



Smart technology for CO₂ handling subsea

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by
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Main Challenges to offshore CO₂ EOR

- CO₂ supply chain not established
 - limited availability of CO₂
 - forecasted need for large volumes
- Facilities and wells are not corrosion resistant
- Limited weight and space available for topside separation on most platforms
- Extremely costly retrofits and additional installations
- Loss of production due to shut down in retrofit period



Øyvind Hagen - Statoil ASA



Subsea CO₂ processing

- Rarely described in literature
- System would
 - Be designed to ensure that the oil and gas to processing facilities contains a limited amount of CO₂, reducing or removing the need for retrofitting for a corrosive environment
 - Reduce the need for space and weight topsides
 - Space for some utilities will be needed (supply of power, MEG/methanol etc.) unless they are supplied from shore or another facility.



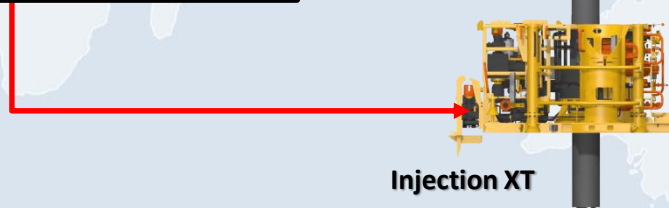
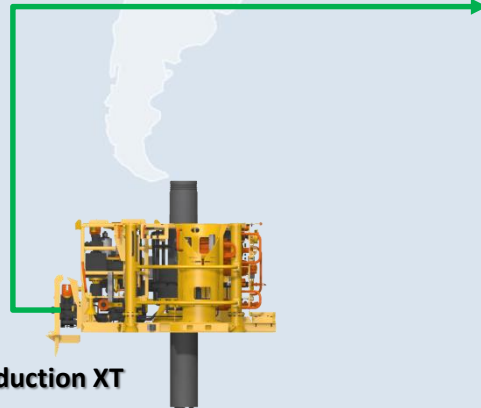
Available Subsea Processing Building Blocks

- Subsea multiphase cooler
- Subsea gas compressor
- Subsea gas/liquid separator
- Subsea liquid/liquid separator
- Subsea de-sanding equipment
- Subsea produced water de-oiling equipment
- Liquid pump
- Multiphase pump
- Subsea control systems
- Subsea power solutions

Subsea process system building blocks

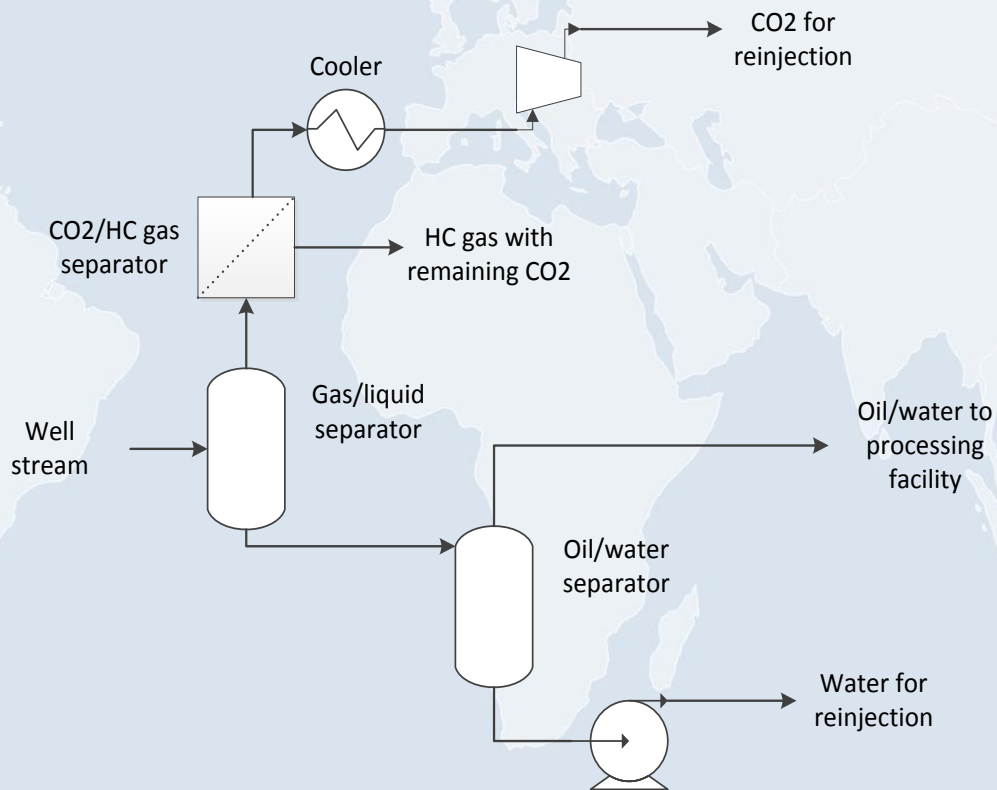
Production XT

Injection XT





Subsea CO₂ Processing



Main functions of a typical processing concept for CO₂-EOR. (Courtesy Aker Solutions)



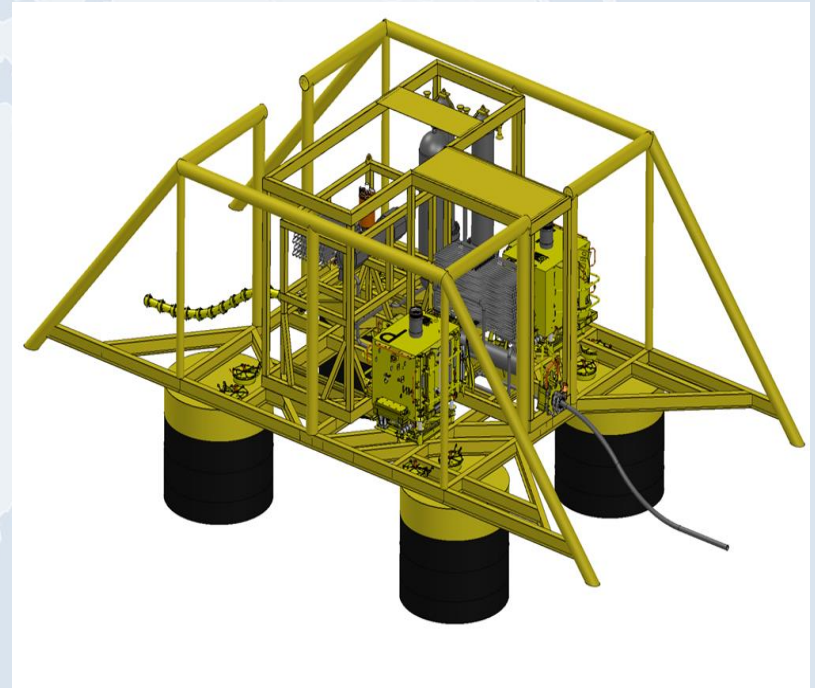
Subsea CO₂ Processing

- Subsea systems are modularized to enable easier installation and retrieval operations
- Compact equipment is mandatory to minimize module size and weight in order to open up for more flexibility with regard to vessel selection
- Several subsea processing projects have been installed and are in operation for various applications
- No systems have yet been installed for subsea CO₂ handling



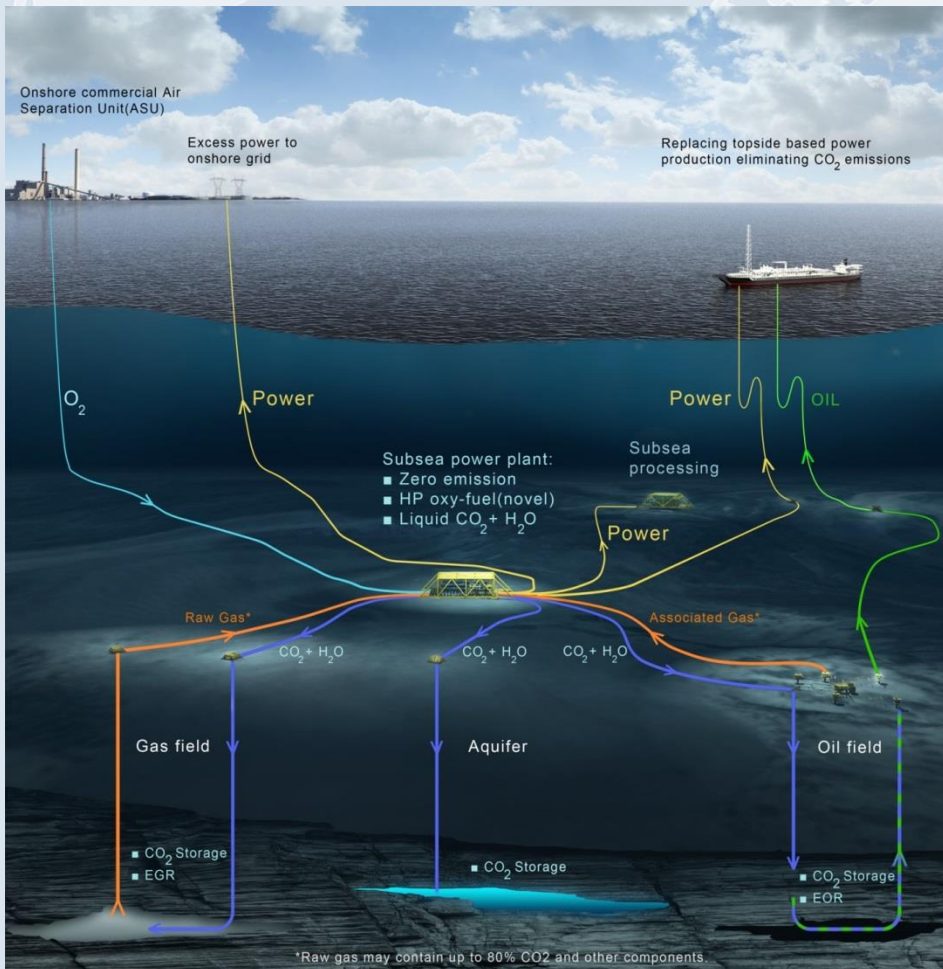
Aspects of the CO₂ Subsea Technology Concept

- Potential mitigation of several previous challenges
- Small subsea facilities serving segments in large reservoir
- Facilities available for injection of CO₂ for permanent storage
- Retrievable modules
 - limited operational time and reuse





New Concept: Zero-emission Offshore Power



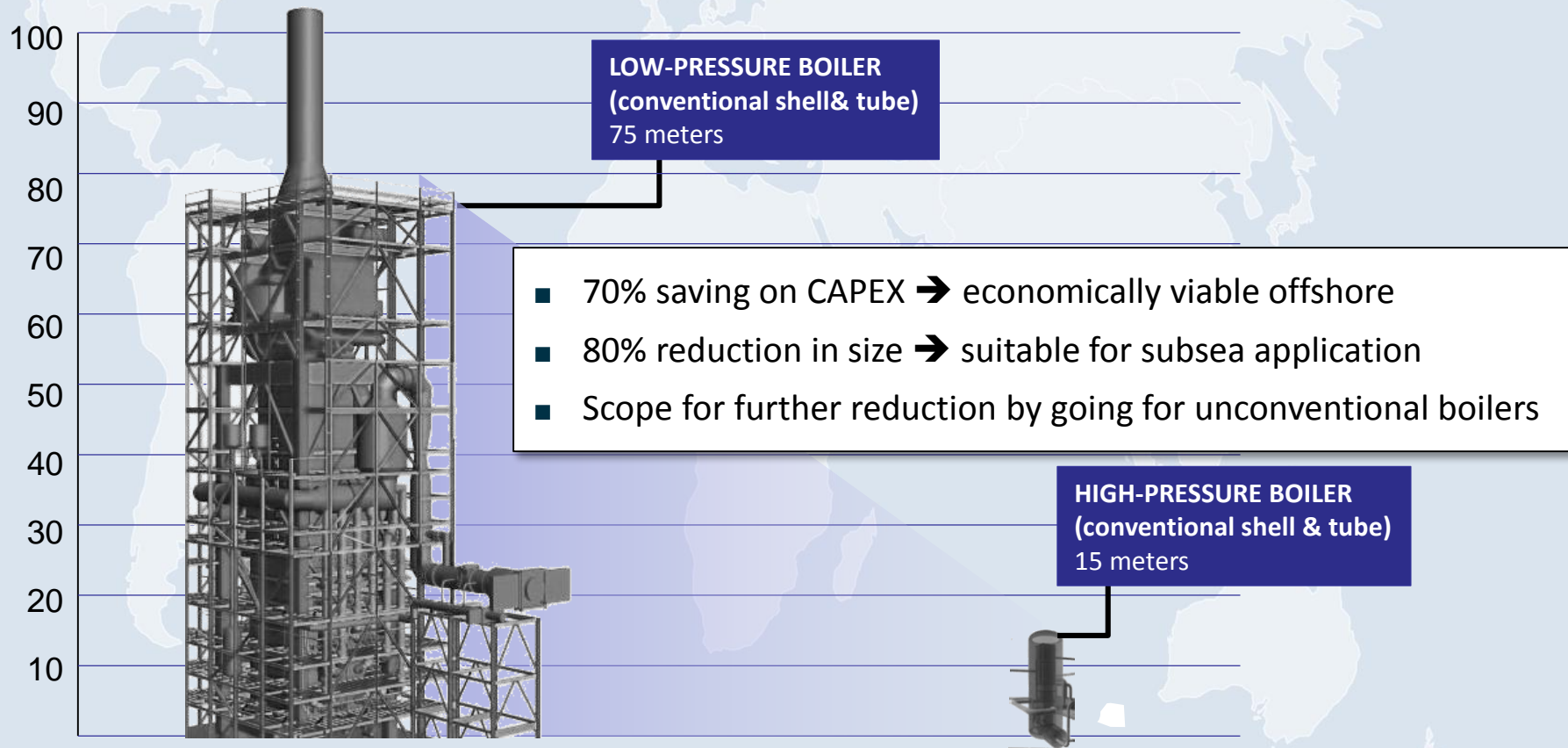
Reduce Offshore Emissions + Produce CO₂ for EOR – locally

- Use “short travelled” local gas
 - Associated gas in oil-fields
 - Stranded gas in gas-fields
- Produce zero-emission power
 - Offshore electrification
 - Sell excessive power to grid
- Use CO₂ & Heat for added value
 - Hot and liquid CO₂ and H₂O
 - CO₂ is “short travelled” for EOR
 - After use, permanent storage

(Courtesy Aker Solutions)



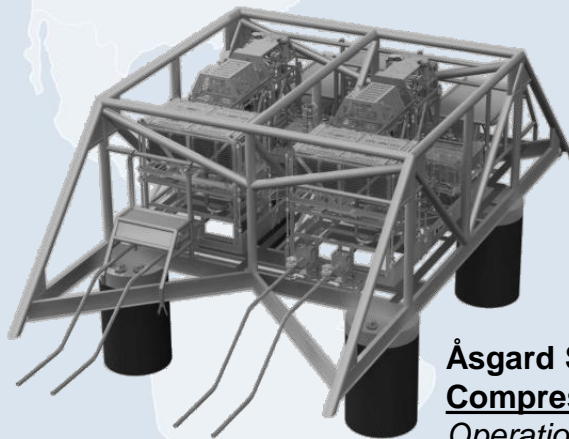
Novelty: Pressurized Oxyfuel = Big Savings



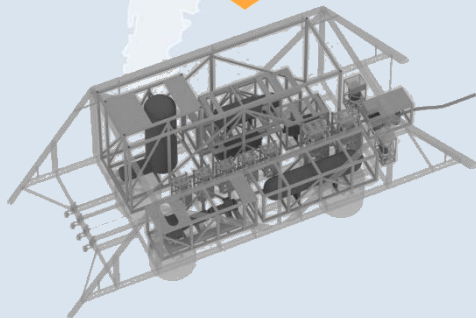
(Courtesy Mitsubishi Hitachi Power Systems Europe)



Oxyfuel: enabler for offshore CO₂ EOR



**Åsgard Subsea
Compressor Station:**
*Operational since
September 2015*



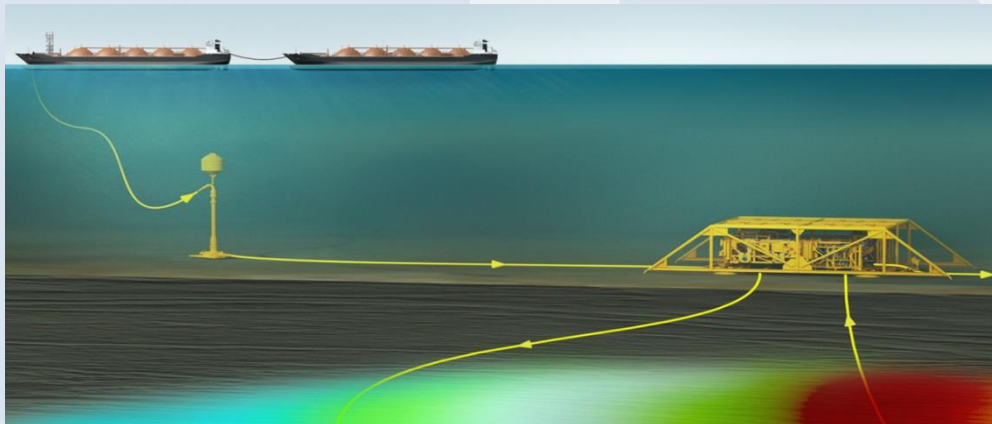
**New concept “cousin”
of Åsgard Subsea
Compressor Station:**
*I.e., most building blocks
field proven*

- Oxy-fuel combustion burns hydrocarbon gas in pure oxygen instead of air
- Will normally require a high degree of exhaust gas recirculation
- Can tolerate high amounts of CO₂ and other contaminants in the feed gas; thus well-suited for:
 - Enhanced gas recovery (EGR) and EOR – it can take all the back-produced CO₂ in with the feed gas thus eliminating the need for additional CO₂ separation
 - CO₂ rich gas fields – it could enable economic developments by producing electricity



Conclusions

- New and emerging subsea technologies can enable technically and economically feasible concepts for offshore CO₂ EOR
- Utilizing such established infrastructure could also enable permanent storage of CO₂ in depleted offshore oilfields - post the commercial EOR period





Thank you for the attention!

For detailed questions and more information,
please contact

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