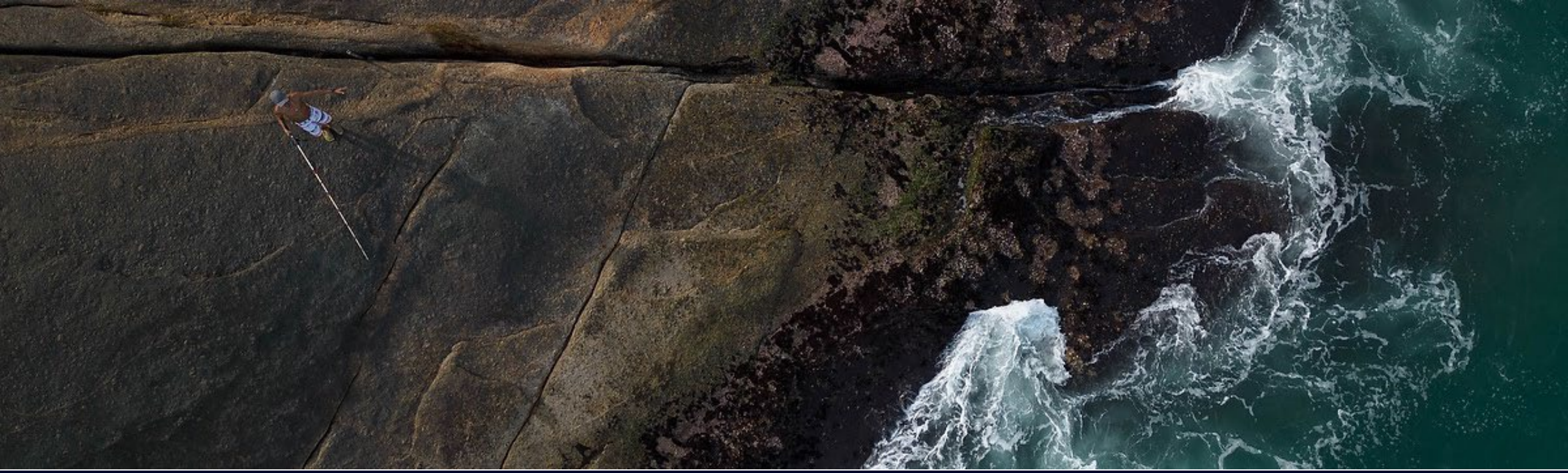

Revolutionizing Offshore CCS

Innovations in logistics and energy integration

Ana Requejo, 30th October 2024

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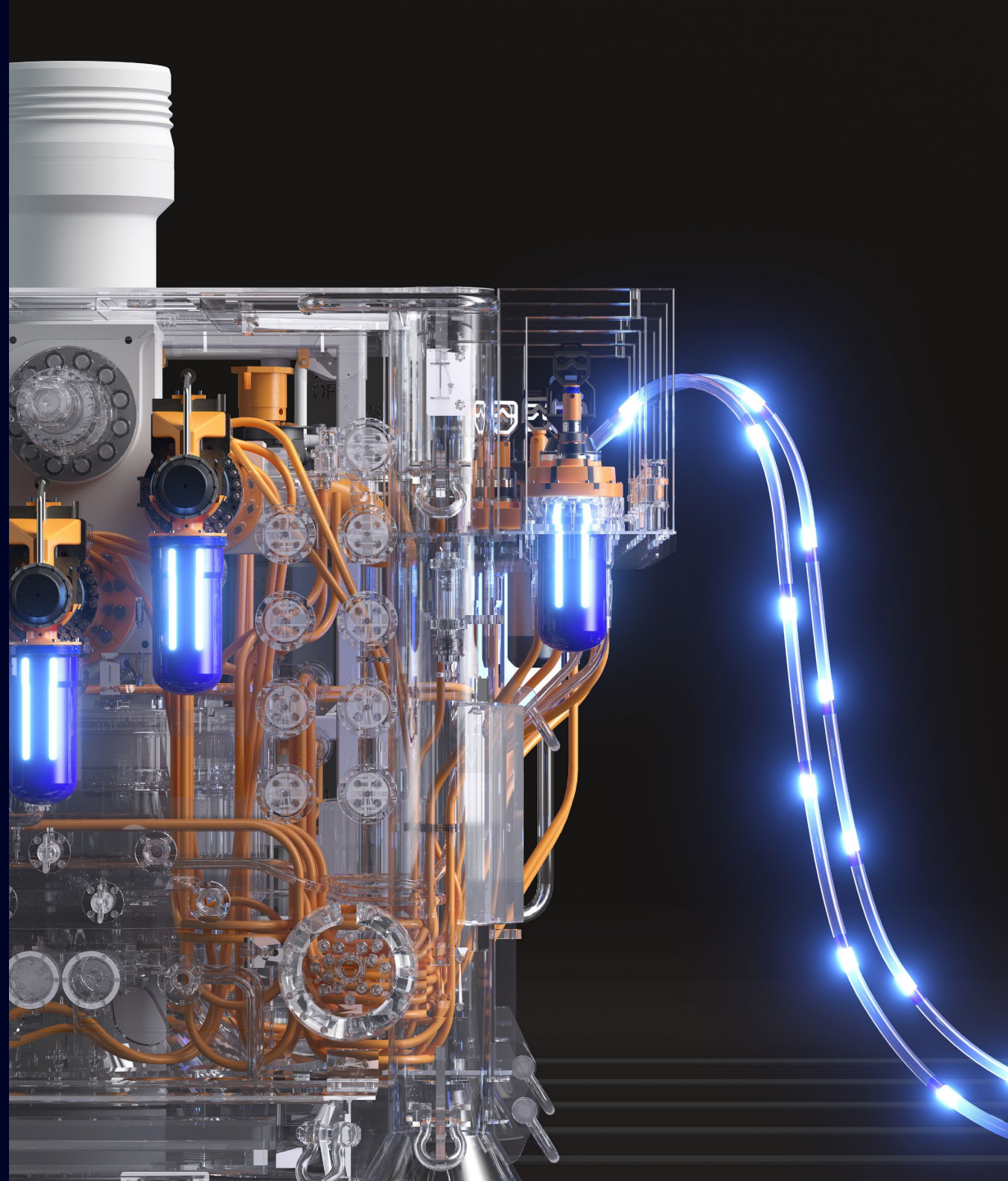
Agenda

1. Key Challenges
2. Subsea CCS -Technology Overview
3. Q&A



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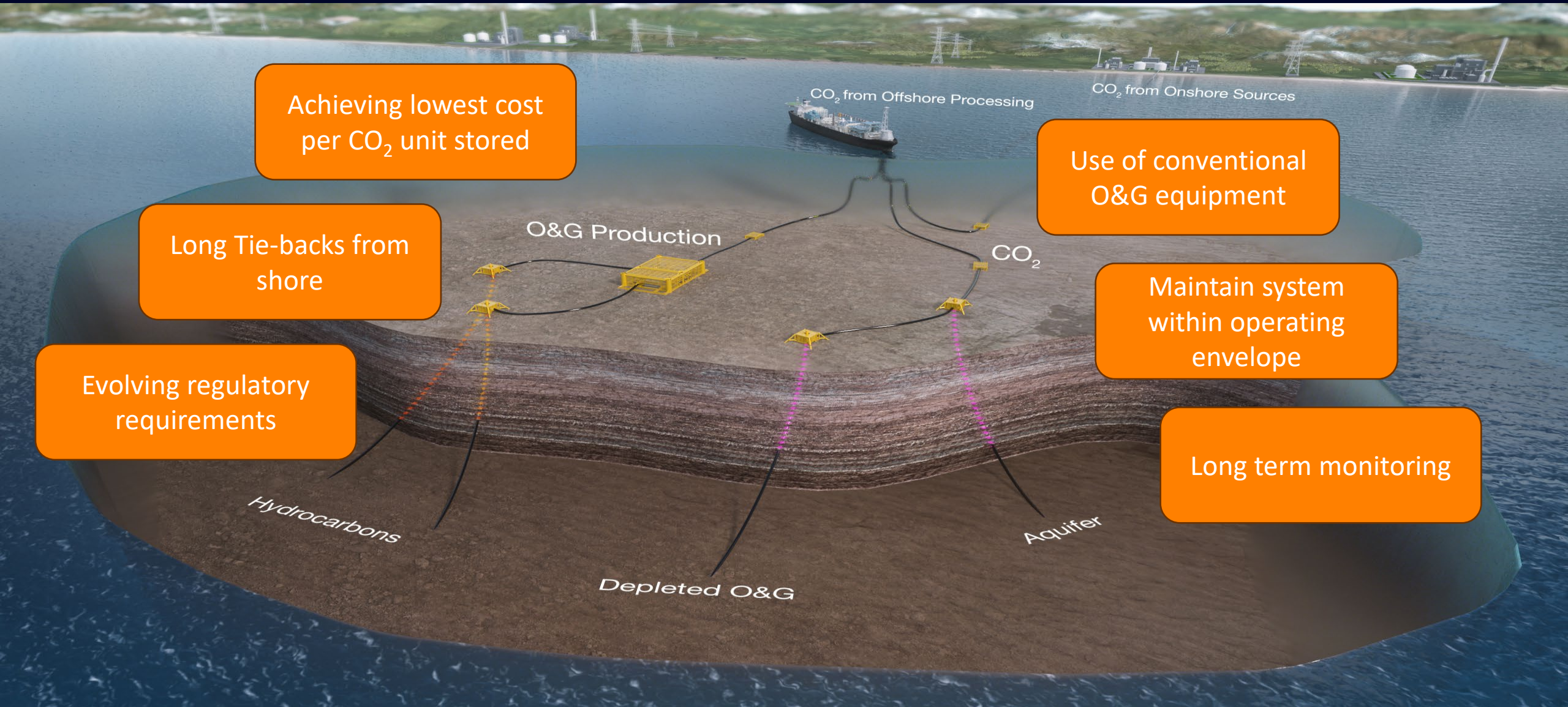
Key Challenges of Offshore CCS Developments



Achieving lowest cost per CO_2 unit stored

Long Tie-backs from shore

Evolving regulatory requirements

Use of conventional O&G equipment

Maintain system within operating envelope

Long term monitoring

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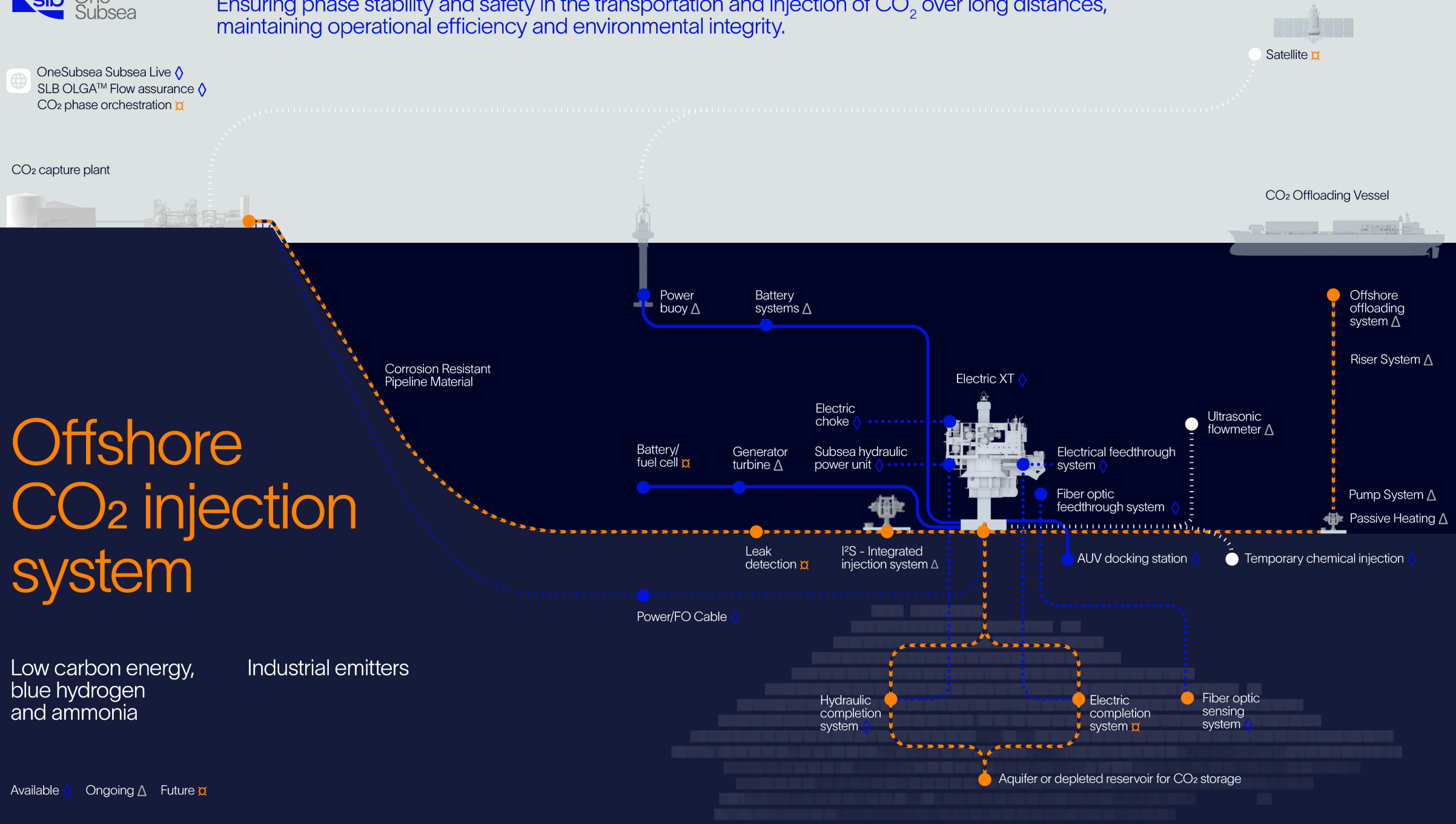
Ensuring phase stability and safety in the transportation and injection of CO_2 over long distances, maintaining operational efficiency and environmental integrity.

OneSubsea Subsea Live ◊
SLB OLGA™ Flow assurance ◊
CO_2 phase orchestration ¤

Offshore CO_2 injection system

Low carbon energy, blue hydrogen and ammonia

Industrial emitters



Available ◊ Ongoing Δ Future ¤

Subsea All-Electric Tree System

Vision

- Qualified for CO2 service
- JIP executed with several partners
- Based on field proven XT platform
- Interfaces with hydraulic completion via sHPU

Value

- Reduction of Umbilical cross section
- Reduction of topside space by up to 70%
- Elimination of hydraulic fluid (environmental impact & OPEX)
- Faster response and start-up
- Flexible Power and Communication interfaces (AC, DC, FO)

Status

- Electrohydraulic CCS Tree version installed in Northern Lights Ph1
- All Electric Tree system available, qualified for CCS – TRL 5
- Ongoing All Electric Tree design simplification for CCS
- First All Electric Tree project announced – Fram Sør

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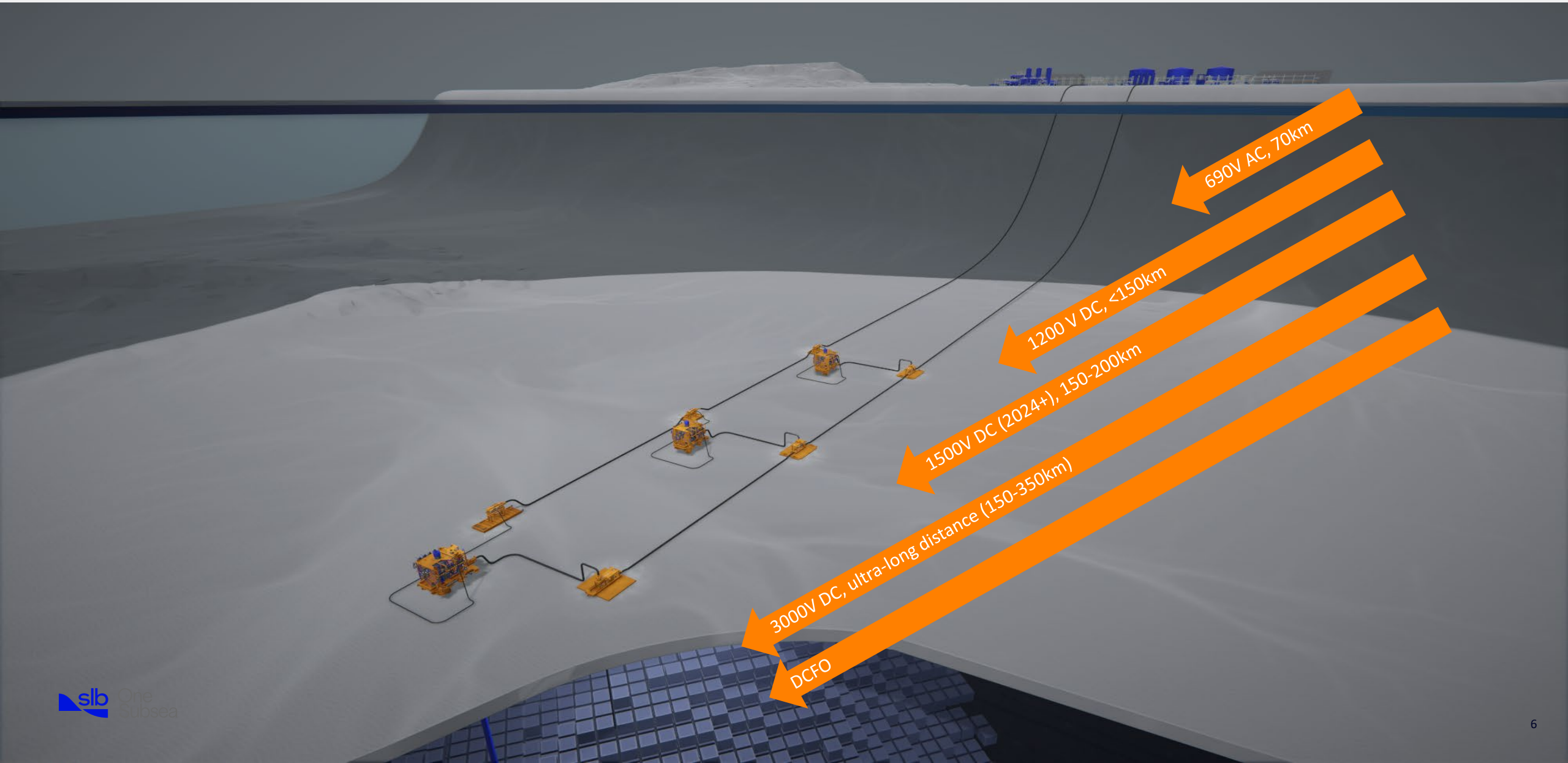
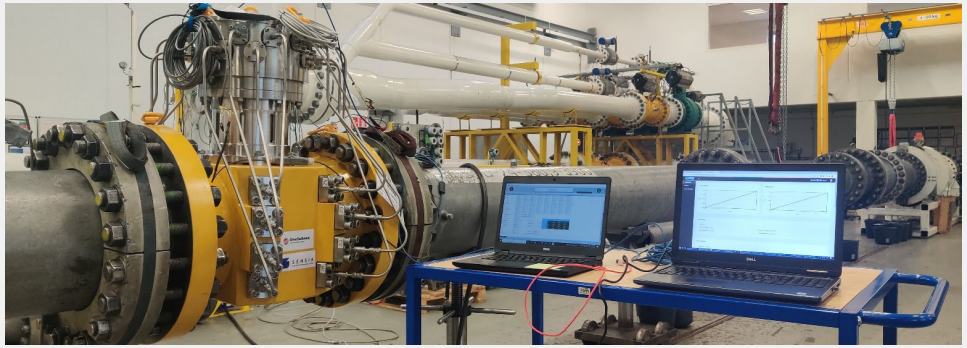
Power Distribution - High level guideline for step-out distances



Ultrasonic Flowmeter



Vision

- Provide safe and controlled injection of CO_2 by providing non-intrusive means of flow measurement subsea
- Can also be used for fiscal metering and leak detection
- Operators actively engaged during development

Value

- Early detection of critical change in flow conditions
- Provides precise adjustment of CO2 injection across multi-well injection system
- Enabler for automated choke control
- Very large measurement range; turndown > 100:1

Status

- Tested according to ISO 17089-1 and OIML R137
- Flow test with supercritical CO2 planned in Nov/Dec 2024
- Technology being screened as part of various FEED studies

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Wave Power Buoy System

Vision

- Integrated wave power generation and power management
- Enable future umbilical-less system architectures
- Provide platform for surface communications gateways

Value

- Enable early integration of renewable power sources for offshore subsea systems, while de-risking future project execution
- Unlock hybrid power solutions to de-risk umbilical-less systems
- Attractive for subsea CCS, and long-distance tie-backs

Status

- Several field test successfully executed
- Actively collaborating with C-Power, Mocean Energy and others to ensure technical interfaces are matured
- Further studies for integrated all-electric & SCSI system ongoing

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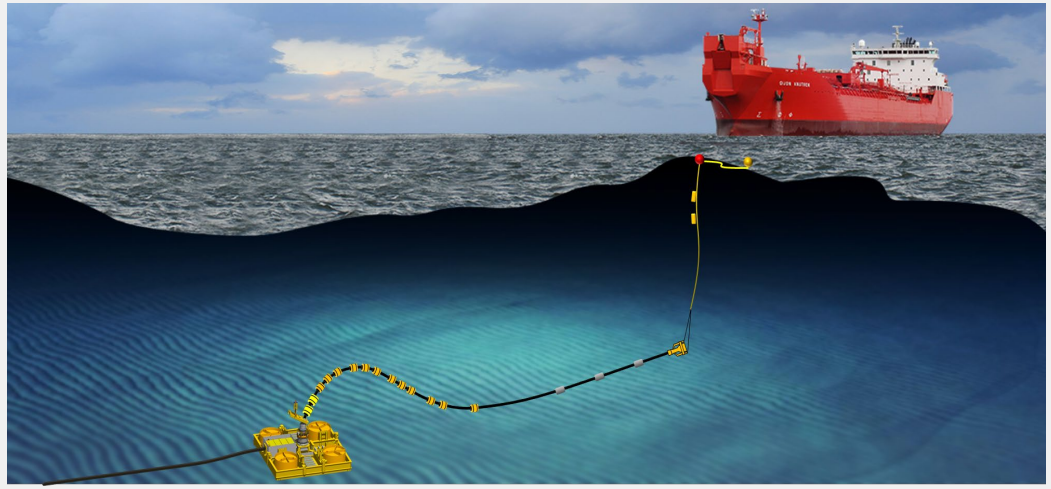
Remote CO_2 Offloading System



Vision

- Early access to CO2 injection wells without pipeline lay
- Direct transport to storage site
- Provides direct transportation from various CO_2 sources to injection field, flexibly adjusting to demand

Value

- Eliminates the need for construction of expensive flow lines, reducing capital expenditure
- Provides rapid adjustment to international policy changes
- Emissions of vessel are small % of total CO_2 stored

Status

- Based on previously delivered submerged loading system technology
- Concept outlined in IOGP 665 guideline
- Ongoing study in Norway

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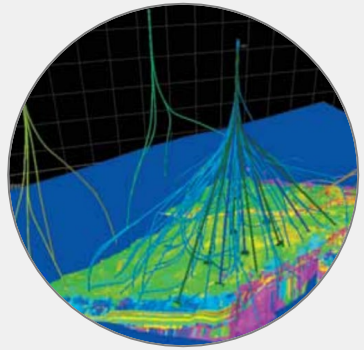
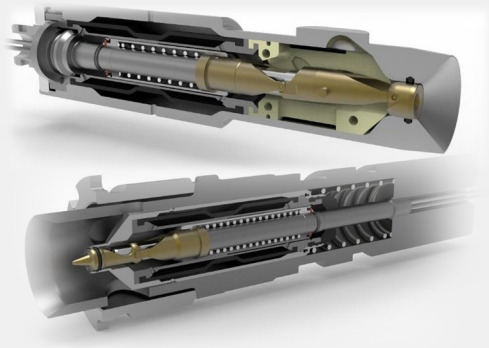
Integration of FO Distributed Sensing in Subsea System





Vision

- Meet CCS MMV requirements
- Validate the CO2 stays in place
- Build confidence in storage volume
- Verify Injection in real-time

Value

- Enable integration of FO for seismic applications into the subsea infrastructure
- Borehole and seabed seismic applications
- Savings in seismic campaigns
- Enable continuous reservoir monitoring

Status

- Active collaboration with SLB reservoir, completions and digital teams
- Optical Feedthrough System and Subsea Optical Amplifier
- Ongoing studies and projects integrating FO DAS/DTS in subsea production and CCS systems

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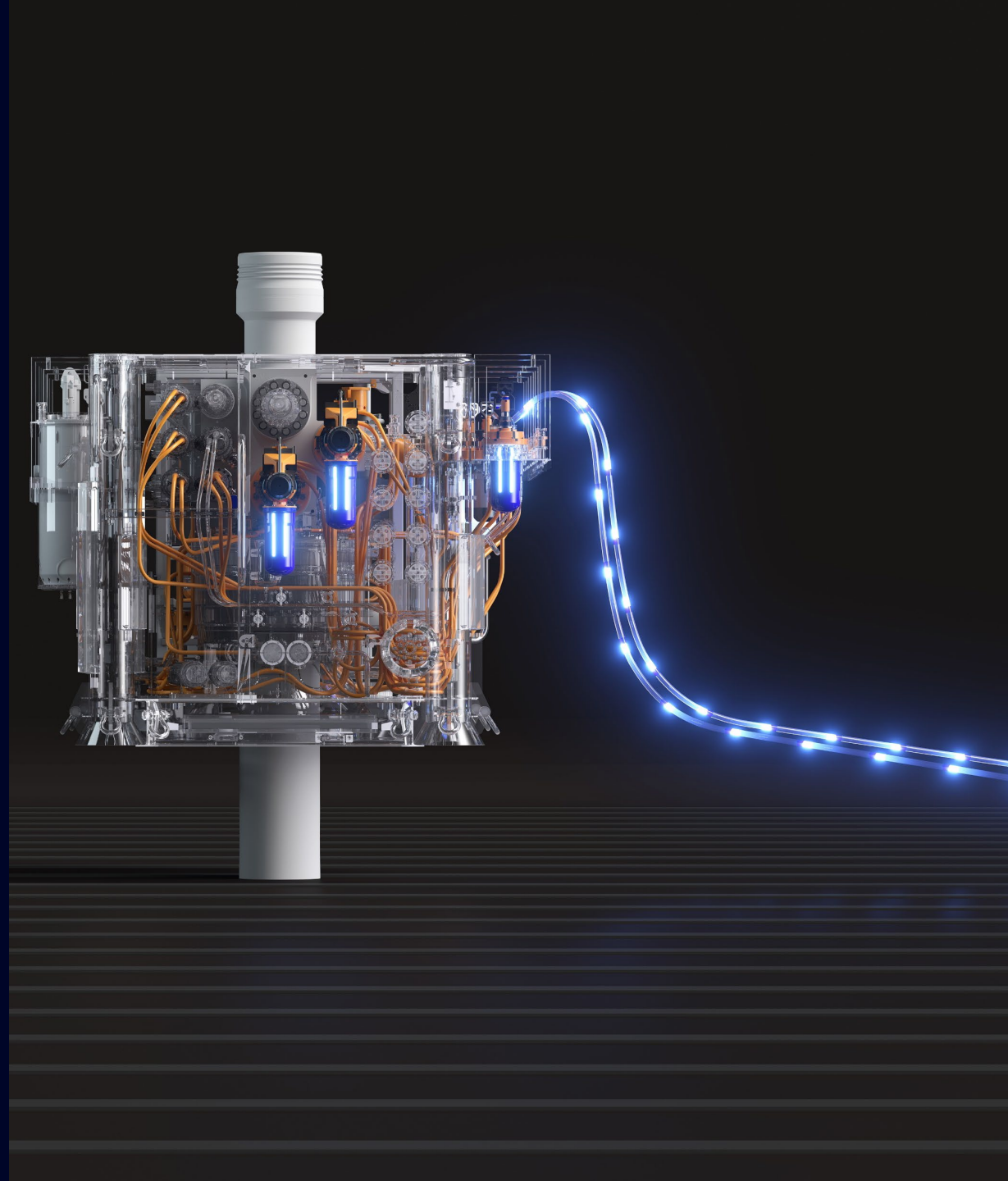
Summary

- CCS projects - best candidates for All-Electric System:
  - No chemicals
  - Enhanced flow control
  - Cost reduction vs electrohydraulic
- Need for further CO2 injection tree simplification
- Options for ultra long-distance P&C
- Ultrasonic Meter advantages in CCS
- Alternative energy sources and offloading
- Integration with reservoir and plant



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Thank you.

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