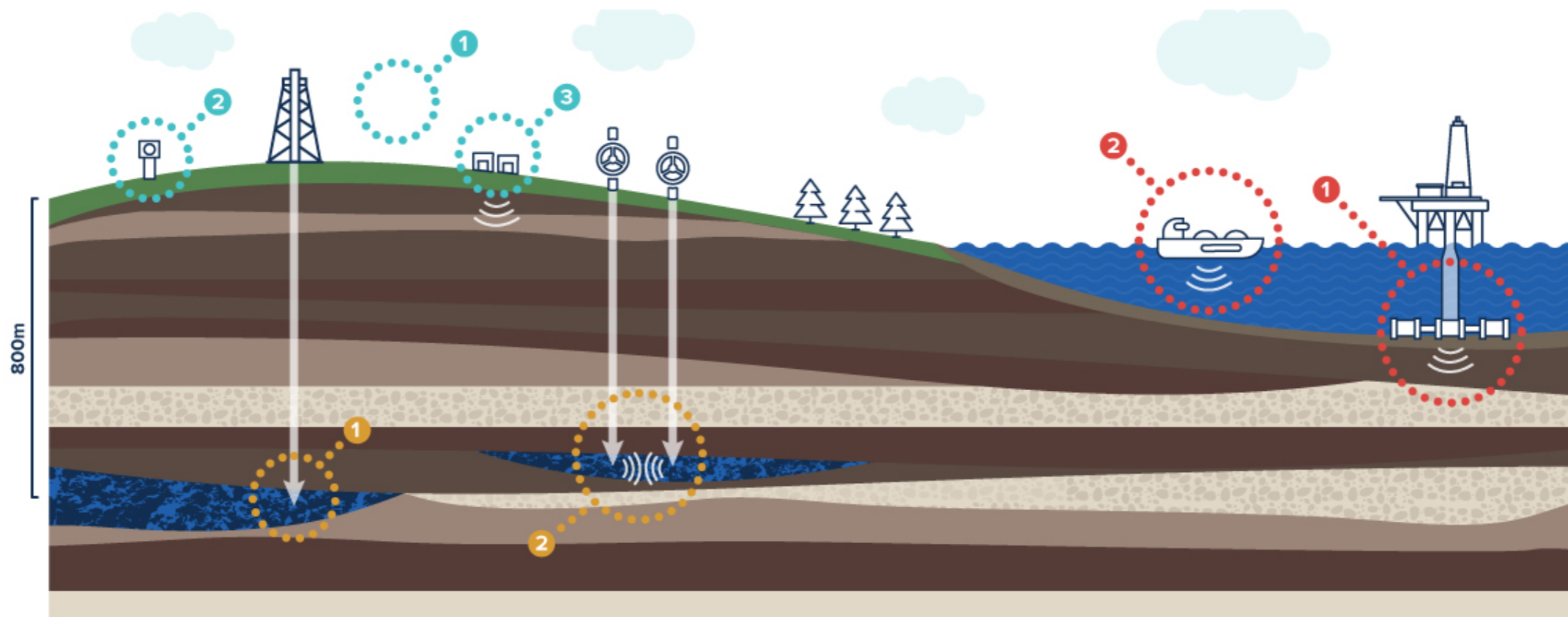


AMPLE GLOBAL STORAGE RESOURCES

Conservative estimates of global storage capacity are several times larger than required this century under any scenario.



MONITORING TECHNOLOGIES



- 1 **ATMOSPHERE**
 AIRBORNE EM
 AIRBORNE SPECTRAL
 SATELLITE INTERFEROMETRY
- 2 **SURFACE**
 EDDY COVARIANCE
 SURFACE GAS FLUX
 SOIL GAS CONCENTRATIONS
 GROUND WATER CHEMISTRY
- 2 **SURFACE**
 2D/3D SURFACE SEISMIC
 LAND EM/ERT
 SURFACE GRAVIMETRY
 TILTMETERS

- 1 **SUB-SURFACE**
 DOWNHOLE FLUID CHEMISTRY
 DOWNHOLE PRESSURE
 DOWNHOLE TEMPERATURE
 GEOPHYSICS LOGS
- 2 **SUB-SURFACE**
 CROSS-HOLE EM
 CROSS-HOLE ERT
 CROSS-HOLE SEISMIC
 MICROSEISMIC
 VERTICAL SEISMIC PROFILING
 WELL GRAVIMETRY

- 1 **OFFSHORE**
 BOOMER/SPARKER PROFILING
 BUBBLE STREAM DETECTION
 MULTI-ECHO SOUNDINGS
 SIDESCAN SONAR
- 2 **OFFSHORE**
 SEABOTTOM GAS SAMPLING
 SEAWATER GEOCHEMISTRY
 SEABOTTOM SEISMIC
 SEABOTTOM EM

EM ELECTROMAGNETIC **ERT** ELECTRICAL RESISTANCE TOMOGRAPHY



LAW AND REGULATION



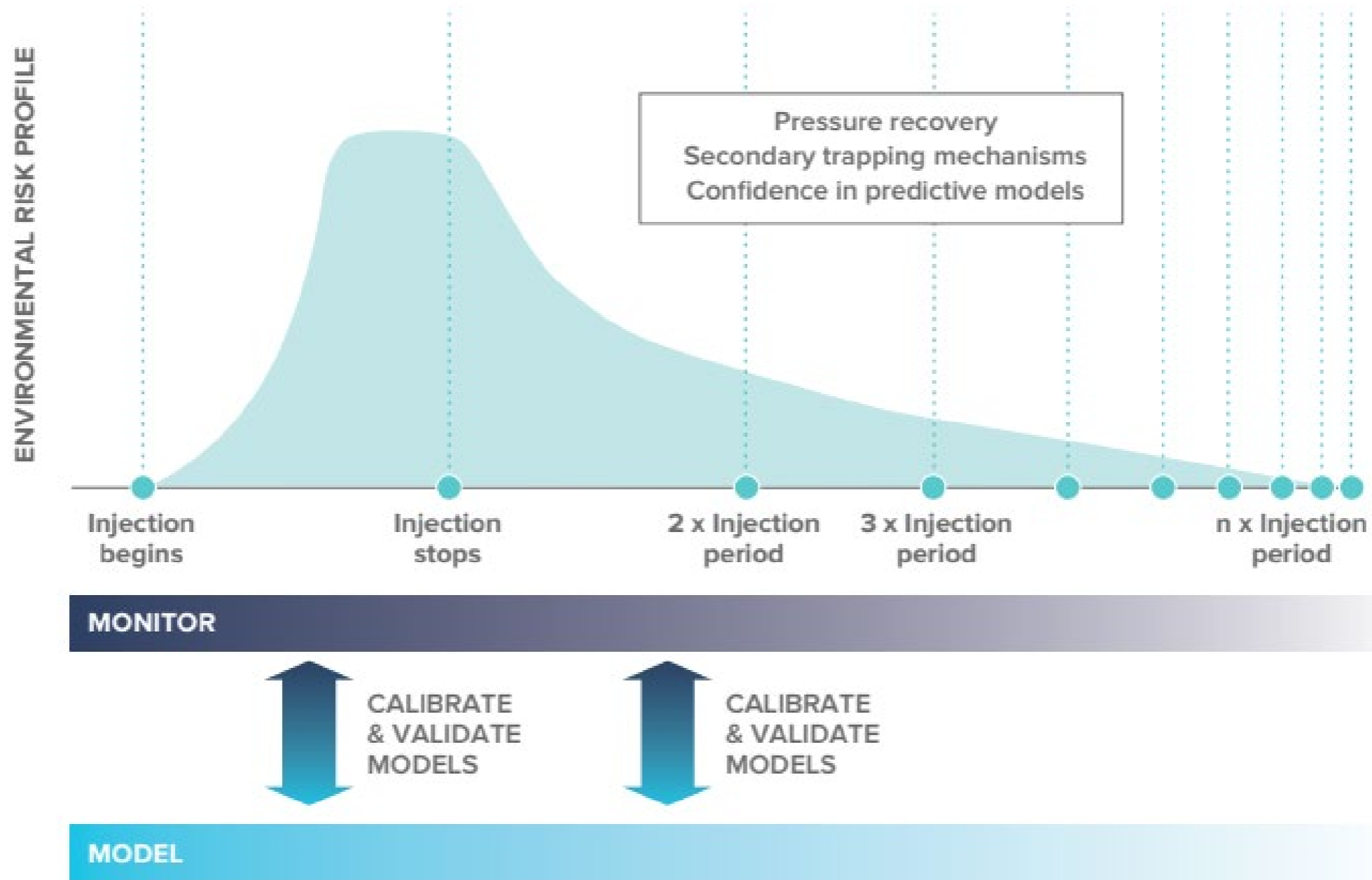
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REGULATION

- Legal and regulatory frameworks are critical for CCS operations.
- CCS-specific frameworks are now in place in many jurisdictions worldwide.
- Regulatory models not only support deployment, but also ensure environmental protection and public safety.
- Clarify rights and responsibilities of operators and relevant authorities.
- Manage the novel risks of the CCS process throughout the project lifecycle.



STORAGE RISK PROFILE



¹ Model reproduced from Benson, S., Carbon Capture and Storage: Research Pathways, Progress and Potential, GCEP Annual Symposium, Stanford University, 2007.



LIABILITY

- Apportioning responsibility for CCS activities is a key feature of many of the CCS-specific frameworks
- Many regimes now include well-characterised examples of how to approach liabilities associated with CCS operations
- Frameworks address the novel challenges of CCS to consider liability throughout the project lifecycle
- Host of different forms of liability may be addressed
- Clear allocation of roles for operators and regulators to ensure security of storage



TRANSBOUNDARY CO₂ TRANSPORT & STORAGE

- Critical issue for those nations with limited domestic storage potential, or those seeking to host storage projects
- Provisions found within international marine legislation had proven a hindrance to transboundary projects
- Adoption in 2019 to allow the ‘provisional application’ of an earlier amendment was a significant development
- Focus must also shift to increasing ratification



DRIVERS



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NECESSARY ACTIVITIES – A WAY FORWARD? (1)

- Storage Characterisation Appraisal
 - Identification of storage sites
 - Appraisal is critical to understand injection rates (not just storage resource estimate)
 - Enables planning for CCS Hubs, future industry
- Portfolio approach
 - National and intra-basin sites required
 - Exploration and appraisal carry a large risk of failure and uncertainty
- Demonstration-scale CO₂ injection, storage and monitoring
 - Addresses novel challenges posed by CO₂ storage operations
 - Experience and expertise



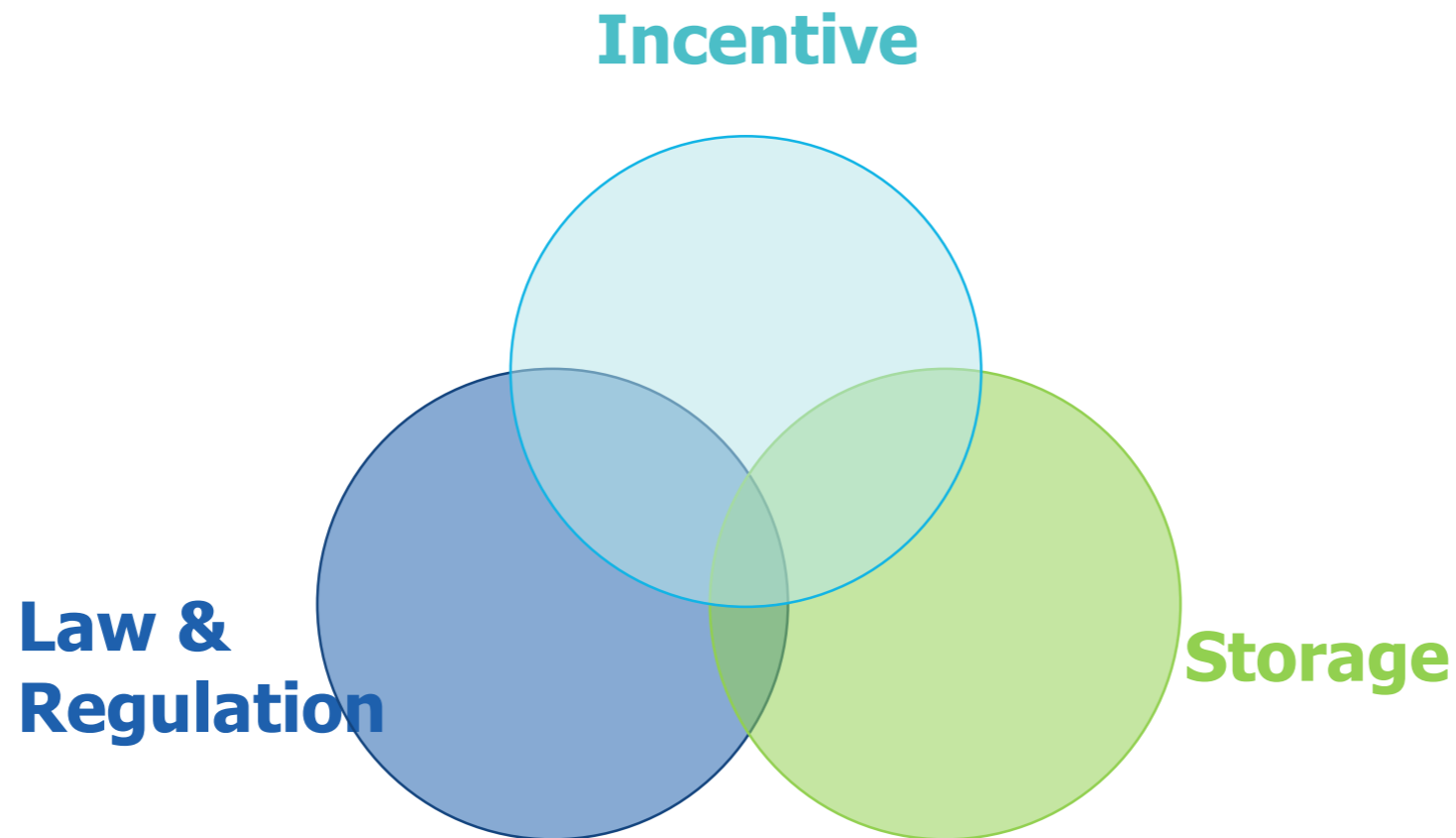
NECESSARY ACTIVITIES – A WAY FORWARD? (2)

- Review of national policy architecture:
 - Consideration of the role of CCS in nations' Nationally Determined Contributions (NDCs) under the Paris Agreement.
 - Review of national climate change and energy policy commitments.
 - International, regional and domestic financing mechanisms to support CCS initiatives – e.g. international grants, carbon crediting schemes, tax relief.
- Rapid development of legal and regulatory frameworks:
 - Examination of existing legal and regulatory frameworks and their ability to support CCS project deployment in each jurisdiction.
 - Consideration of novel challenges posed by CCS activities.
 - Design and development of CCS-specific regimes or amendment to existing models.
 - Institutional arrangements to support regulatory models – regulatory authorities and oversight.



A COUNTRY PERSPECTIVE OF FACILITY DEPLOYMENT

- The 'high-scoring' nations highlight the significance of:
 1. Developed storage resources – available now
 2. Incentive – a commercial driver for injection and storage
 3. Law and regulation – throughout the project lifecycle



QUESTIONS & ANSWERS



THANK YOU!

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一般公開ウェビナー

□ 9月22日(火) 22:00-23:00 (日本時間)

「Achieving a Net Zero Emissions Economy: Returning Carbon to the Earth」

(英語での開催になります)

インスティテュート日本語サイト：

□ イベント案内ページ：<http://jp.globalccsinstitute.com/latest-events/>

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□ インスティテュート英語HP内 “Audio and Visual Library”：
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日本における問合せ先：グローバルCCSインスティテュート日本事務所 (JapanOffice@globalccsinstitute.com)



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