

# MCEED

## DEEPWATER DEVELOPMENT

28 - 30 March 2023 | Millennium Gloucester Hotel | London, UK

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# Addressing concerns for Oil and Gas Production with progressive reduction of GHG Emissions

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# Oil & Gas Industry Challenge

## Climate Change

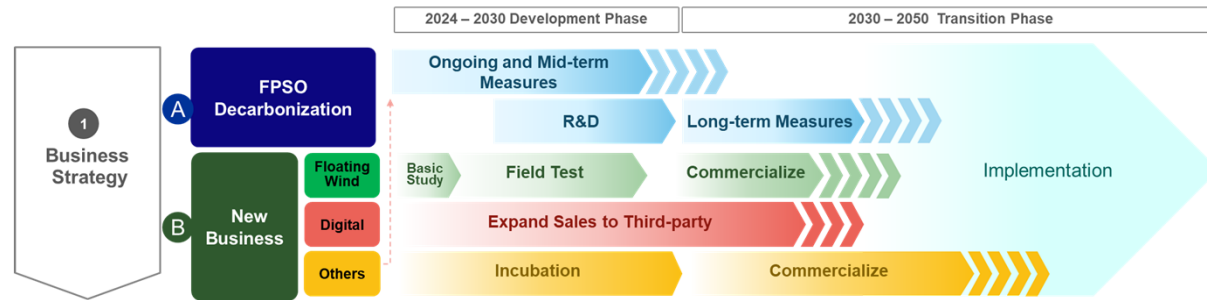
- Identified as a Significant Risk causing severe economic and social consequences
- Nearly 200 countries acknowledged risk and take action to limit global avg temp rise to 1.5C
- To better assess the risk, the Task Force on Climate-related Financial Disclosure (TCFD) was formed
- According to IPCC, as of 2019 the energy sector was responsible for 73.2% of global GHG emissions
  
- The Oil & Gas Industry needs to recognize this risk as a Challenge to improve
- This presentation presents steps MODEC as an industry leader is taking to meet this Challenge

# GHG Emissions Reduction Corporate Strategy

- Declare support of Recommendations of the Task Force on Climate-related Financial Disclosures (TCFD)
- Contribute to achieving global goals of “Realization of a low or zero carbon society”
- Identify and manage significant risks to business continuity due to Climate Change
- Develop business strategies to address these significant risks
- Communicate to the public, clients, supply chain our intentions for FPSO Decarbonization and New Business
- Change our design culture to focus on developing appropriate Designs

***Diligently pursuing Business Model Evolution, MODEC aspires to achieve Net Zero by 2050***

- A** Continuing contributions to stable oil and gas supply by FPSOs, while minimizing GHG emissions
- B** Accelerating the business model evolution to contribute to clean energy generation

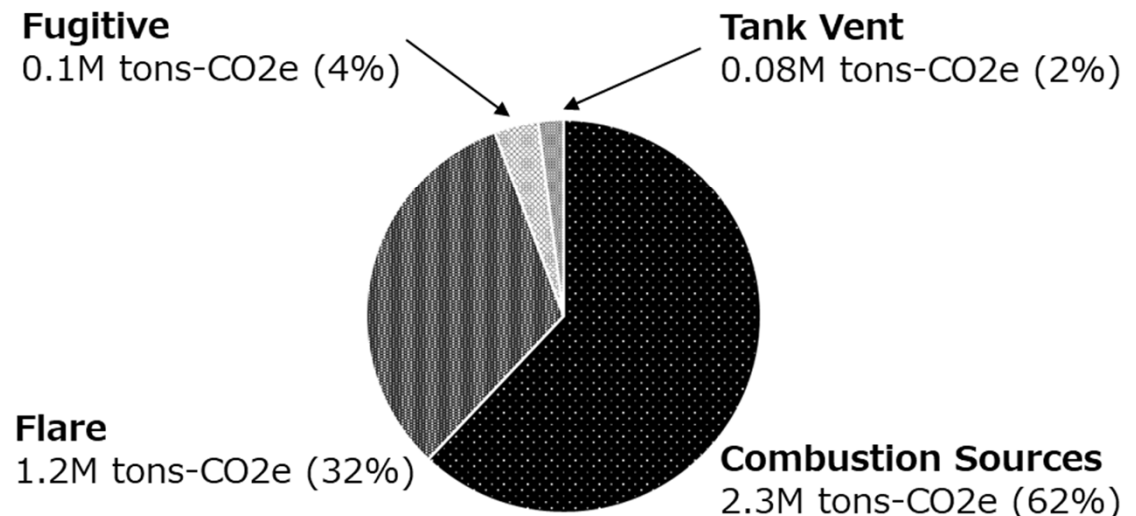


## Key Sources of GHG Emissions from FPSO

Survey existing / operating facilities to estimate sources:

1. Combustion Sources (62%):
  - Fuel Burning for electricity
  - Fuel Burning for heating
2. Flare (32%):
  - Upset scenarios causing shutdown
  - Various scenarios for environmental conservation
3. Fugitive (4%):
  - Leakages from piping flanges
  - Leakages from equipment
  - Leakages from tanks
4. Tank Vent (2%)
  - Inert Gas blanketing exhaust
  - Emissions from volatized gas from oil tanks

### GHG Emissions from All MODEC F(P)SOs (2021)



Focus is on reducing these sources of emissions. How?

# Roadmap to Target Zero GHG Emissions

Set a plan on Emissions Reduction based on existing technology and development of future technology – Below estimates identified

## Combustion Sources:

- 25% reduction with GTCC / imported power
- 75% reduction with CCS

## Flare:

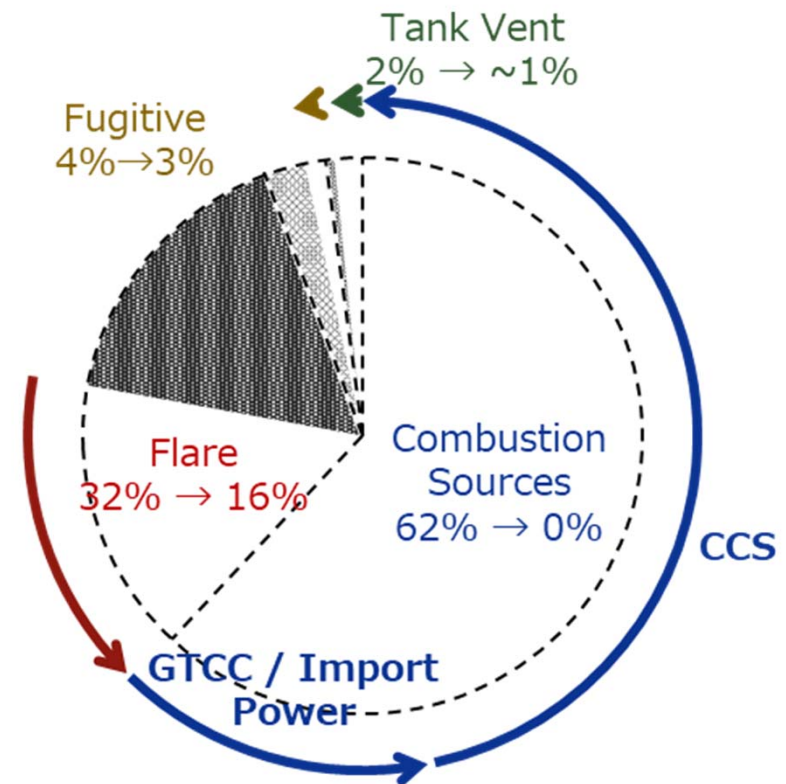
50% reduction by steady efforts to improve Asset Integrity (target)

## Fugitive:

33% reduction by steady efforts to improve Asset Integrity (target)

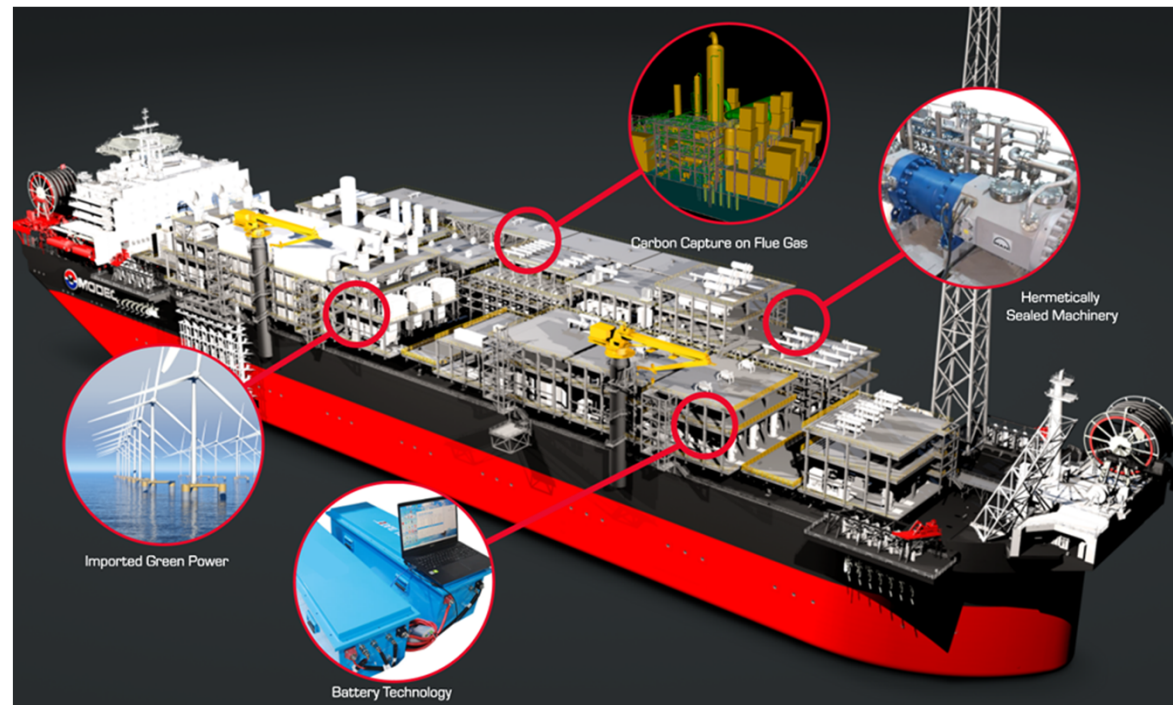
## Tank Vent:

90% reduction by gas recovery system



# Case Studies on Emissions Reduction Initiatives

Monitoring and analytics  
Predictive Maintenance Programs  
Improved Coating Systems  
Higher integrity valves / Seal systems  
Cargo Tank Fuel Gas Blanketing  
Cargo Tank and Low-Pressure Vapor Recovery  
Start up Flare Reduction / Restart from Settle Out  
LP and HP Closed Flare System  
VFD on High Powered Motors  
Re-bundling designs on Compressors  
Depressurization Relief Capture  
LED Lighting  
Gas Turbines Heat Recovery  
Use of Waste Streams for Fuel  
Combined Cycle Power Generation  
Electric Startup Heaters  
Extended SW Lift Depth  
Inlet Air Chilling  
Heat Integration  
Reduced Manning/Enhanced remote operation  
Carbon Capture on Reservoir Gases  
Tertiary Water Treatment on Produced Water

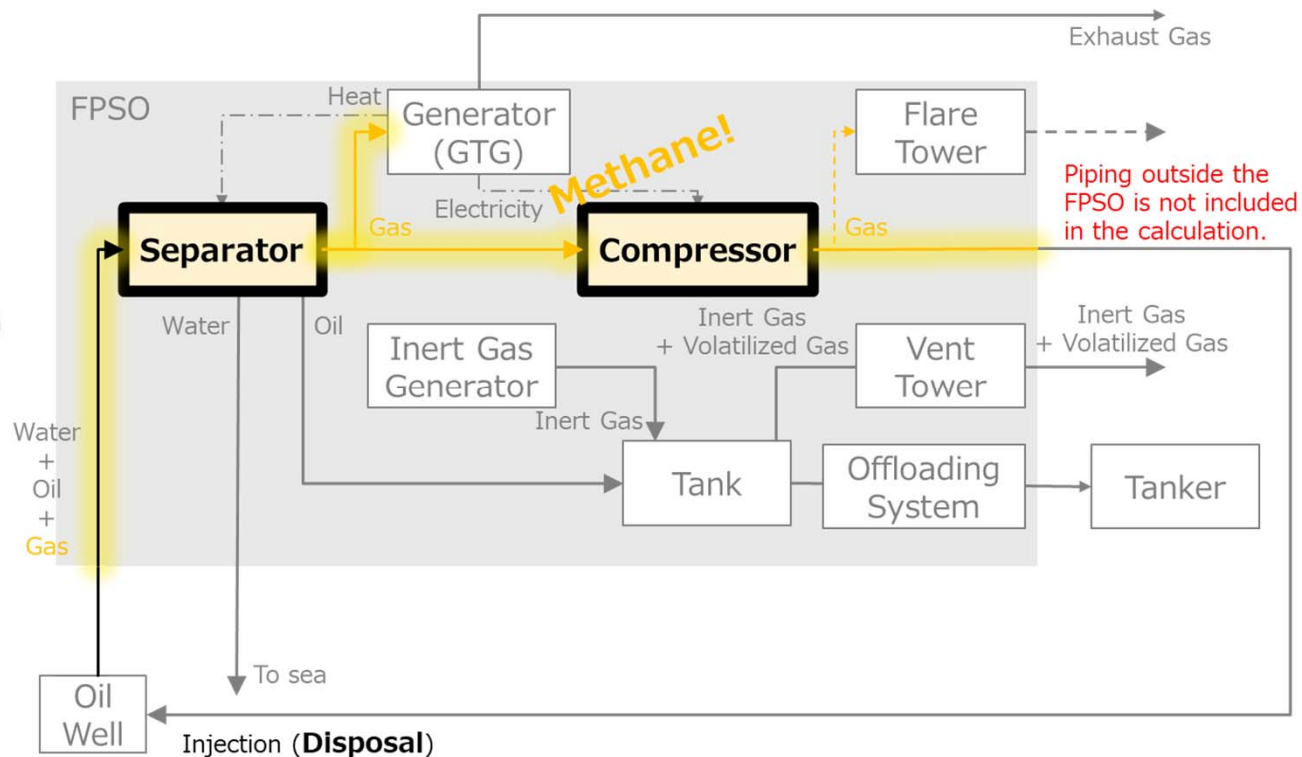


# Lower / Eliminate Fugitive Emissions

1. Typically Associated with Asset Integrity issues
2. Amplified by complexity of systems with increased “leak points”
3. Addressing now on existing facilities

## Solutions:

1. Eliminate designed in “leak points”
2. Investigate / select equipment with better leak protection
3. Commission monitoring and measuring systems around leakage points
4. Continually maintain basic fabric maintenance



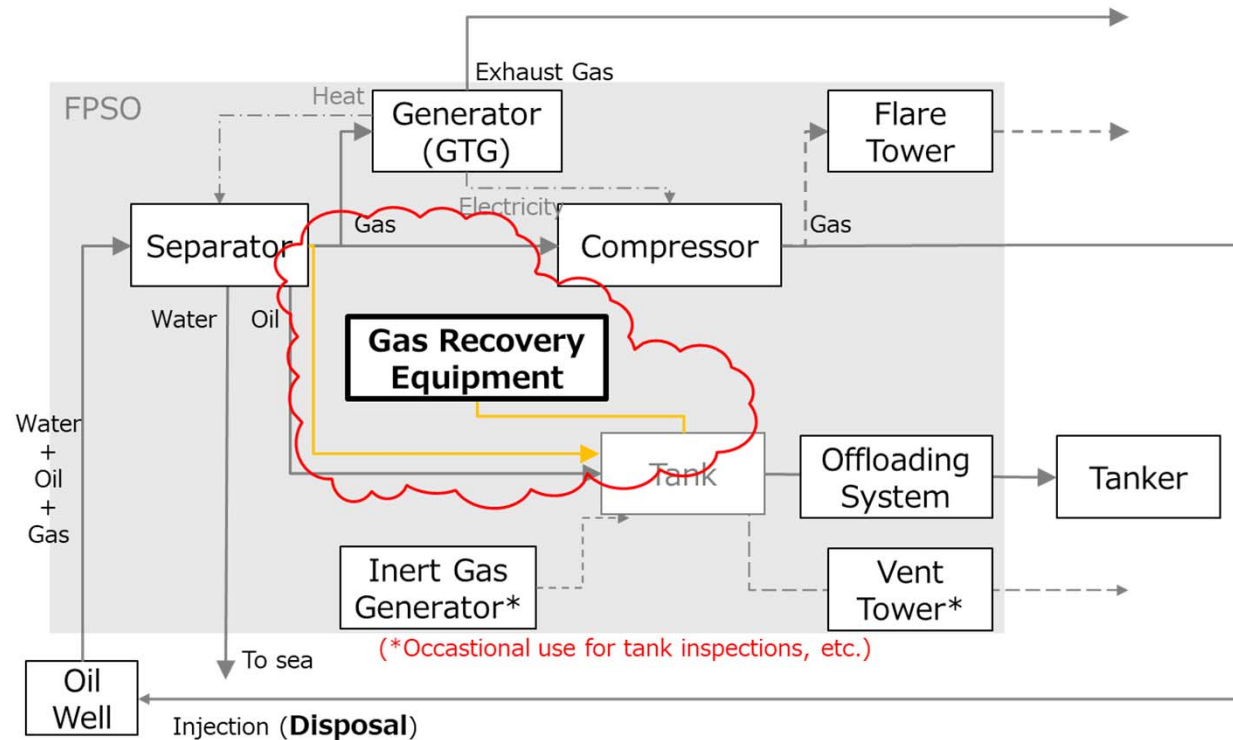


## Lower Tank Vent Emissions

1. Utilize associated gas in place of traditional inert exhaust gas
2. Capture the associated gas discharged by tank filling
3. Re-process the associated gas through the compression system

### Solutions:

1. Add Vapor Recovery Unit to topsides
2. Install Associated Gas Header as primary tank blanketing medium
3. Maintain traditional IGG as system back up
4. Pair with Closed Flare System to capture other LP emissions normally vented



# Capture Flare / Vent Emissions

Project Example:

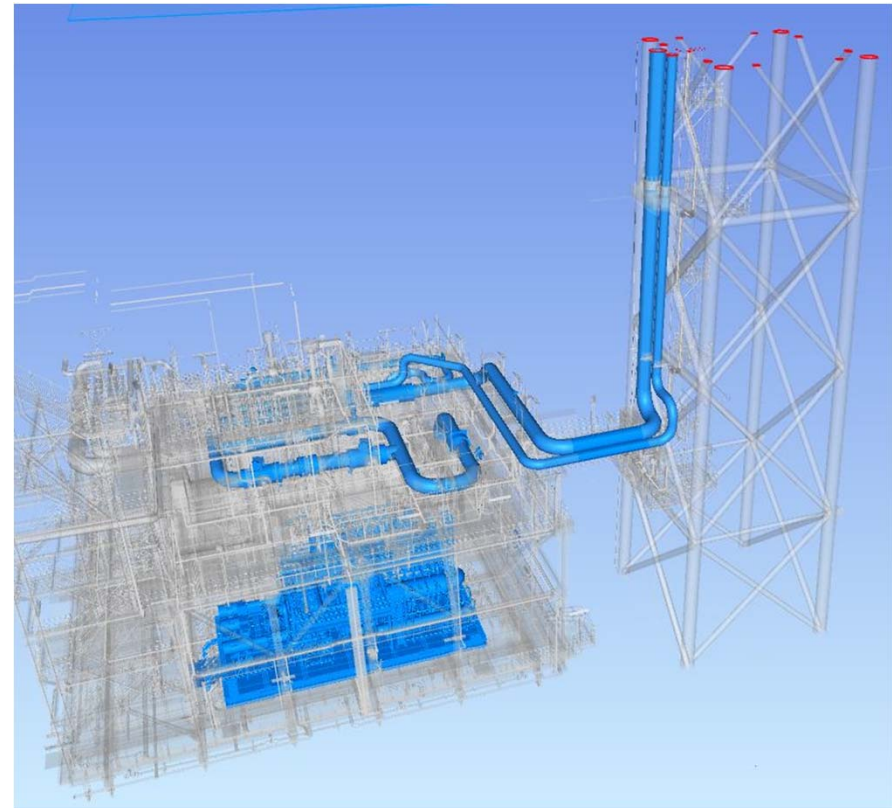
Bacalhau FPSO

Fuel Gas Blanketed Cargo Storage Tanks with  
2x100% Liquid Ring Compressor VRU (shown) to

Collect LP Gas from Tanks and other sources

Connected to HP/LP Flare Headers with fast  
opening valve systems eliminating

Normally vented associated gases to flare



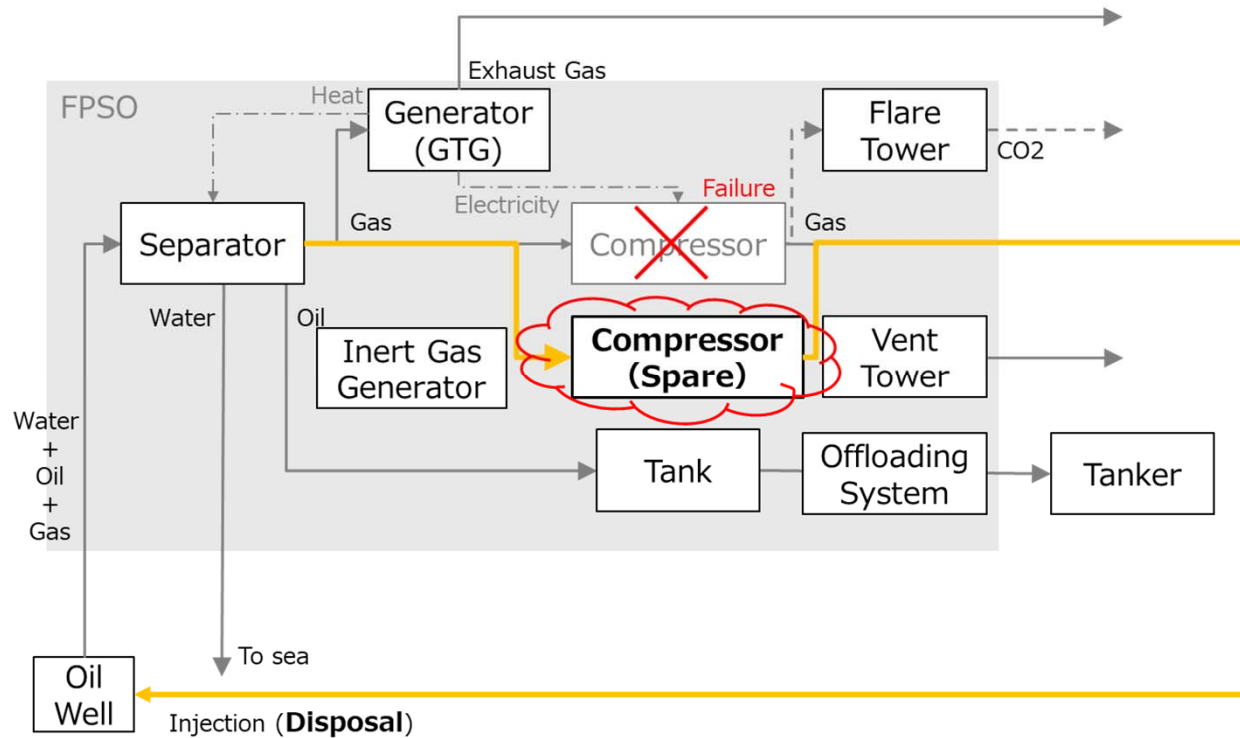
# Reduce Flaring Scenarios

1. Install onboard sparing to allow equipment changeover / shut down
2. Invest in VSD / VFD on compressors to minimize depressurization during emergency shutdown
3. Improve Asset Integrity to maintain stable production
4. Consider battery technology as backup to power generation

Solution:

Eliminate regular flaring with reprocessing

Minimize emergency flaring with better Asset integrity and system redundancy

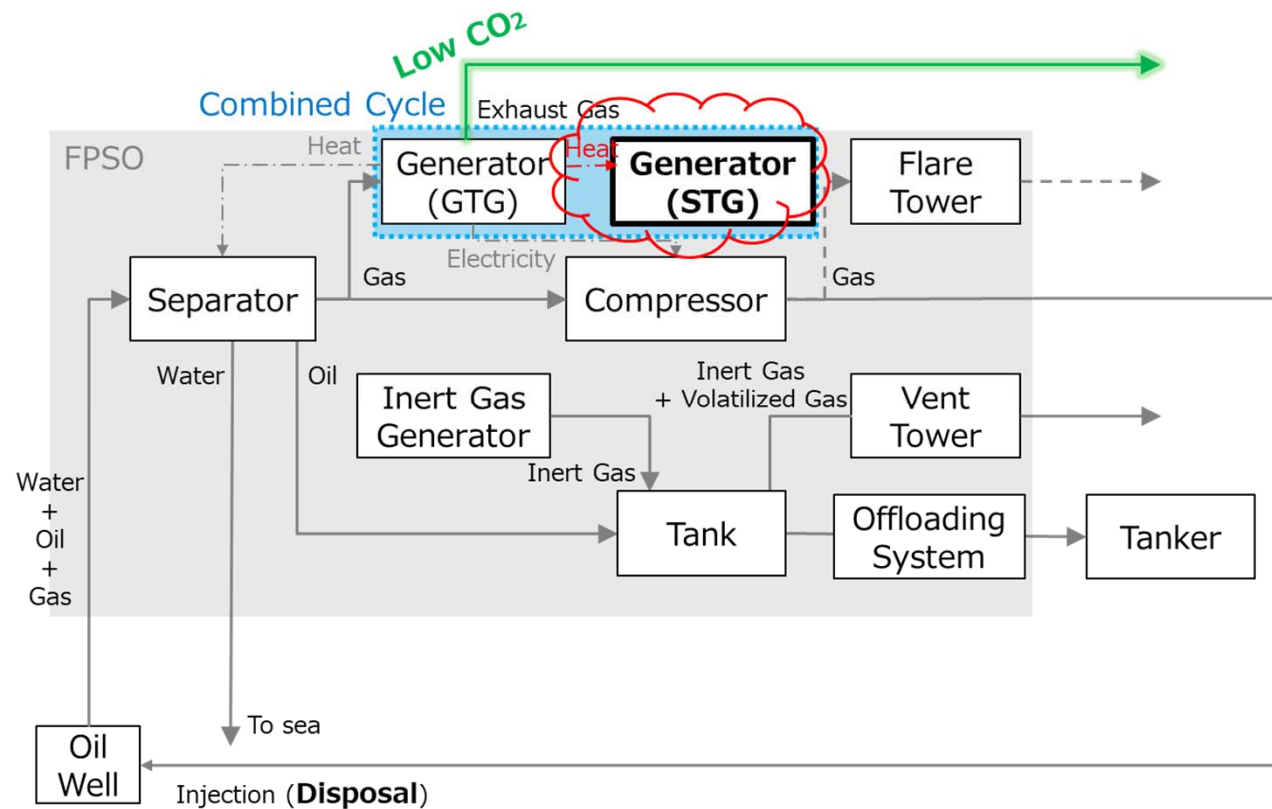


## Lower Combustion Emissions

1. Centralize power generation on facility, ie. All electric motor driven equipment
2. Introduce more efficient Power Generation, ie. Combined Cycle
3. Consider pre-investment for future importation of power
4. Utilize latent heat within the system wherever possible

### Solution:

1. Work with Operators and Supply Chain to apply technology to floating solutions
2. Design in flexibility for future modifications



# Increase Efficiency of Power Generation

Project Example:

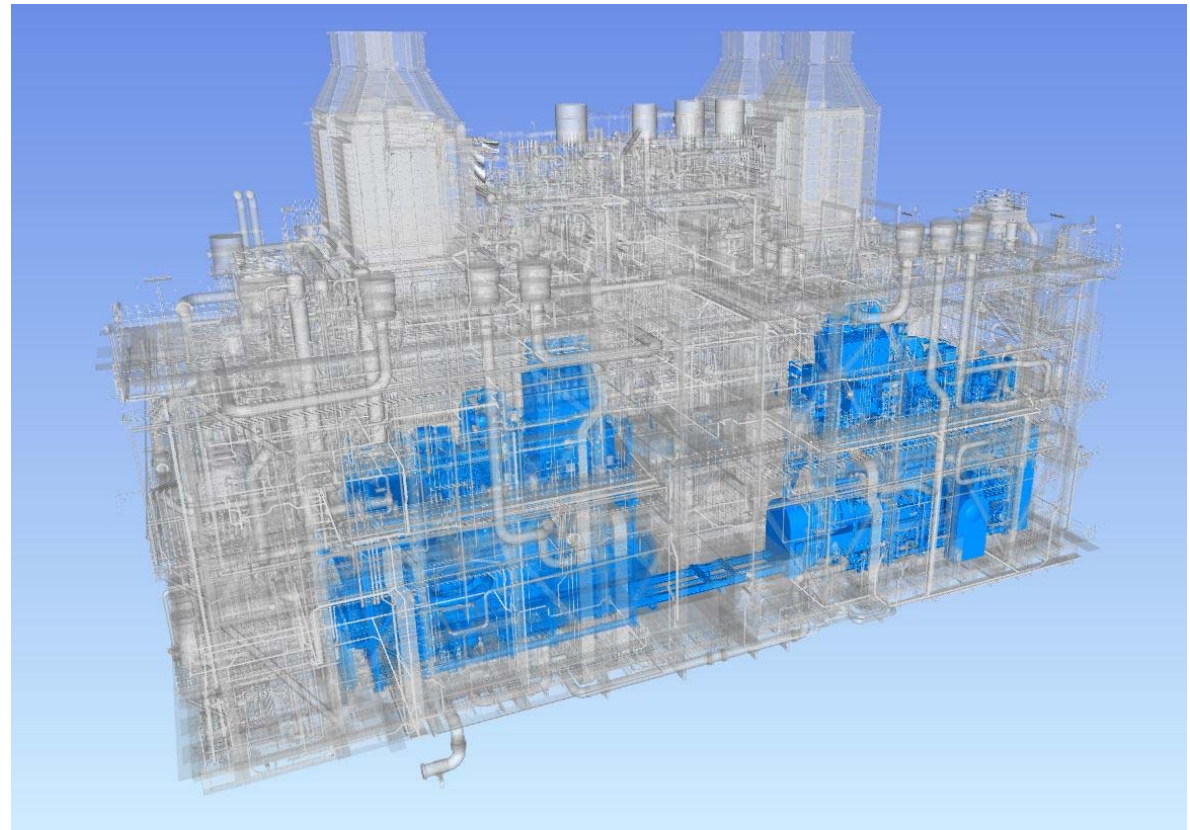
Bacalhau FPSO

4x33% Gas Turbine Gensets (GTG) paired with  
4 x OT Steam Generators (OTSG) feeding  
2x100% Steam Turbine Gensets (STG)

Reduces emissions by 25% utilizing steam  
generated from GTG exhaust to run STGs

Steam used to heat the process heat medium

Extending design development to next  
generation . . .



# Eliminate Combustion Emissions

Future Developments include:

## 1. Post Combustion Carbon Capture System

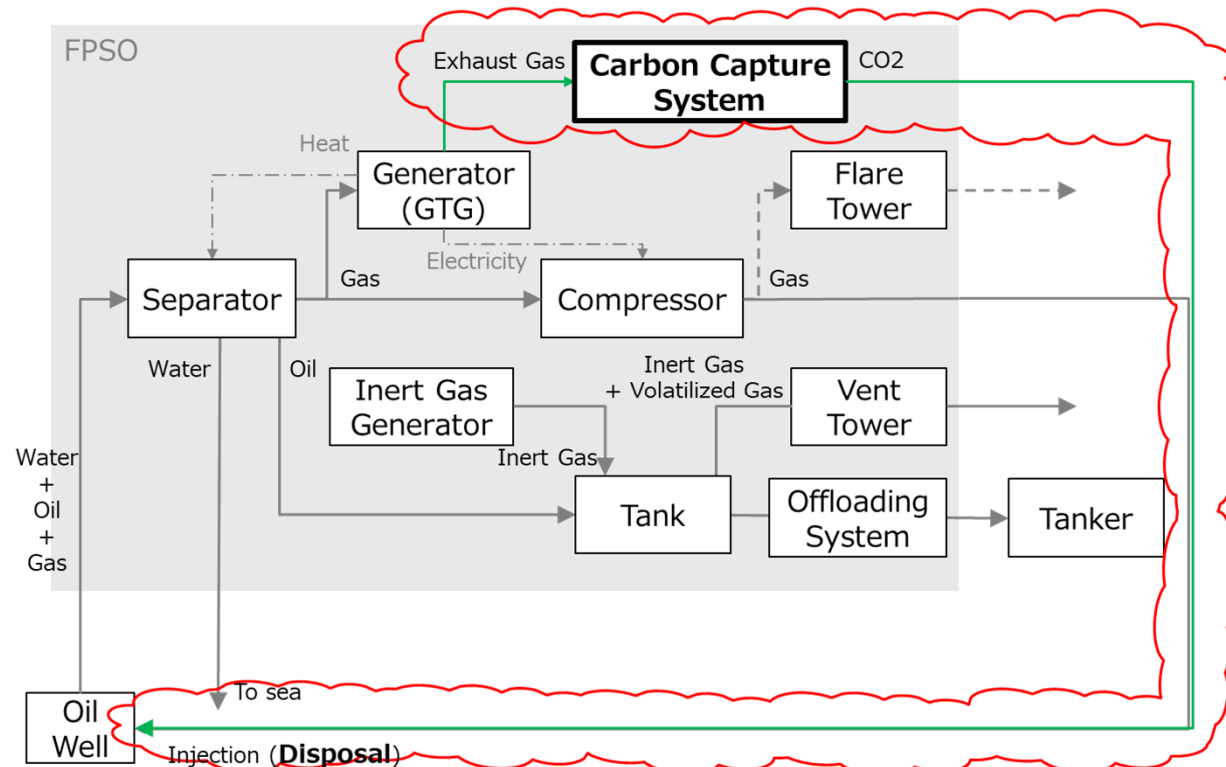
- Leverage knowledge of Pre-Combustion Carbon Capture Technology
- Work with Supply Chain in development of modularized systems
- Integrate System within overall FPSO processes

## 2. Alternative Fuels for Power Generation

## 3. Reliable Imported Power

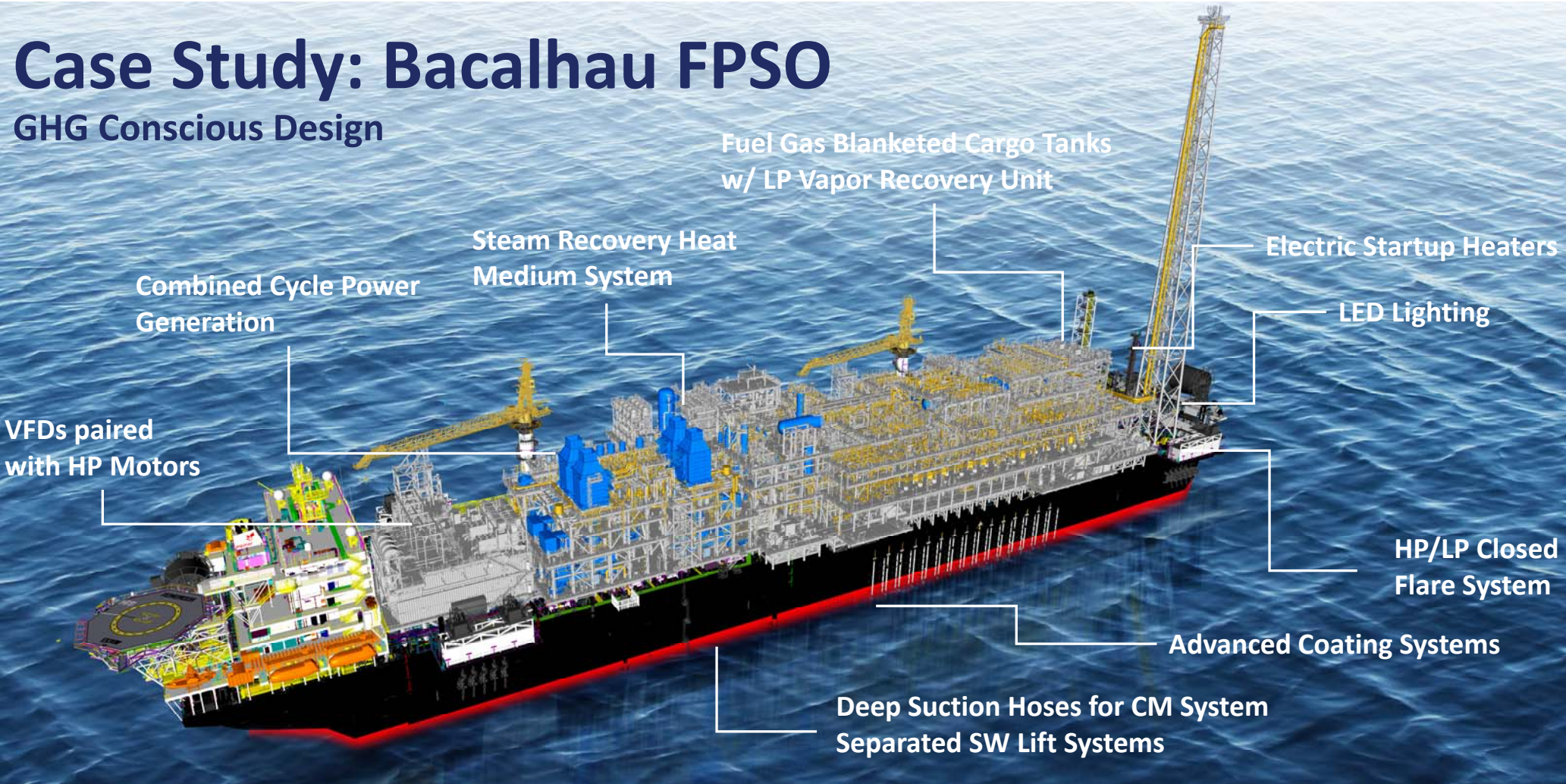
Challenges:

1. Disposal of carbon captured from exhaust
2. Scalability / footprint on topsides
3. Onshore/Nearshore/Offshore infrastructure



# Case Study: Bacalhau FPSO

## GHG Conscious Design



# Possible Field of the Future





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