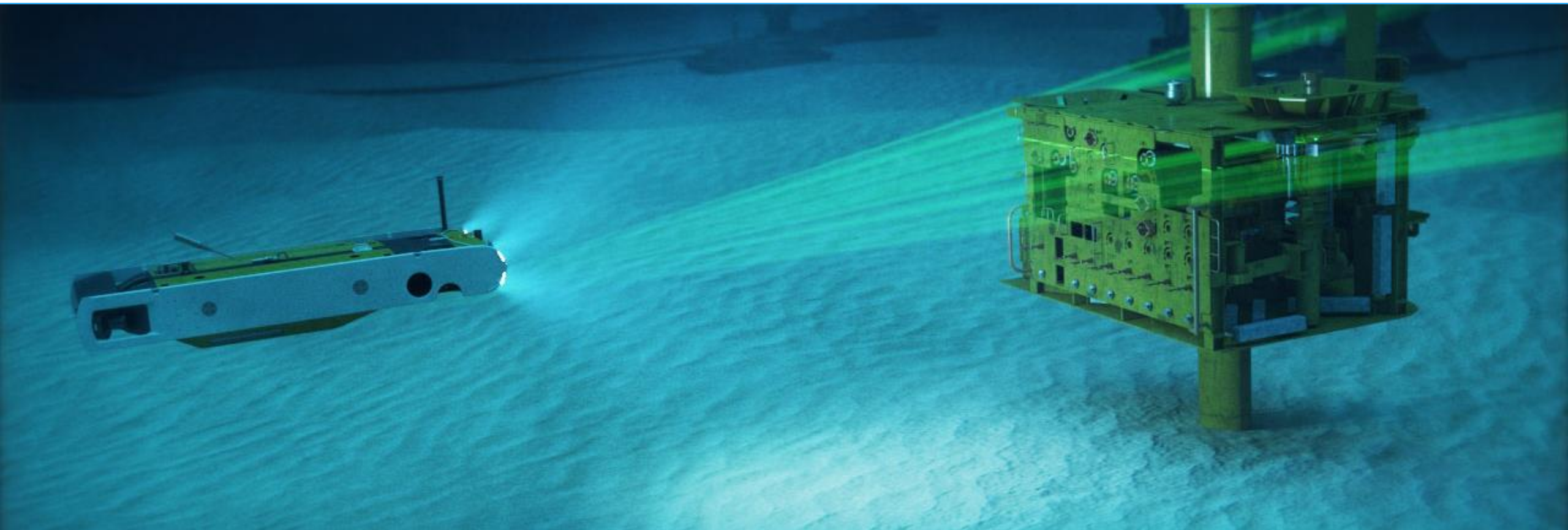


OneSubsea IMR Services

uROV: Rethinking subsea field operation and design using drone technology

16 September 2019



uROV : untethered ROV

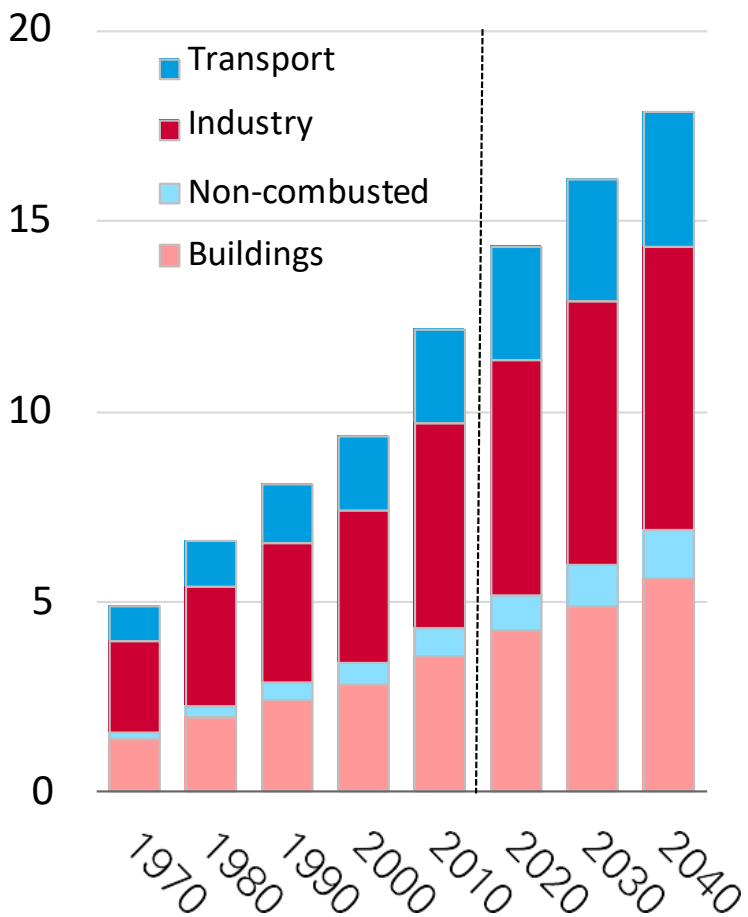
Schlumberger-Private

Schlumberger

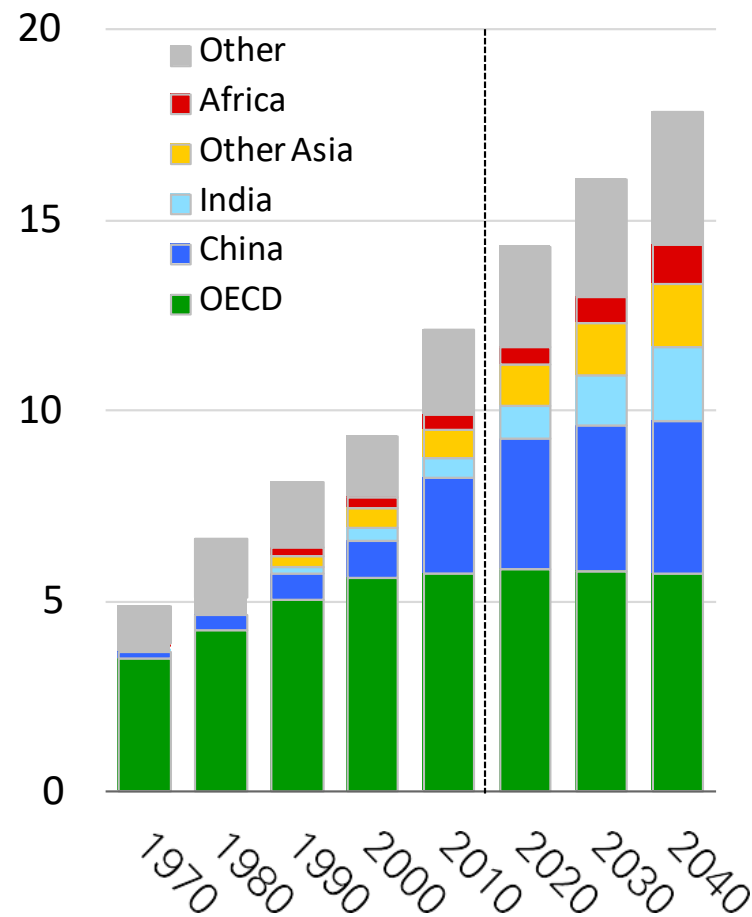
Primary energy demand

End-use sector

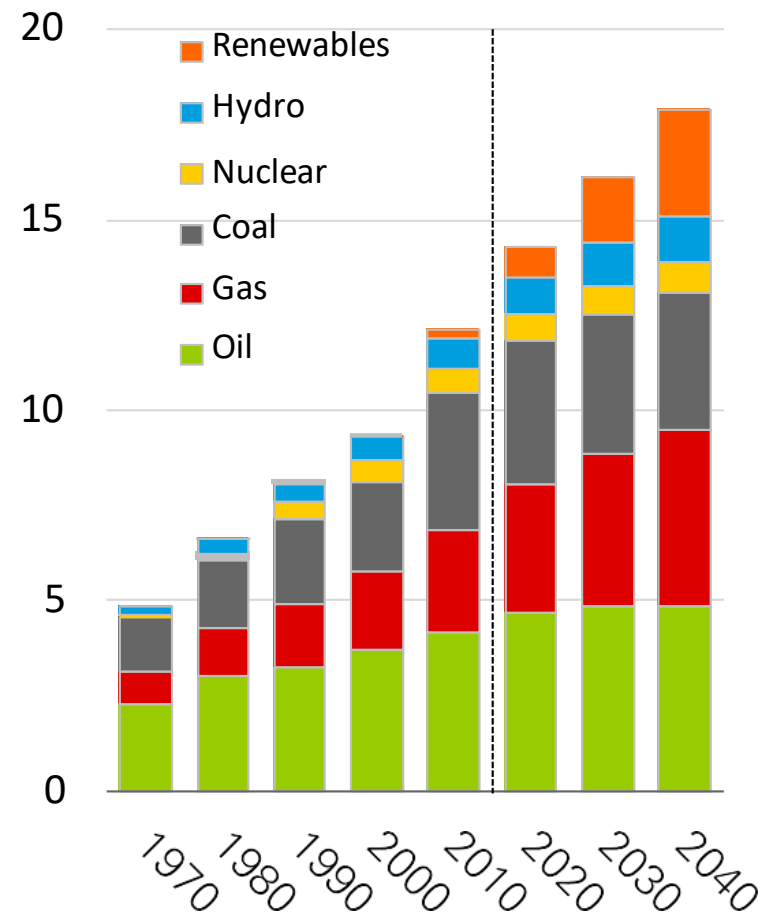
Billion toe



Region



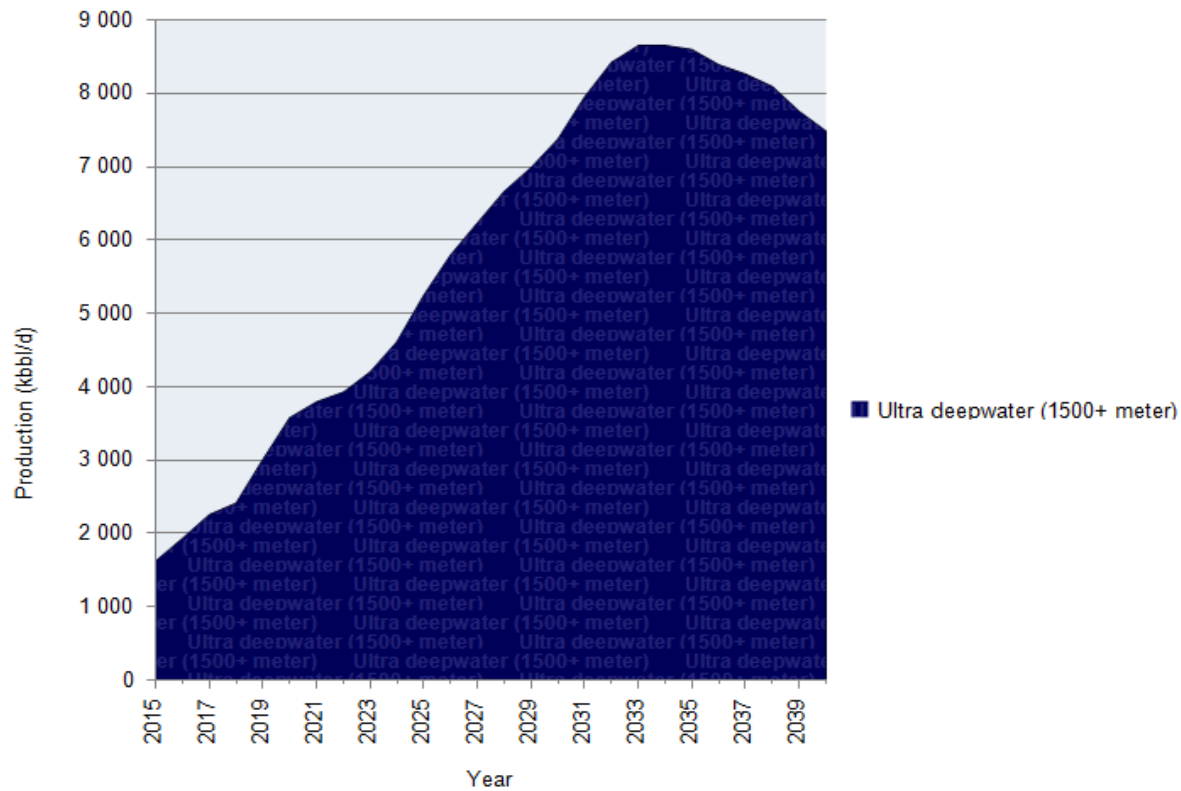
Fuel



2019 BP Energy Outlook

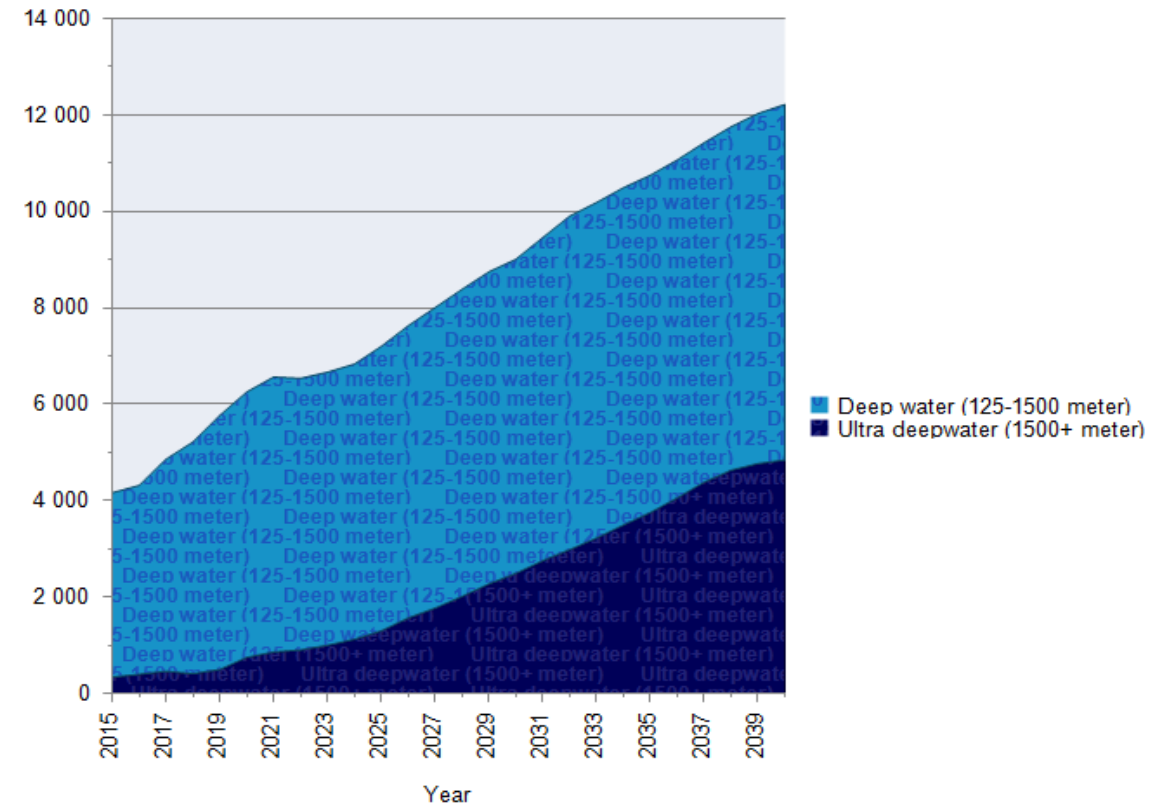
© BP p.l.c. 2019

Deepwater Oil



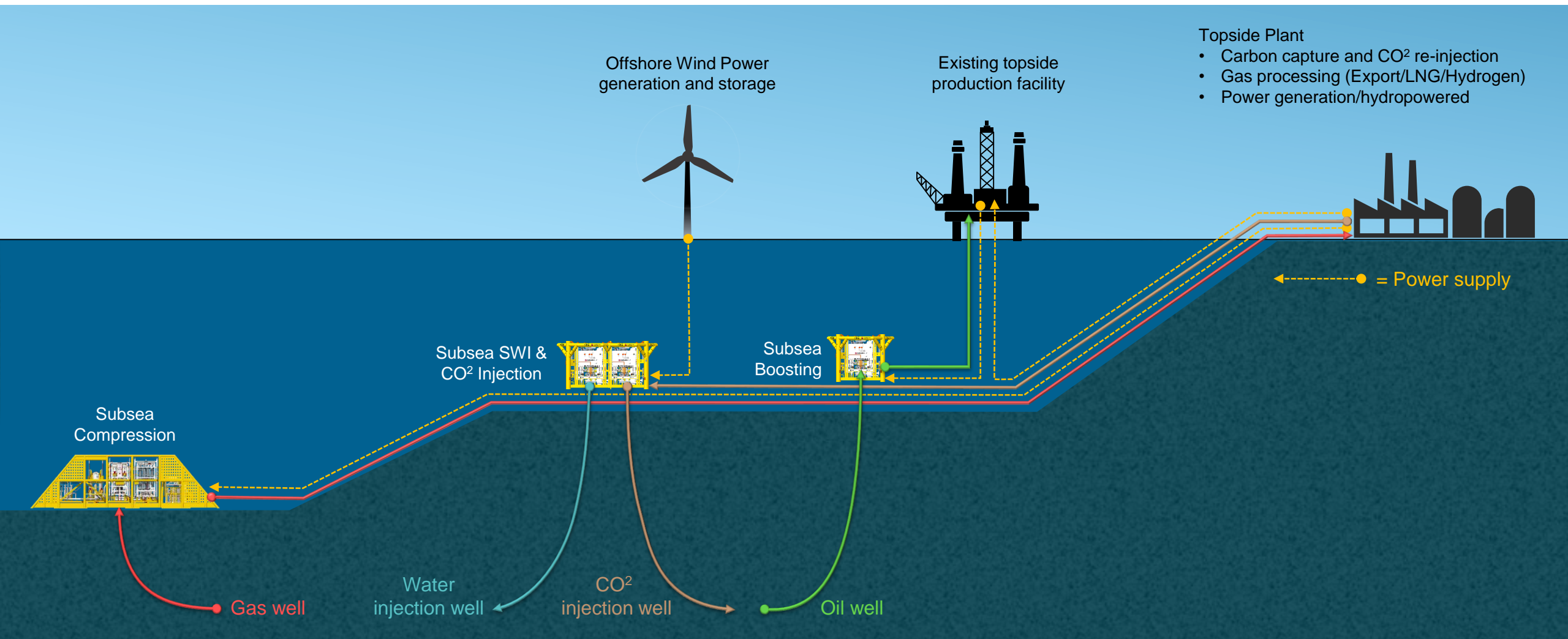
Source: Rystad Energy UCube, version 2019-09-05

Offshore Gas



Source: Rystad Energy UCube, version 2019-09-05

Carbon neutral hydrocarbon production



uROV Basic Roadmap



2020+



2022+



2025+



- Valve actuation
- Barrier fluid & chemical supply
- Subsea sampling
- Assist installation & intervention
- Pump operation acoustic sensing

Differentiation

Autonomous Vehicles in Support of Naval Operations 2005, National Academy of Sciences

ROV

"Joystick control"

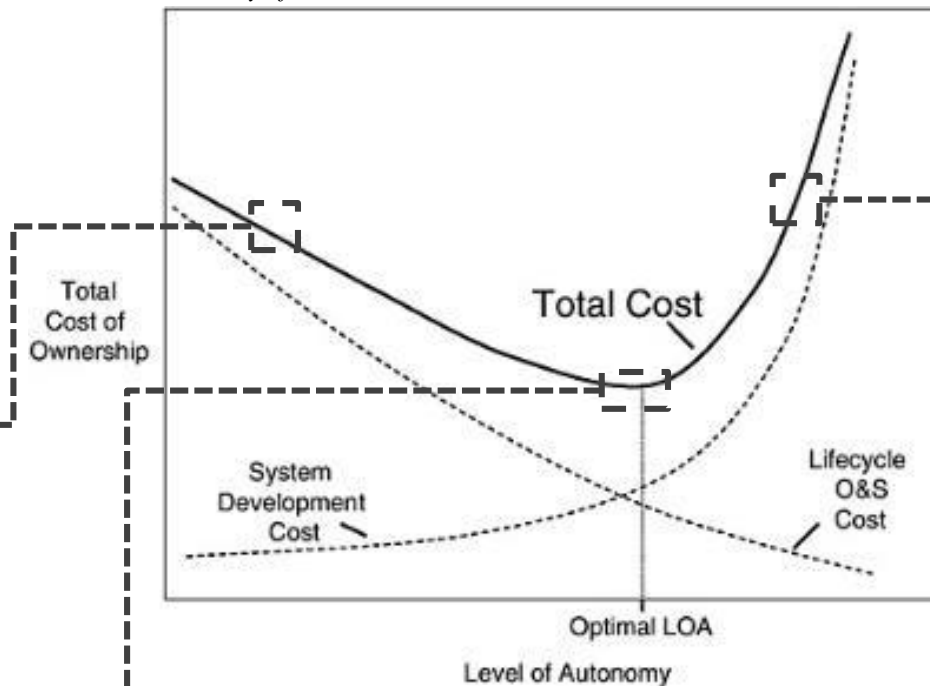
- Legacy approach
- Expensive deployment
- Data through tether



AUV

"Fire and forget"

- Trust issue around sensitive infrastructure
- Development cost



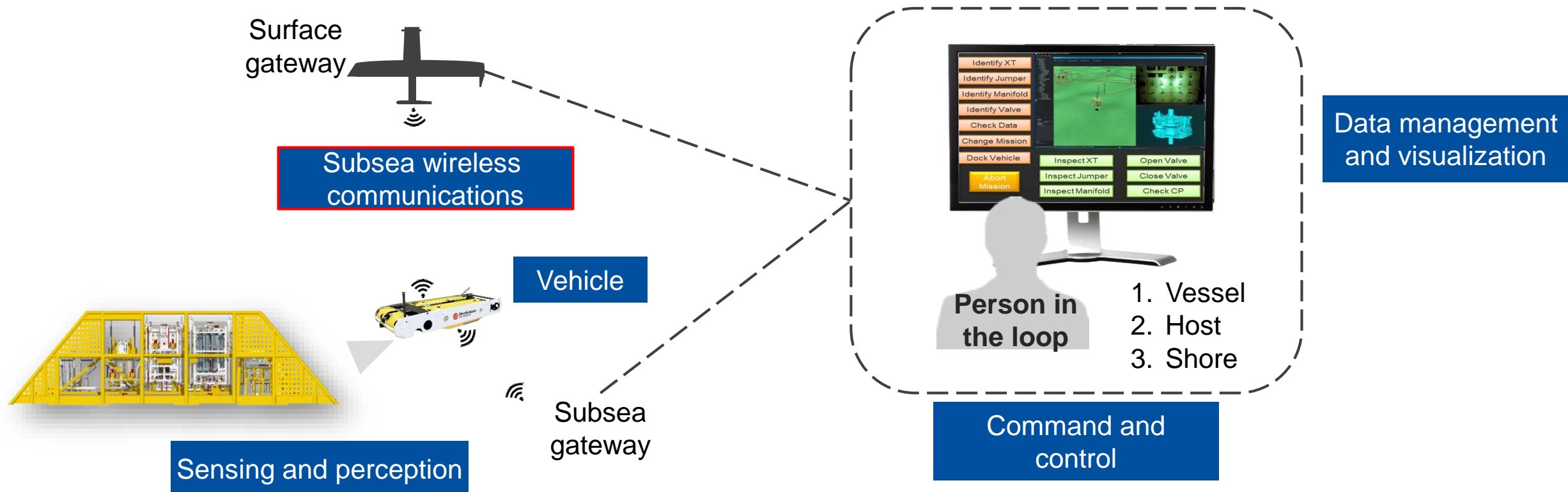
uROV: untethered ROV

"Supervised autonomy"

- Pragmatic approach
- Prescribed real-time data
- Agile



Supervised Autonomy



Subsea Wireless

$R_T=25$ kbps



$R_T=50$ kbps



$R_T=100$ kbps



$R_T=200$ kbps



$R_T=400$ kbps



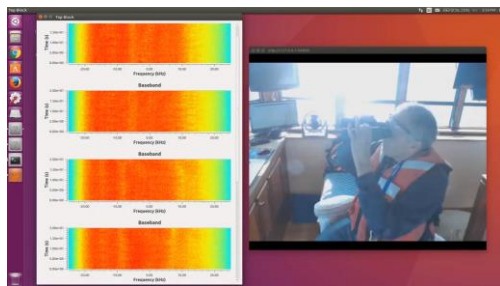
$R_T=800$ kbps



Deepwater Horizon BOP (480 × 270) at 29 fps, open source codec, no optimization.

Subsea Wireless Development

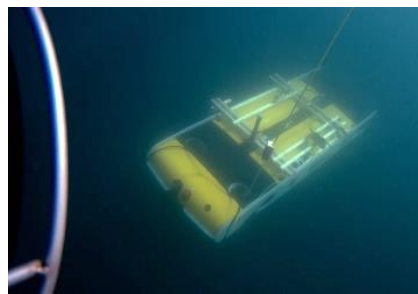
2017



1,000m tests
Horizontal channel:
100 kbps

Vertical channel:
100 kbps

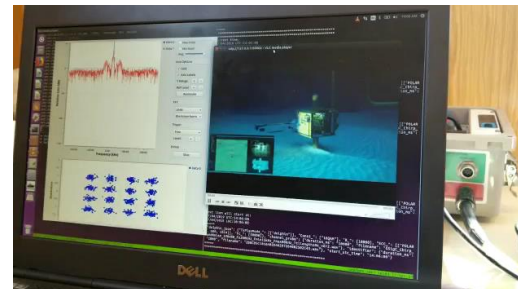
2018



Modem development (3m)
Horizontal channel:
300 kbps

Integration tests
Vehicle characterization

2019-Apr



2,150m tests
Vertical channel:
150 kbps (100 kbps eff.)

1,000m tests
Vertical channel:
200 kbps (133 kbps eff.)

2019-June, August



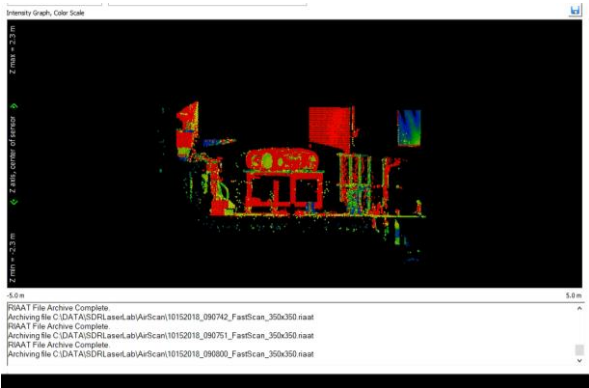
DRiX to uROV
1,000m



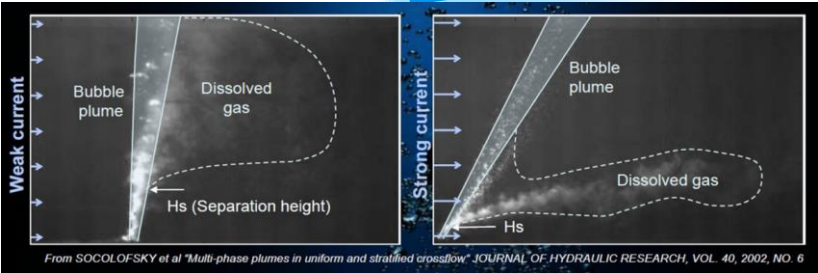
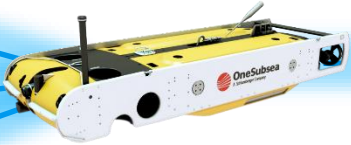
Sensing & Perception



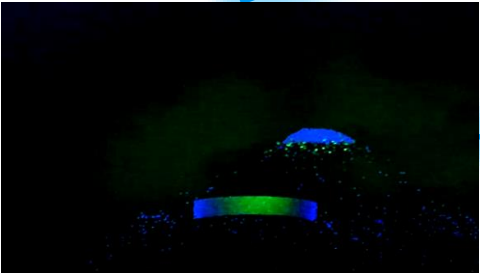
Computer vision through machine learning



LiDAR-streaming through comms



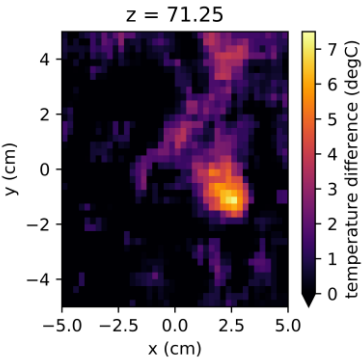
Hydrocarbon leak detection



LiDAR-navigation and acquisition

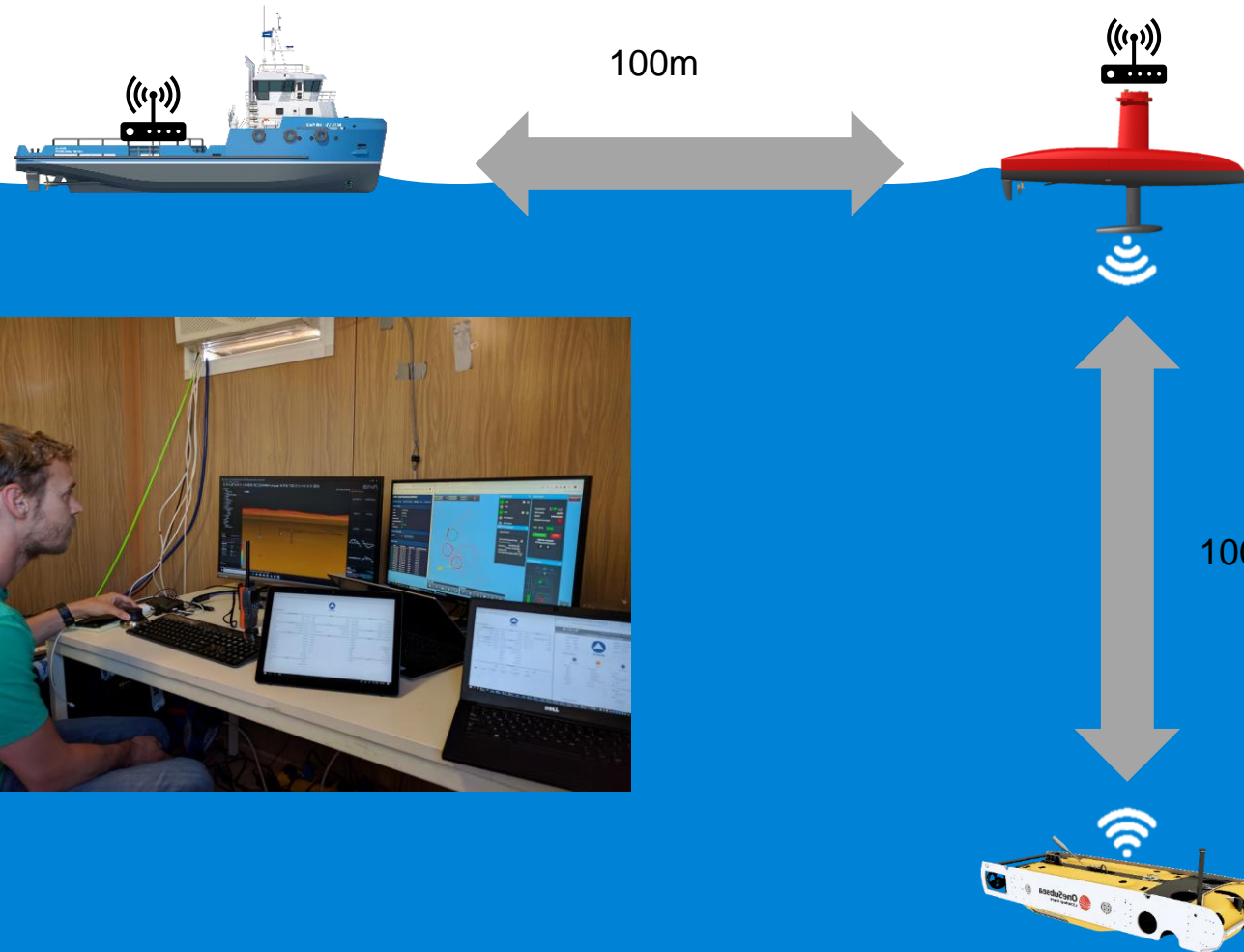


LiDAR-temp. profiling

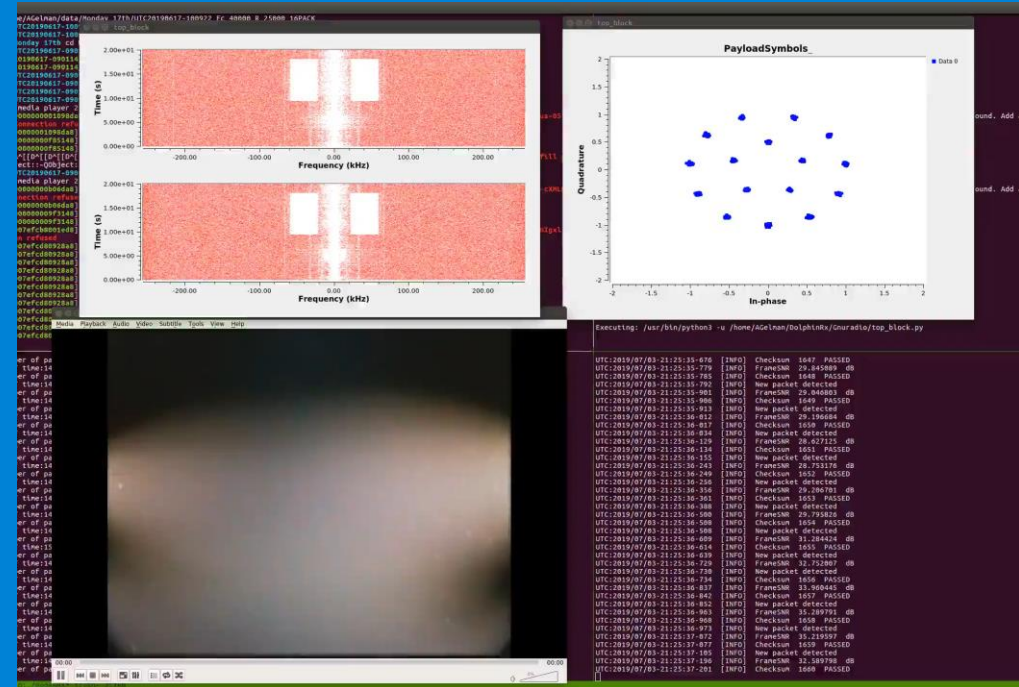




Status Sept. 2019



- Achieved “Person in the Loop” Supervised Autonomy at 1km
- Autonomous mission execution
 - Mission update/change
 - Live video, Sonar, LiDAR transmission



Summary

- Target 50% Cost reduction compared legacy IMR services
- Improved asset integrity – More frequent surveillance and less deployment time
- CO2 reduction – No ROV vessel deployment and standby
- Independent of weather and sea state
- Supporting long tie-back solutions
- Boosting systems are perfect hosts

