



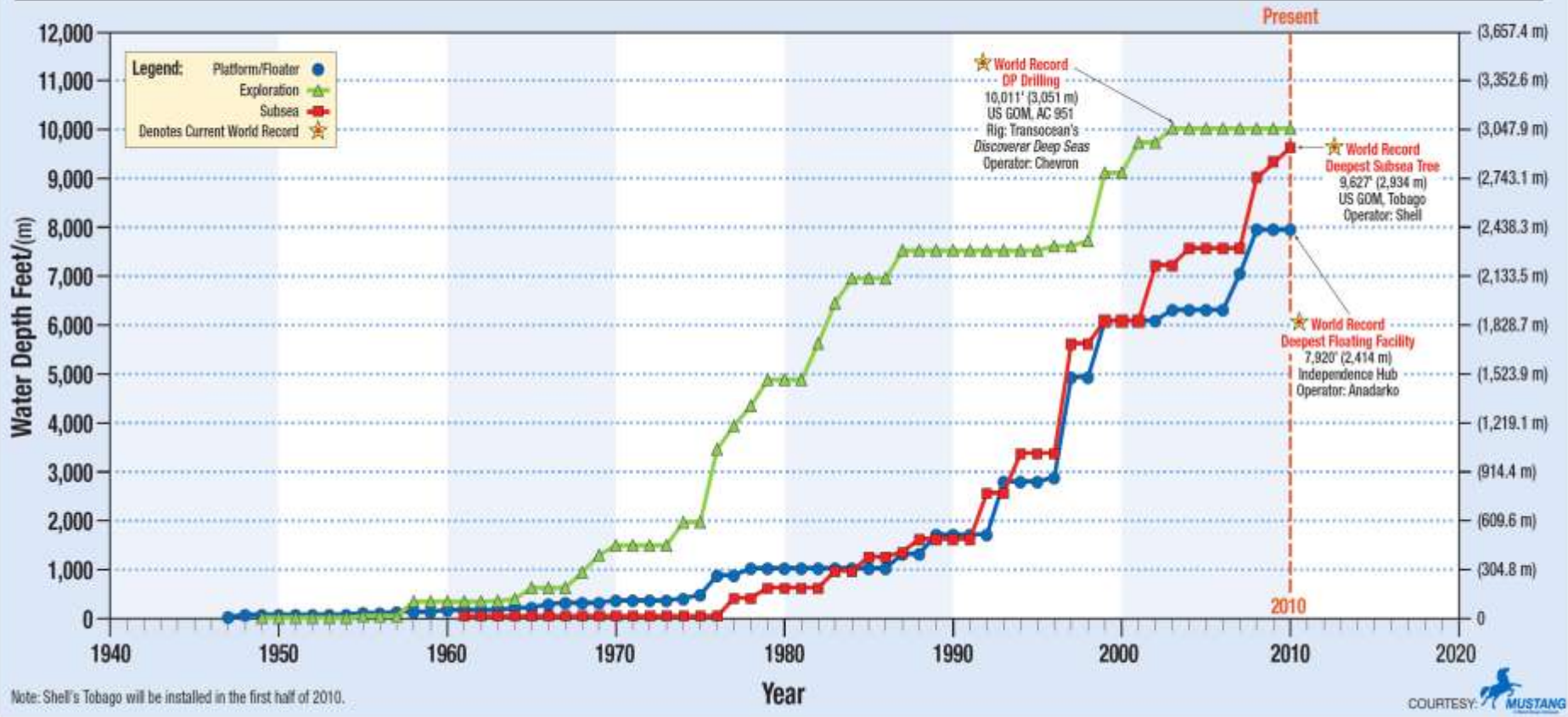
# Mobile Offshore Production Systems for Offshore Oil and Gas Fields

Presented by: Bruce Crager

Rice Annual Forum XIII

September 14, 2010  
Houston, TX

## Worldwide Progression of Water Depth Capabilities for Offshore Drilling & Production (As of March 2010)



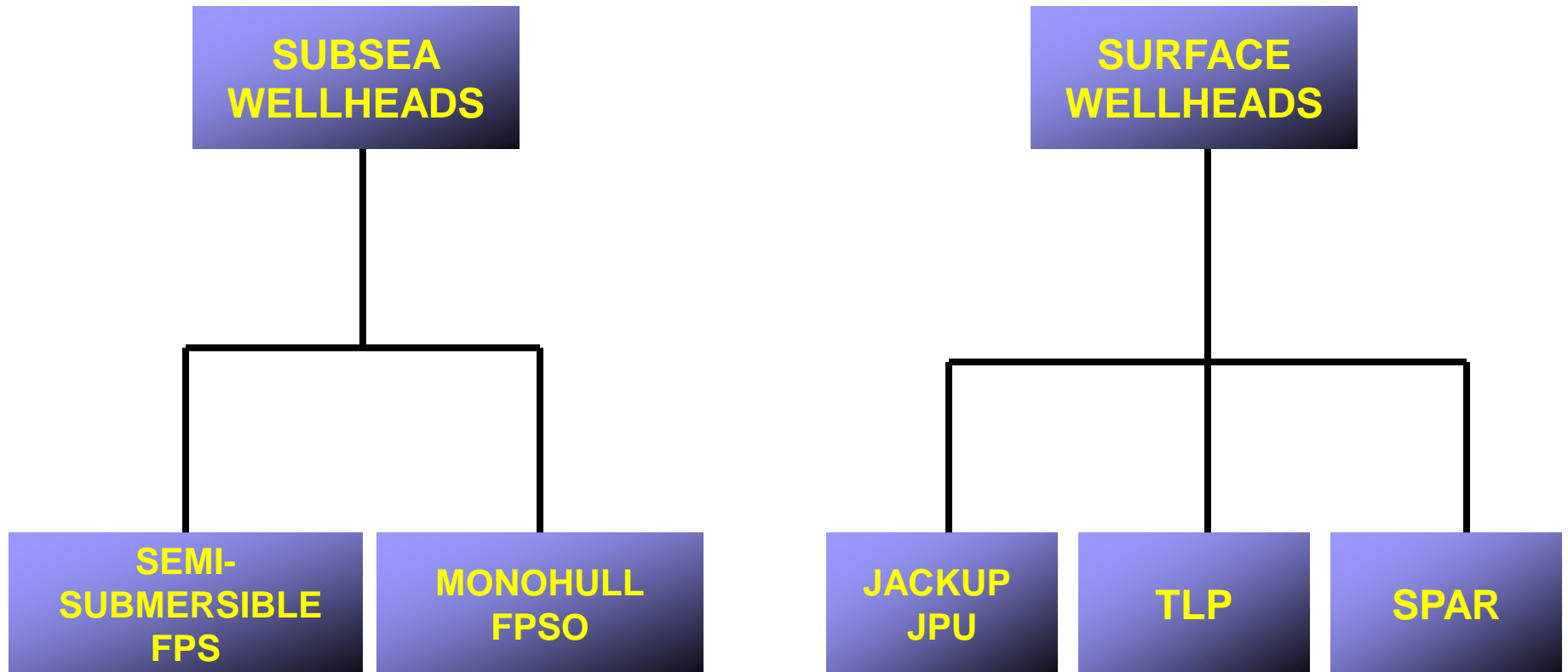
1. Deepwater drilling began long before we had production capability
2. Time and depth gap between drilling and production is closing
3. 10,000' has been the water depth threshold for almost 10 years



# Issues Driving Use of Mobile Offshore Production Systems (MOPS):

- Water Depth
- Gas or Oil Production (Primary Function)
- Geographical Location
- Oil Export Options
- Gas Usage / Export Options
- Fabrication
- Wellhead Location (Surface, Subsea or both)

# Mobile Offshore Production Systems: Principal Types

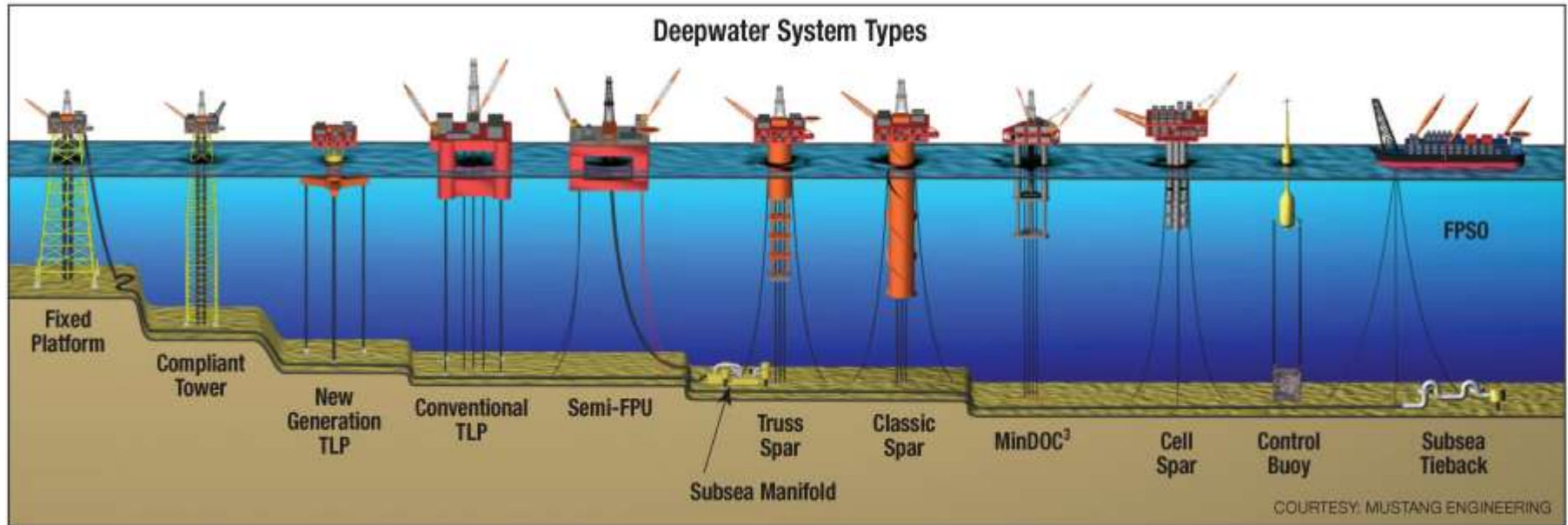


## Wellhead / Tree Location: Surface vs. Subsea

	<u>Advantages</u>	<u>Disadvantages</u>
<b>Subsea Completions</b>	Lesser or no need for on-site surface support	Complex / costly to access for intervention
	Enables wide areal distribution of wells	Requires remote control system
	Can reduce project capex	May increase opex
<b>Surface Completion</b>	Simpler / cheaper to access for intervention	Requires supporting platform
	May reduce drilling cost Lower opex	Restricted areal coverage, directional wells
		Requires heave compensation on floater

# PRODUCTION SYSTEM TYPES

## Solutions for Recovery of Offshore Oil & Gas



### Three System Groups:

1. **Dry Tree Systems** – Fixed Platform, Production Jackup, Compliant Tower, TLP, Spar
2. **Wet Tree Systems** – New Gen. TLPs, Conventional TLPs, FPSOs, Cell Spar, Control Buoy, SS Tiebacks, Semi-FPS
3. **Mixed Dry / Wet Tree Systems** – Fixed Platforms, New Gen. TLP, Conventional TLP, Spar

# Jackup Production Unit (JPU)

**Operating:** 40

**First:** 1971, Gulftide, Ekofisk

**Deepest:** Harding, UK, 400 ft

**Depth Range:** 43 ft – 400 ft

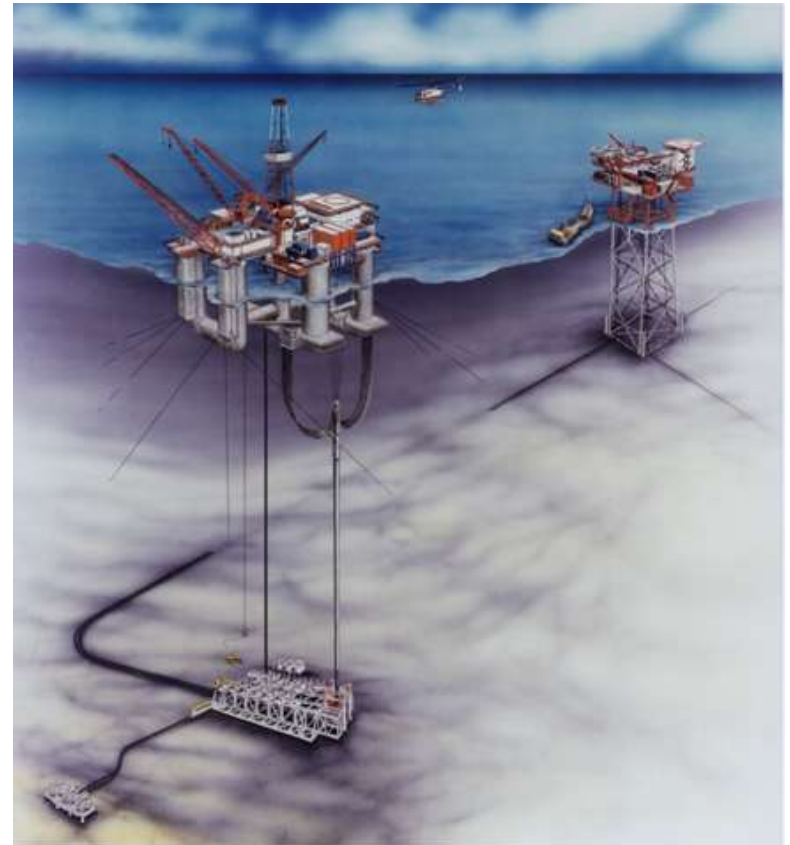
**Construction:** 2

**Locations:** Worldwide



# FPS - Semi Submersible

<b>Operating :</b>	39
<b>Stacked:</b>	4
<b>First:</b>	1975, Argyll, Hamilton
<b>Deepest:</b>	7,920 ft, MC920 Independence Hub
<b>Construction:</b>	6
<b>Locations:</b>	Worldwide





# FPSO

<b>Operating :</b>	182
<b>Stacked:</b>	13
<b>First:</b>	1977, Castellon, Shell
<b>Deepest:</b>	8,300 ft, Cascade Chinook
<b>Construction:</b>	29
<b>Locations:</b>	Worldwide



# TLP

<b>Operating :</b>	24
<b>First:</b>	1984, Hutton, Conoco
<b>Deepest:</b>	4,674 ft, Magnolia GB783/84
<b>Construction:</b>	1
<b>Locations:</b>	North Sea, Angola, Gulf of Mexico, Indonesia and Equatorial Guinea



# SPAR

**Operating :** 18

**First:** 1996, Neptune, VK 826

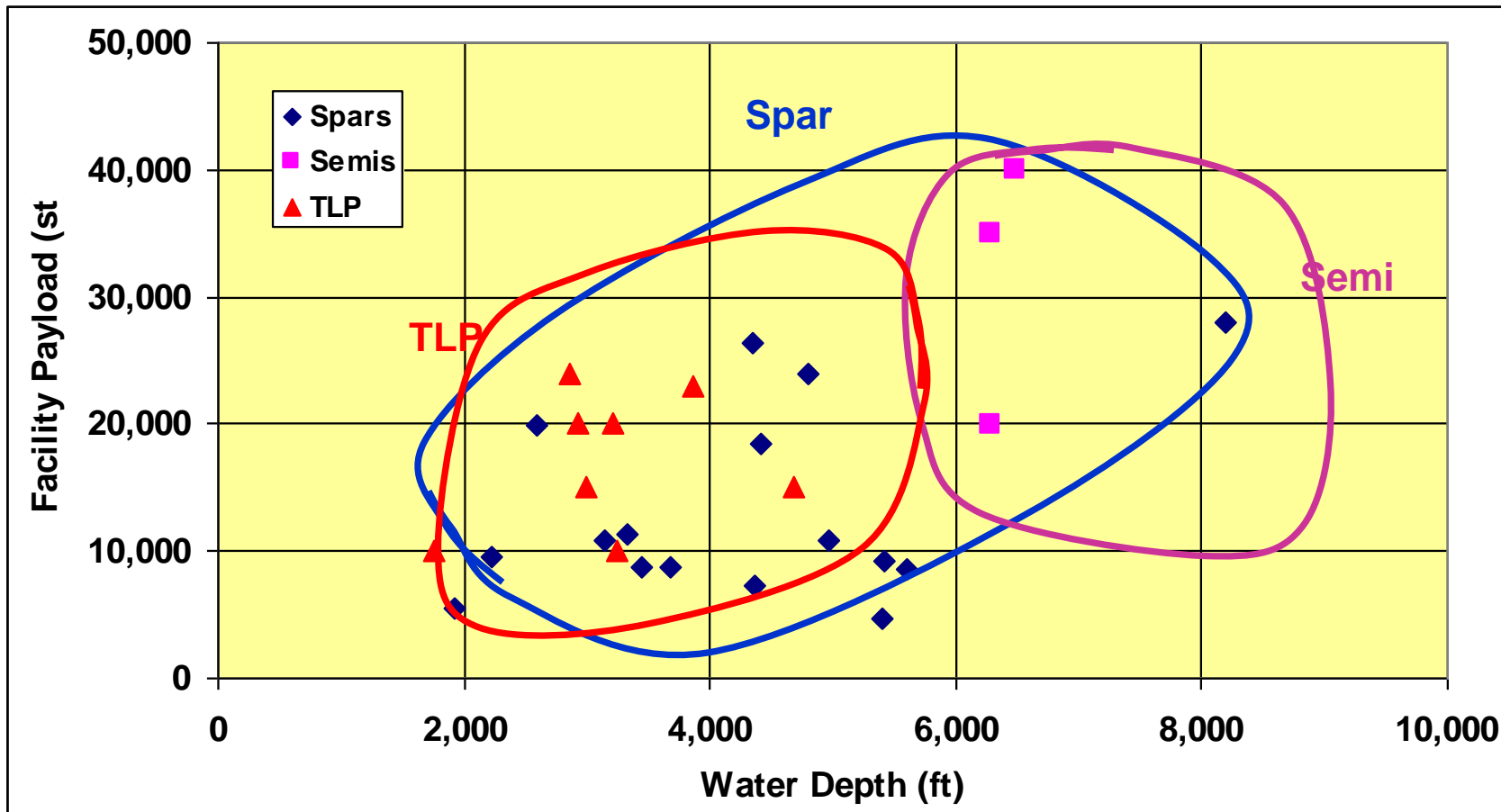
**Deepest:** Perdido 8,008 ft  
Alaminos Canyon 857

**Construction:** 0

**Locations:** Gulf of Mexico, Malaysia



# Optimum Application Ranges

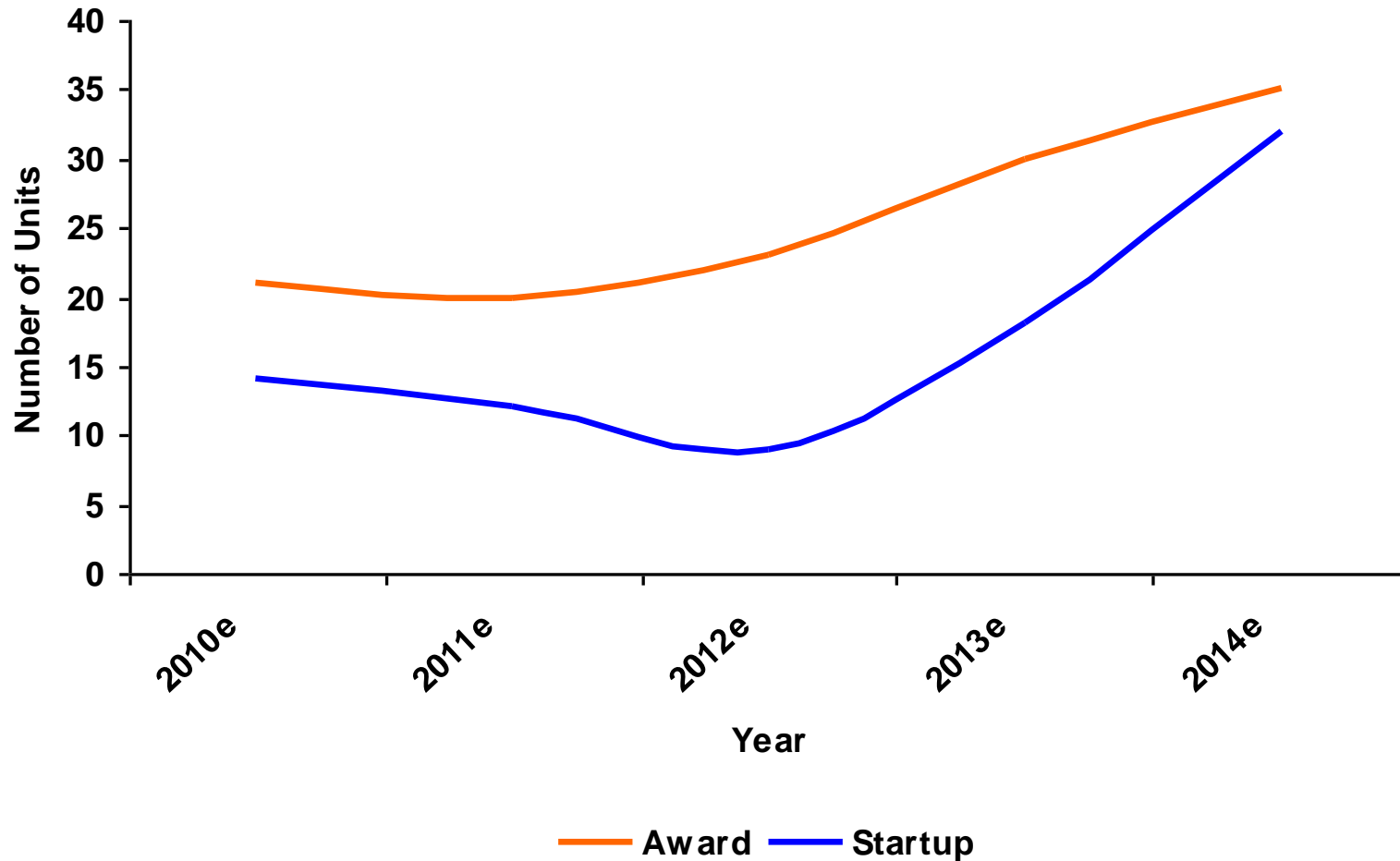


Source: FloaTEC

# Worldwide Forecast Floating Activity by Year 2010-2014e

Units to Award 2010-2014: 129

Units to Start-up 2010-2014: 85



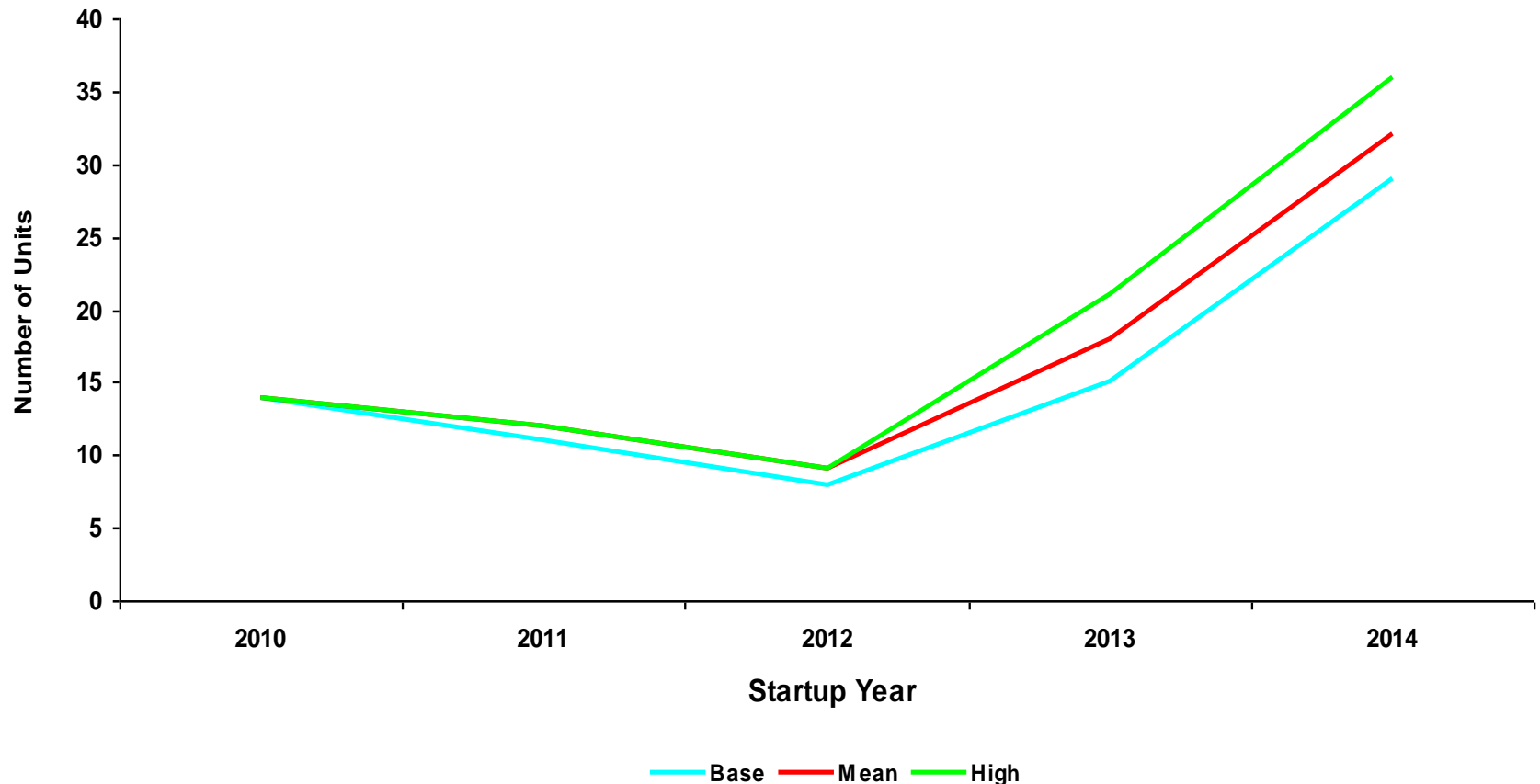
Source: Quest Offshore Resources, Inc.

# Worldwide Forecast Floating Activity by Year 2010-2014e

## Base Mean and High Case

Units to Award 2010-2014: 129

Units to Start-up 2010-2014: 85



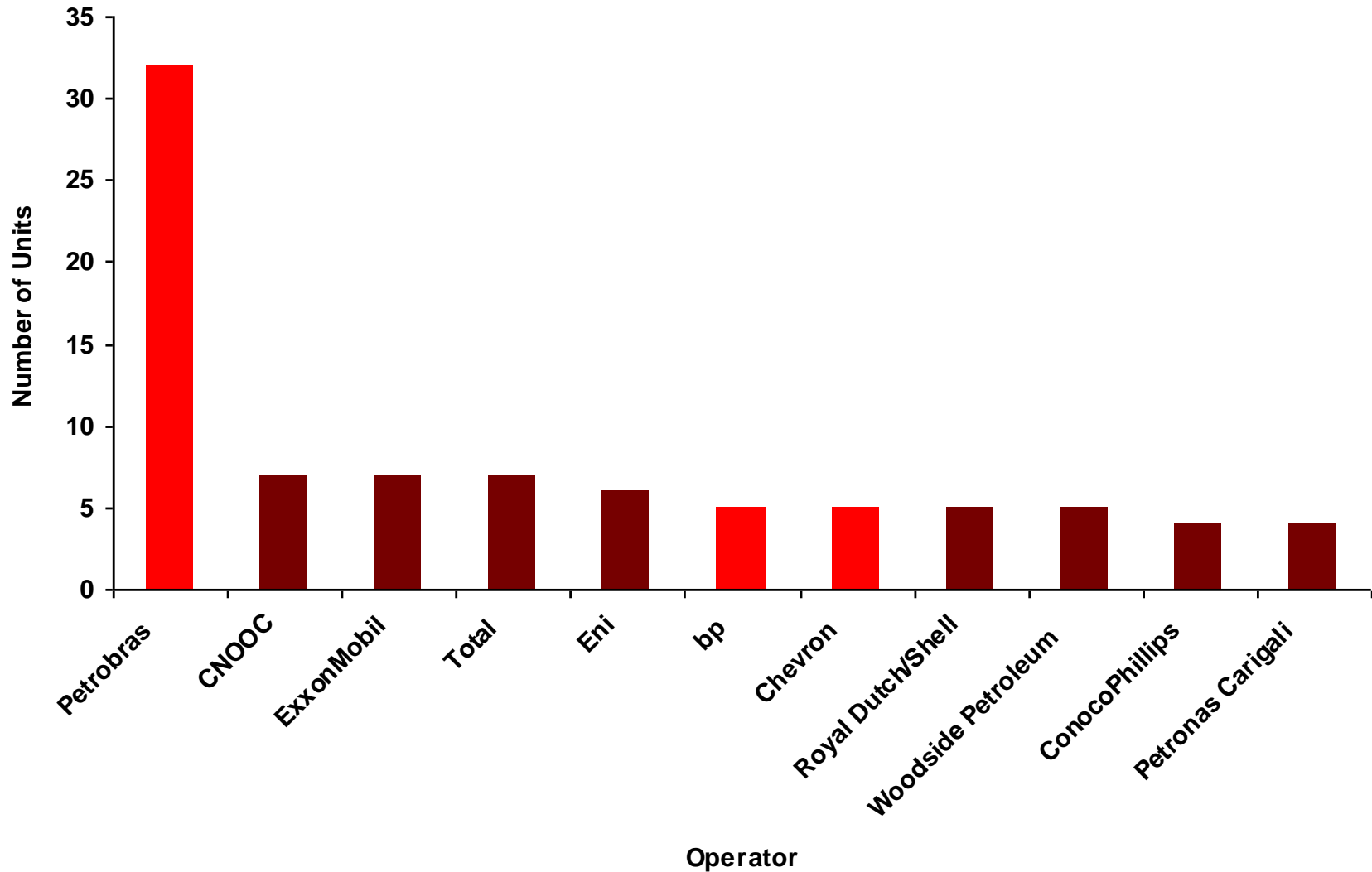
Source: Quest Offshore Resources, Inc.



# Top Operator Analysis

# Worldwide FPSO Top Operators

Flowing and Under Construction Top 11 Operators (87 of 211 Units)

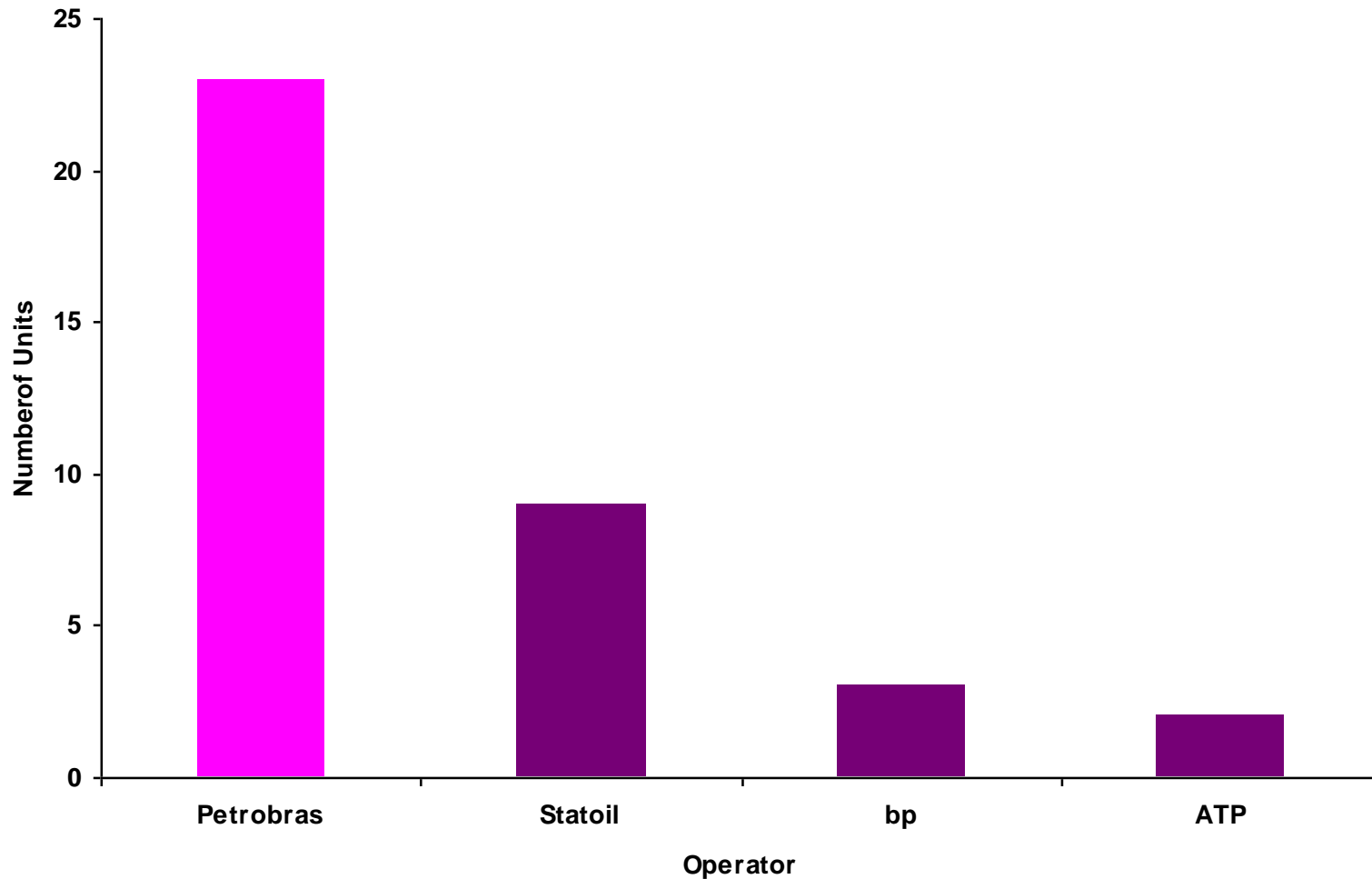


Source: Quest Offshore Resources, Inc.



# Worldwide FPS-Semi Top Operators

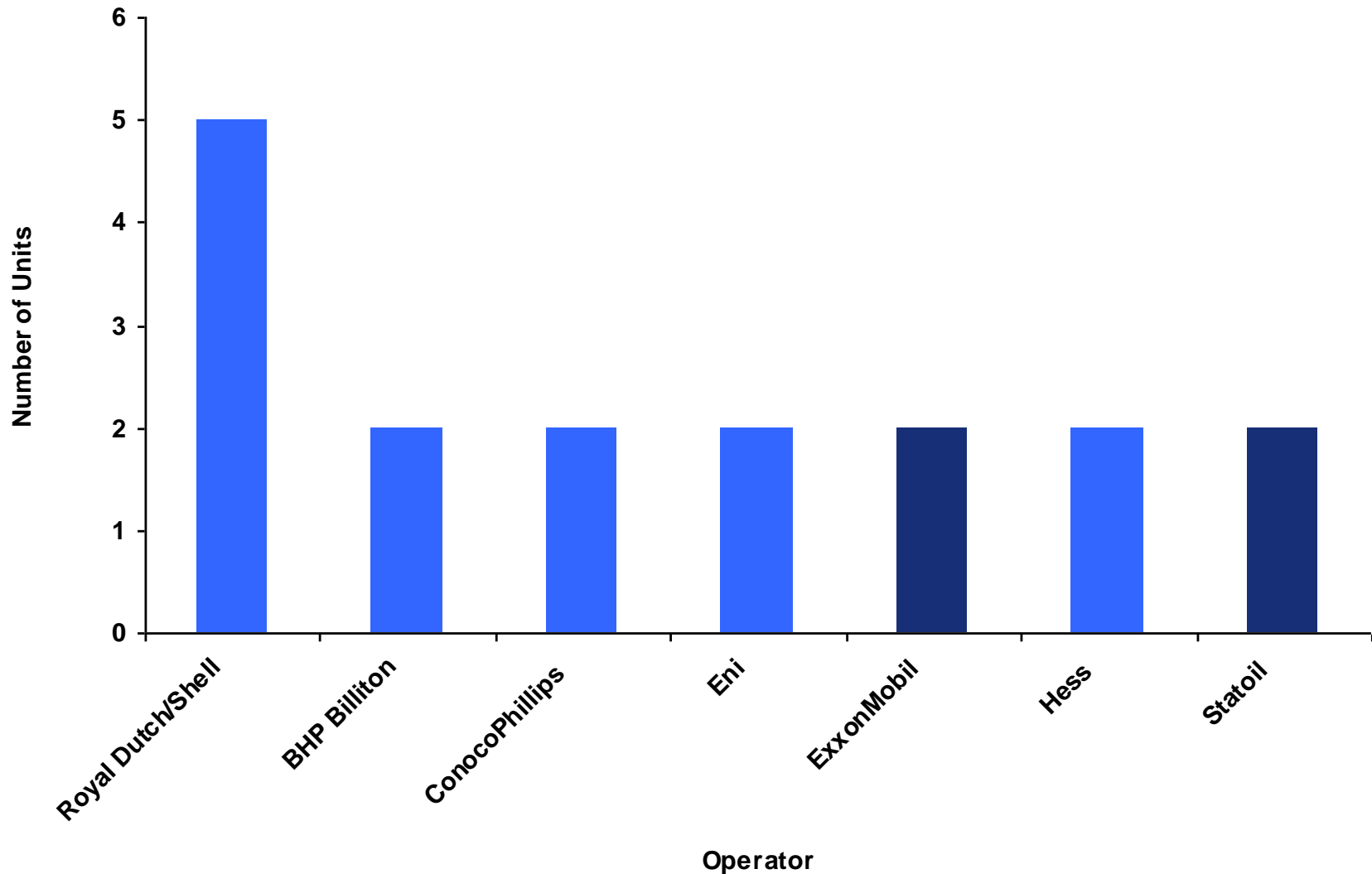
Flowing and Under Construction Top 4 Operators (37 of 49 Units)



Source: Quest Offshore Resources, Inc.

# Worldwide TLP Top Operators

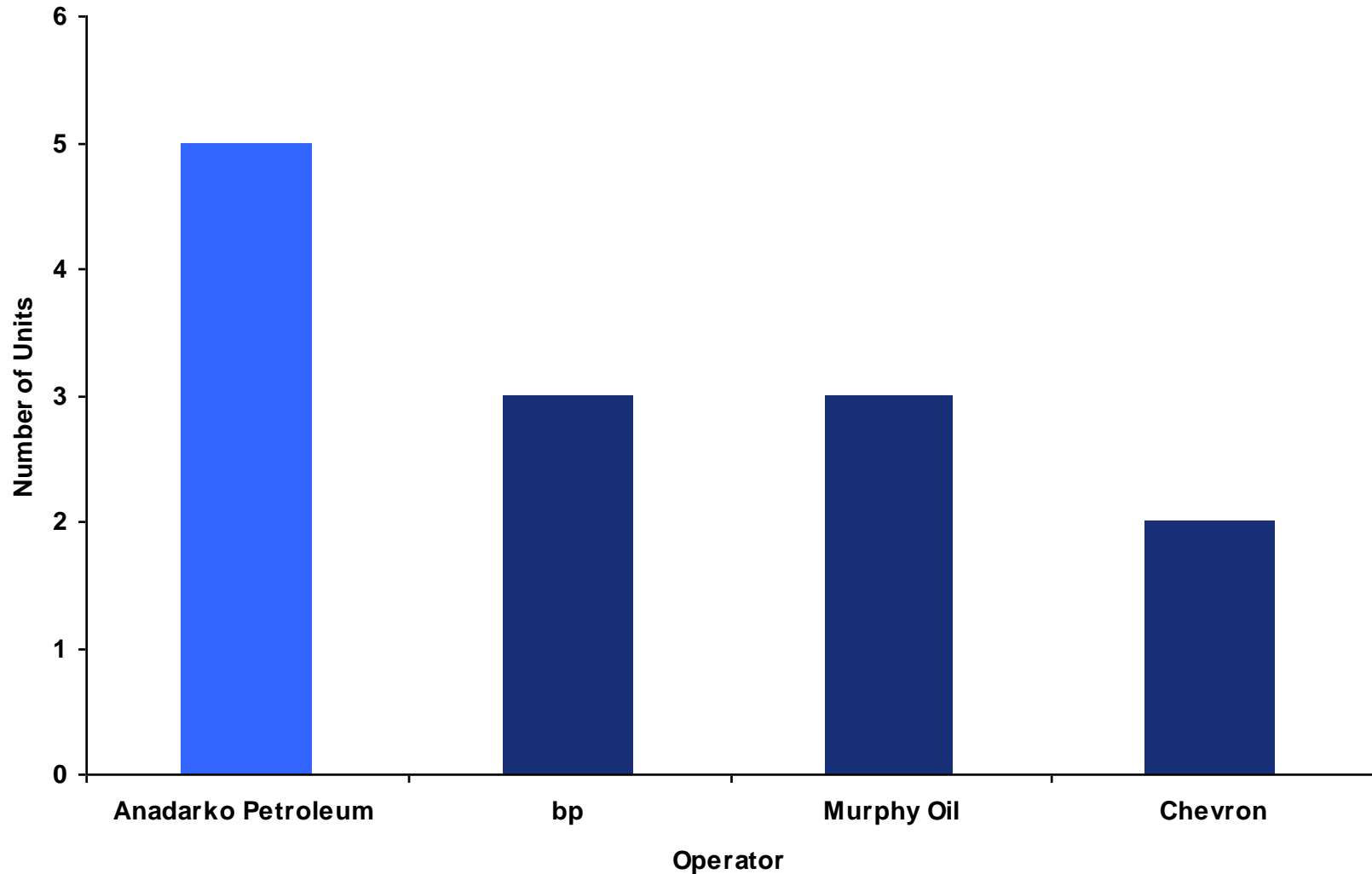
Flowing and Under Construction Top 7 Operators (17 of 24 Units)



Source: Quest Offshore Resources, Inc.

# Worldwide Spar Top Operators

Flowing and Under Construction Top 4 Operators (13 of 18 Units)



Source: Quest Offshore Resources, Inc.

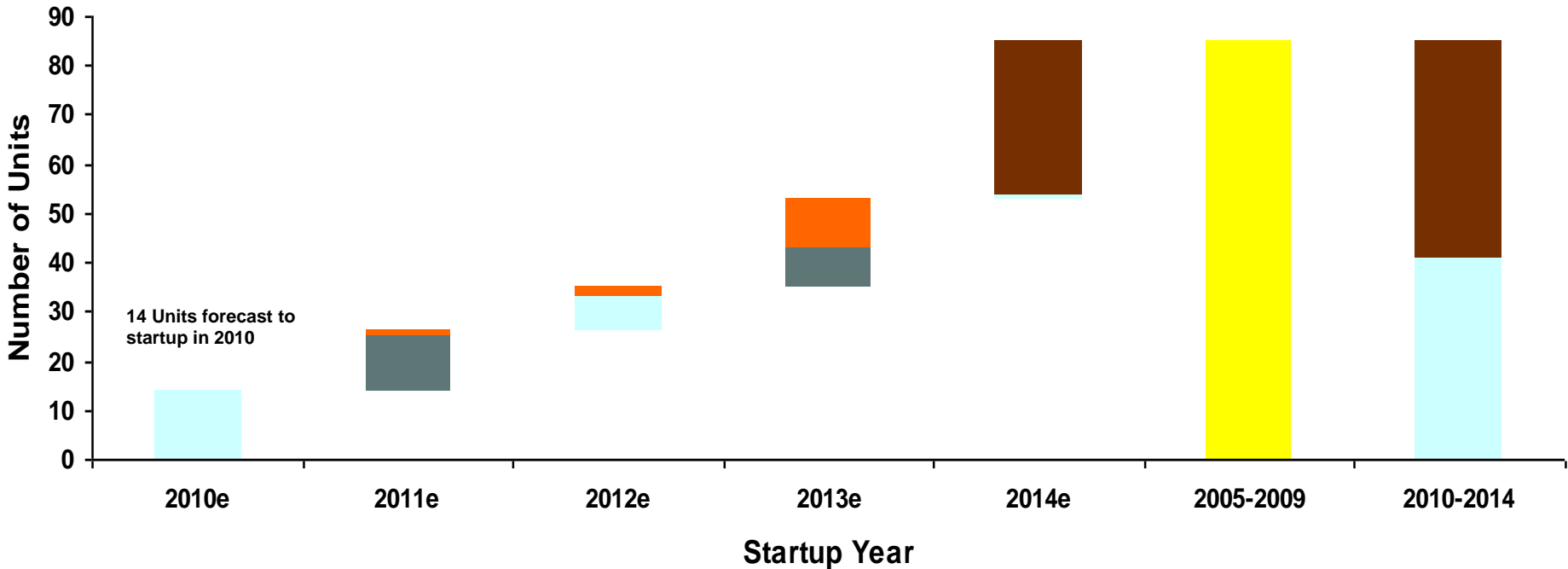


# Normalized Forecast

# Worldwide Forecast Floating Activity by Year 2010-2014e

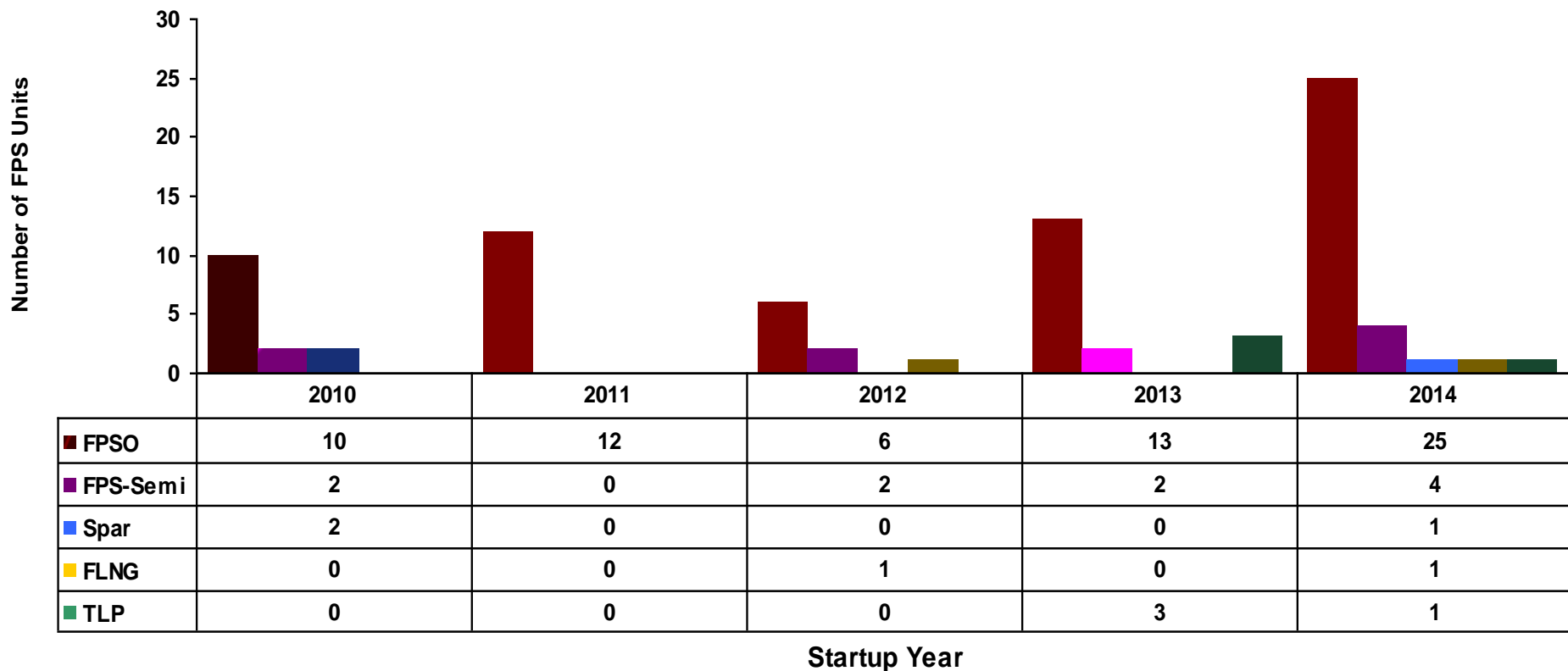
## Normalized Case - 85 Unit Startups

*Forecast Demand Drivers: Deepwater exploration, marginal field exploitation, and early production / phased developments*



# Activity Share by FPS Type 2010-2014e Startup Year

## Normalized Case - 85 Units

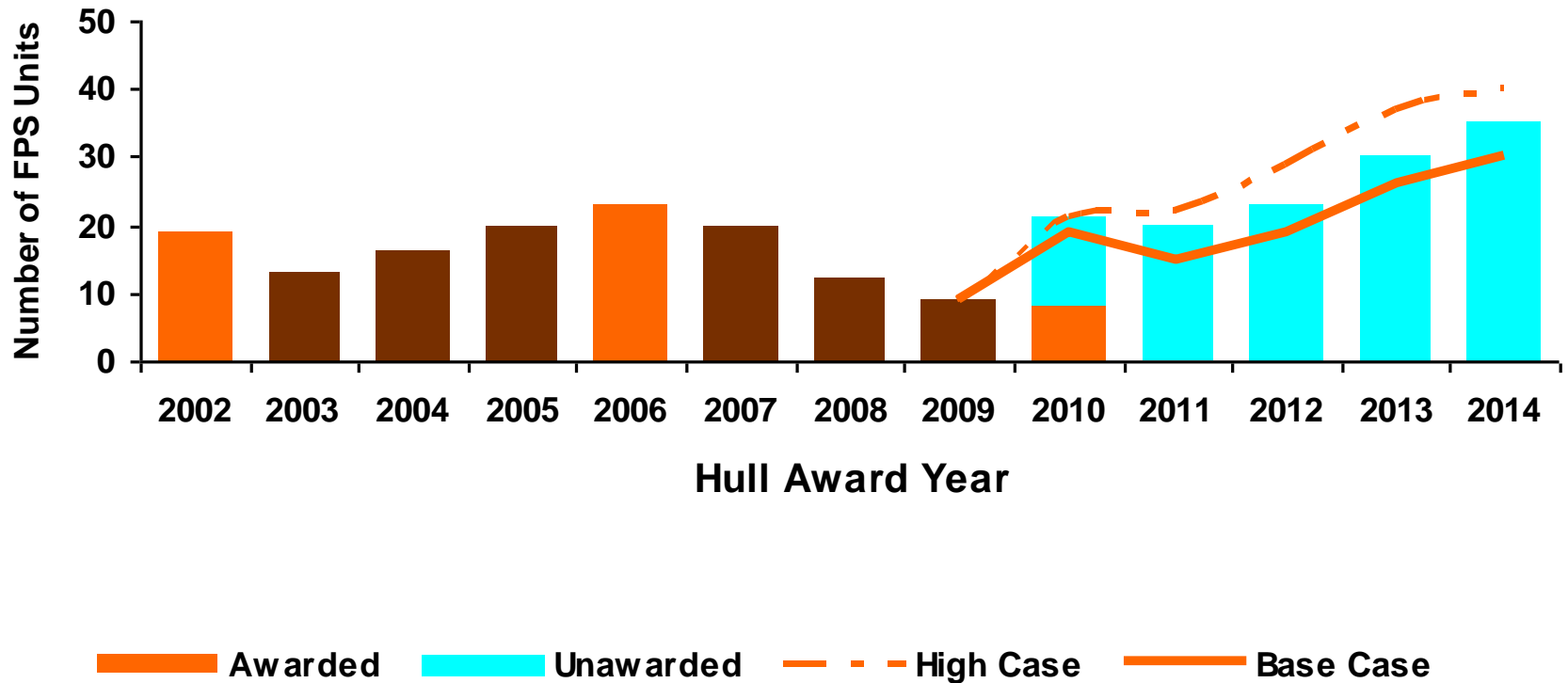


Source: Quest Offshore Resources, Inc.



# Global Award Analysis

# Worldwide FPS Awards 2002 (A) – 2014 (e) (Mean Case)

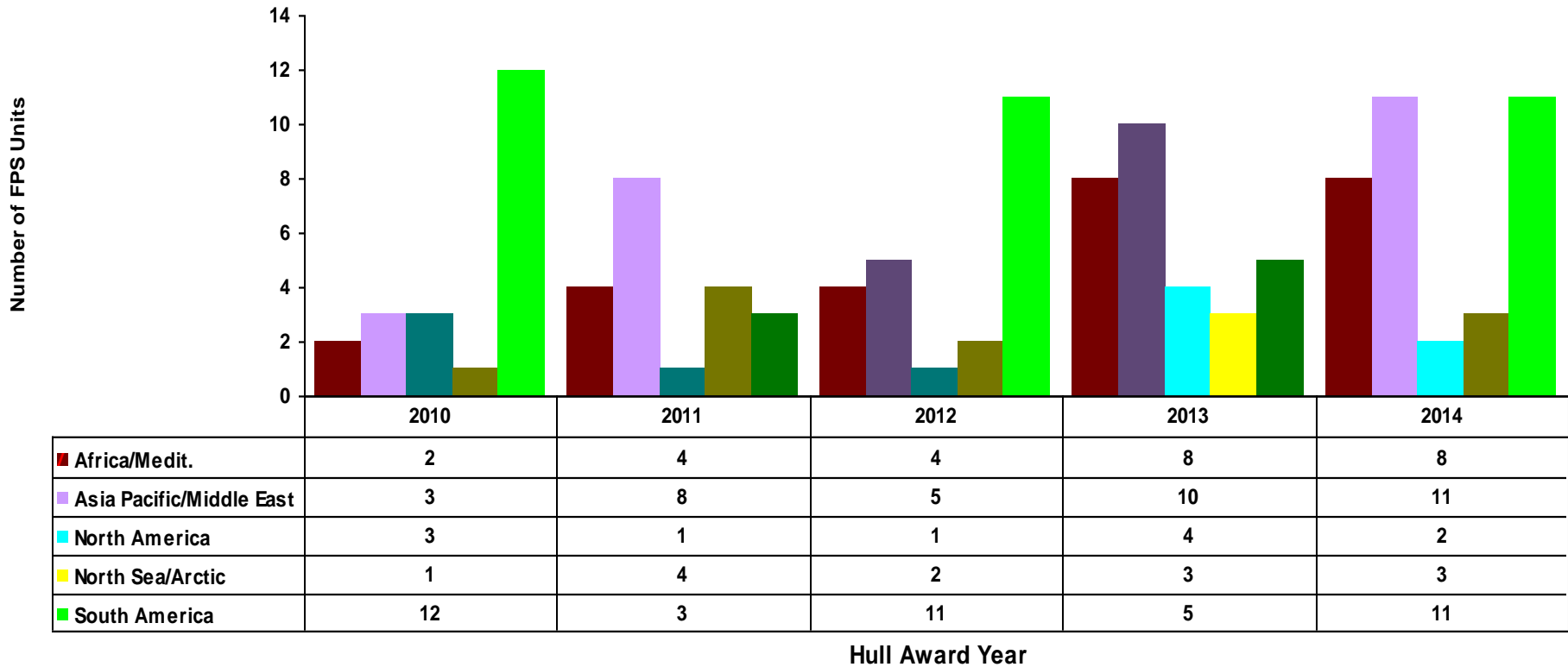


Source: Quest Offshore Resources, Inc.



# Worldwide FPS Forecast Awards 2010 (e) – 2014 (e)

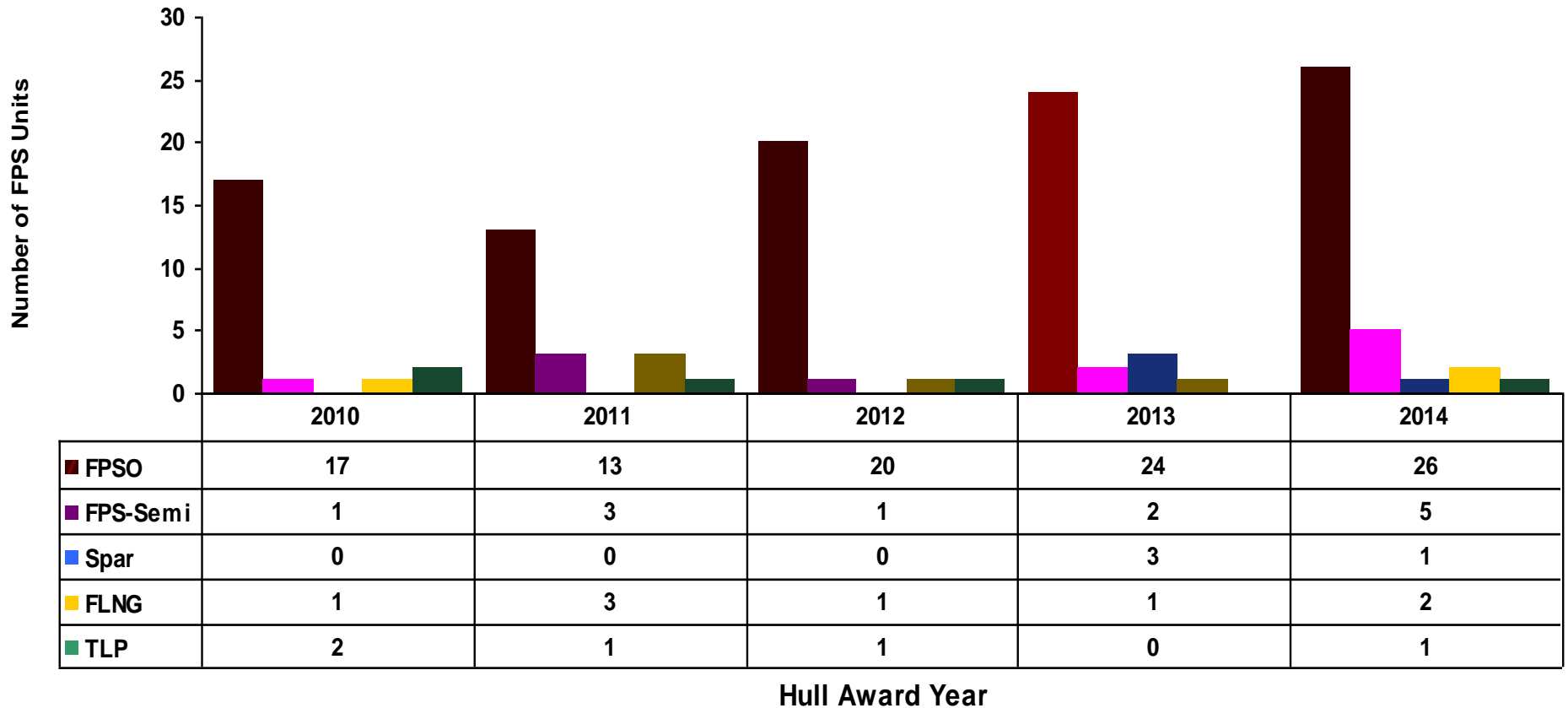
## Area Activity Share By Region (129 Units Mean Case)



Source: Quest Offshore Resources, Inc.

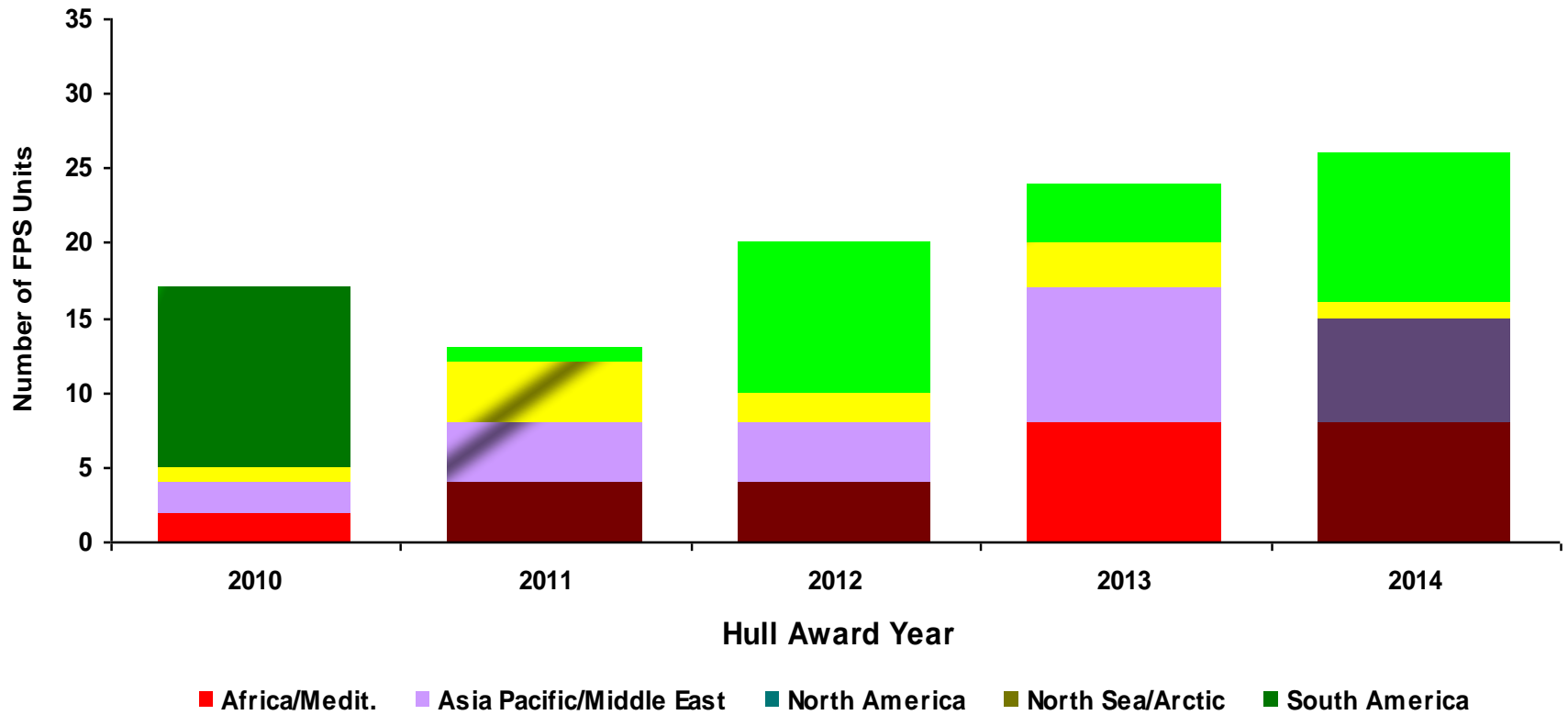
# Worldwide FPS Awards 2010 (A) – 2014 (e) Mean Case

## By FPS Type (129 Units)



Source: Quest Offshore Resources, Inc.

# World Wide **FPSO** Awards 2010 (e) – 2014 (e) Mean Case

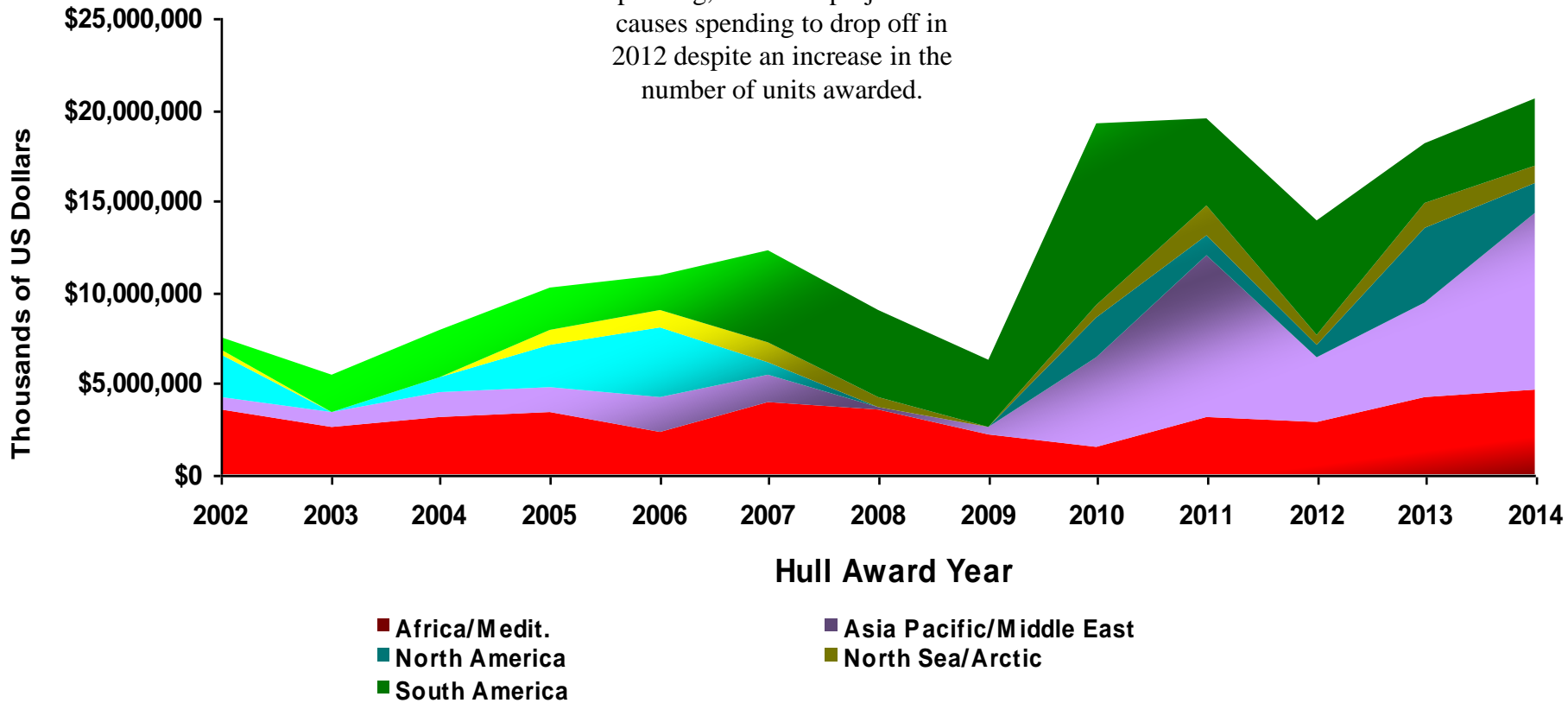


Source: Quest Offshore Resources, Inc.

# Worldwide Forecast FPS Spending by Year (Mean Case)

## Regional Contribution Millions of US Dollars by FPS Award Year

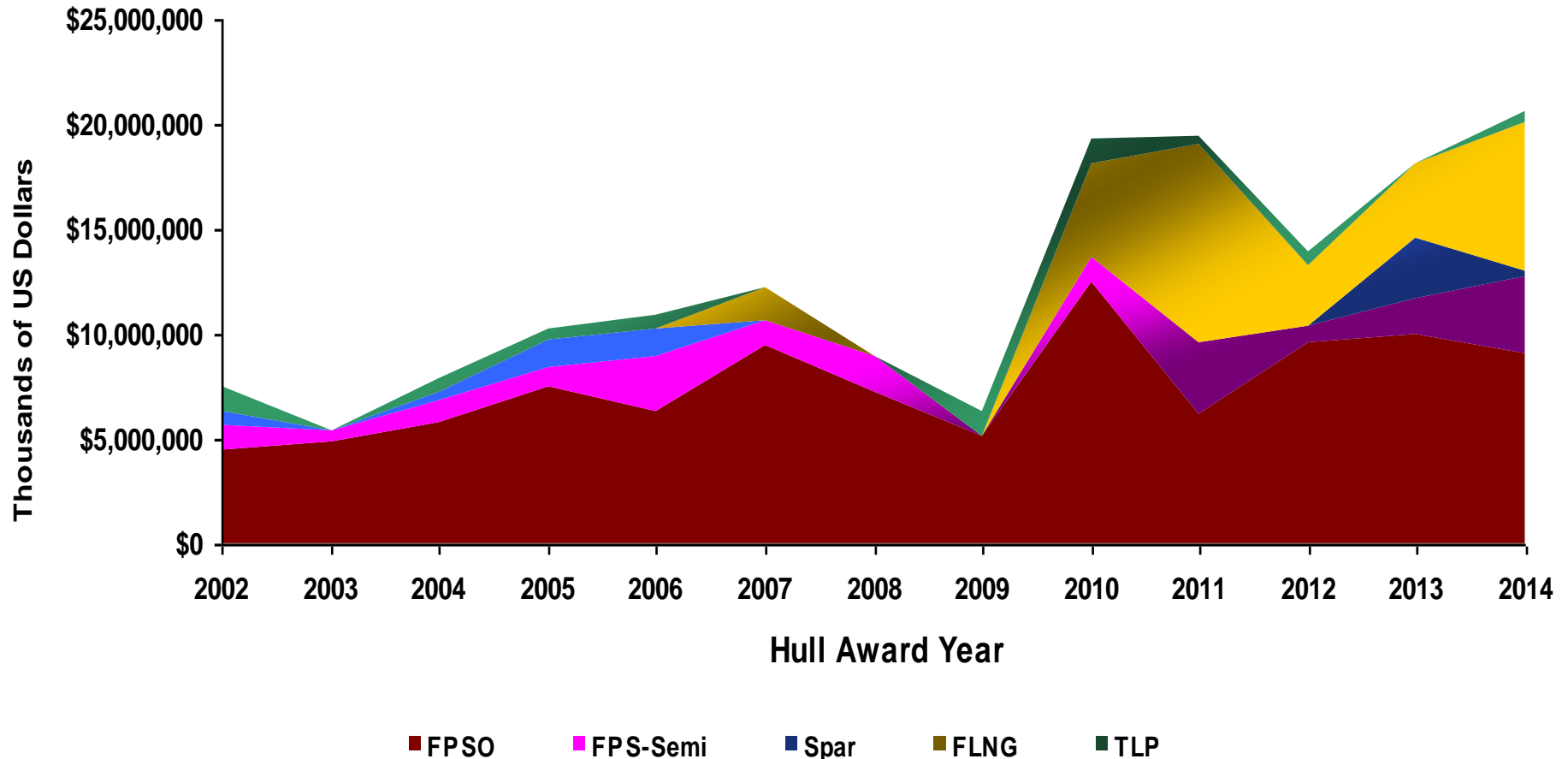
South America and Asia will be the key drivers for increases in spending, while the project mix causes spending to drop off in 2012 despite an increase in the number of units awarded.



Source: Quest Offshore Resources, Inc.

# Worldwide Forecast FPS Spending by Year

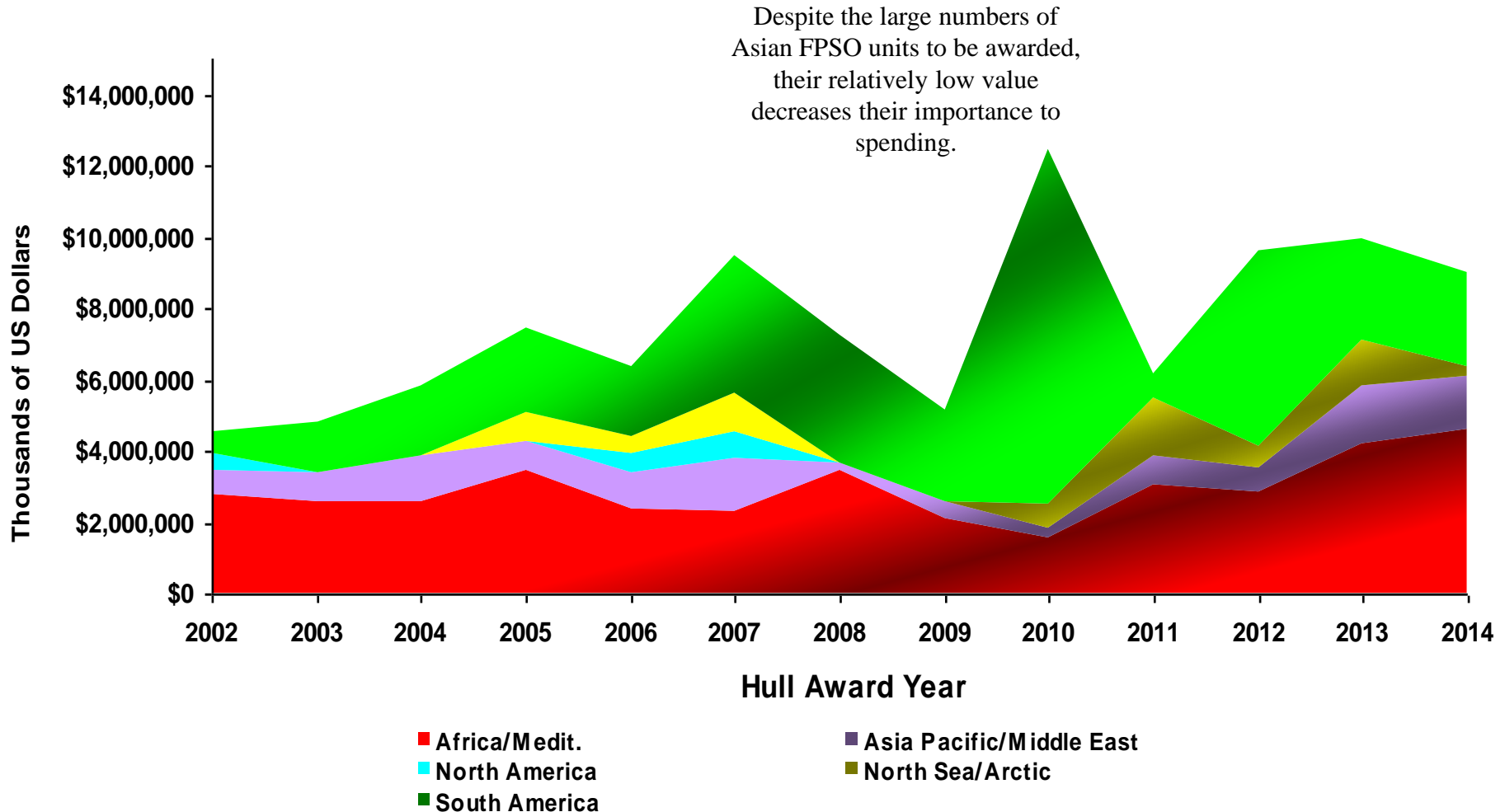
Type Contribution Millions of US Dollars by FPS Award Year



Source: Quest Offshore Resources, Inc.

# Forecast FPSO Spending by Year (Mean Case)

## Millions of US Dollars by Region by FPS Award Year





# Leased FPS Units

# Forecasted Off Contract FPS Leased Fleet Availability

by Type and Year 2010-2014 (Likely to be retired and EWT excluded)

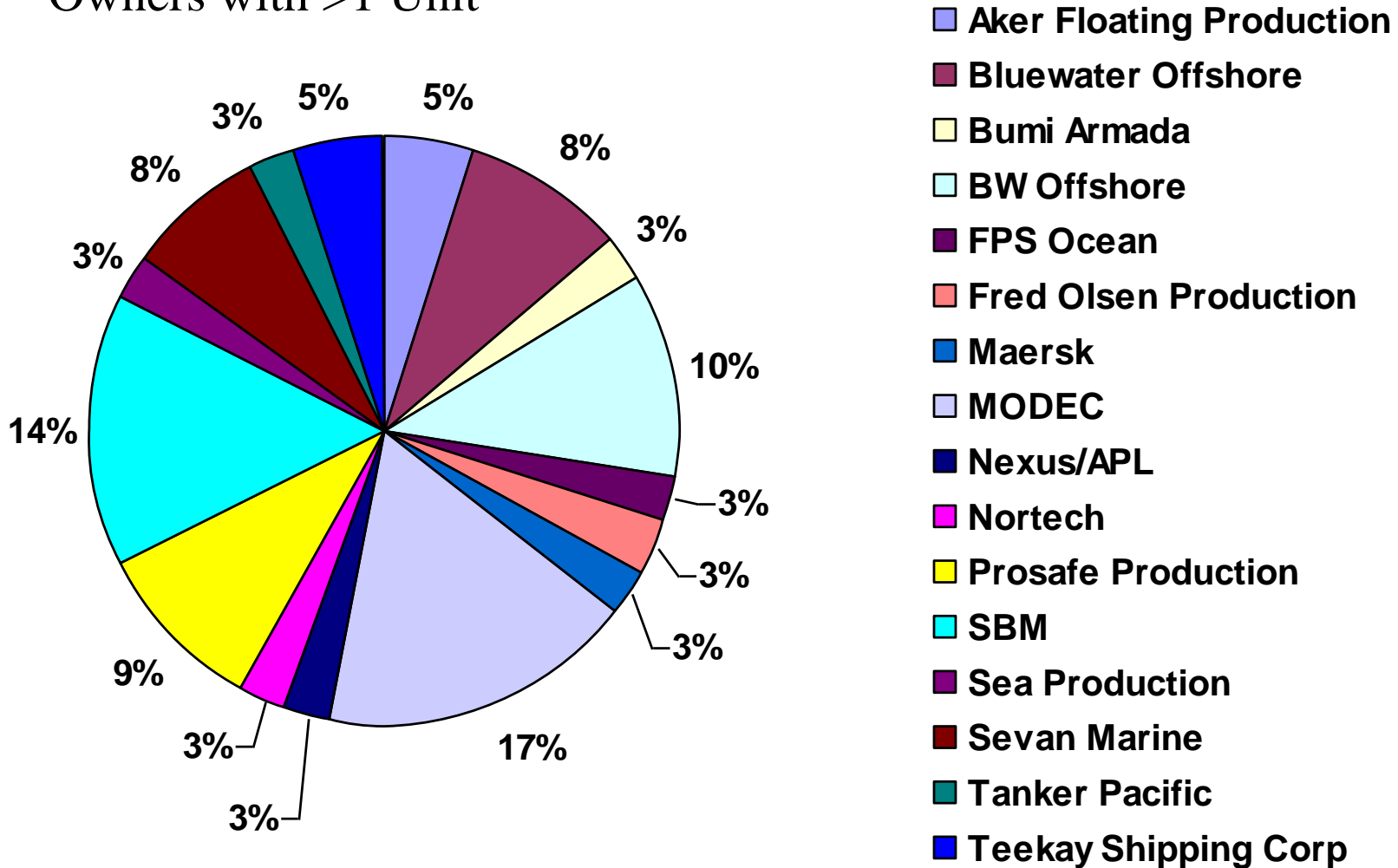


Source: Quest Offshore Resources, Inc.



# Leased FPSO Market Share by Owner

Owners with >1 Unit



Includes JV Shares

Source: Quest Offshore Resources, Inc.

# Leased **FPSO** Market Share by Owner

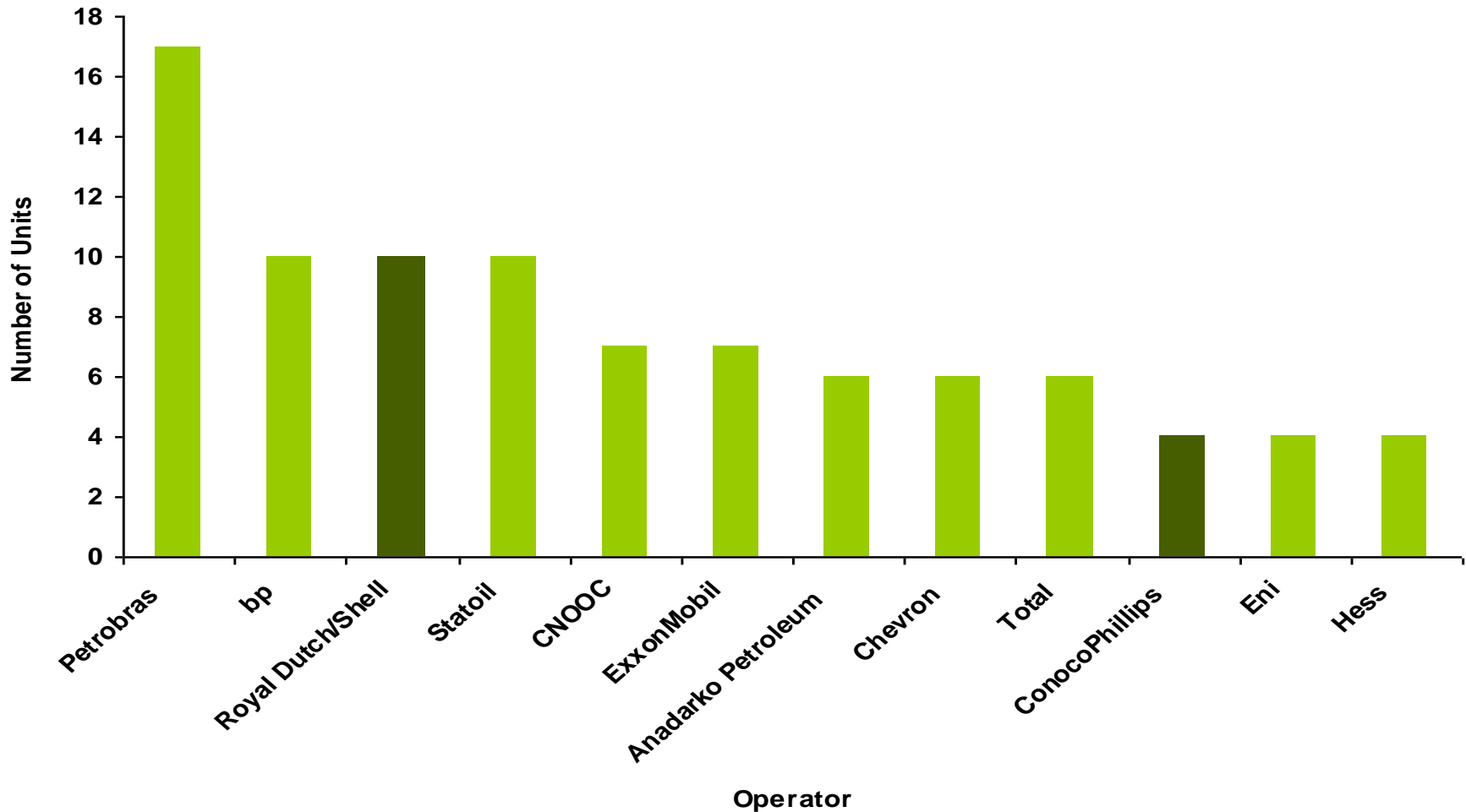
Owners with >1 Unit

Owner	Grand Total	Percentage
<b>MODEC</b>	<b>15</b>	<b>16.3%</b>
<b>SBM</b>	<b>12</b>	<b>13.0%</b>
<b>BW Offshore</b>	<b>9</b>	<b>9.8%</b>
<b>Bluewater Offshore</b>	<b>7</b>	<b>7.6%</b>
<b>Prosafe Production</b>	<b>7</b>	<b>7.6%</b>
<b>Sevan Marine</b>	<b>6</b>	<b>6.5%</b>
<b>Aker Floating Production</b>	<b>4</b>	<b>4.3%</b>
<b>Teekay Shipping Corp.</b>	<b>4</b>	<b>4.3%</b>
<b>Bumi Armada</b>	<b>2</b>	<b>2.2%</b>
<b>Fred Olsen Production</b>	<b>2</b>	<b>2.2%</b>
<b>Maersk</b>	<b>2</b>	<b>2.2%</b>
<b>Nexus</b>	<b>2</b>	<b>2.2%</b>
<b>Nortech</b>	<b>2</b>	<b>2.2%</b>
<b>SBM/MISC</b>	<b>2</b>	<b>2.2%</b>
<b>Tanker Pacific</b>	<b>2</b>	<b>2.2%</b>
<b>Other</b>	<b>14</b>	<b>15.2%</b>
<b>Grand Total</b>	<b>92</b>	<b>100.0%</b>

Includes JV Shares

Source: Quest Offshore Resources, Inc.

# Operator **Owned** FPS Market Share by Owner



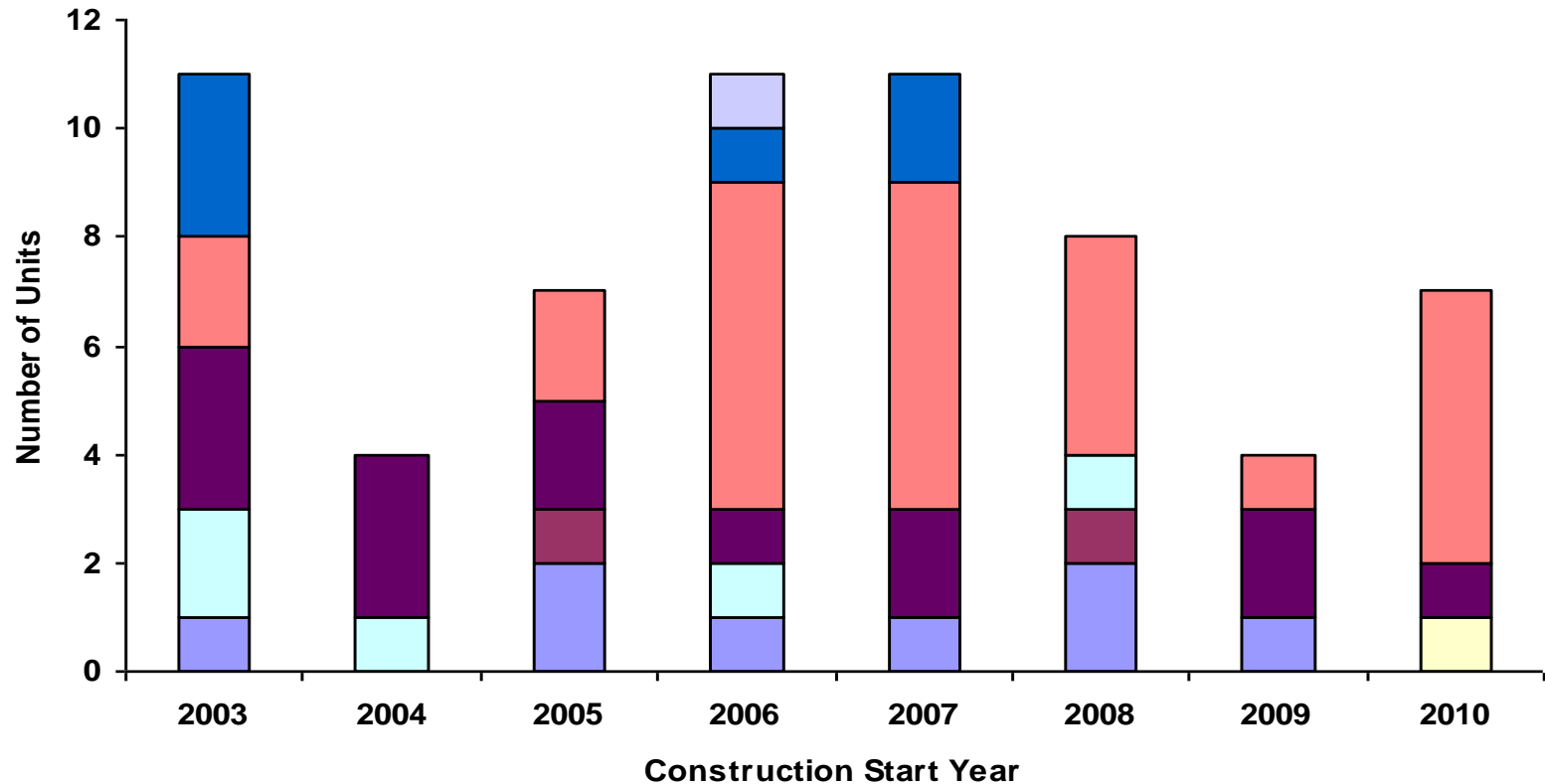
Source: Quest Offshore Resources, Inc.



# **Global Hull Fabrication Analysis**

# Market Share – FPSO Hull Fabrication (Number of Units)

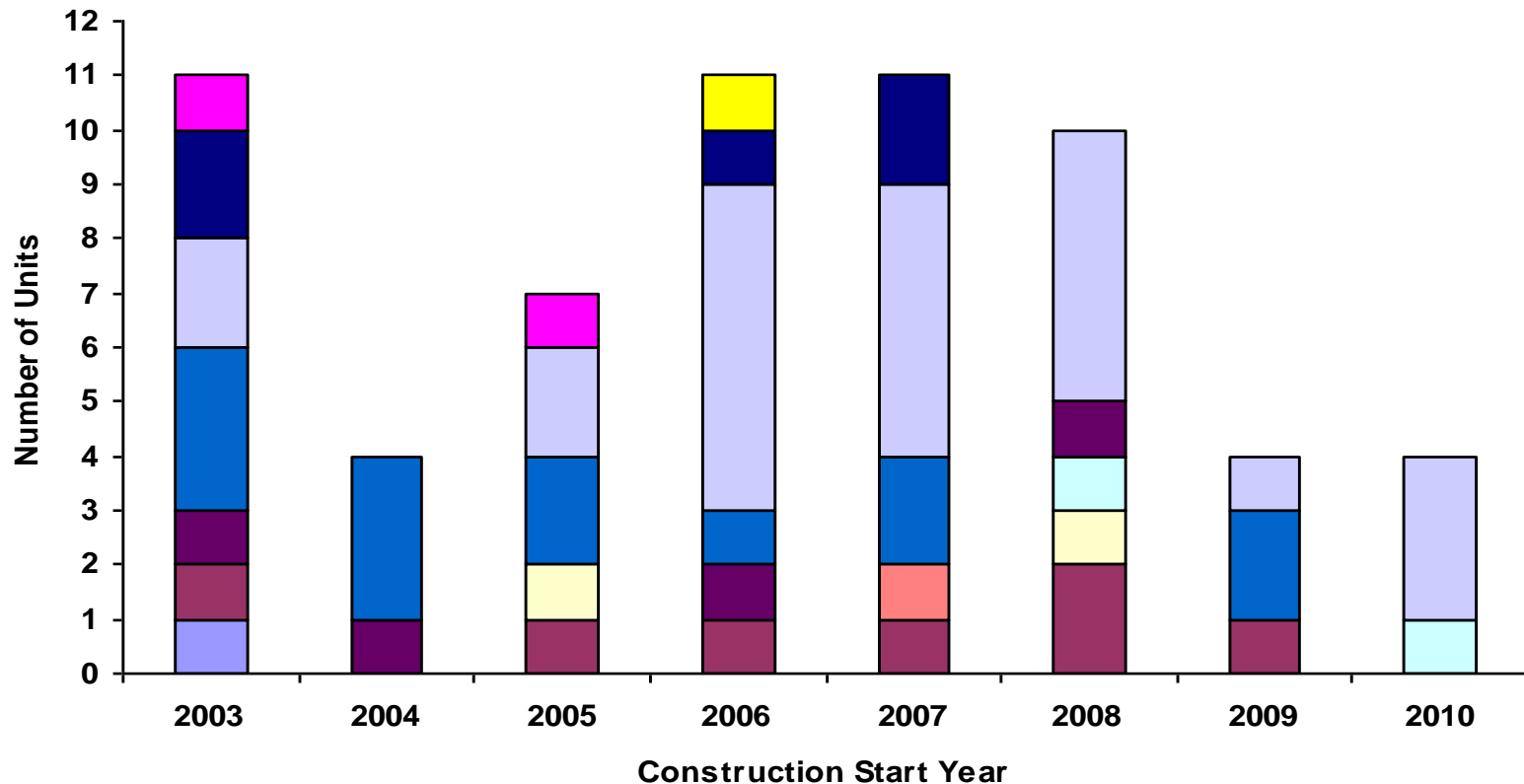
## Major FPS Shipyards 2003-2010 By Fabrication Start Year



■ COSCO   
 ■ DSME   
 ■ Dubai Dry Docks   
 ■ HHI   
 ■ Jurong   
 ■ Keppel FELS   
 ■ SHI   
 ■ Yantai Raffles

# Market Share – **FPSO** *Topsides* Fabrication (Number of Units)

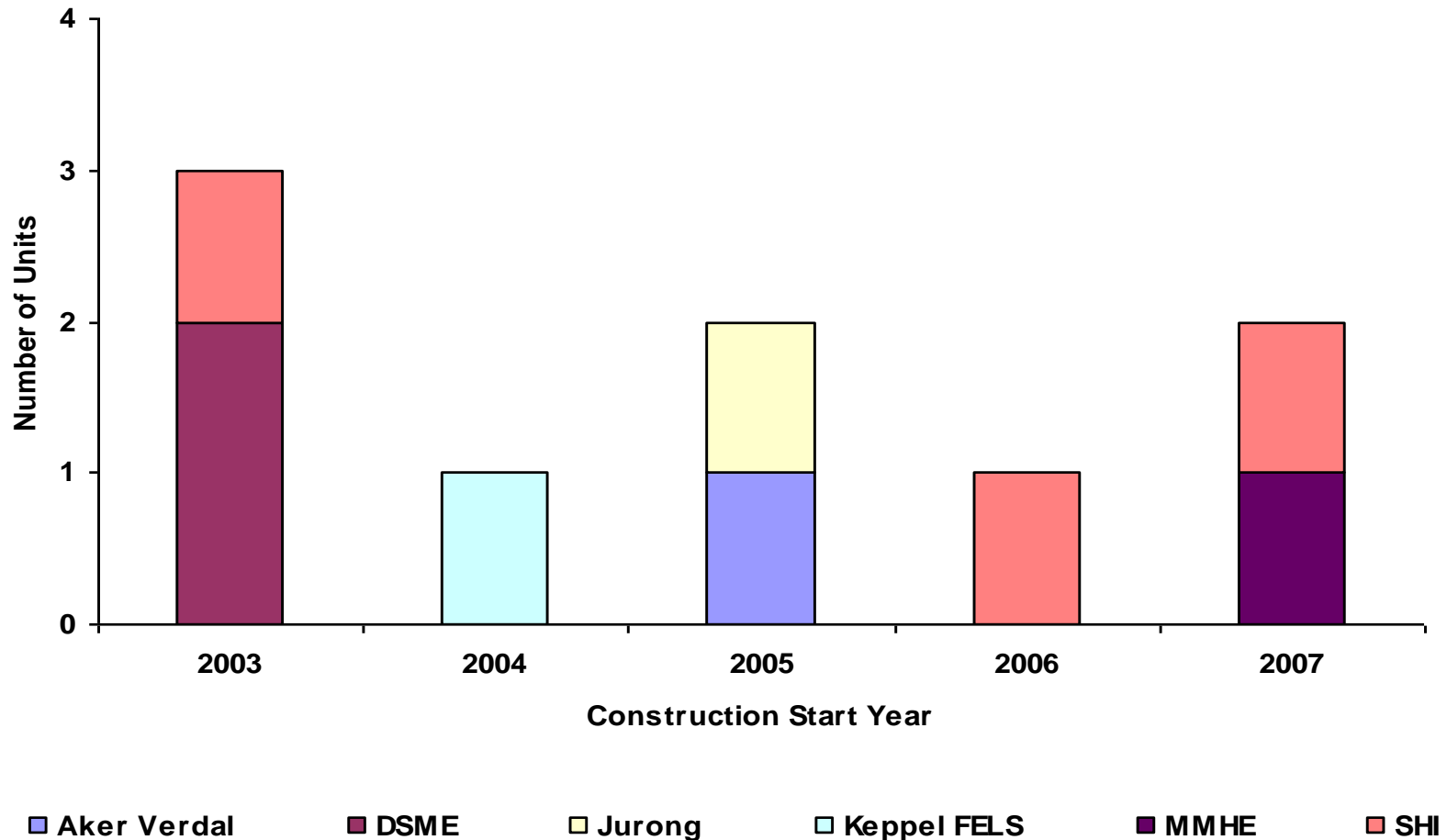
## Major FPS Shipyards 2003-2010 By Fabrication Start Year



- Aker Verdal
- COSCO
- DSME
- Dubai Dry Docks
- HHI
- J Ray - Batam
- Jurong
- Keppel FELS
- SHI
- SMOE/ Sembawang
- Yantai Raffles

# Market Share – **FPS-Semi Hull** Fabrication (Number of Units)

## Major FPS Shipyards 2003-2010 By Fabrication Start Year



# Market Share – **FPS-Semi** *Topsides* Fabrication (Number of Units)

## Major FPS Shipyards 2003-2010 By Fabrication Start Year



■ Aker Verdal ■ Gulf Island Marine ■ J Ray - Morgan City ■ Keppel FELS ■ Kiewitt ■ MMHE





# Conclusions

# Conclusions

- MOPS market continues to expand
- Leased FPSOs are approximately 1/2 of the FPSO market
- FPSOs are by far the most common type of MOPS
- A number of FPSO units are available today
- Floating Production Systems are the only option for surface facilities in water depths greater than 1,750 ft



# Questions?



# Selecting a MOPS Unit Type: Principal Determining Criteria

- Surface or Subsea Completions
- Need for Well Access and Intervention
- Drilling Program Requirements
- Access to Existing Hydrocarbon Export Infrastructure
- Water Depth and Environmental Regime
- Size and weight of process equipment

# Principal Operational Sensitivities

- Oil Export Method / Storage and Offloading Systems
- Environmental Parameters and the Mooring System
  - Permanent moorings
  - Disconnectable options
  - Weathervaning (single-point) vs. spread moorings
- Process System Sensitivities



# Operational Considerations

- System Availability / Uptime
  - Is redundancy required?
  - What cost for the final %?
  
- Achieving Safety and Environmental Protection Objectives
  
- Recruiting and Retaining Competent Crew
  
  
- Maintenance Criteria

