

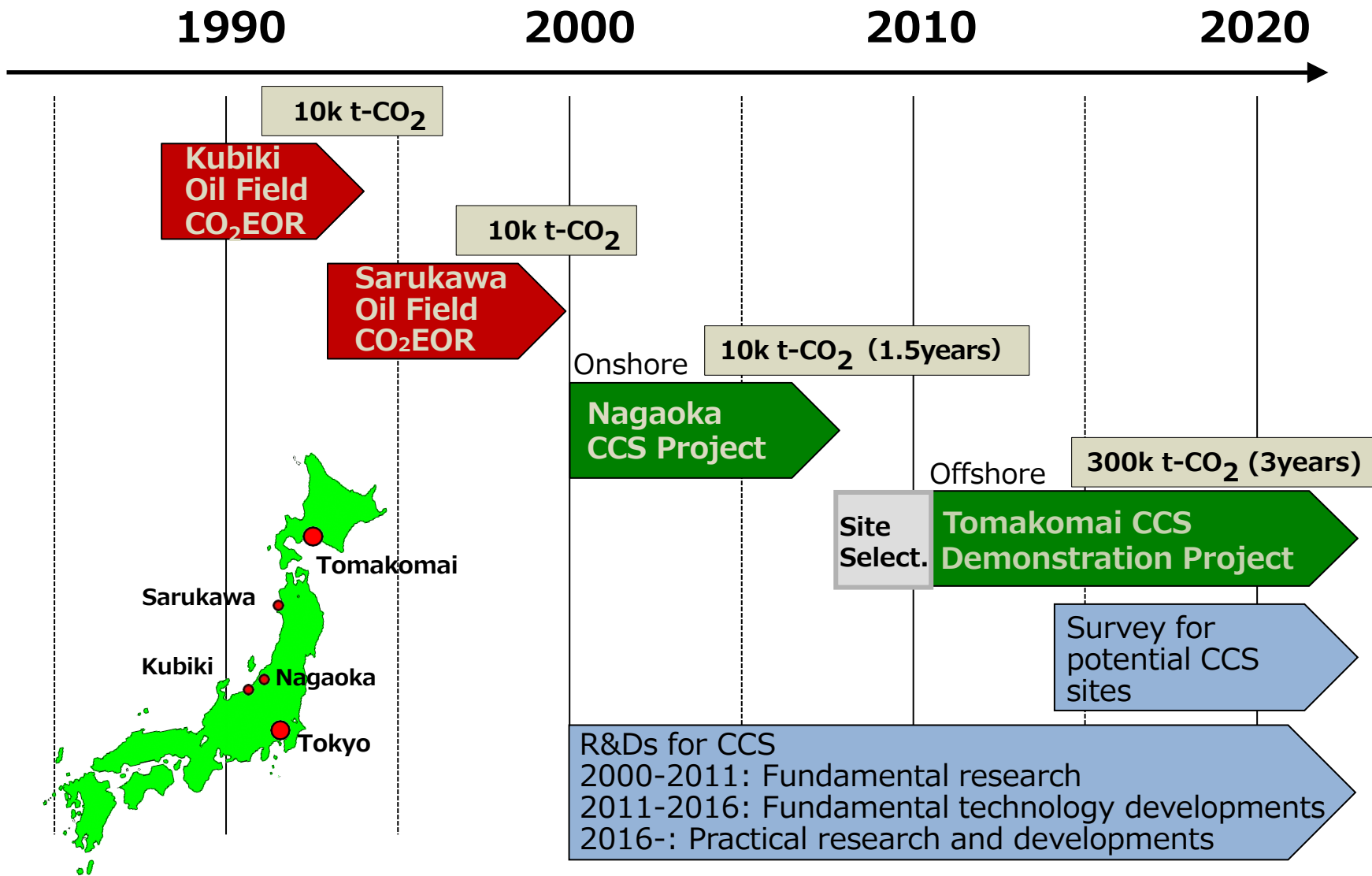
Japan's CCUS policy

Oil and Gas Division

Agency for Natural Resources and Energy

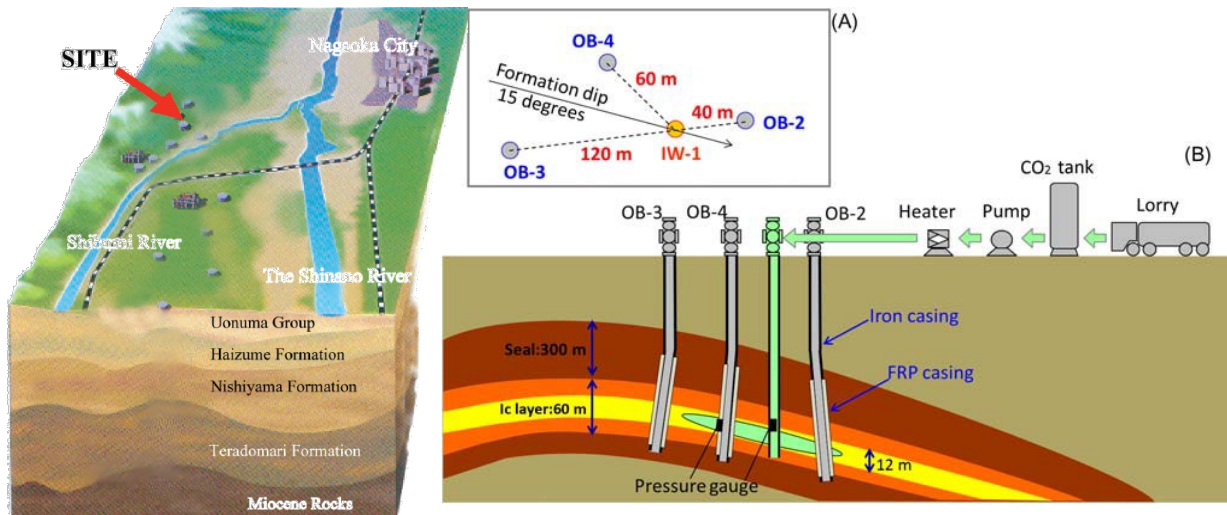
1. Footsteps of CCS in Japan

Past CCS Projects in Japan



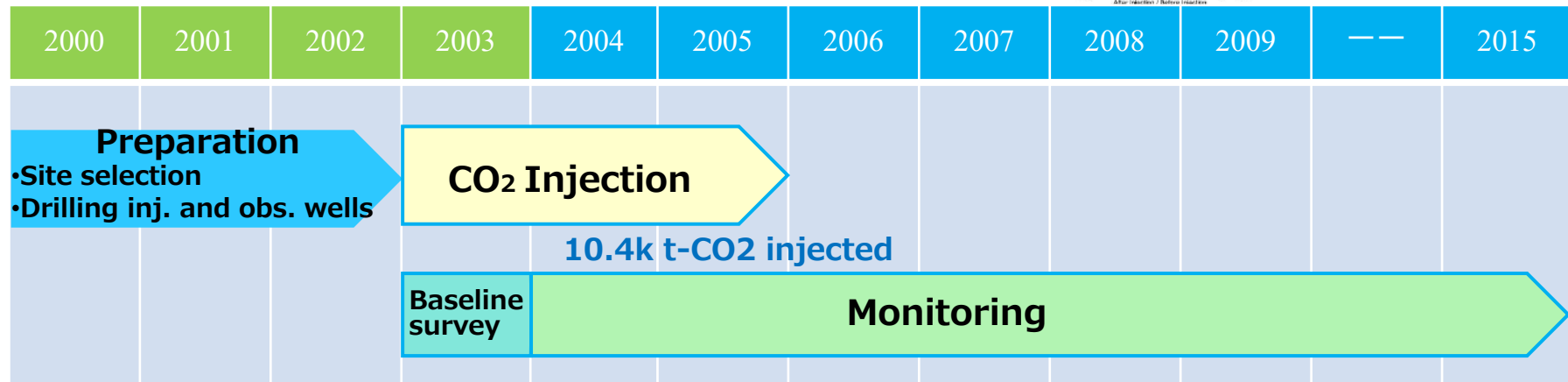
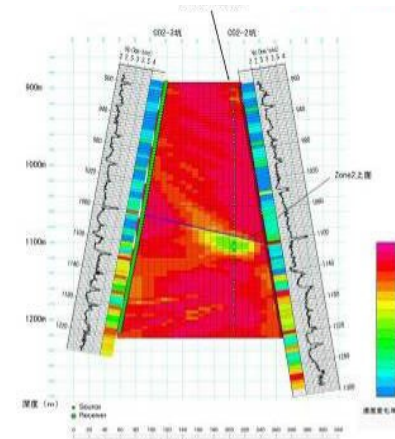
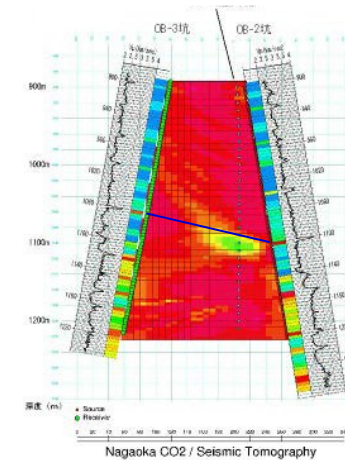
Past CCS Projects in Japan: Nagaoka CCS PJ

- Onshore CCS was successfully conducted and fundamental technologies such as evaluation of reservoir properties and CO₂ migration, and CO₂ monitoring.
- Practical guidance for CCS was compiled and published based on these experiences.



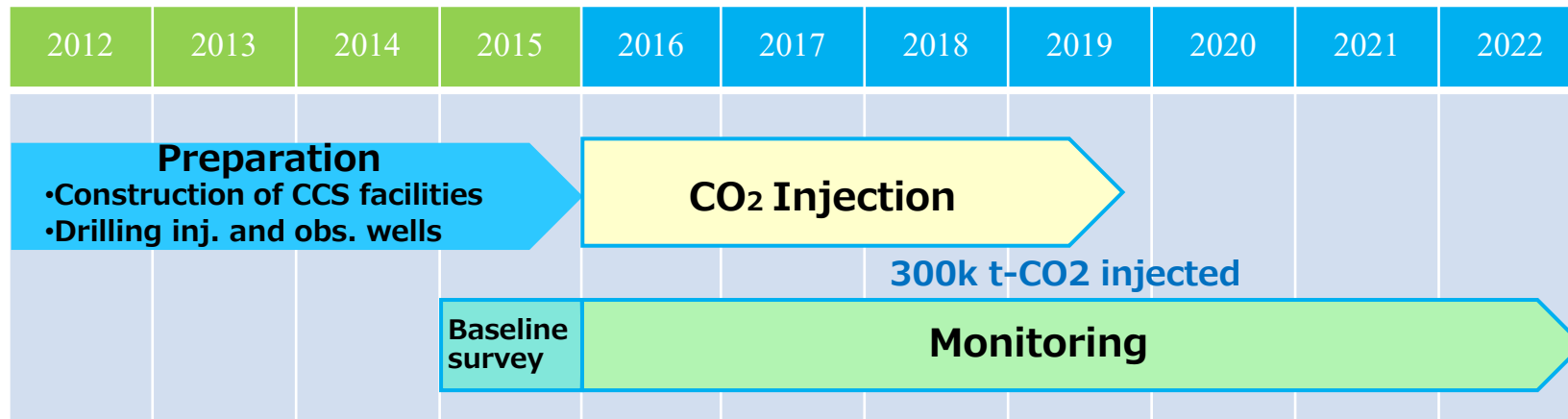
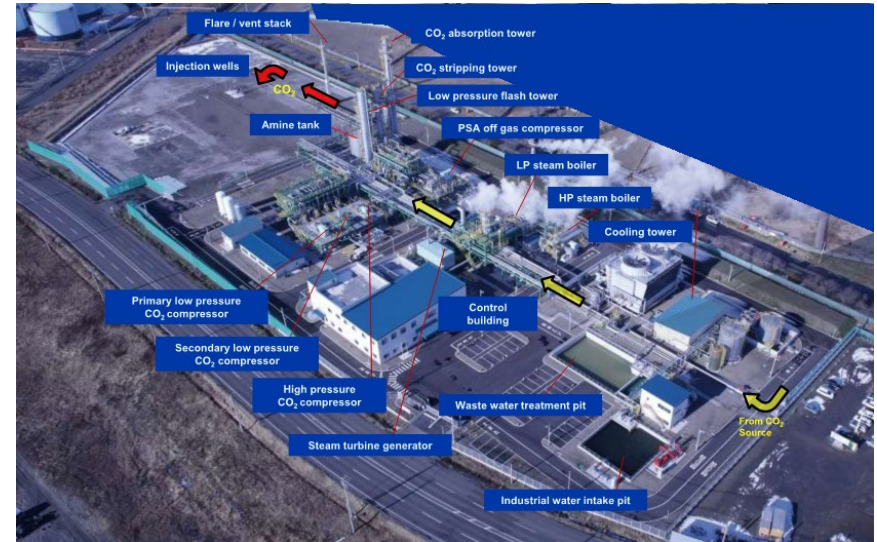
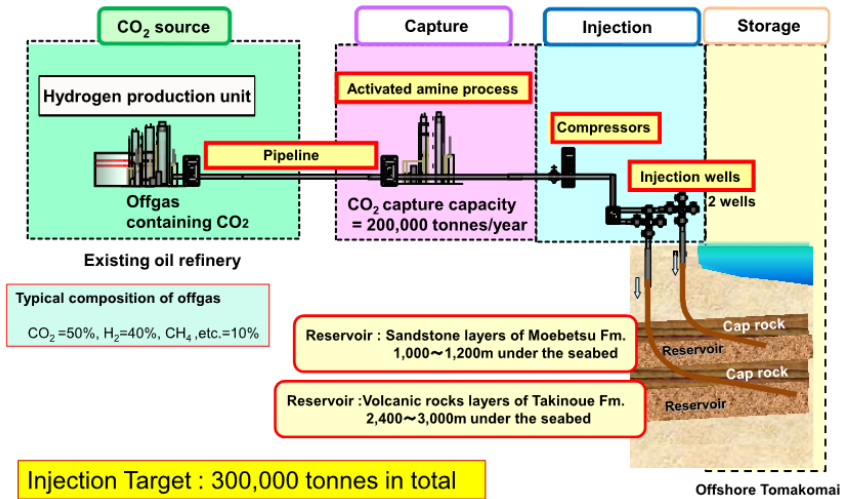
At the completion of injection

After 5.75 yrs. from the compl.

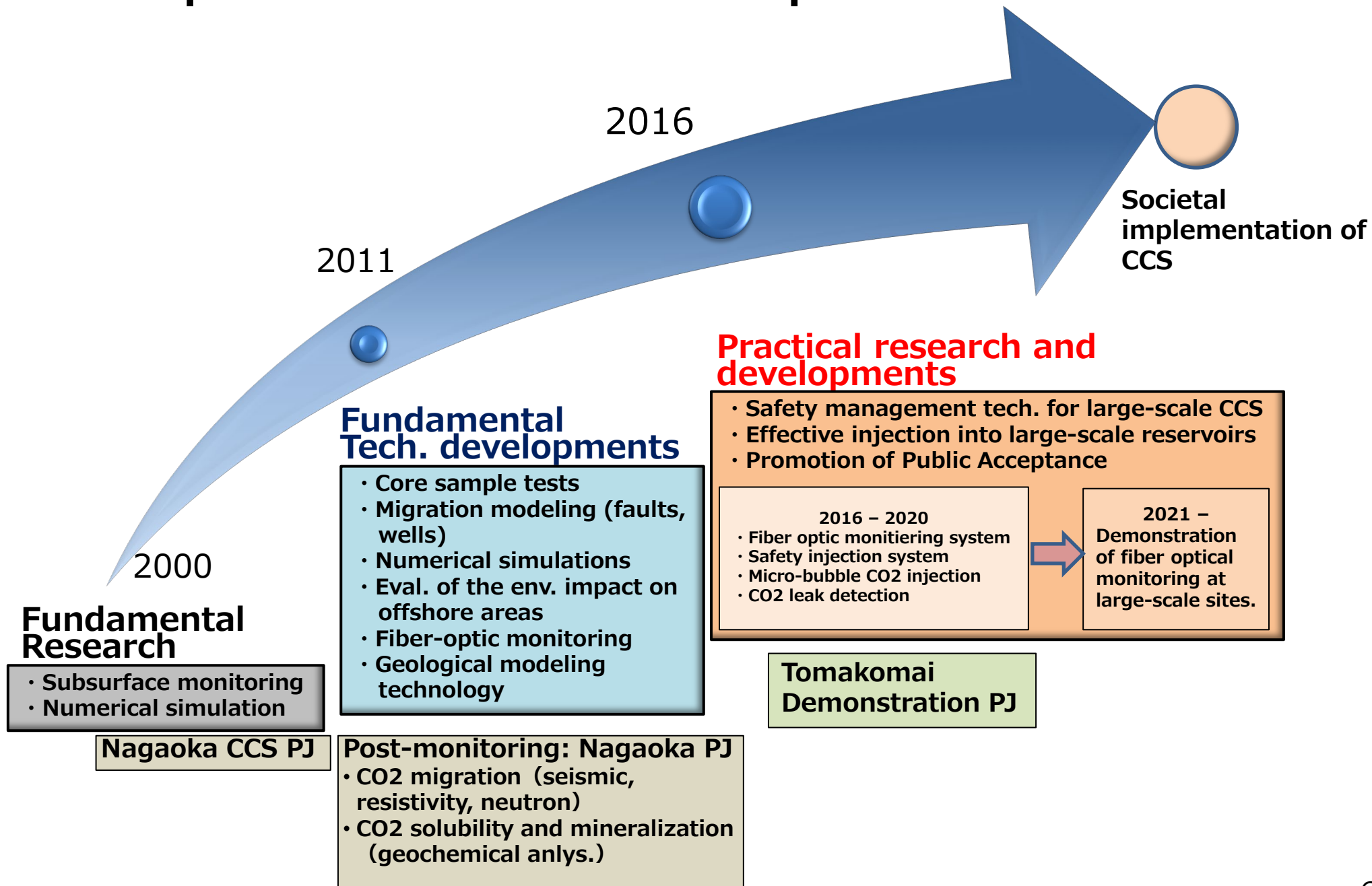


Past CCS Projects in Japan: Tomakomai Demonstration PJ

- Demonstrate full-chain CCS system from capture to storage
- Remove concerns about earthquakes by the data collected;
No influence by natural earthquakes on CO₂ stored, No perceptible earth tremors induced by CO₂ injection
- Disclose project information & data and enhance understanding of CCS by residents



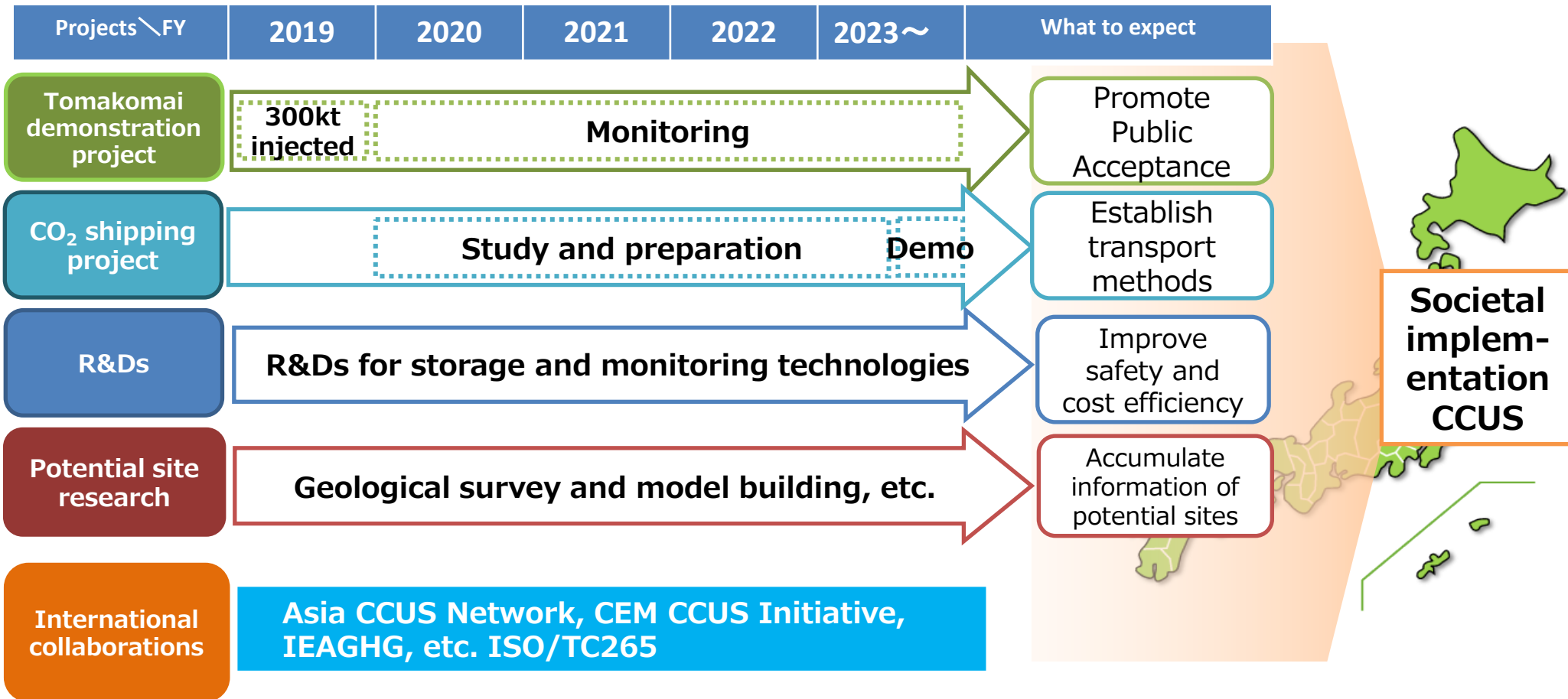
Footsteps of Research and Developments



Current CCS Projects in Japan

- Toward the start of CCS business by 2030, the followings are being carried out;

① Tomakomai demonstration project ② CO₂ shipping project ③ R&Ds for storage and monitoring technologies ④ Investigation of Potential CO₂ storage sites



Liquefied CO2 Shipping Demonstration Project

- A demonstration project for long-haul transportation from emission sources to places suitable for storage will be carried out to establish liquefied CO2 shipping techniques. **Specifically, demonstration transportation, including a 1,000-km long-haul transportation route of from Maizuru to Tomakomai, will start in 2024**, with the aim of achieving the world's first results.

Demonstration of transportation by ship

- Important techniques for the CCS hub & cluster plan, in which multiple hubs in Japan are assumed, for transporting CO2 captured at distant emission sources
- Transportation by a 1,000-ton class liquefied CO2/LPG convertible transport ship



Maizuru Power Station
(Coal fired power plant)

Capture

Coal fired power plant

- Capture with solid absorbents (approx. 10,000 tons/year)
- Capture to start in 2023

Capture

IGCC

- Capture based on physical absorption (approx. 100,000 tons/year)

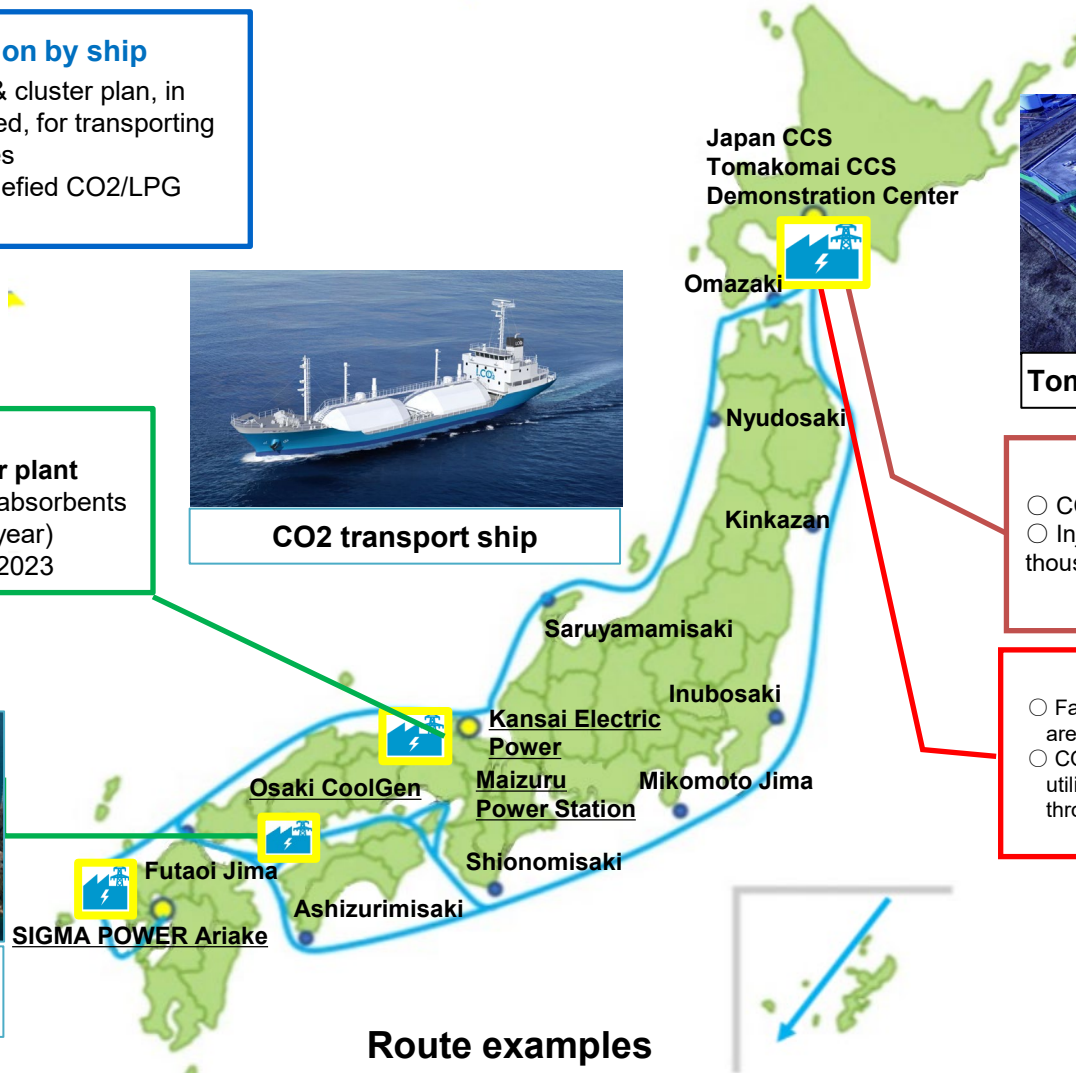


Osaki CoolGen (IGCC)

Carbon recycling R&D base



CO2 transport ship



Tomakomai CCS demonstration

Storage and monitoring

- CCS demonstration underway
- Injection started in 2016 and 300 thousand tons completed in Nov. 2019

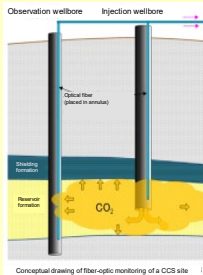
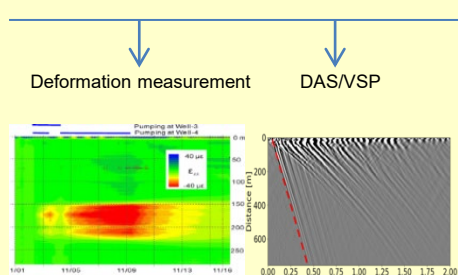
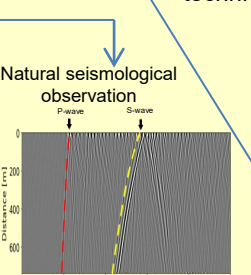

Tomakomai CCS/CR hub

- Facilities for Tomakomai CCS demonstration are utilized.
- CO2 captured in distant emission sources is utilized in Tomakomai, an industrial city, through efforts of carbon recycling.

Route examples

R&D Project of CO2 Storage Techniques for Safe Implementation of CCS

- CCS, in the transition phase from practical implementation to commercialization, has challenges of risk reduction and economic efficiency improvement toward commercialization.
 - R&D on CO2 storage techniques will be continued with the aim of achieving the establishment of low-cost and practical-scale safety control techniques with safety ensured.
- ⇒ Including fiber-optic measurement techniques, development of a reservoir control system and tool to evaluate social acceptability called social license to operate (SLO), and wellbore plugging feasibility study
- With the aim of prompt establishment and widespread proliferation of the techniques, every option available for overseas deployment should be considered, including the use of joint crediting mechanism (JCM).

<p>Fiber-optic measurement technique</p>	<p>2020 Functional establishment ▼</p>	<p>2023 Technical establishment ▼</p>
<p>○ Advantage: Functional establishment in domestic indoor field tests</p> <ul style="list-style-type: none"> (1) Implementation of the multi-sensor function (see figure below) <ul style="list-style-type: none"> → Reduction of monitoring costs (2) Semipermanent use → Suppression of facility and maintenance costs (3) Full-time continuous position observation <ul style="list-style-type: none"> → Improved safety 	<p>○ Large-scale demonstrative verification and technical establishment</p> <ul style="list-style-type: none"> • Verified in a US site (a few hundred thousand t-CO2 class) • In-well measurement and surface elastic wave measurement <ul style="list-style-type: none"> → Establishment of geologic stability monitoring techniques → Establishment of CO2 behavior monitoring techniques 	<p>○ Practical application to CCS</p> <ul style="list-style-type: none"> • Application to domestic and overseas CCS sites <ul style="list-style-type: none"> → Improvement of safety and economic efficiency → Overseas deployment of Japan's techniques ○ Ripple effects <ul style="list-style-type: none"> • A wide range of application including building maintenance <ul style="list-style-type: none"> → Acquisition of enormous market
		
		 <p>Demonstration in North Dakota, US</p>

- ▼2023- Practical application
- Practical application to CCS
 - Application to domestic and overseas CCS sites
 - Improvement of safety and economic efficiency
 - Overseas deployment of Japan's techniques
 - Ripple effects
 - A wide range of application including building maintenance
 - Acquisition of enormous market

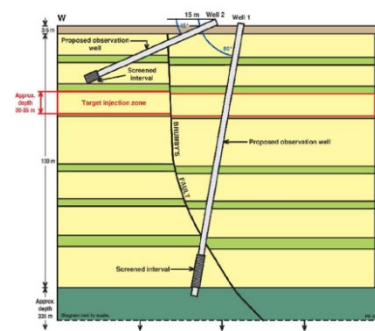
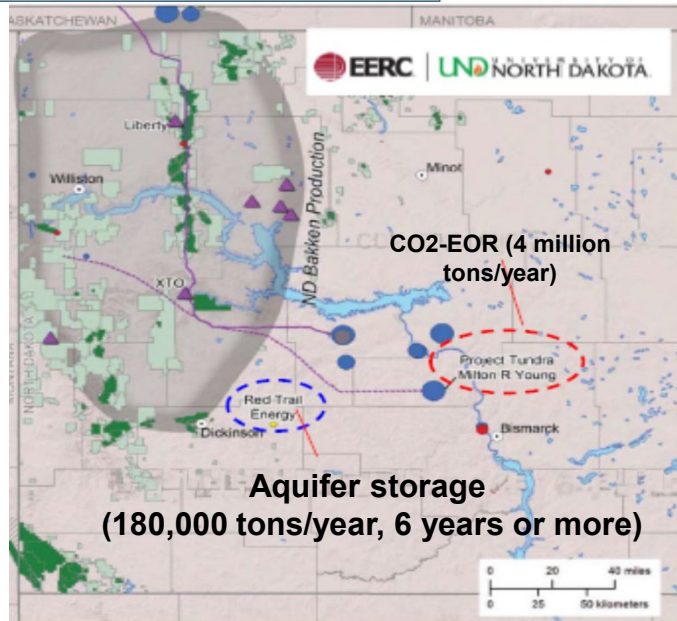
R&D Project of advanced monitoring systems for CCS

- Large-Scale Demonstrative Verification in Cooperation with Overseas Institutions
- Fiber-optic monitoring and measurement systems are to be demonstrated in the US (EERC) and Australia (CSIRO and CO2CRC).



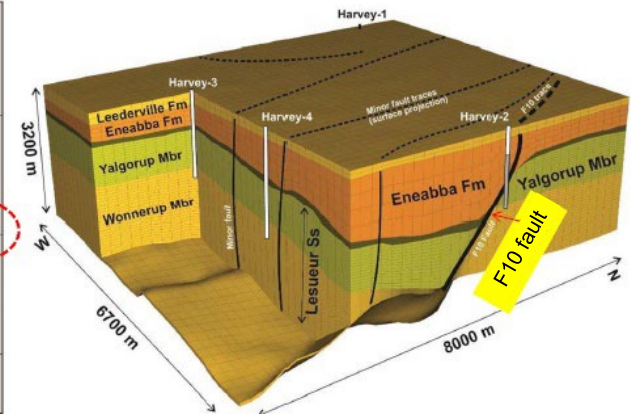
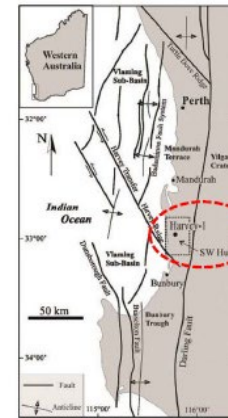
North Dakota, US
Demonstration site
 (in progress)
 (An MOU has been concluded between RITE and EERC)

- Geologic stability monitoring
- CO₂ behavior monitoring



SW Hub demonstration site in Western Australia, Australia
Otway, Victoria, Australia
 (under planning)
 (An LOI has been concluded between RITE and CSIRO, and an MOU between RITE and CO2CRC)

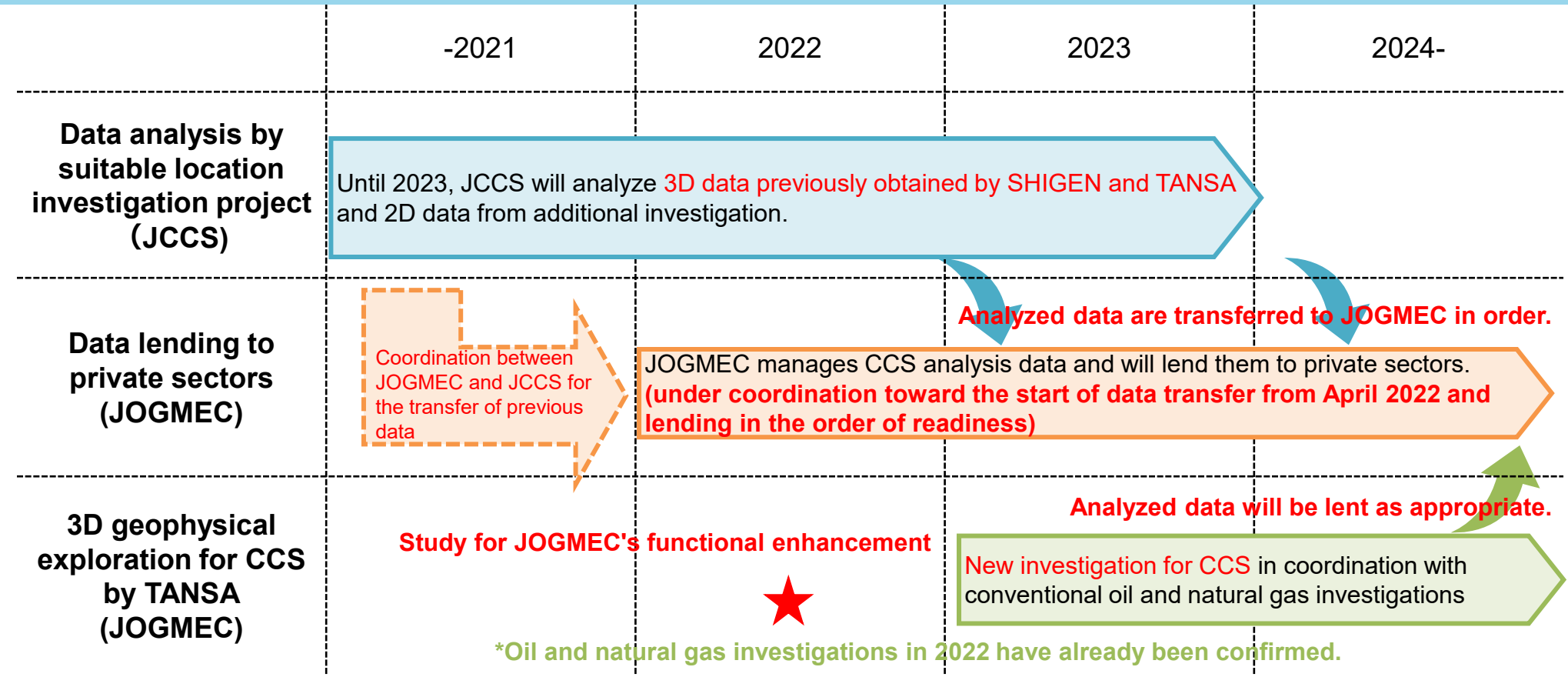
- Stability evaluation of faults
- Shallow fault leakage monitoring technique



Field tests for stability evaluation of faults in deep formations

Lending of Data from Suitable Location Investigation Project and Geophysical Exploration by TANSA

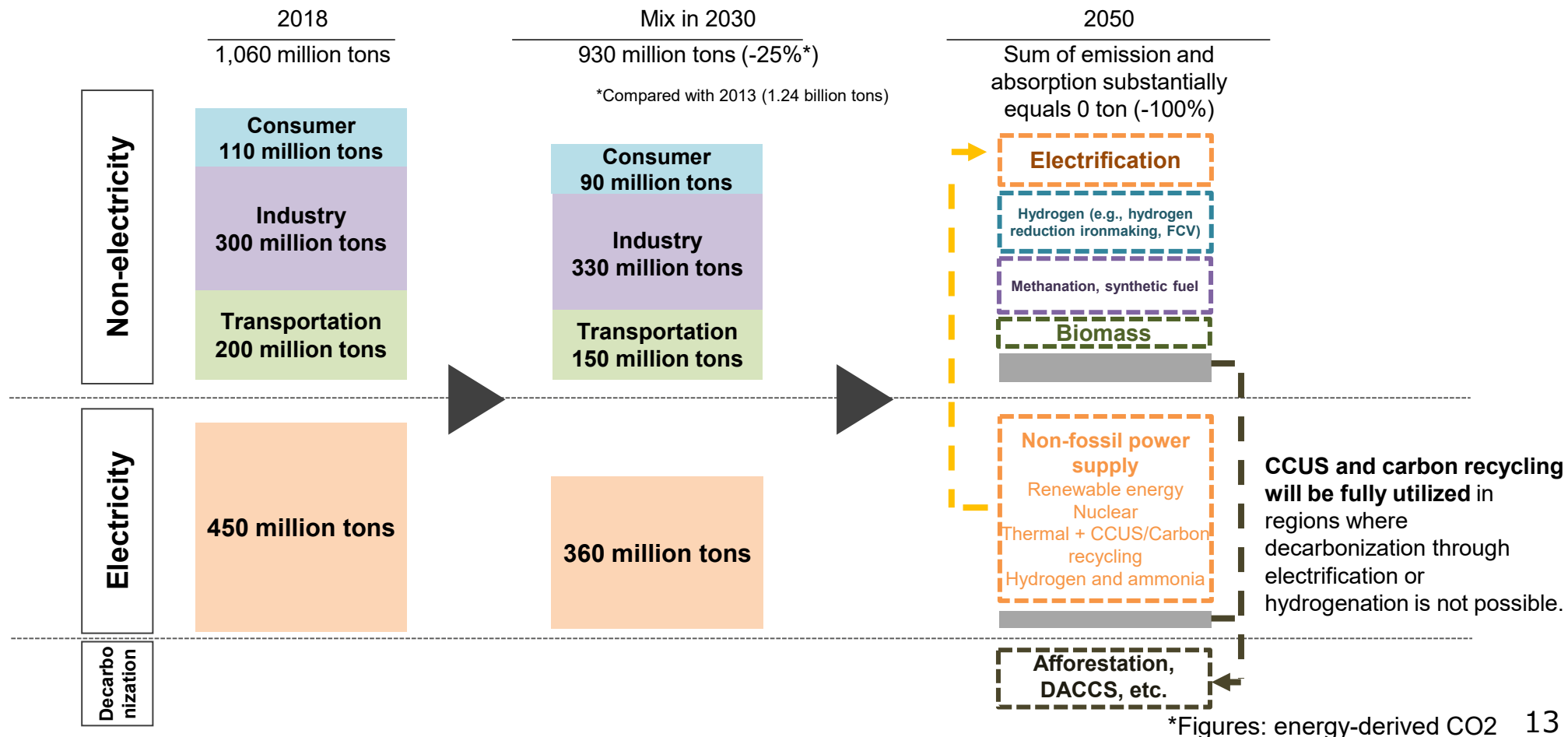
- With the need for building a mechanism for promptly lending data analyzed by JCCS for suitable location investigation to private sectors in preparation for the commercialization of CCS, such data have been transferred to JOGMEC in order. Some of the data have been available since May 10, 2022. Available data are increasing in the order of readiness.
- Previous suitable location investigations utilizing SHIGEN or TANSA were intended for the development of oil and natural gas. When CCS investigation is added to JOGMEC's functions*, investigations intended for CCS will start from 2023 at the earliest, in addition to the current oil and natural gas investigations. A bill for the relevant things has been introduced and is being discussed in the current Diet session.



2. Status of CCS in Japan

Status of CCUS toward 2050 Carbon Neutrality

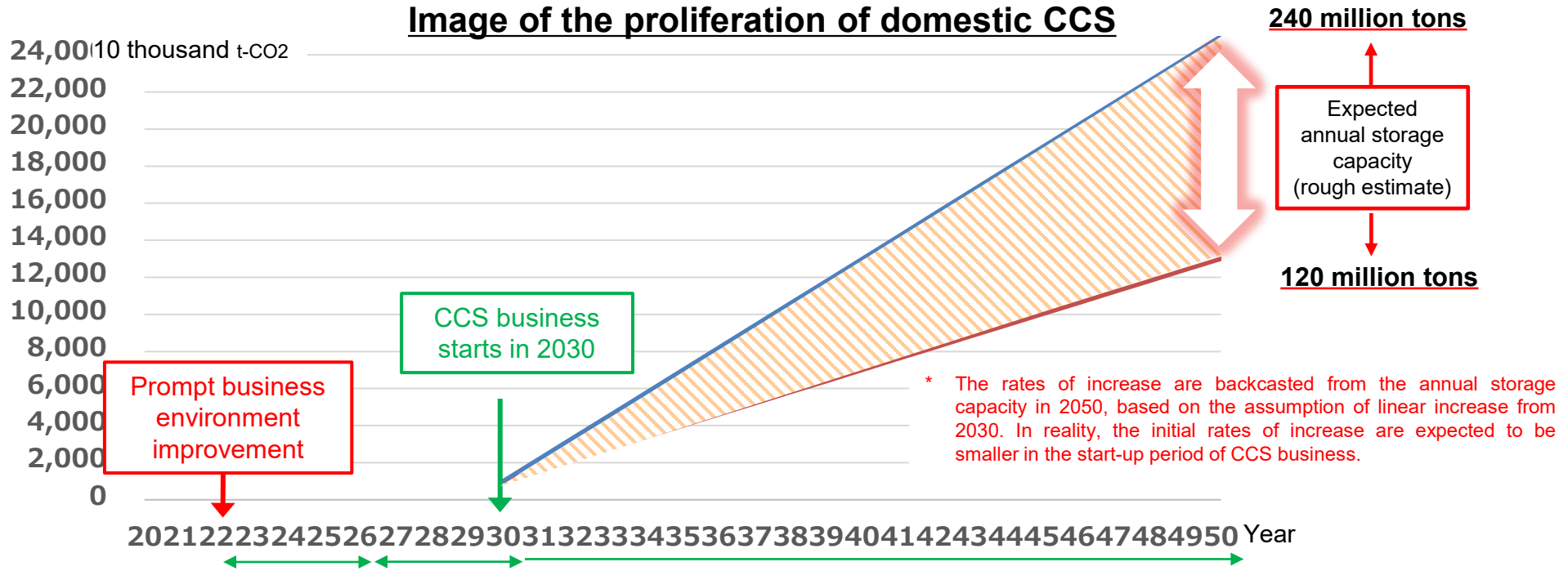
- To achieve carbon neutrality in the entire society, the electricity sector should enhance non-fossil power supply while the non-electricity sector including industry, consumer, and transportation sectors (fuel and heat users) should promote electrification by decarbonized electric power, hydrogenation, and decarbonization with methanation or synthetic fuel.
- Toward 2050 carbon neutrality, utilization of CCUS is indispensable for decarbonizing thermal power plants. Also, CCUS and other processes should be fully utilized in sectors where emission of CO2 is unavoidable because decarbonization through electrification or hydrogenation is not feasible.



Roughly Estimated Annual Storage Capacity of CCS in 2050

- Based on IEA trial calculation, annual storage capacity of Japan's CCS can be roughly estimated at 120 to 240 million tons in 2050. Supposing CCS is introduced in 2030, the number of injection wells needs to increase by 12 to 24 every year during the 20 years until 2050.
- To start CCS business by the end of 2030, operators have to start FS, etc. in 2023 and make final investment decisions by 2026.

Image of the proliferation of domestic CCS



To start CCS business **by the end of 2030**, operators have to

(1) start FS, etc. **in 2023** and

(2) make final investment decisions **by 2026**.

Reference: number of injection wells to be required

- 120 million tons/year: 240
- 240 million tons/year: 480

*Storage capacity per injection well: 0.5 million tons/year

*Prospecting cost: approx. 5 billion yen/well on land, approx. 8 billion yen/well at sea

CCS Long-Term Roadmap Intermediate Summary

Basic principles

To implement CCS systematically and rationally to promote sound development of CCS business in Japan with minimal social costs, thereby contributing to the development of Japan's economy and industry, as well as the securing of stable energy supply.

Substance

The Government is to make a commitment to improve business environment toward the start of CCS business by 2030 on the assumption that rough estimate of annual CO2 storage capacity in 2050 is in the range from 120 to 240 million tons. The concrete actions in the next clause are to be implemented as required.

In addition, the CCS Business and Domestic Laws Study WG and the CCS Business Costs and Implementation Scheme Study WG are to be newly organized under the CCS Long-Term Roadmap Study Group for additional study focusing on those challenges to complete the final summary of the CCS long-term roadmap by the end of this year.

◆WG study items (draft) *The study items and members are to be determined later.

- ✓ CCS Business and Domestic Laws Study WG: Study of various challenges in preparation for the legislation of domestic laws governing CCS business
- ✓ CCS Business Costs and Implementation Scheme Study WG: Study of current costs and future cost targets in the entire CCS value chain as well as ideal support from the Government

CCS Long-Term Roadmap Intermediate Summary

Concrete actions

*To be discussed in the CCS Business and Domestic Laws Study WG.

(1) Study of the legislation of domestic laws required for implementing CCS business

- ⇒ Agendas toward the legislation of laws governing CCS business should be organized by the end of 2022 (example: foundation of a "CO2 injection and storage right" and limitation of operator responsibility (transfer of responsibility to the Government)). Then, laws governing CCS business should be legislated promptly toward the start of CCS business by 2030.

*To be discussed in the CCS Business Costs and Implementation Scheme Study WG.

(2) Efforts aimed to reduce CCS costs

- ⇒ R&D and demonstration should be conducted continuously to reduce costs in the entire CCS value chain including capture, transportation, and storage. The Government and the private sector should discuss and define future cost targets and incorporate them into the efforts.

*To be discussed in the CCS Business Costs and Implementation Scheme Study WG.

(3) Study of ideal support from the Government for CCS business

- ⇒ The Government should actively research places suitable for CCS in cooperation with operators and disclose evaluation data in possession including existing data.
- ⇒ Ideal support from the Japanese government for advanced CCS business should be studied, referencing to subsidy systems in leading CCS countries such as Europe and the US to provide full support for construction and operation stages in the entire CCS value chain including capture, transportation, and storage. Note that the initiative of this project will be taken by operators.
- ⇒ In the future, ideal additional support from the Government should also be studied flexibly based on commercialization stages, referencing to subsidy systems in the US and other countries.

*Introduction of a carbon pricing system, which has already introduced in Europe, is not a precondition for the discussion toward the commercialization of CCS due to various factors that have to be considered.

(4) Promotion of public acceptance on CCS business

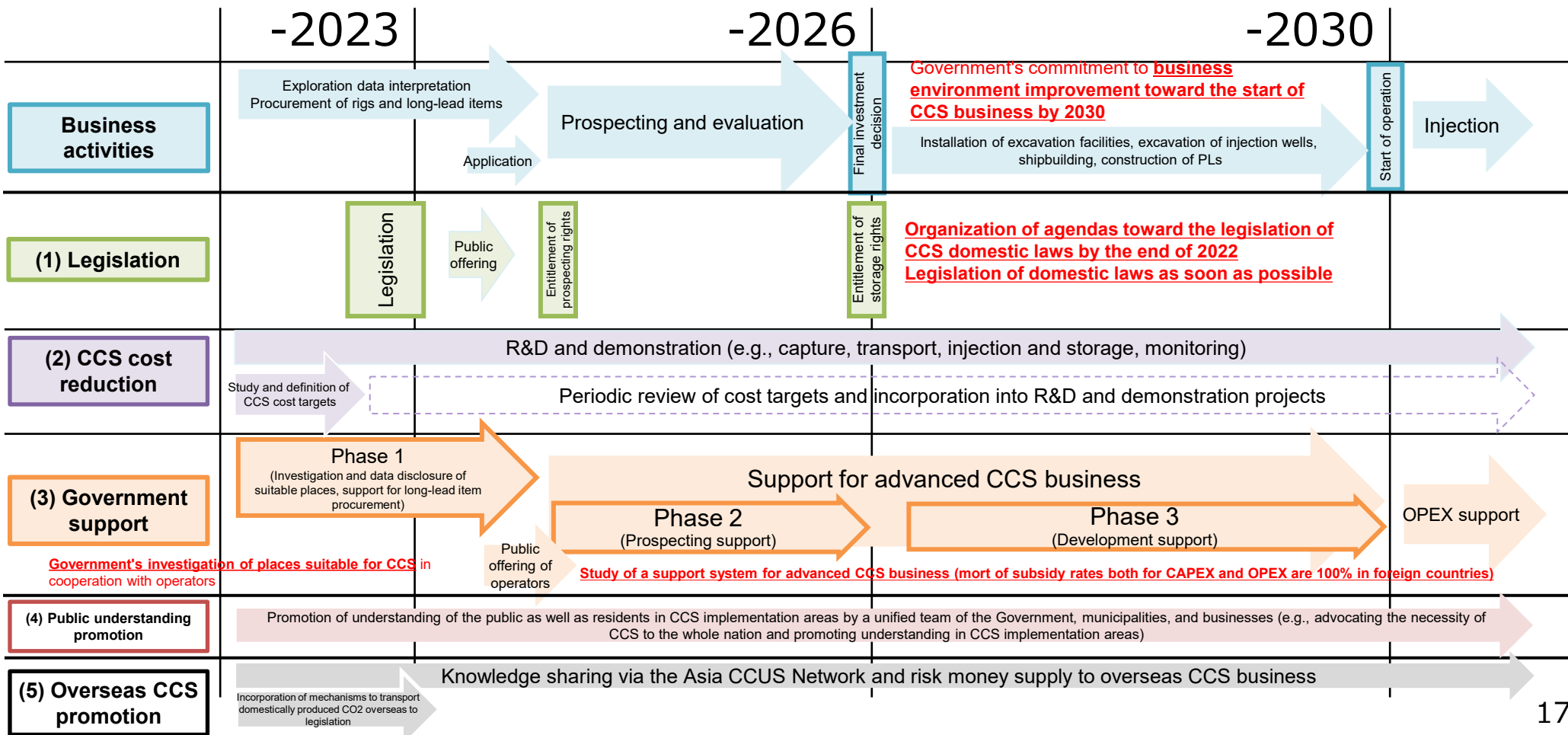
- ⇒ Based on the way of thinking that all available technologies should be used without ruling out any possibility, with the aim of achieving the ambitious target of carbon neutrality by 2050, the Government, municipalities, and businesses should cooperate together to advocate the necessity of CCS in preparation for carbon neutrality by 2050 to the public in order to promote public acceptance as well as residents in CCS implementation areas through the explanation about, for example, the economic ripple effects of CCUS to the municipalities.

(5) Promotion of overseas CCS business

- ⇒ In view of carbon neutrality in Asian emerging countries relying on fossil fuels, overseas CCS business should be supported through knowledge sharing via the Asia CCUS Network, risk money supply to overseas CCS business, and rule making of CCS credits in JCM.
- ⇒ A mechanism for export of domestically produced CO2 should be incorporated in CCS domestic laws to be legislated.

CCS Long-Term Roadmap Intermediate Summary

- **Business environment improvement toward the start of CCS business by 2030 should be clearly declared as a government target.**
- To achieve the target, the following actions should be taken:
 - (1) **Agendas toward the legislation of CCS domestic laws should be organized by the end of 2022 to legislate such laws as soon as possible.**
 - (2) **Future cost targets should be defined for each CCS value chain, and R&D and demonstration should be conducted to reduce costs.**
 - (3) **The Government should actively research places suitable for CCS in cooperation with operators** (including disclosure of existing data). **Ideal support from the Government for advanced CCS business should be studied, referencing to support systems including substantial subsidy systems (most of subsidy rates both for CAPEX and OPEX are 100%) in leading CCS countries such as Europe and the US. Ideal additional support from the Government should also be studied flexibly based on commercialization stages, referencing to subsidy systems in the US and other countries.**
 - (4) **The Government, municipalities, and businesses should cooperate to promote understanding of the public as well as residents in CCS implementation areas.**
 - (5) **Overseas CCS should be promoted** through knowledge sharing via the Asia CCUS Network and risk money supply to overseas CCS business.



3. Promotion of overseas CCS business

Activities of Asia CCUS Network Forum

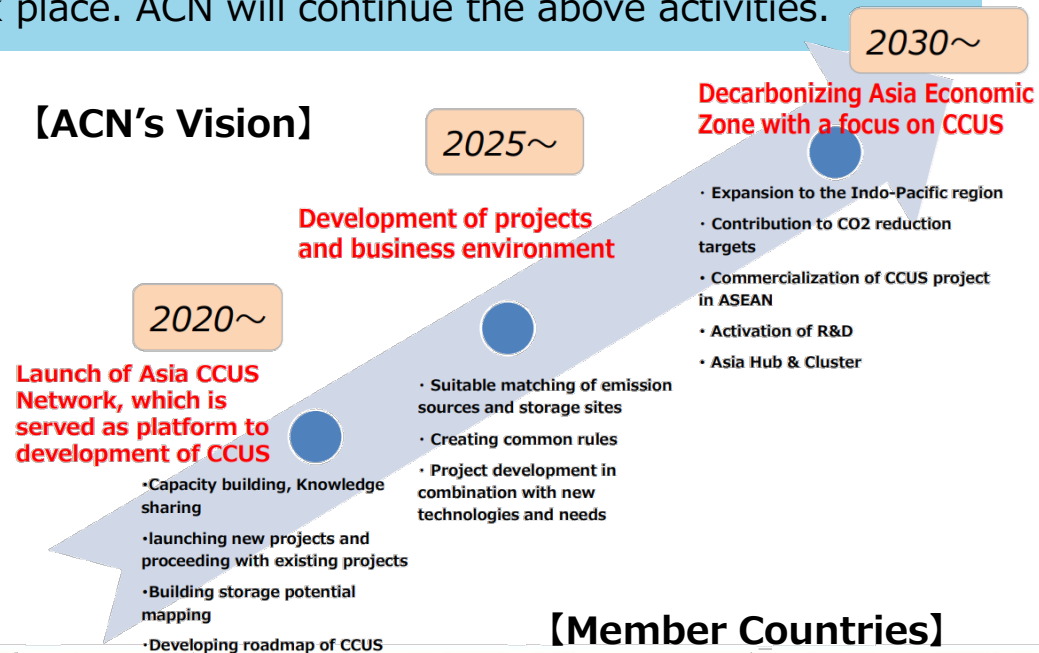
- Through the Asian CCUS network (ACN) launched in June 2021 as part of the AETI framework, it will contribute to knowledge sharing, developing human resources, and improving the business environment for CCUS utilization in Asia.
- ACN aims at creating common rules and developing CCUS projects, and realizing storage network throughout Asia.
- In FY2021, total of seven events including the first forum, knowledge sharing conferences for member countries, and technical workshops took place. ACN will continue the above activities.

【The second Asia CCUS Network Forum】

30 September 2022 at Tokyo Prince Hotel (hybrid meeting)

- ACN's vision "Realization of an Asia-wide CCUS network by 2030 and creation of a pilot project by 2025" was announced.
- The member countries exchanged their views to harmonize countries' policies, legal systems, and support measures for CCS.
- Japan expressed its intention to enforce CCS acts as soon as possible.

【ACN's Vision】



【Member Countries】

