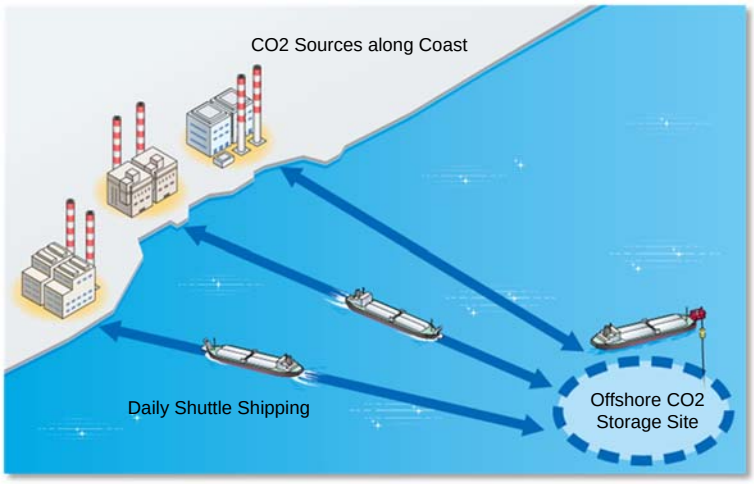
Task 2. Study of Shuttle Ship Transportation and Injection System

Background and goals

Why we need offshore CO2 storage
- Major CO2 sources exist along the coasts.
- Japanese coastal waters are actively used.

Key benefits of CO2 shuttle ship transportation system
- Mitigating source-sink matching especially in Japan where the CO2 emission sources are mainly located in coastal regions.
- Mitigating water depth limit which enable the storage in the deep sea area away from the coast.
- Facilitating the changes in project scale and distance of conveyance.
- Enabling the reuse of the system.

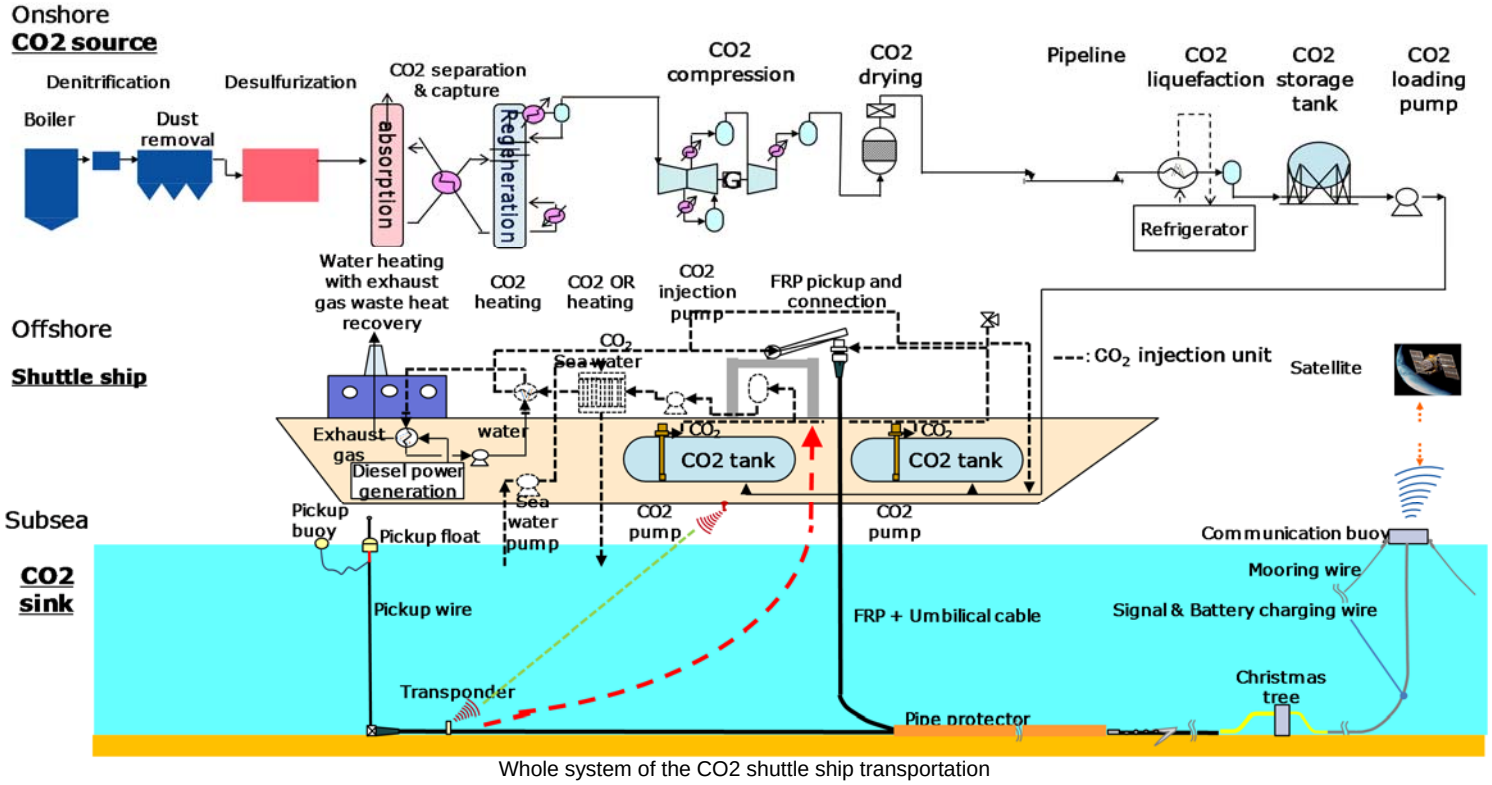
Objectives
- Clarifying the requirements for the whole system and its components
- Preliminary design of the whole system
- Planning the system operational verification test (SOVT) for onboard FRP pickup and coupling



CO2 SHUTTLE SHIPPING APPLICATION

System Components

For CO2 direct injection from the ship to the well(s), the FRP Pickup System is proposed.
- Onshore: CO2 compression, drying, pipeline, liquefaction, storage tank, loading
- Offshore: vessel, DPS, injection, other onboard facilities
- Subsea: FRP, umbilical cable, FRP pickup unit (buoy, float, wire, etc.), communication buoy



Whole system of the CO2 shuttle ship transportation

Element		Function
Shuttle ship	DPS: Dynamic Positioning System	System to automatically keep ship at the fixed position with the thrust of propeller or thruster. The DPS for this system should move ship to the proper position for the length of the wire to be wound and unwound.
FRP pickup & connection	FRP : Flexible Riser Pipe	Pipe to carry liquefied CO2 from the onboard injection unit into the reservoir through the injection well.
	Anchor	Equipment to fix FRP to the seabed to avoid excessive tension to the Christmas tree.
	Coupler (Connector)	Equipment to connect and disconnect the onboard injection unit and FRP.
	Pickup Buoy, Float, Rope, Wire	Pickup buoy and float works as markers. Pickup rope is to be hooked and picked by the ship crew. Pickup wire is to be wound by the onboard winch for FRP pickup and connection.
CO2 injection	Umbilical Cable	Cable to contain several lines to feed electricity to the subsea equipment and to communicate between the vessel and the subsea one.
	Christmas Tree	Assembly of valves and chokes used for subsea injection well control.
Monitoring	Communication Buoy	Assembly of buoy (fixed by the mooring wires), battery, solar panel and communication equipment to transfer the data between the subsea equipment and onshore control center for monitoring and control.