"Expectation for CCS toward 2050“

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Matsuoka Toshifumi

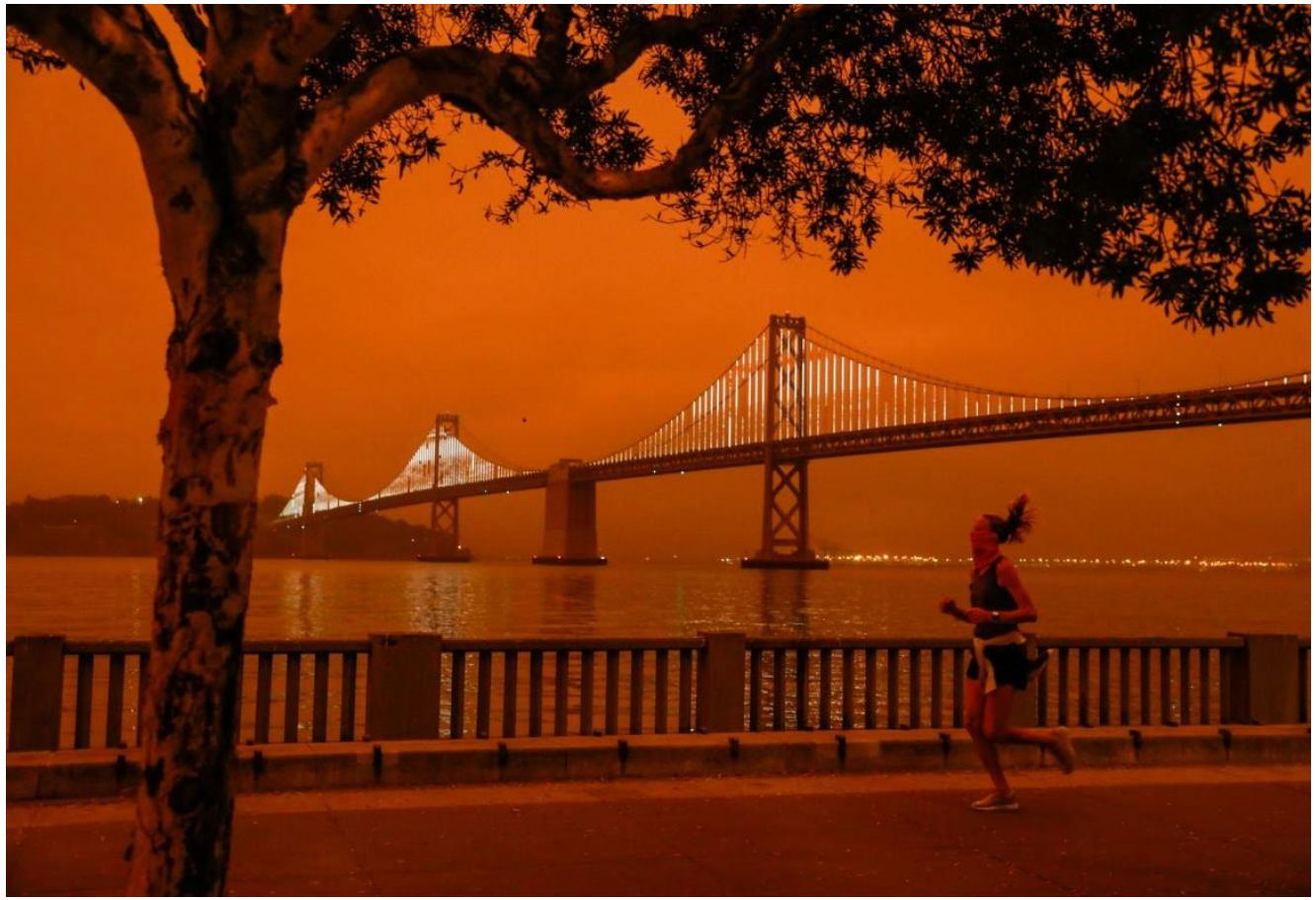
Emeritus Professor Kyoto University

Fukada Geological Institute

Expectation for CCS toward 2050

1. Role of CCS for Global Warming
2. Target of CO_2 Reduction in 2050 in Japan
3. Journey to Activation, Expansion, and At-scale CCS
4. Remaining Tasks to Solve
5. Summary

The Earth is burning!



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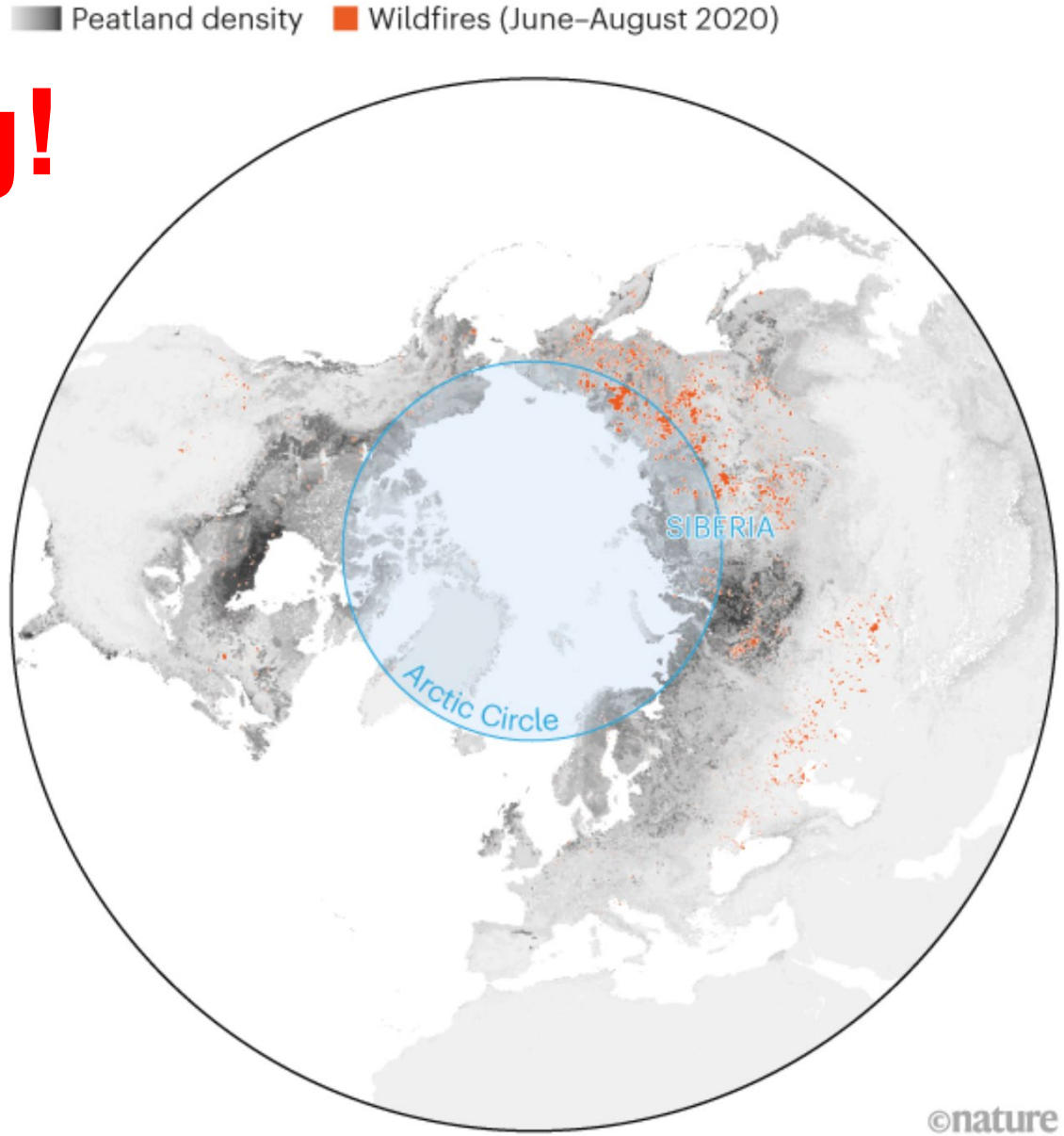
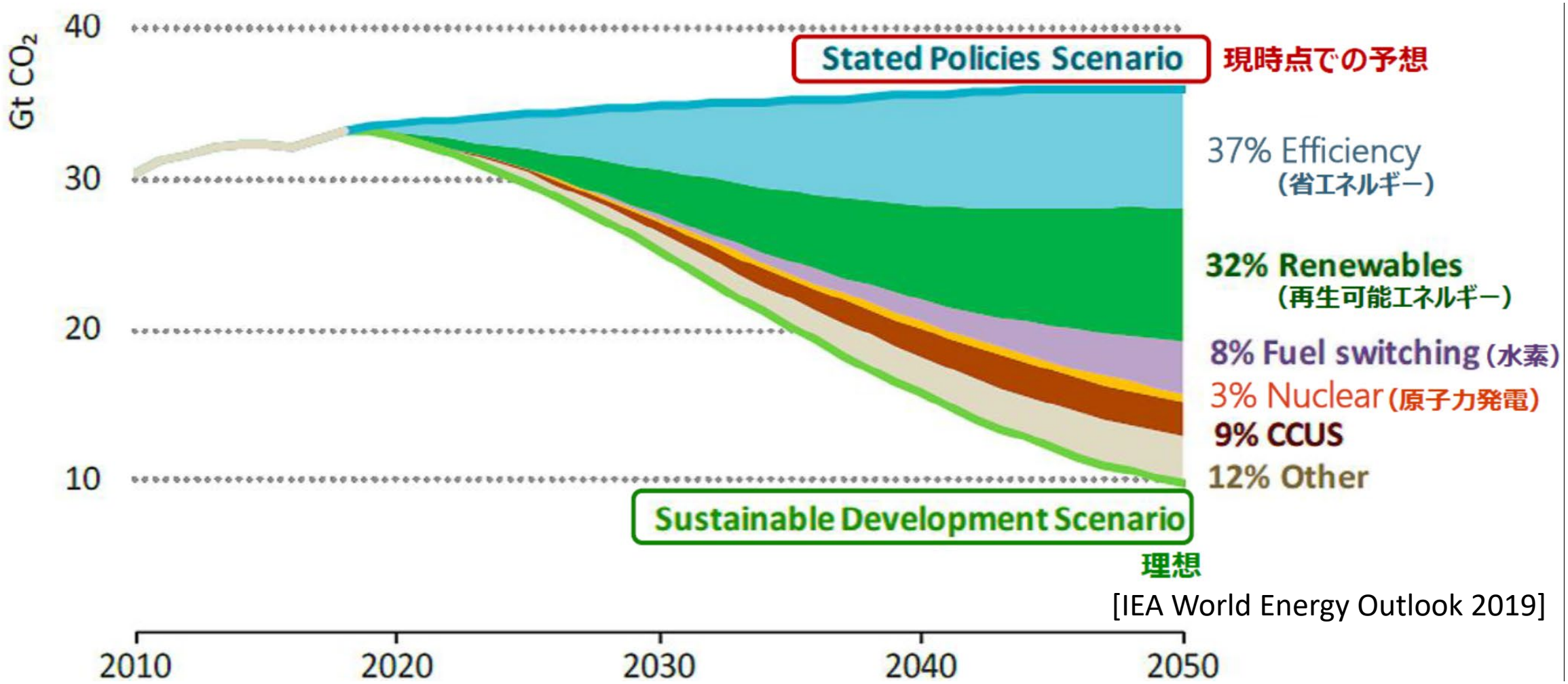


Sources: Copernicus Atmosphere Monitoring Service/European Centre for Medium-Range Weather Forecasts; Hugelius, G. *et al. Proc. Natl. Acad. Sci. USA* **117**, 20438–20446 (2020)

CCS expects 2.5Gt CO2 Reduction in 2050



[IEA World Energy Outlook 2019]

Huge Amounts & No Time : Is this feasible?

Yes, 2.5Gt CCS in 2050 is feasible

OPEN

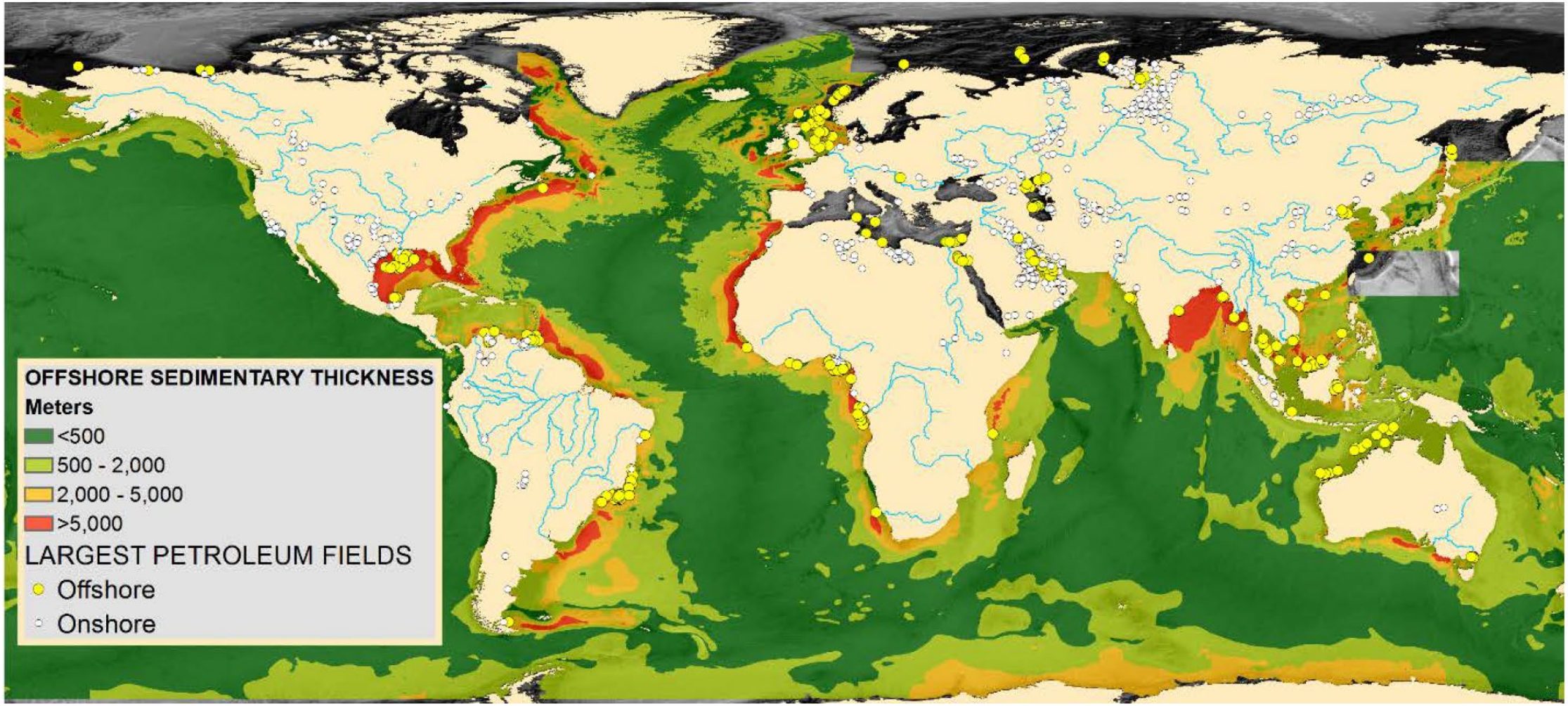
Maturing global CO_2 storage resources on offshore continental margins to achieve 2DS emissions reductions

P. S. Ringrose[1,2*] & T. A. Meckel[3]

Most studies on CO_2 emissions reduction strategies that address the 'two-degree scenario' (2DS) recognize a significant role for CCS. For CCS to be effective, it must be deployed globally on both existing and emerging energy systems. For nations with large-scale emissions, offshore geologic CO_2 storage provides an attractive and efficient long-term strategy. While some nations are already developing CCS projects using offshore CO_2 storage resources, most geographic regions have yet to begin. This paper demonstrates the geologic significance of global continental margins for providing broadly-equitable, geographically-relevant, and high-quality CO_2 storage resources. We then use principles of pore-space utilization and subsurface pressure constraints together with analogs of historic industry well deployment rates to demonstrate how the required storage capacity can be developed as a function of time and technical maturity to enable the global deployment of offshore storage for facilitating 2DS. Our analysis indicates that 10–14 thousand CO_2 injection wells will be needed globally by 2050 to achieve this goal.

SCIENTIFIC REPORTS
nature research
2019

Global offshore resources



Global distribution and thickness of sediment accumulations on continental margins, with largest oilfields and main river systems

P. S. Ringrose & T. A. Meckel (2019) Maturing global CO2 storage resources on offshore continental margins to achieve 2DS emissions reductions, Scientific Report

Main findings: Global scale-up

Using historical well development trajectories transposed into a future CO_2 injection industry, we can infer that:

- A single 'Gulf-of-Mexico well development' CO_2 injection model could achieve the 7 Gtpa storage by 2043 and 12 Gtpa by 2050. Cumulative storage in 2050 would be 116 Gt.
- Alternatively, five 'Norway offshore well development' models could achieve the 7 Gtpa storage by 2050. Cumulative storage in 2050 would be 73 Gt.
- Cumulative storage of >100 Gt by 2050 is most efficiently achieved with 5-7 regions pursuing a Norwegian-scale offshore well development model:
  - Resources are equitably distributed and would likely occur in multiple offshore basins close to the main locations of onshore capture

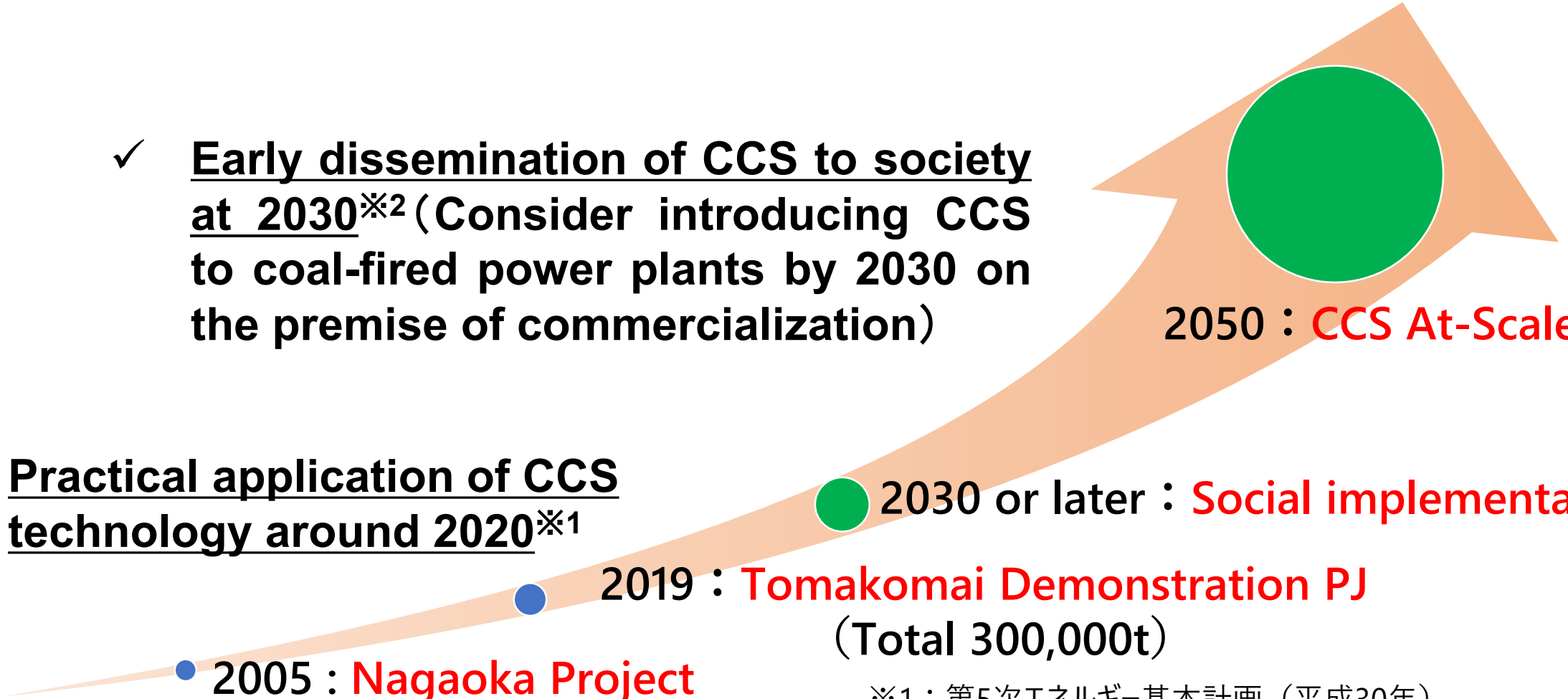
It will only take a fraction of the historic worldwide offshore petroleum well development rate to achieve the global requirements for geological storage of captured CO_2 under the 2DS scenario

from : Ringrose RITE CCS Workshop, 23 Jan 2020

Target of CO_2 Reduction in 2050 in Japan

✓ **Contribution to 80% CO2 reduction in 2050※2**

✓ **Early dissemination of CCS to society at 2030※2（Consider introducing CCS to coal-fired power plants by 2030 on the premise of commercialization）**



✓ **Practical application of CCS technology around 2020※1**

※1：第5次エネルギー基本計画（平成30年）
※2：パリ協定に基づく成長戦略としての長期戦略（令和元年）

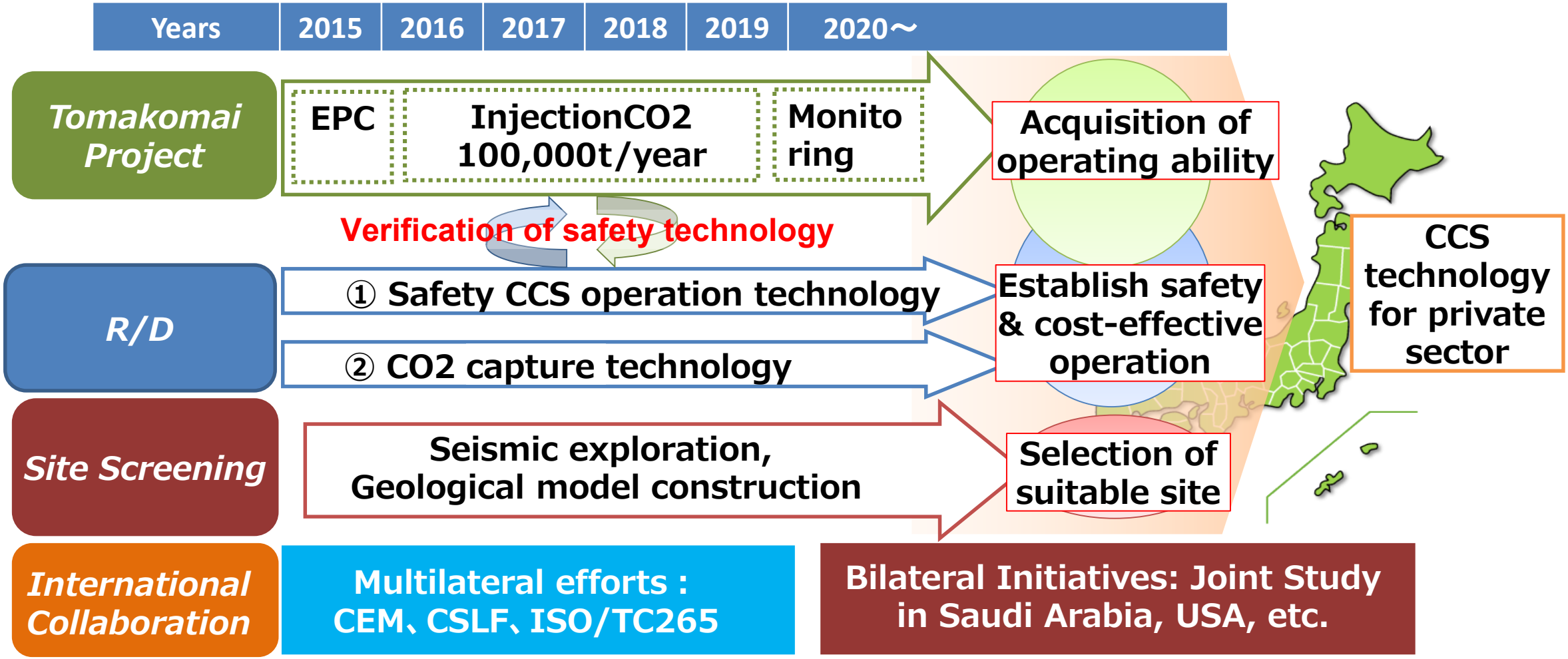
CCS is indispensable for 80% reduction of CO_2

- Study of mitigation scenarios by RITE for 80% reduction (total 1.0Gt in Japan)
- Reduction costs with CCS and without CCS are more than three times difference
- Only domestic efforts, 80% reduction is hard to achieve
- How to realize a large CCS in 2050 in Japan?
- Sites, Cost, Road Map, Regulation, Liability etc.

RITE Home page

Present Stage toward a large CCS in Japan

Guided by the "Basic Energy Plan" of Japan, the CCS technology at 2020 is; (1) CCS demonstration in Tomakomai, (2) Research and development for safety operation and cost reduction, (3) Survey of suitable injection sites for CCS, (4) International collaboration is underway.

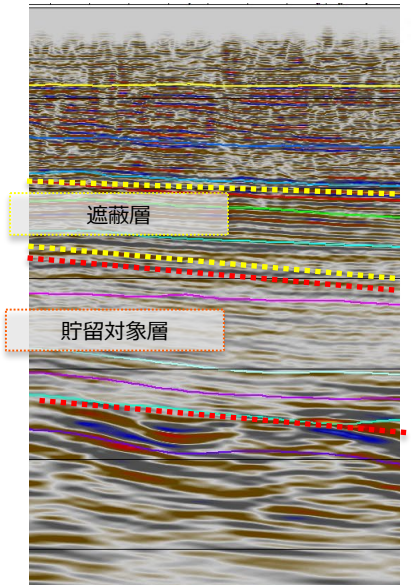


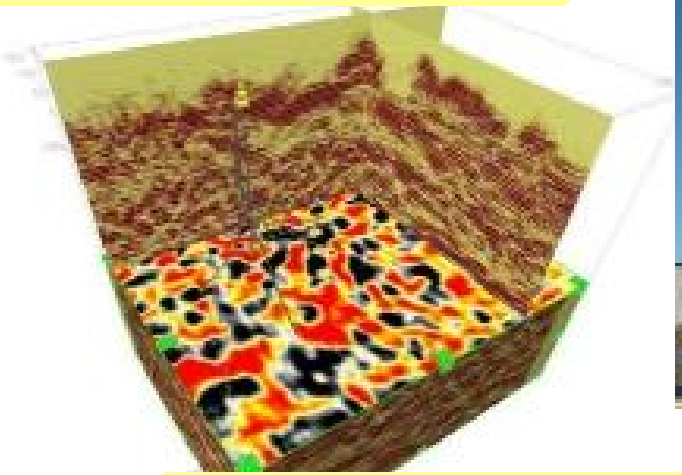
Geologic Storage Potential Survey

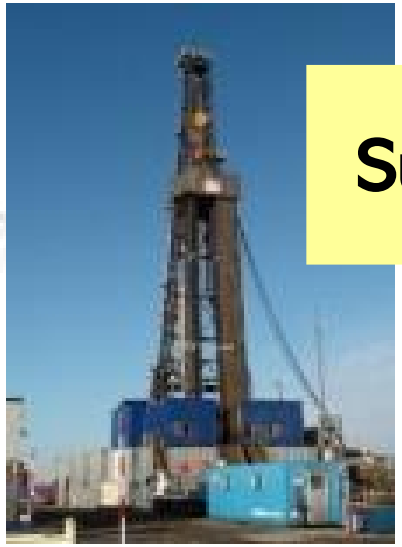
- 1st screening (2005, RITE) using literature and geological data, the storage potential in coastal areas was estimated at **146.1 Gt.**
- To select **promising CCS sites** in the business case, Geological and Geophysical surveys have been conducting from 2014.

2D Seismic Exploration Survey

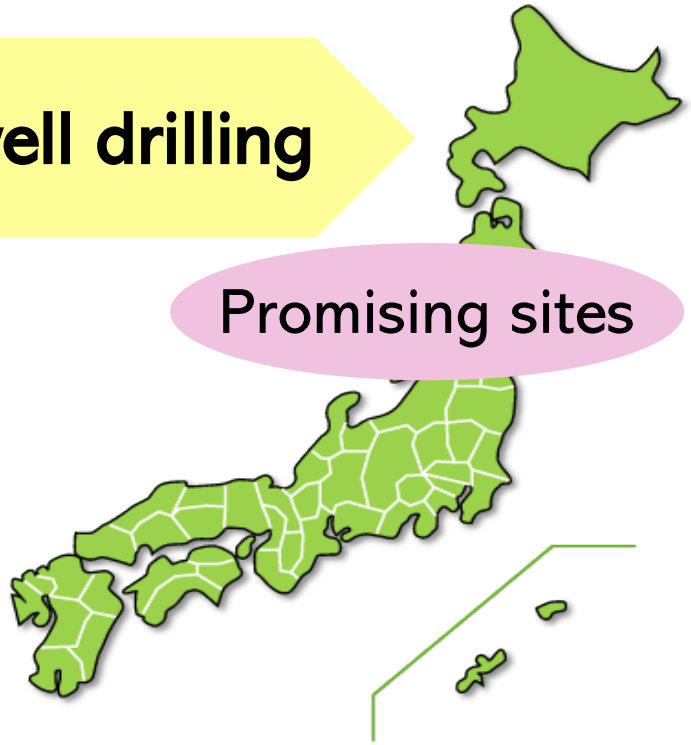
3Gt at 6 areas







Survey well drilling

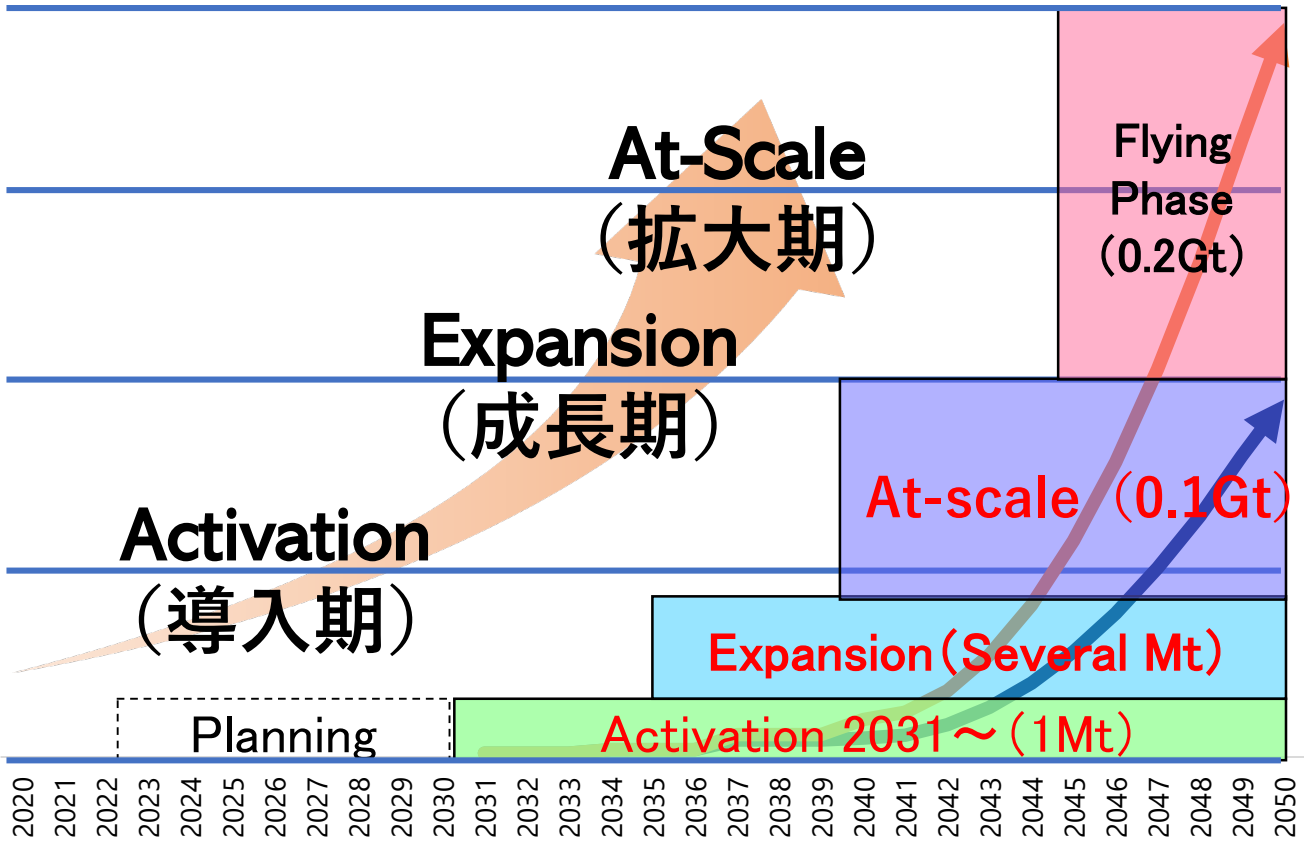


3D Seismic Exploration Survey

7 Gt at 6 areas

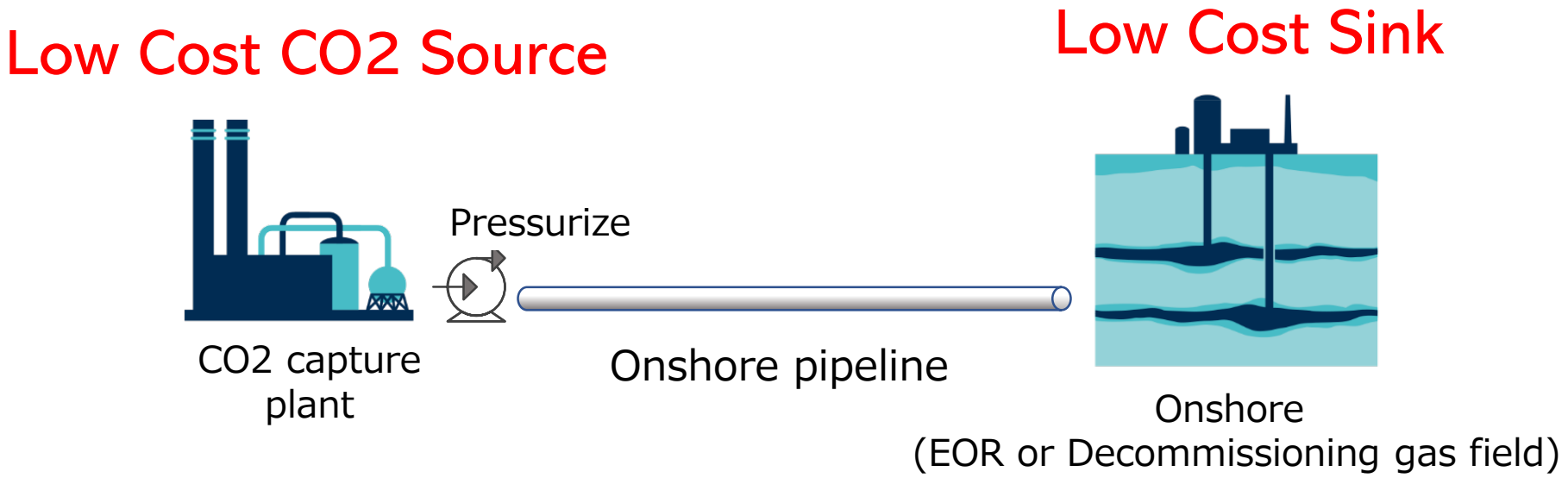
Journey to Activation, Expansion, and At-scale

- ✓ From 2030 to 2050, CCS will gradually expand while checking economic efficiency and technological trends for 0.1Gt injection per year.
- ✓ This expanding scenario reduces capital investment at the initial stage of the CCS and mitigates the business risk for stranded assets.
- ✓ By 2030, design the institution and concrete Road-map.



Activation Phase 2030 (Low-hanging fruit)

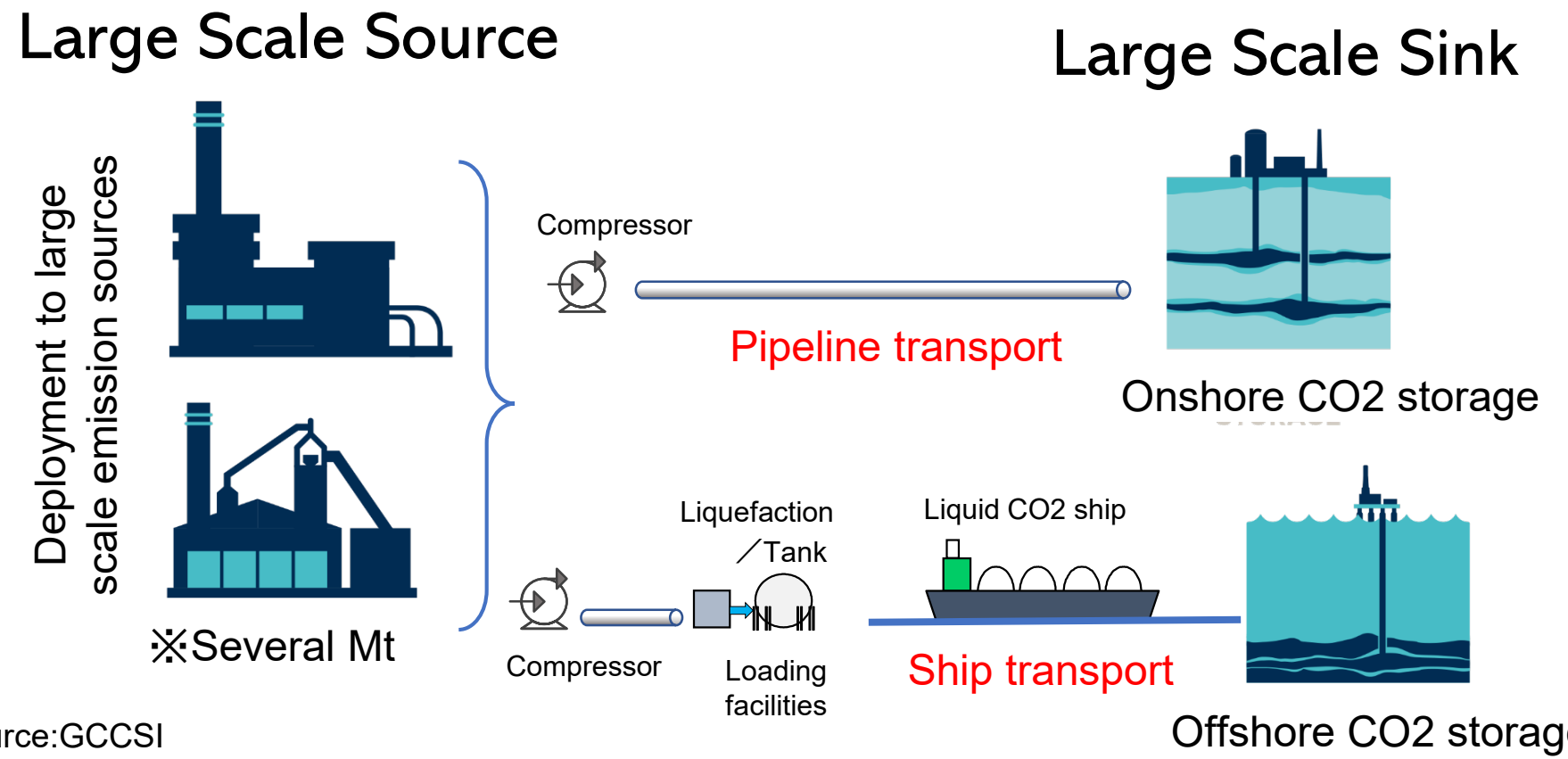
- ✓ Overseas CCS projects are introducing for already captured CO2 in existing CO2 sources and combining with EOR.
- ✓ In Japan as well, by considering CCS for already captured CO2 in the existing plants (Natural gas plants, Chemical plants) and using depleted oil/gas fields, the initial investment costs for CCS can be lowered. **Find low-hanging fruit**.
- ✓ However, the scale of CCS is small.



source:GCCSI

Expansion Phase 2035 (large-scale CO2 sources)

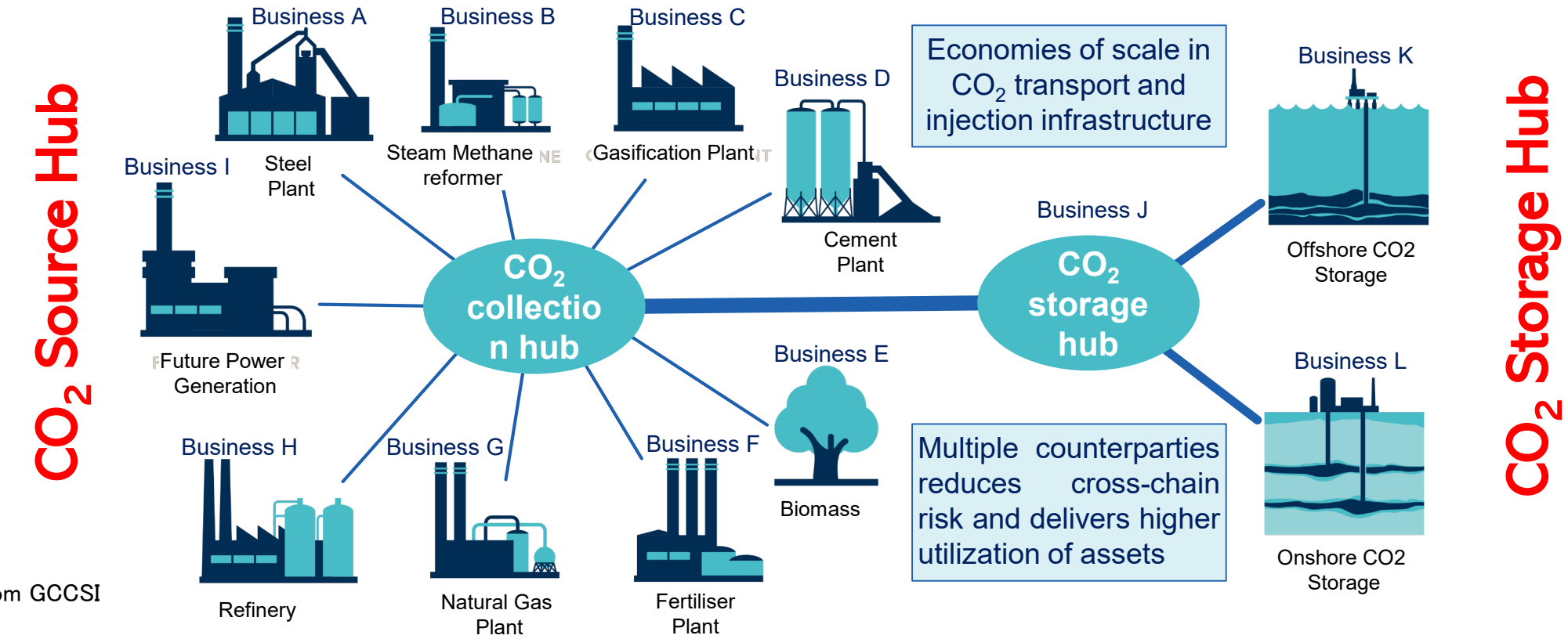
- ✓ CCS for large-scale emission sources is essential against global warming.
- ✓ Since it targets large-scale CO2 sources, Capture, Transportation, and Storage facilities are necessary large-scale.
- ✓ **Ship transport CCS in Maritime Nation**.



source:GCCSI

At-scale and Flying Phase 2040 (Hub & Custer)

- ✓ For further expansion, **the cost reduction by Hub & Cluster**.
- ✓ Pipeline networks connecting large-scale CO2 sources, also large transportations to the CO2 storage hub.
- ✓ With the expansion of the scale of CCS, it is also essential to secure human resources.



from GCCSI

Remaining Tasks to Solve

- How to drive private sector investments?
- To design the institution of CCS, Japan needs to learn from abroad about Government policies and roles.

✓ **Capital support**：Government grants, etc. (USA, Canada, etc.).

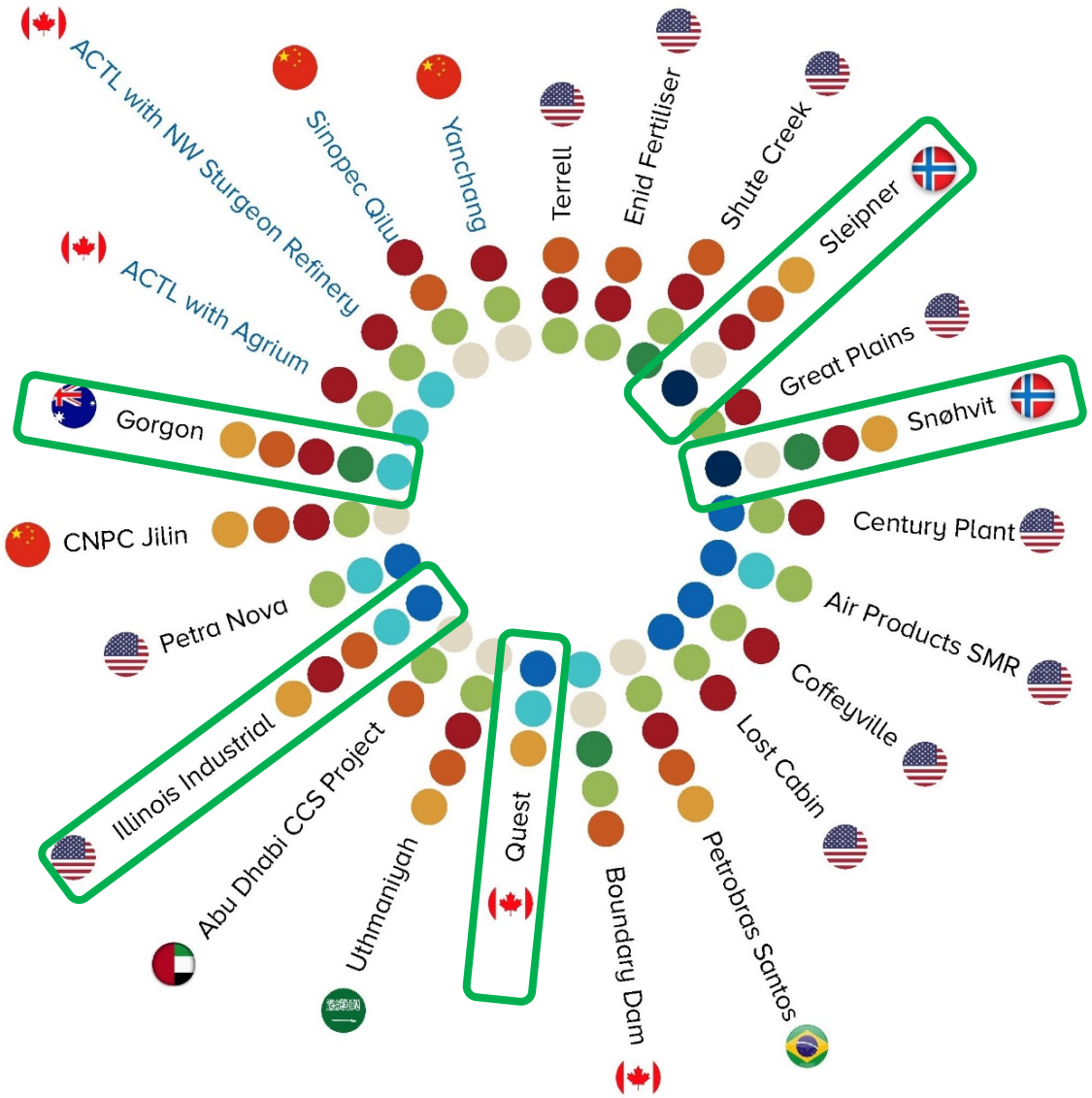
✓ **Value of CO2 reductions**（Benefits of storing CO2）：Tax credits, Emission credit, Carbon tax avoidance, etc. (USA, Canada, Norway, etc.)

✓ **Business risk reduction**：Government guarantees, Transfer of long-term liability, etc. (US, Canada, Australia, etc.)

Large Scale CCS

- 19 large scale CCS facilities are operating now. In USA many EOR projects are running.

- **Low Cost Capture**
- **Carbon Tax :**
  - Sleipner, Snohvit,
- **Emission Credit :**
  - Quest, Illinois Industrial
- **Grant Support :**
  - Gorgon



From GCCSI 2019

Summary

- ✓ CCS for the reduction of 2.5Gt in the world is technically and geologically possible.
- ✓ CCS is a must for Japan to reduce CO2 emissions by 80% in 2050.
- ✓ Japan is an island country with many earthquakes, but it is possible geologically to construct CCS sites in at-scale phase. (Numbers that take into account existing active faults)
- ✓ The scenario of a large CCS in 2050 needs to have three phases (Activation（導入期）, Expansion（成長期）, and At-scale（拡大期）), and gradually expanded CCS amounts and mature Japanese CCS technology.
- ✓ However, there are still many issues to be solved to attract private investment. **Starting widespread public debate is argent.**