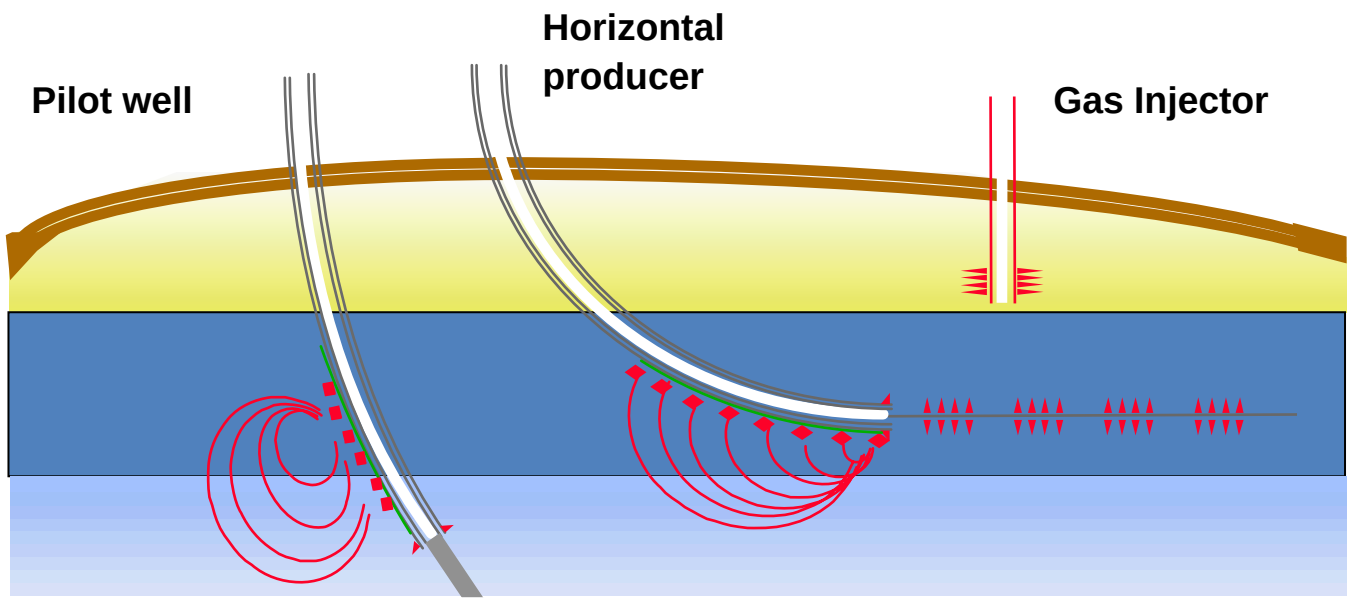
NEW TECHNOLOGIES FOR OIL AND GAS

Intelligent Wells

Wells Equipped at Completion with Downhole Controls and Sensors

Proactive Remediation of Fluid Inflow

- **Remote controlled Downhole zonal control valves**
- **Implement reservoir decisions without intervention**



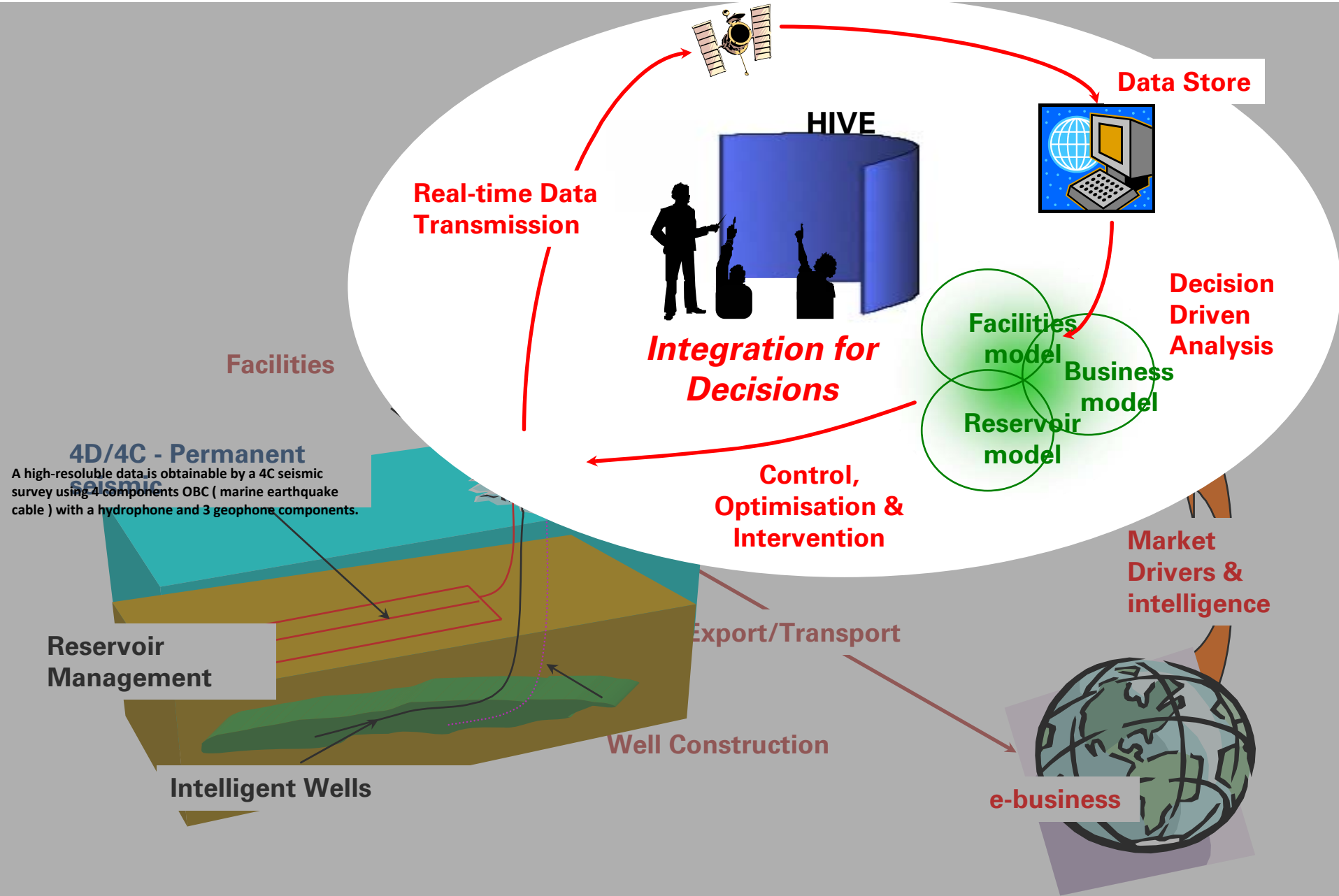
Continuous data from wells

Pressure Performance ***Inflow Distribution*** ***Flowing Phase***

Downhole Seismic ***Reservoir Saturation***

- **Optical Pressure Gauge**
- **Optical Distributed Temperature Gauge.**
- **Data is transmitted up the wellbore via fibre optics.**

DIGITAL OILFIELD



MULTI PHASE PUMPING

Multiphase production systems require the transportation of a mixture of oil, water and gas, often for many miles from the producing well to a distant processing facility.

This represents a significant departure from conventional production operations in which fluids are separated before being pumped and compressed through separate pipelines. By eliminating this equipment, the cost of a multiphase pumping facility is about 70% that of a conventional facility and significantly more savings can be realized if the need for an offshore structure is eliminated altogether.

However, multiphase pumps do operate less efficiently (30-50%, depending on Gas volume fraction and other factors) than conventional pumps (60- 70%) and compressors (70-90%).

Still, a number of advantages in using multiphase pumps can be realized, including:
1)Increased production through lowering backpressure on wells;
2)Elimination of vapor recovery systems;
3)Reduced permitting needs;
4)Reduction in capital equipment costs; and,
5)Reduction in “footprint” of operations.

CONVENTIONAL AND MULTIPHASE PUMPING

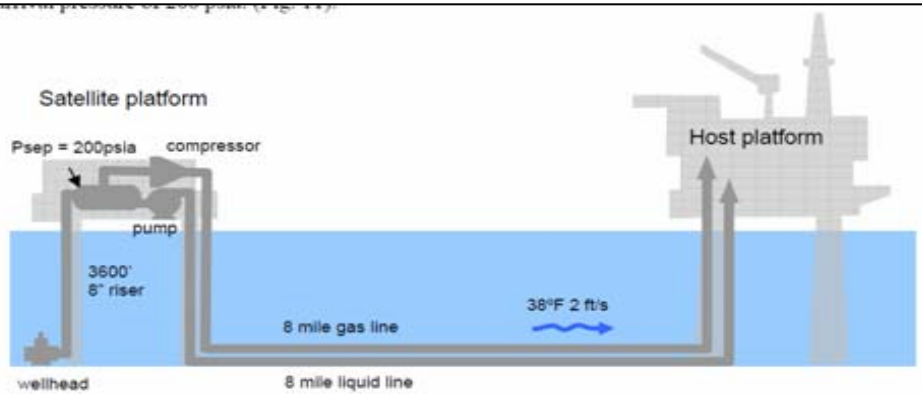


Figure 10: Schematic of Production System using satellite platform

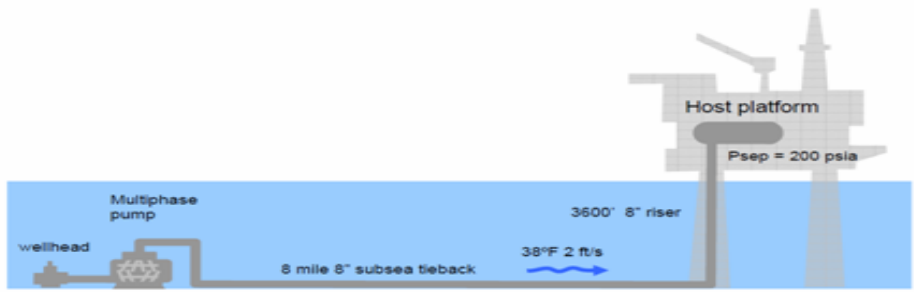


Figure 11: Schematic of Production System using subsea multiphase pump

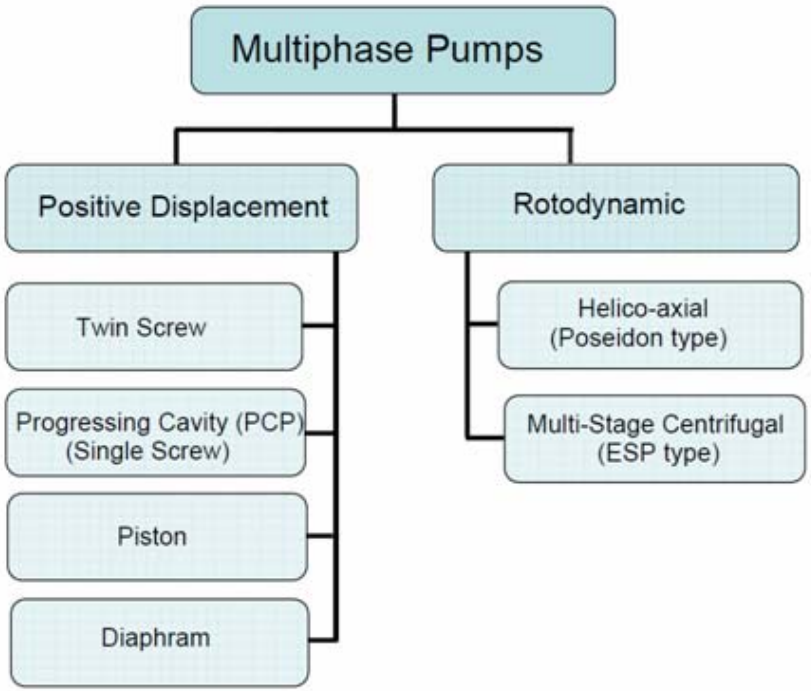
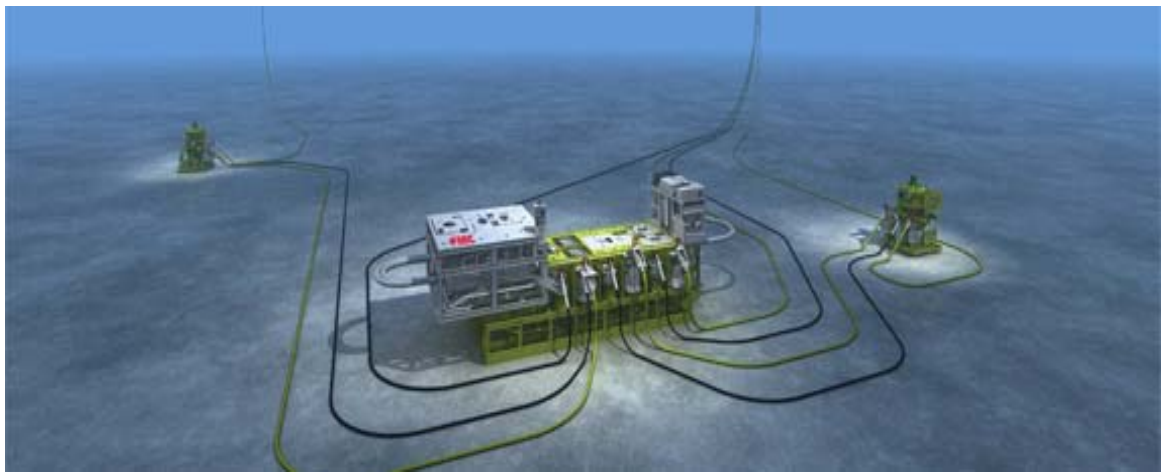


Figure 1: Types of Multiphase Pumps

- **Multiphase pumping is a relatively new technology and acceptance has been hampered by a lack of engineering design tools.**
- **Recently, pipeline simulation codes have incorporated the ability to model multiphase pump performance as part of the overall multiphase production system**

SUBSEA PROCESSING

- Normally used in deepwater
- Separation of heavy oil and water
- Reinjection of water to boost production in a mature field development.
- The separation system may also includes cyclone modules that will perform water treatment before reinjection the water back into the reservoir.



"a true subsea development is very environmentally friendly."

NEW TECHNOLOGIES BEING DEVELOPED FOR THE BRAZILIAN PRE-SALT

R, D & I Levy: 1% Gross Revenue

Pré-sal Petróleo

Libra Acid Gas Processing

HISEP™

Dense Phase CO_2 Separation - **HISEP™**: gravitational bulk CO_2 separation

PILOT PLANT

HISEP Development together with the partners:

AkerSolutions

FMC Technologies

OneSubsea
A Cameron & Schlumberger Company

SAIPEM

Description

Subsea dense gas separation and boosting

Subsea bulk gas removal for topside gas plant debottlenecking to extend oil production plateau

Risks and Challenges

Hydrate mitigation in start and shutdowns

Dense gas phase pump performance

High pressure separation at sea bottom

Operational philosophy (process control)

Potential/Captured Benefits

FPSO processed GOR reduced from 420 to ~150 m3/m3

FPSO: Reduction of weight, footprint and power requirement

Oil production increase

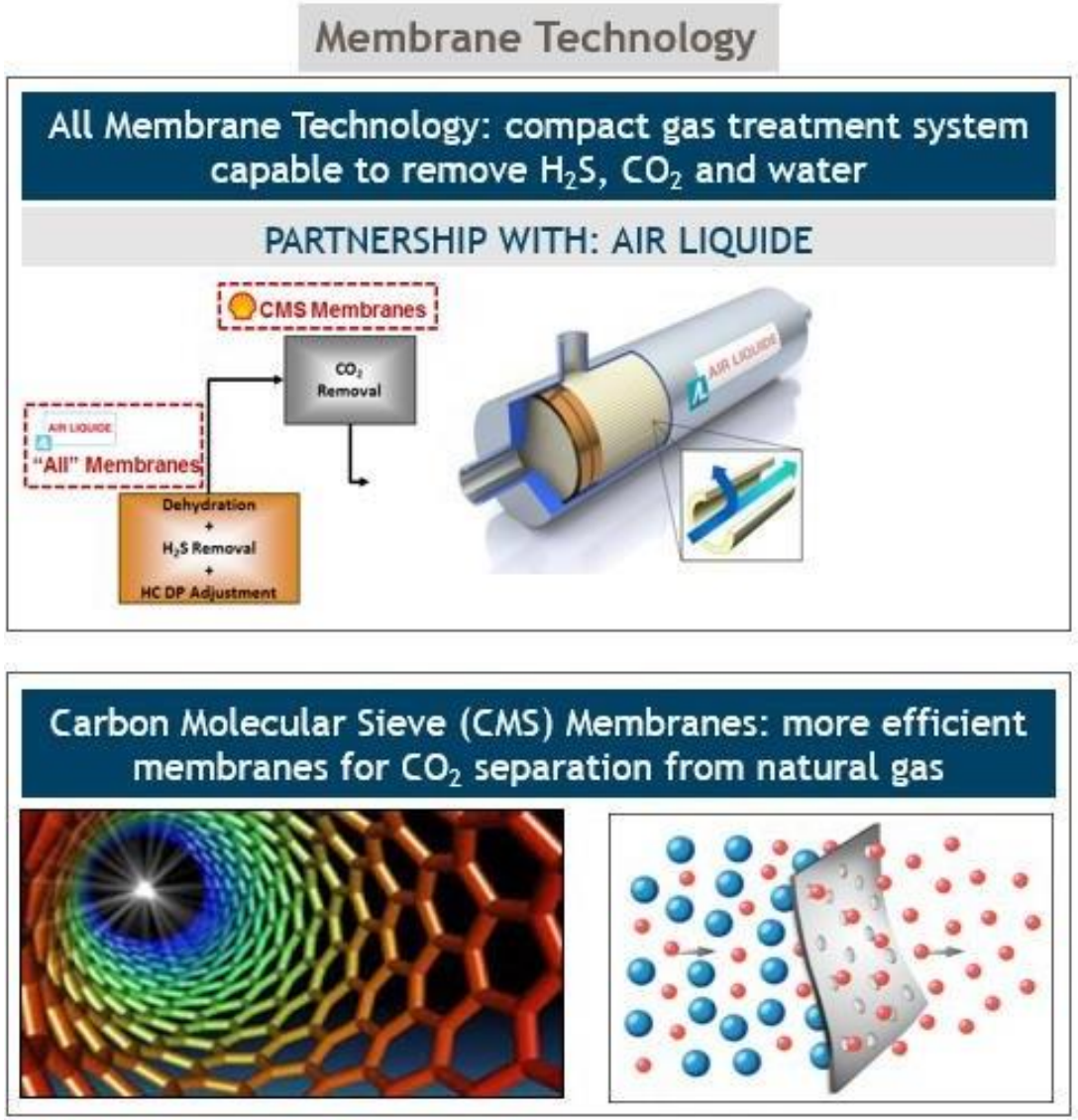
Source: Petrobras

Pré-sal Petróleo

GLOBAL OFFSHORE BRAZIL SUMMIT

GULF QUEST

Acid Gas Processing



Description

New membrane technology for CO_2 separation

Carbon sieves with slit-like microporous lead to higher CO_2 selectivity and permeability

Risks and Challenges

Difficulty to handle for scale-up

Brittleness

Ongoing pilot test at a Petrobras site in Sergipe

Potential/Captured Benefits

FPSO: Reduction of weight, footprint and power requirement

Reduce HC losses

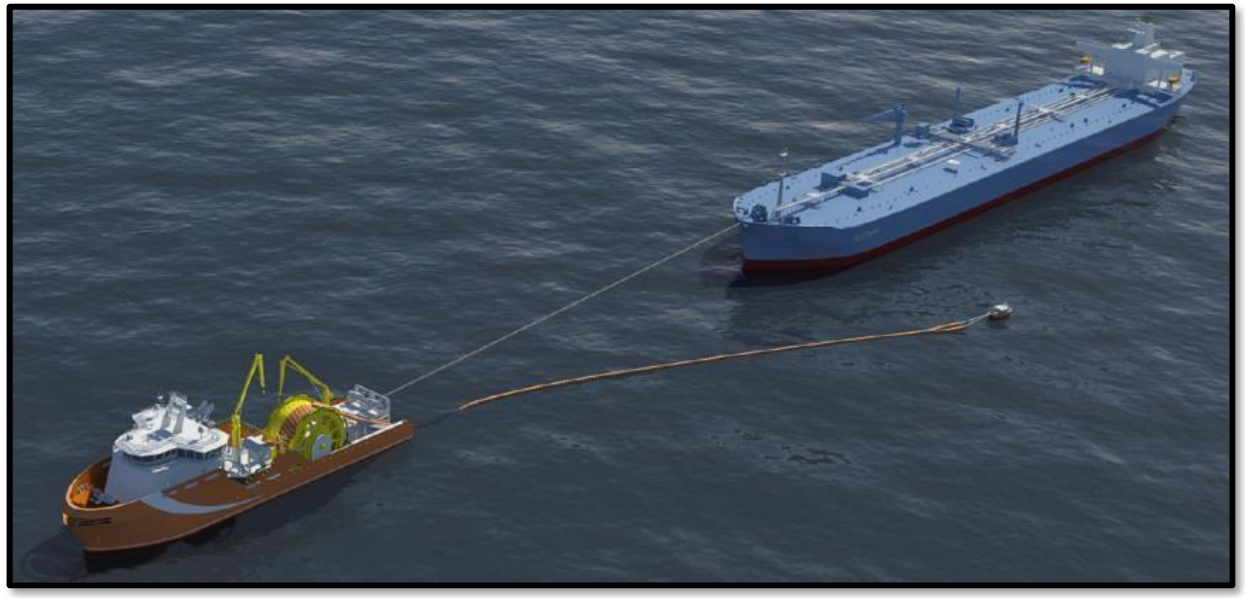
Capable to remove H_2S, CO_2 and water

GULF QUEST

Pré-sal Petróleo

GLOBAL OFFSHORE BRAZIL SUMMIT

CTV – Cargo Transfer Vessel



Description

Evaluate the Cargo Transfer Vessel (CTV) as an alternative to the DPST's (Dynamic Position Shuttle Tankers) - Libra base case for offloading today - in the Santos Basin environment

Risks and Challenges

Maneuverability in congested area including emergency situations

Keep at least the same safety level as DPST's

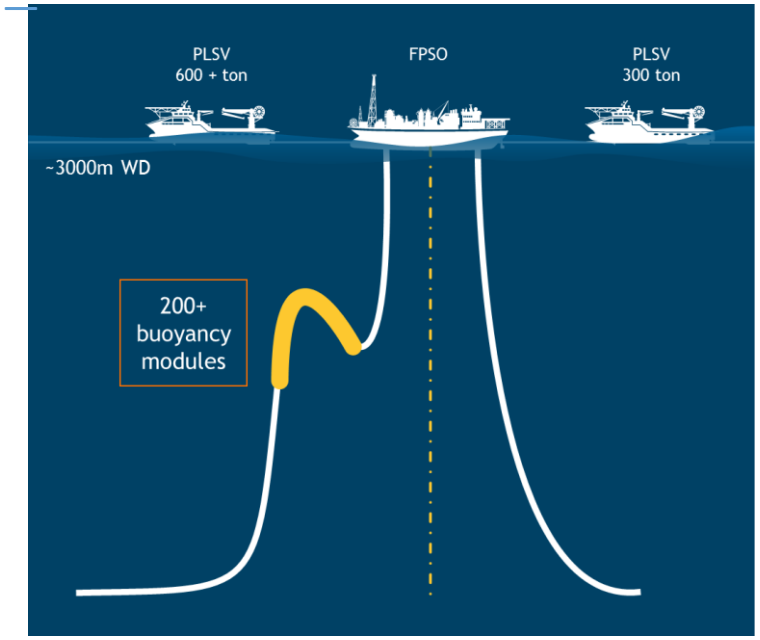
Potential/Captured Benefits

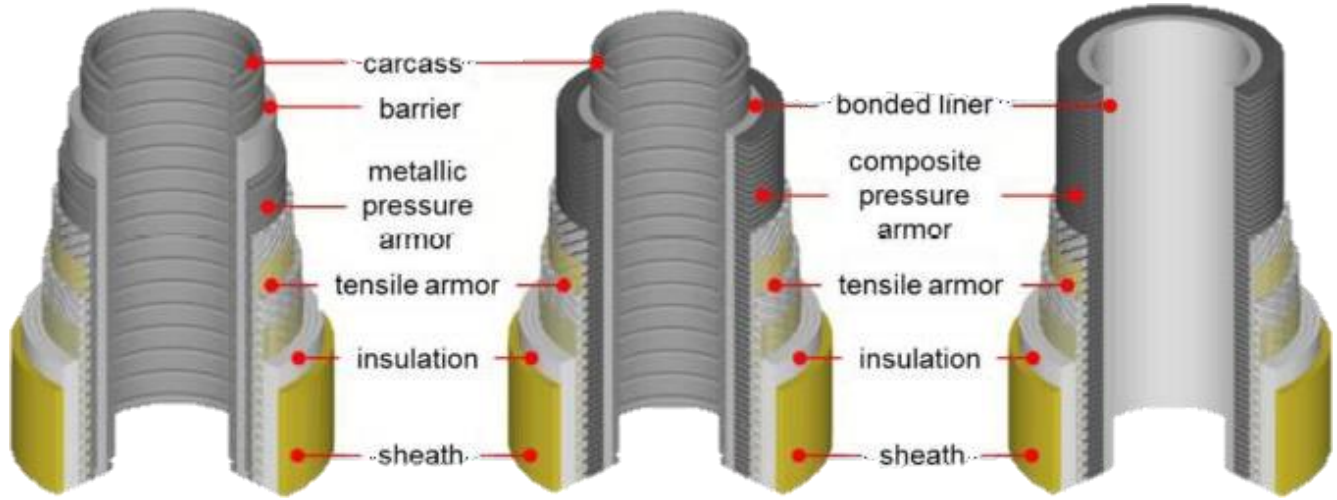
Optimization in offloading will lead to cost reduction

Source: Petrobras

Free Hanging Catenary – Next Generation of Flexible Pipes

Hybrid Composite Flexible Pipes





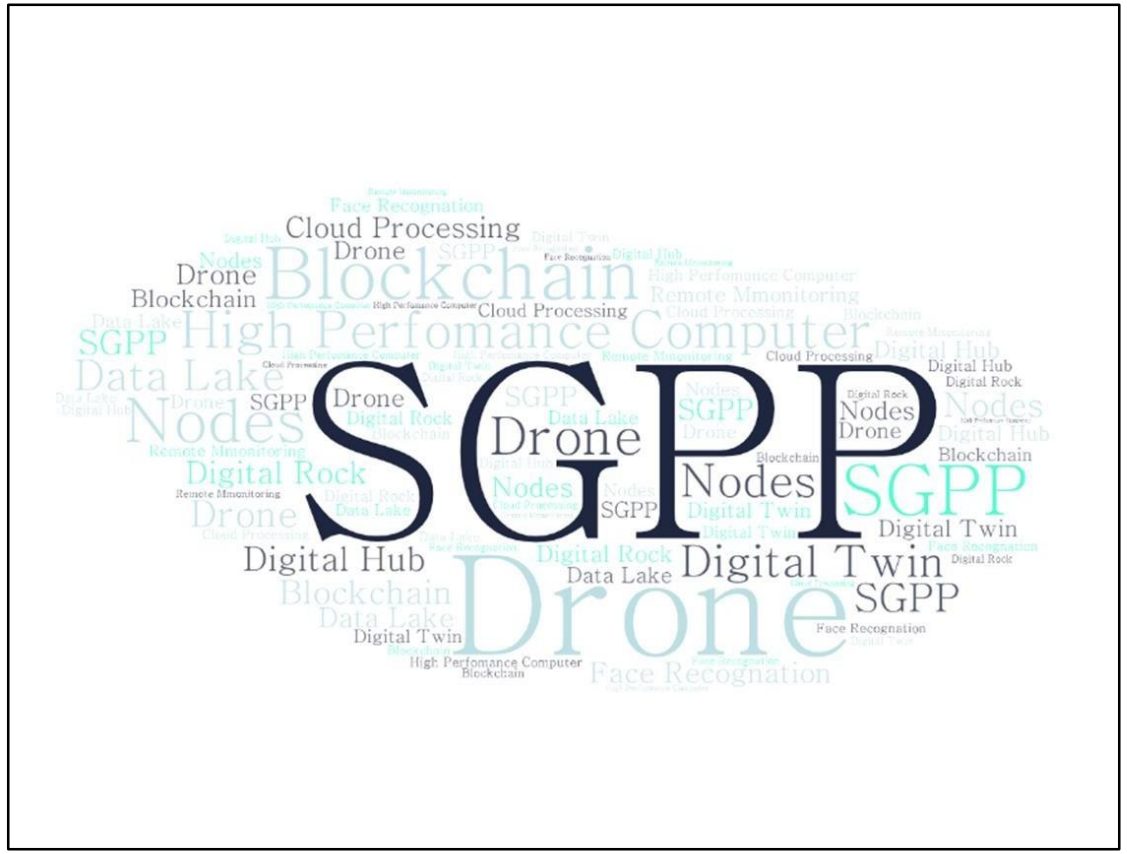
CONVENTIONAL FLEXIBLE PIPE

COMPOSITE PRESSURE ARMOUR HYBRID FLEXIBLE PIPE

- Less installation time (up to 40%-50%)
- Less HSE exposure
- Reduces overall riser installation CAPEX by 20% to 30%

Source: Petrobras

Digital Transformation



Description

Customized system to support our activities: PSC management, HC commercialization and Unitized reservoirs production control

Risks and Challenges and

Process mapping of the company

Input of individual contract data into the system

Potential/Captured Benefits

Online monitoring of contracts

Improvement of traceability, transparency and performance

Simulation of the State oil and gas cargo schedule

Next step: Analytics and artificial intelligence

Source: Petrobras

THANKS