Platform Technologies for Offshore Renewable Energy Conversion

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Objectives

DON'T RE-INVENT THE WHEEL !

- **Oil & Gas Industry has been developing offshore technology for 100 years., is there anything that we can learn ?**

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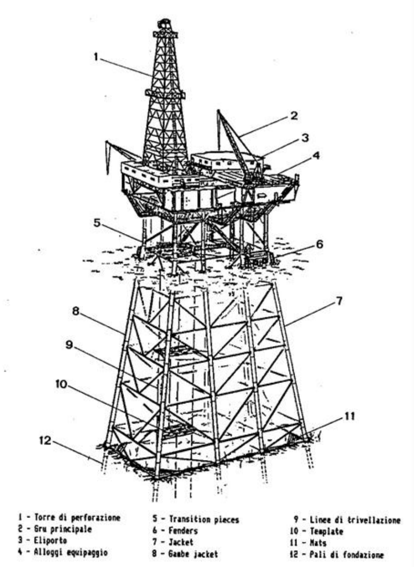
Available Offshore Platform Technologies

- Fixed Platform
  - ✓Jacket Structure
  - ✓Gravity based
  - ✓Compliant Structures
  - ✓Guyed towers



- Floating Platform
  - ✓Semi-sub
  - ✓Tension Leg
  - ✓SPAR
  - ✓FPSO

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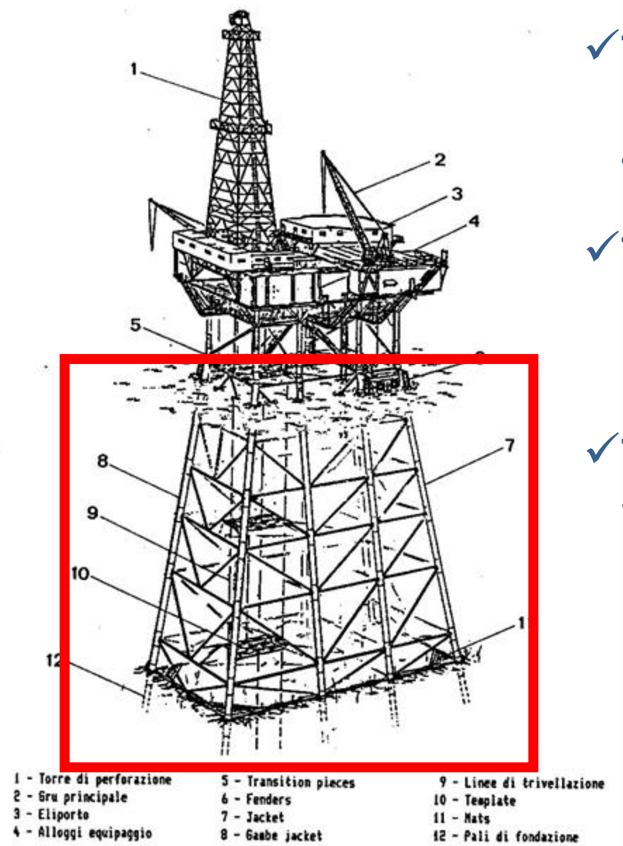
Fixed Platforms: Jacket Structures



- ✓ The steel jacket type platform on a pile foundation is by far the most common kind of offshore structure and they exist worldwide as well as the eldest.
- ✓ These structures generally support superstructures having 2 or 3 decks with drilling and production equipment and workover rigs as well.
- ✓ The use of these platforms is generally limited to a water depth of about 150 – 180 m in the North Sea environment

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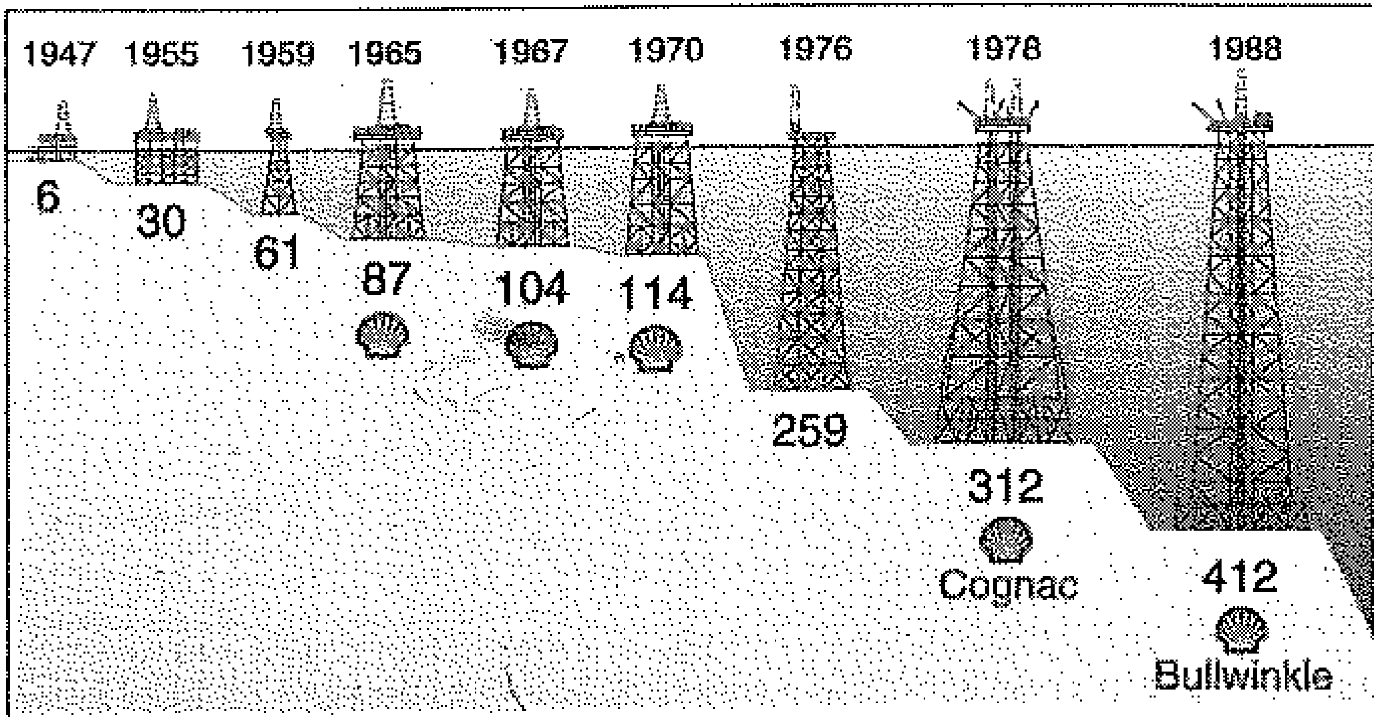
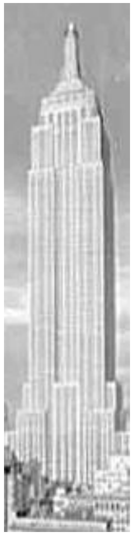
Development of Fixed Offshore Structures





✓At present the record is scored by Bullwinkle jacket installed at a 412 m water depth.

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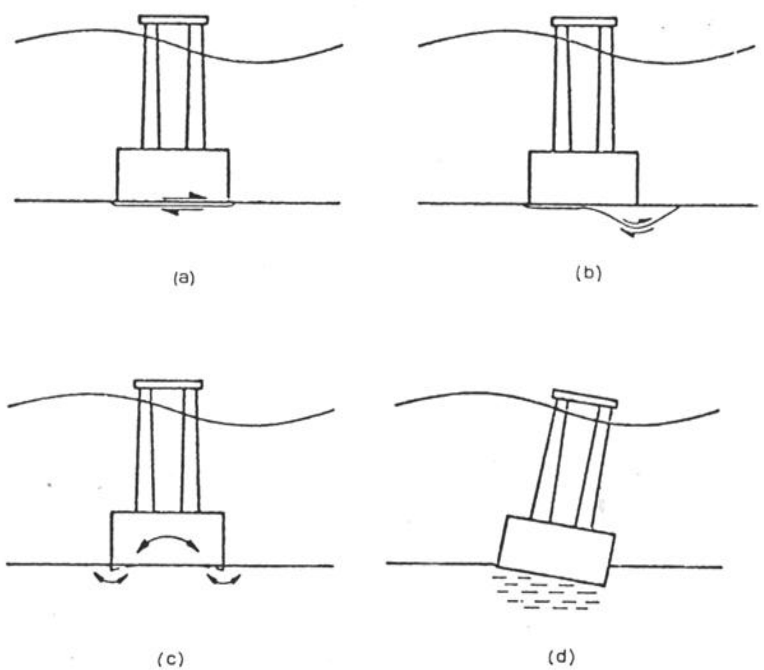
Fixed Platforms: Gravity Based

- ✓Gravity structures are offshore structures that are placed on the seafloor and held in place by their weight.
- ✓These structures do not require piles or anchors. Moreover the huge bottom section is quite suited for production of and storage of oil.
- ✓Since gravity base structures require large volume and high weight, concrete has been the most common material for gravity structures .

Fixed Platforms: Gravity Based



✓ **Because of the nature o these platforms, they are often prone to scour of their foundation and sinkage**

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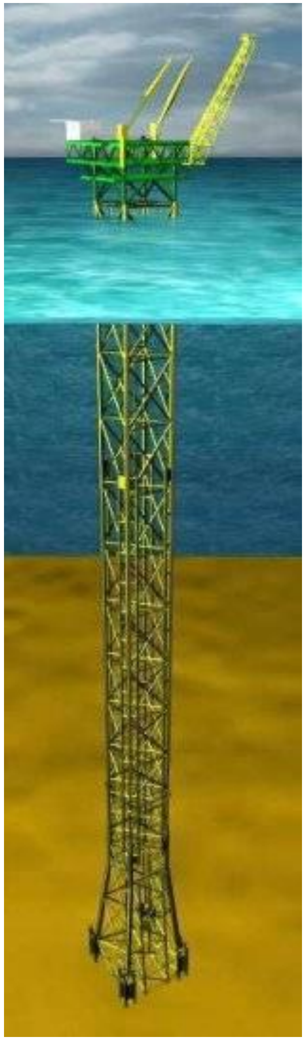
Fixed Platforms: Compliant Towers



- ✓A compliant tower is similar to a traditional jacket platform and extends from surface to the sea bottom, and it is fairly transparent to waves. However, unlikely jacket plkatforms, a compliant tower is designed to flex with the forces of waves, wind and currents .
- ✓The first tower emerged in the early 1980s
- ✓Compliant towers are designed to sustain significant lateral deflections and forces, and are typically used in water depths ranging from 1,500 and 3,000 feet (450 and 900 m).
- ✓At present the deepest is Baldpate in 580 m of water

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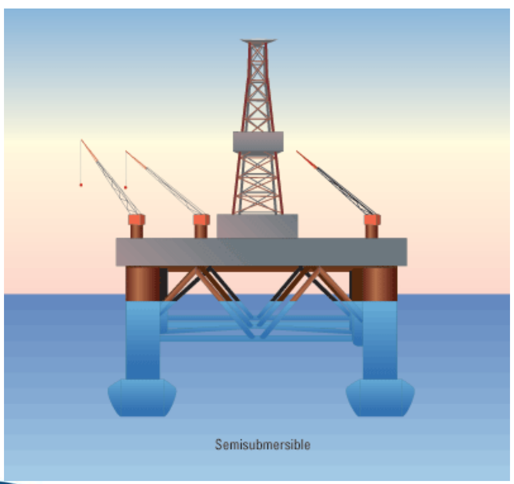
Floating Platforms: Semi-Submersible



- ✓Offshore drilling in high water depth requires that operations be carried out from a floating vessel, as fixed structures are not practical
- ✓semi-submersible are multi legged floating structures with a large deck interconnected at the bottom underwater with horizontal buoyant members called pontoons.
- ✓A semi-submersible obtains its buoyancy from ballasted, watertight pontoons located below the ocean surface and wave action.
- ✓Today's "deepest" semisub is Atlantis PQ (-2156 m)

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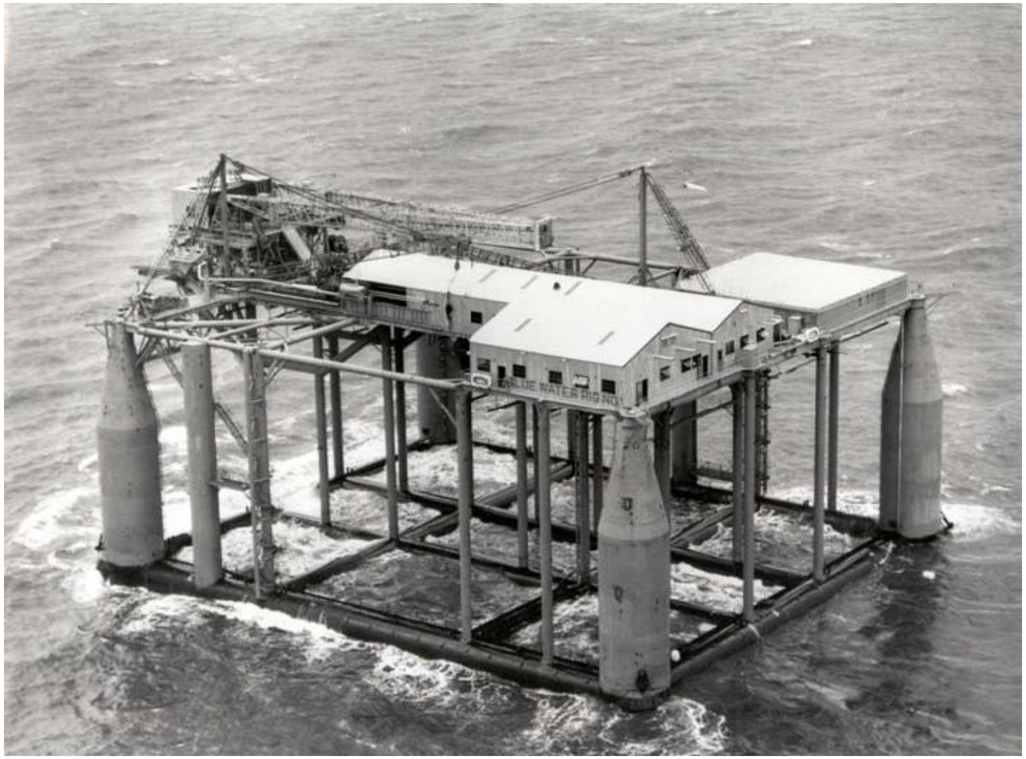
Floating Platforms: Semi-Submersible



✓The first semi-submersible arrived in 1961. Blue Water Drilling Company owned and operated the four column submersible drilling rig Blue Water Rig No.1 in the Gulf of Mexico

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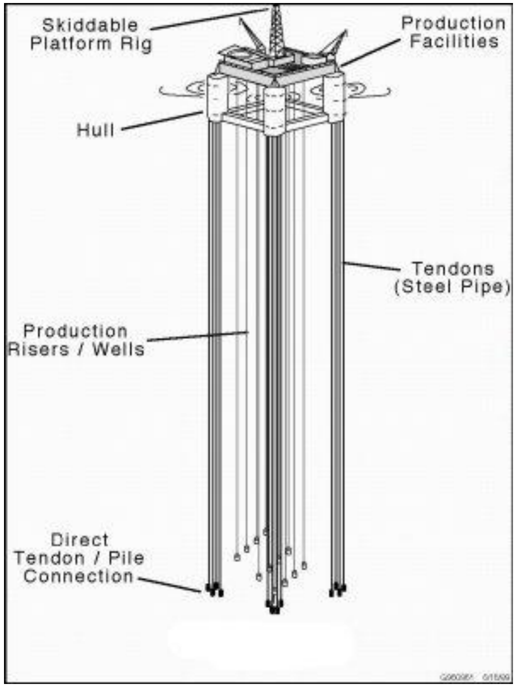
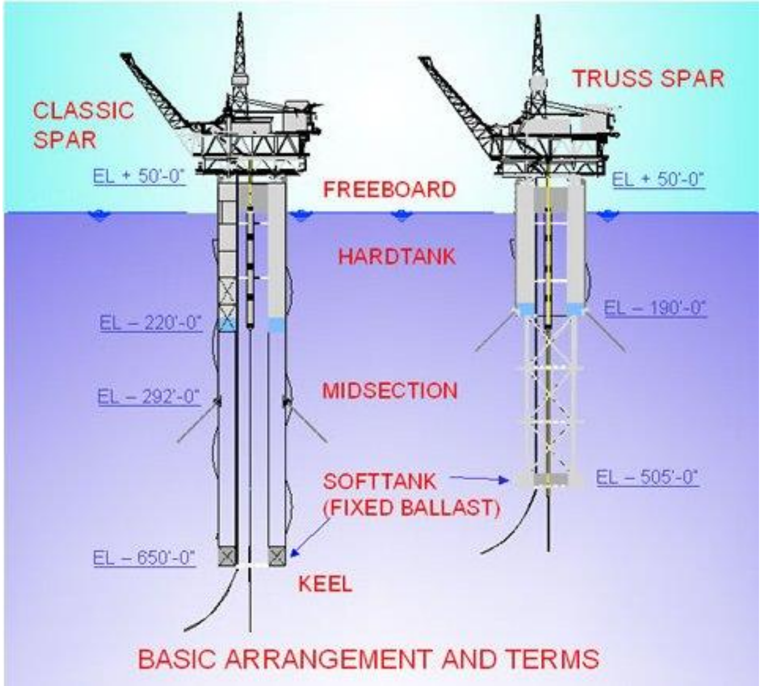
Floating Platforms: Tension Leg Platforms



- ✓A Tension-leg platform or Extended Tension Leg Platform (ETLP) is a vertically moored floating structure normally used for the offshore production of oil or gas, and is particularly suited for water depths greater than 300 metres (about 1000 ft) and less than 1500 meters (about 4900 ft)
- ✓The platform is permanently moored by means of tethers or tendons grouped at each of the structure's corners
- ✓The first Tension Leg Platform was built for Conoco's Hutton field in the North Sea in the early 1980s

Floating Platforms: SPAR



- ✓ **The Spar concept is a large deep draft, cylindrical floating caisson designed to support drilling and production operations. Its buoyancy is used to support facilities above the water surface. It is generally anchored to the seafloor with multiple taut mooring lines**

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Floating Platforms: SPAR

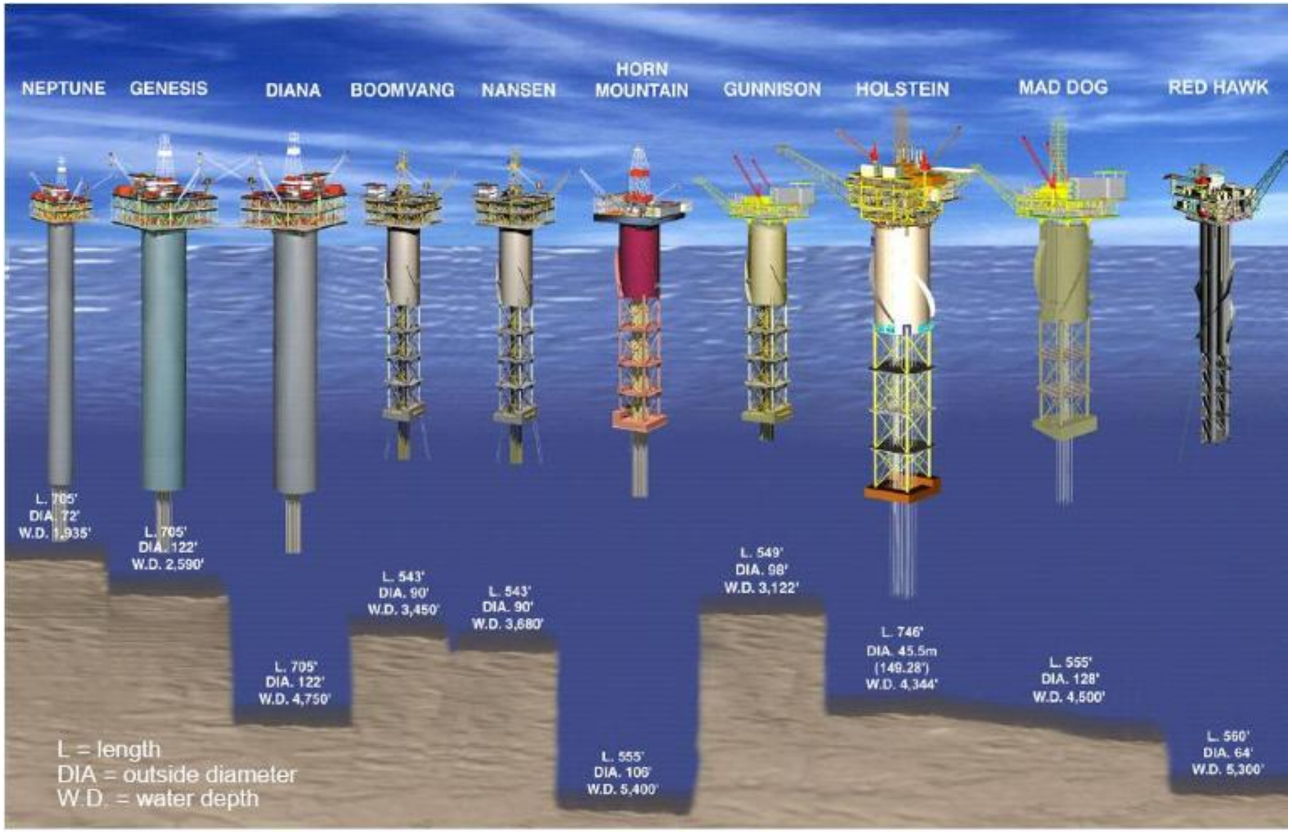

Figure 43. Progression of spar deepwater development systems (image courtesy of Technip-Coflexip).

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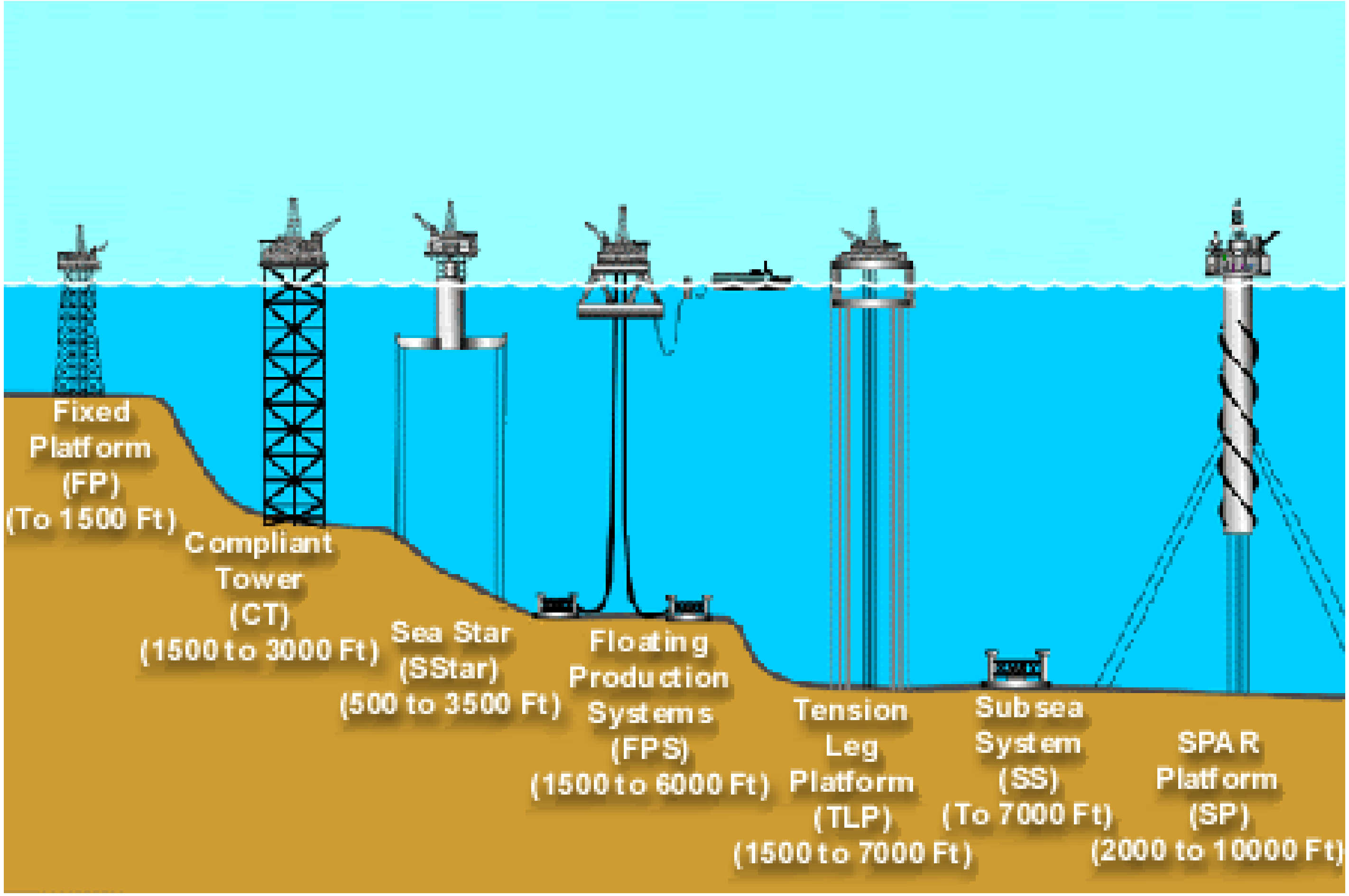
Floating vs. Fixed Offshore Structures



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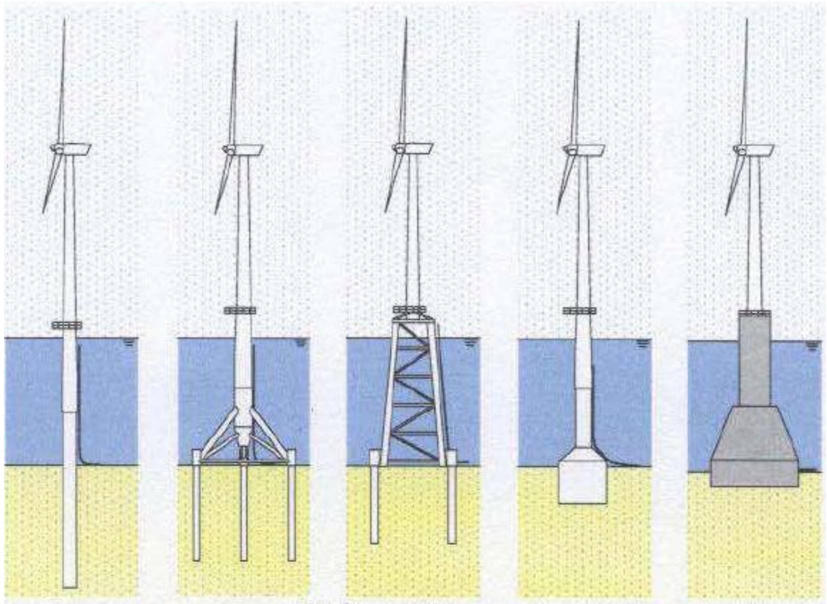
Fixed Structures: Offshore Renewable Applications



- ✓ On the surface, it would seem that support structures for OWTs could be designed based on the design principles used in the oil and gas industry, however
- ✓ Contrary to offshore structures, where the dominant loading is typically from wave loads, offshore wind turbine support structures may be equally loaded by wind and wave loads

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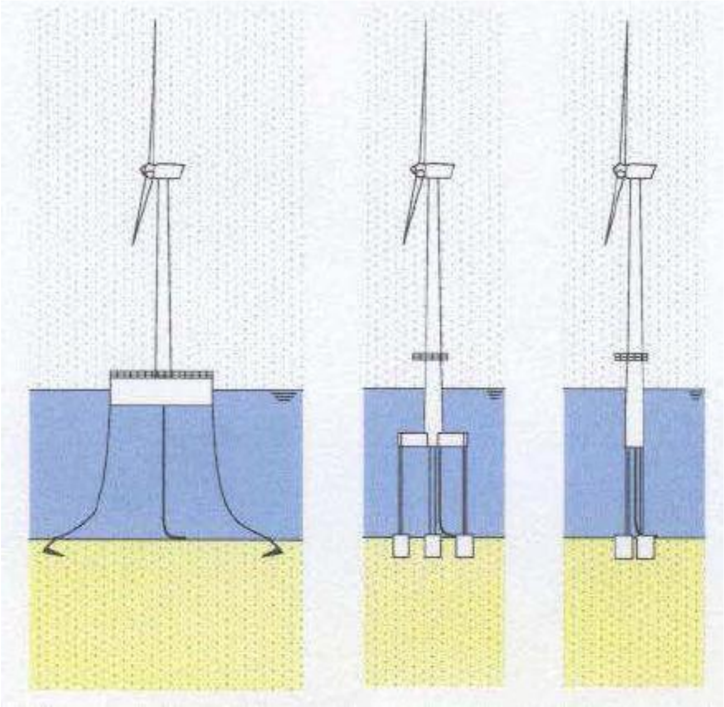
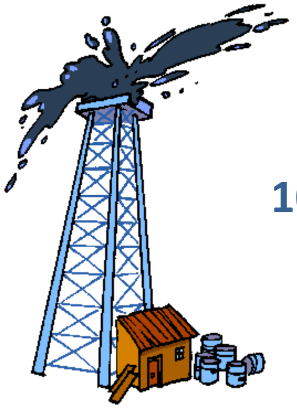
Offshore Renewable Applications



✓Technical feasibility of floating structures has already been successfully , however, the economics that allowed the deployment of thousands of offshore wind turbines have yet to be demonstrated for renewable energy conversion platform

Offshore Renewable: Challanges



100.000 BPD x 100 $/Brl = 10 M$/d

(1500kWx 24h) x 0.10 $/kWh = 3600 $/d

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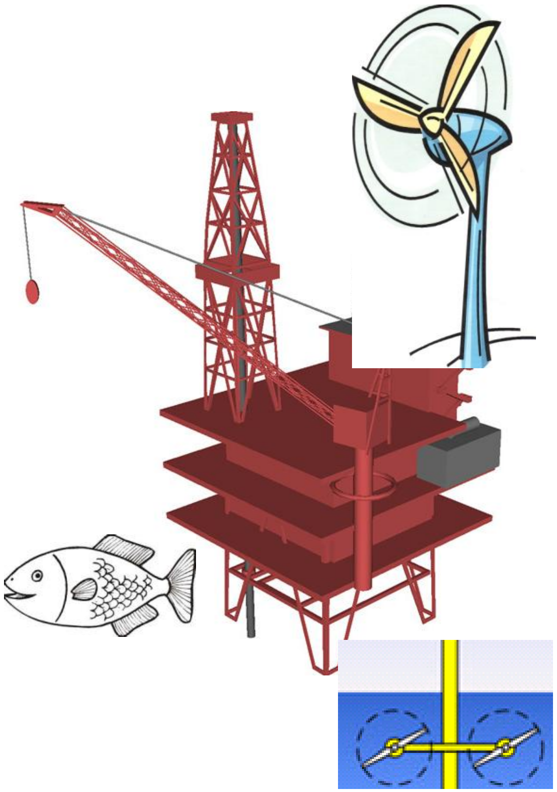
Offshore Renewable: Opportunities



✓Re-use of oil platforms

✓Combination of different re-newable sources

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