

# **Artificial Lifting Systems Hybrid or Combined Technologies**

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# Hybrid Systems Technologies

## **What is the hybrid System?**

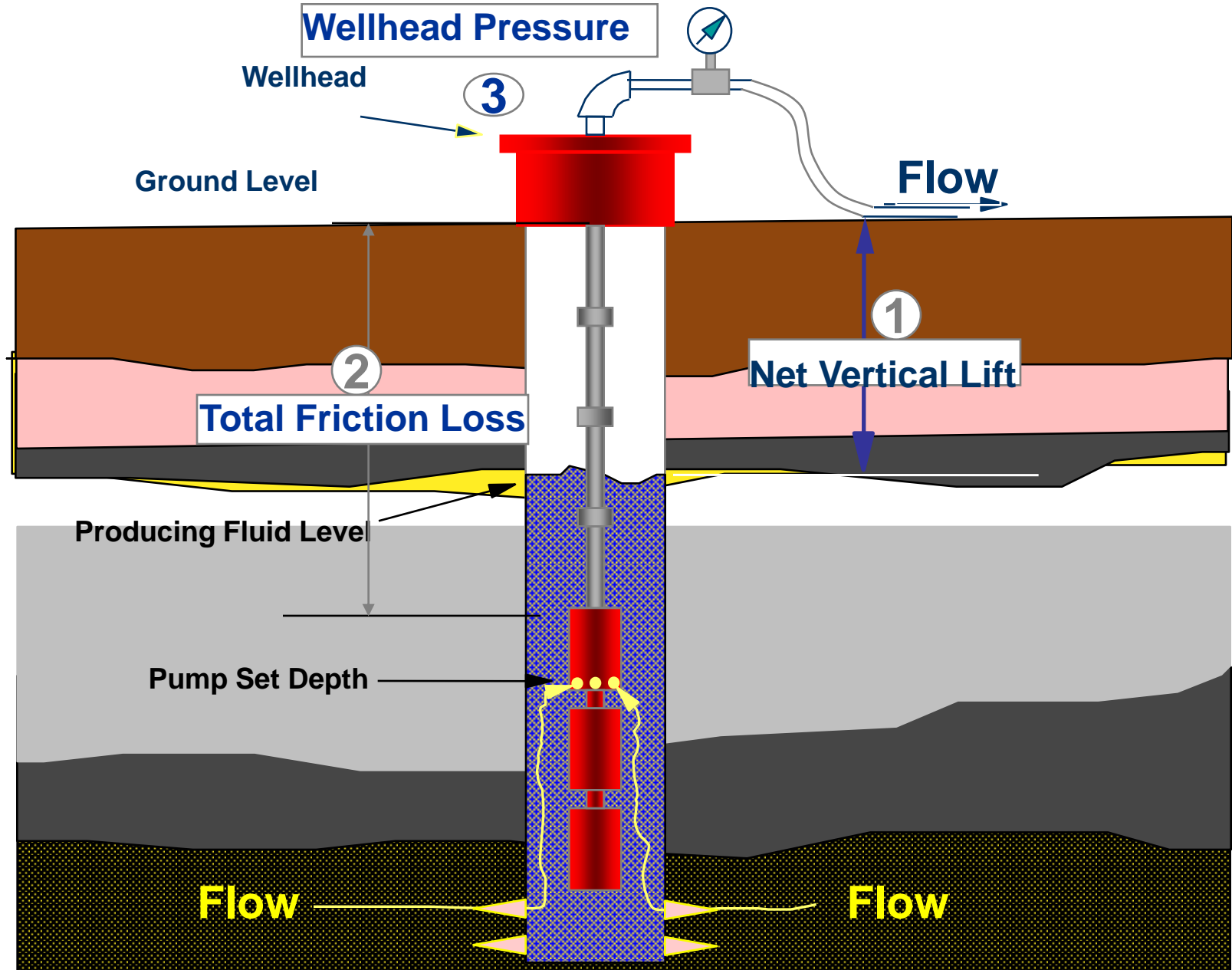
- Hybrid system combines the strength of more than one type of Artificial Lifting System.
- It will help in adding extra reliability by having two types of artificial lifting methods particularly in offshore or high potential application.
- It can increase efficiencies, save power and, will extend the capabilities of just a single lifting methods.
- In general, it will expand the application envelopes of opportunity.

# Hybrid Systems Technologies

## **Hybrid Systems can be one of the following combinations:**

- ESP/ Jet Pump
- ESP / Gas Lift
- Reciprocating Rod Pump / Horizontal Pumping System (HPS)
- Jet Pump / HPS
- ESP/ PCP

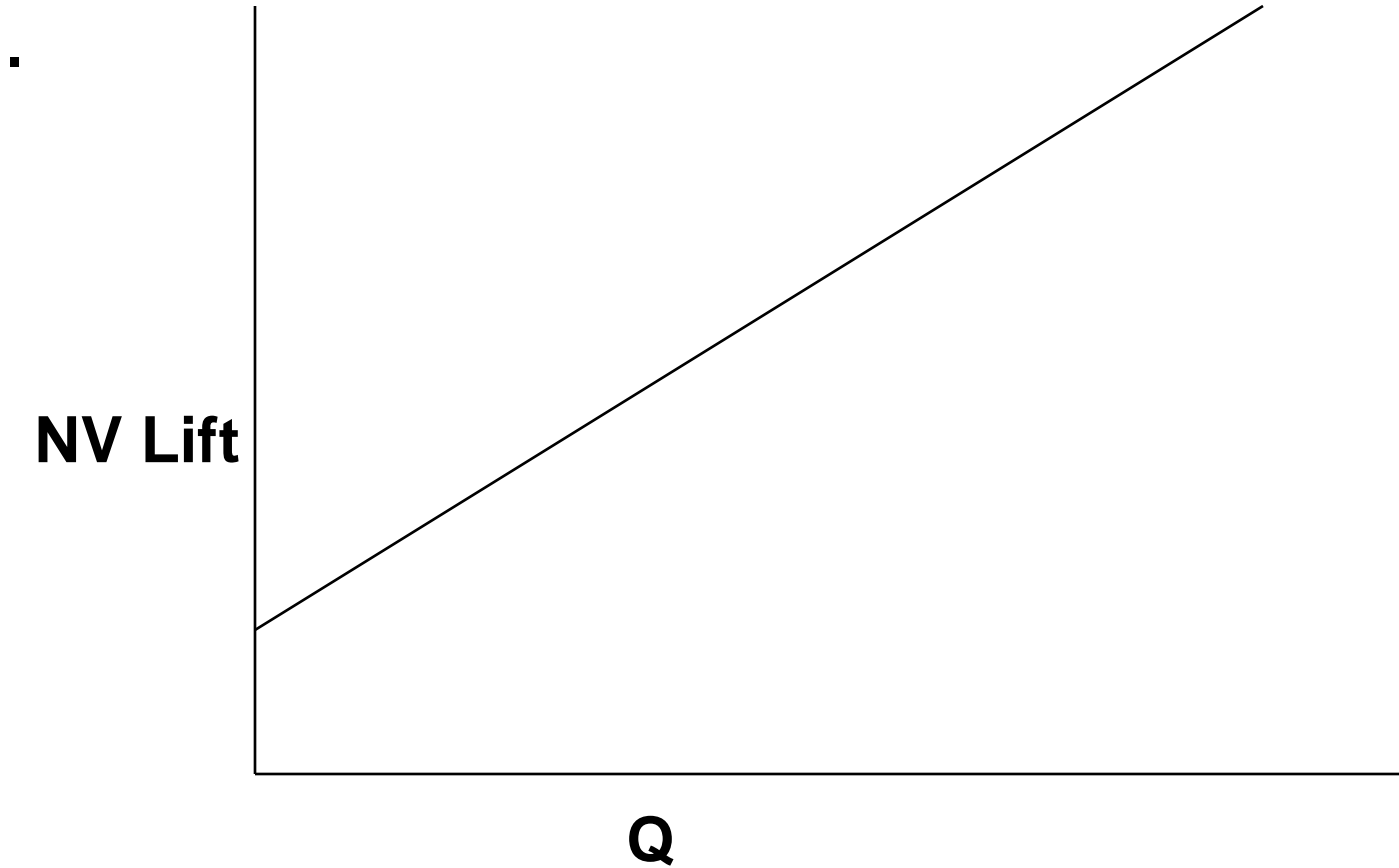
# Components of the TDH



# Total Dynamic Head

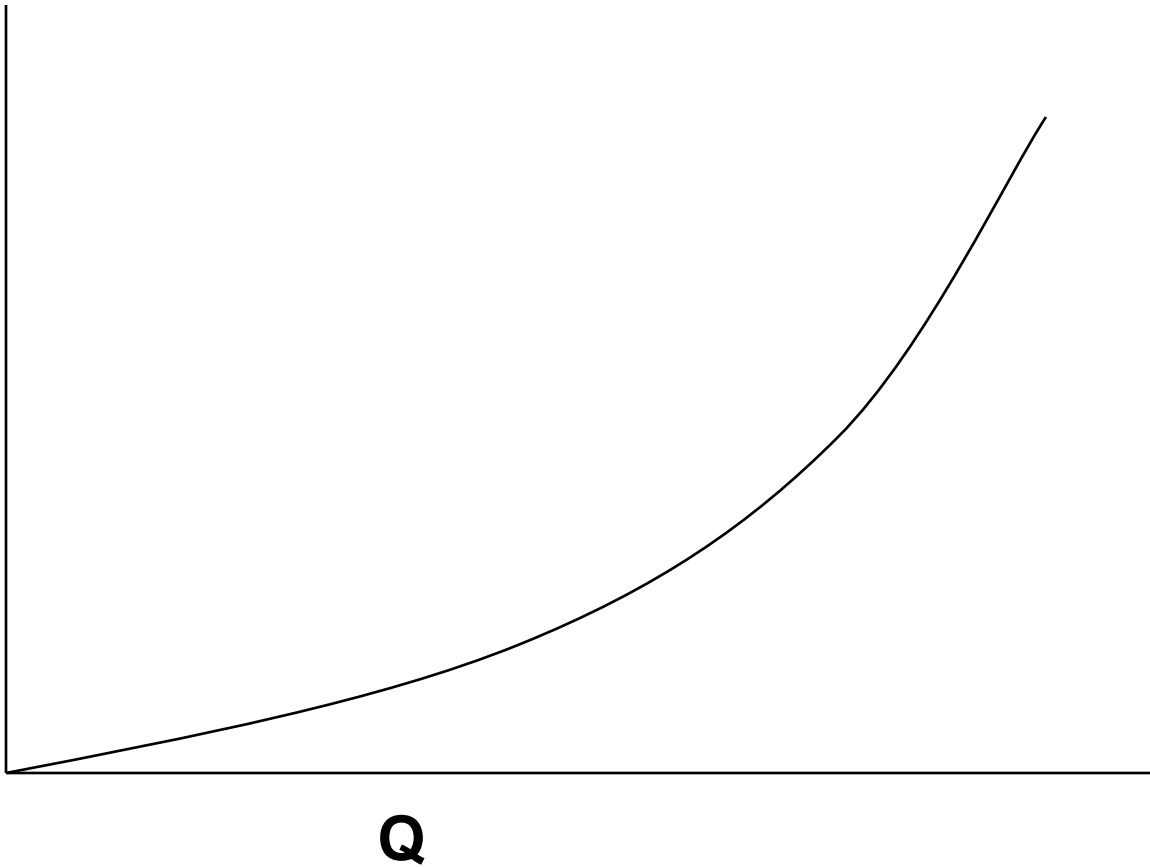
- *TDH is a sum of three basic components:*
- 1) The Net Vertical Lift or net distance which the fluid must be lifted
- 2) The friction loss in the tubing string
- 3) The wellhead pressure which the unit must pump against.

# Net Vertical Lift v Q (Flow rate)

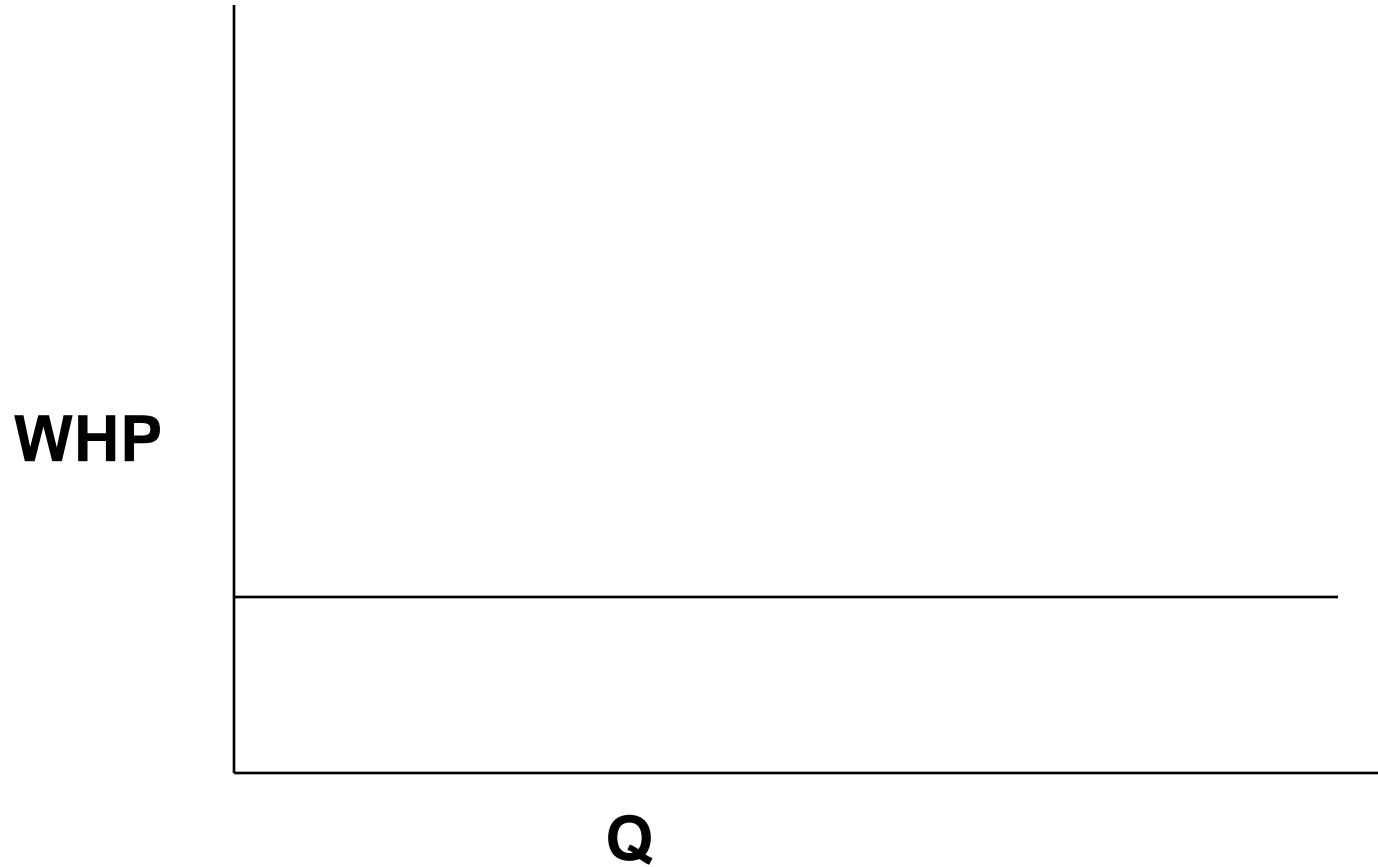


# Friction Loss v Q (Flow rate)

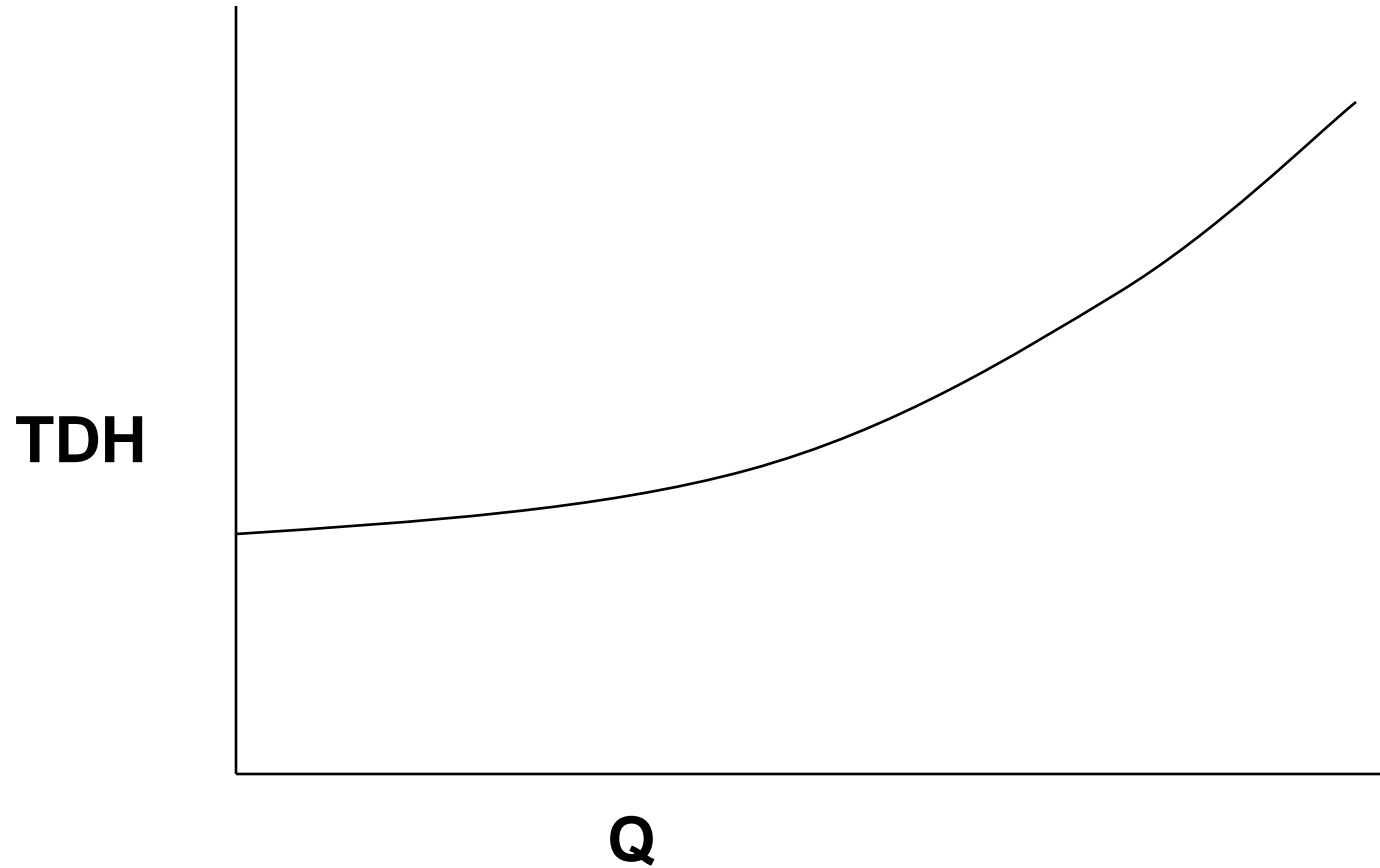
Friction  
losses



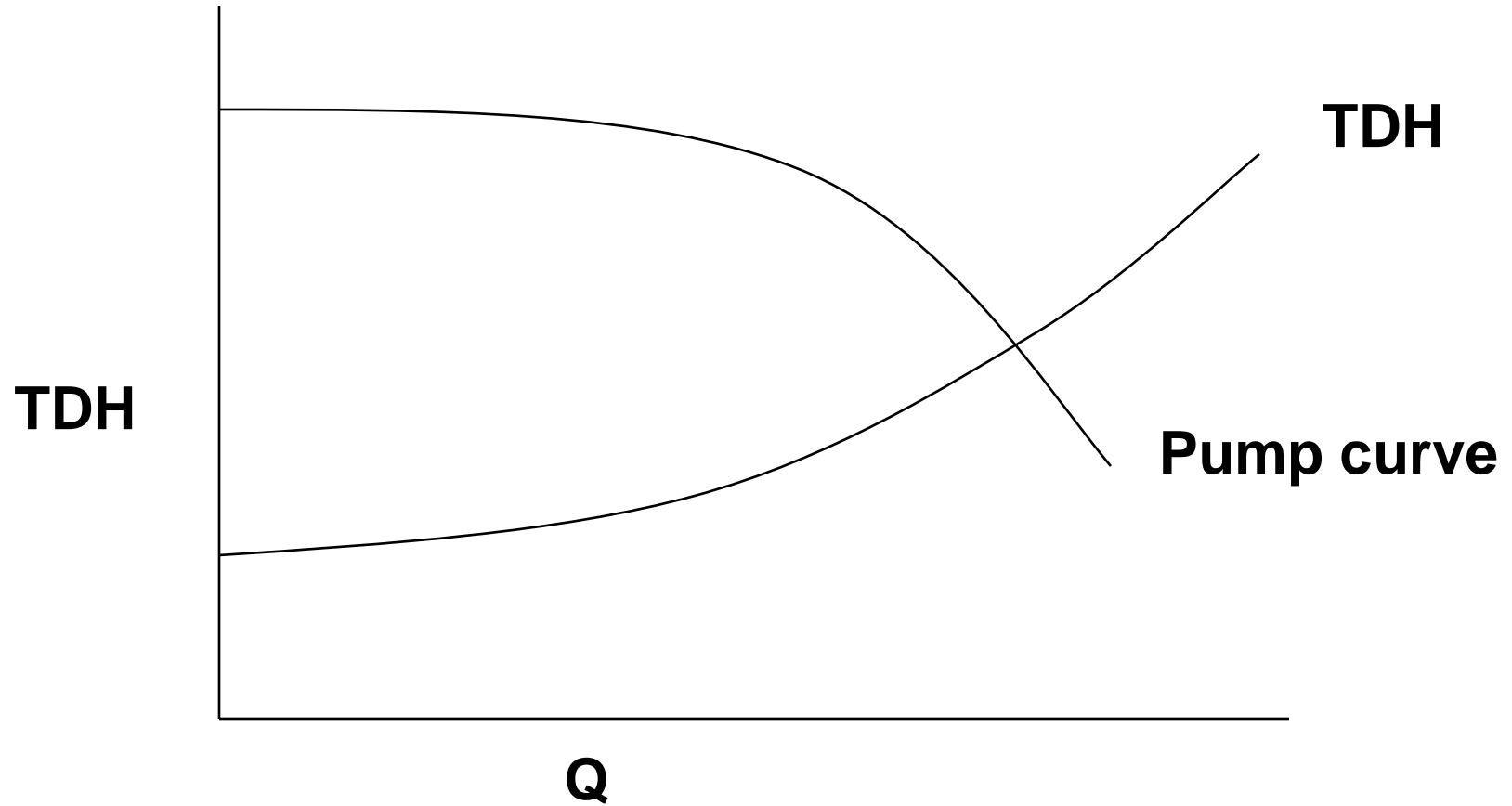
# Well Head Pressure v Q (Flow rate)



# TDH (System) v Q (Flow rate)



# TDH (System Curve) v Pump Curve



# Artificial Lift Systems

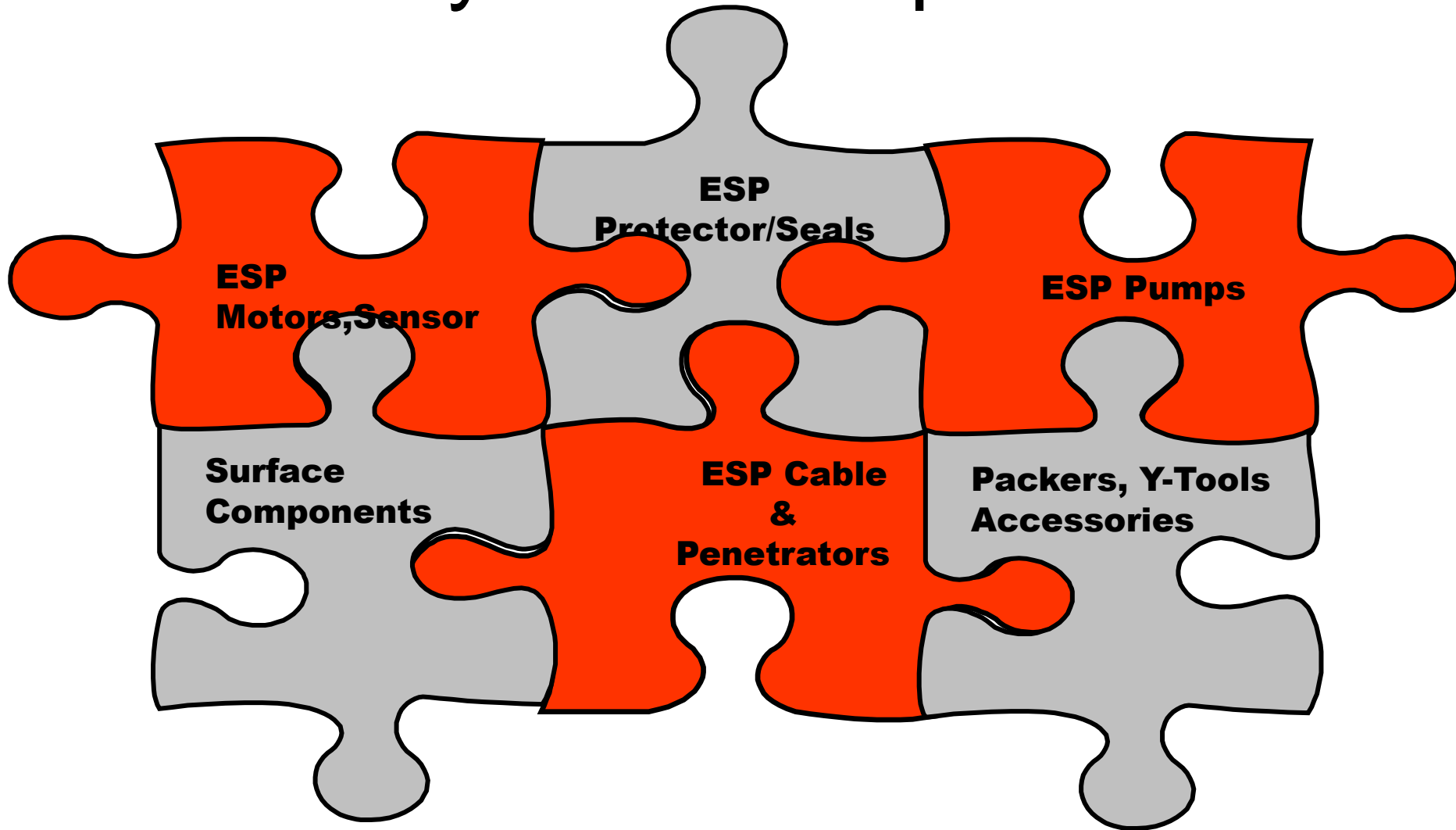
- ◆ **Electric Submersible Pumping Systems**
- ◆ **Horizontal Pumping Systems**
- ◆ **Reciprocating (beam) Rod Lift Systems**
- ◆ **Progressing Cavity Pumping Systems**
- ◆ **Gas Lift Systems**
- ◆ **Hydraulic Lift Systems**
- ◆ **Optimization**

# Electric Submersible Pumping Systems

- ◆ Surface Equipment
- ◆ Motors & Pumps
- ◆ Seal Sections
- ◆ Intakes & Gas Separators
- ◆ Variable Speed Controllers
- ◆ Accessories



# ESP System Components



# Hybrid Systems Technologies

## ESP systems

### Surface Unit



# Artificial Lift Optimization



**Elimination Process**



**Systems Analysis**

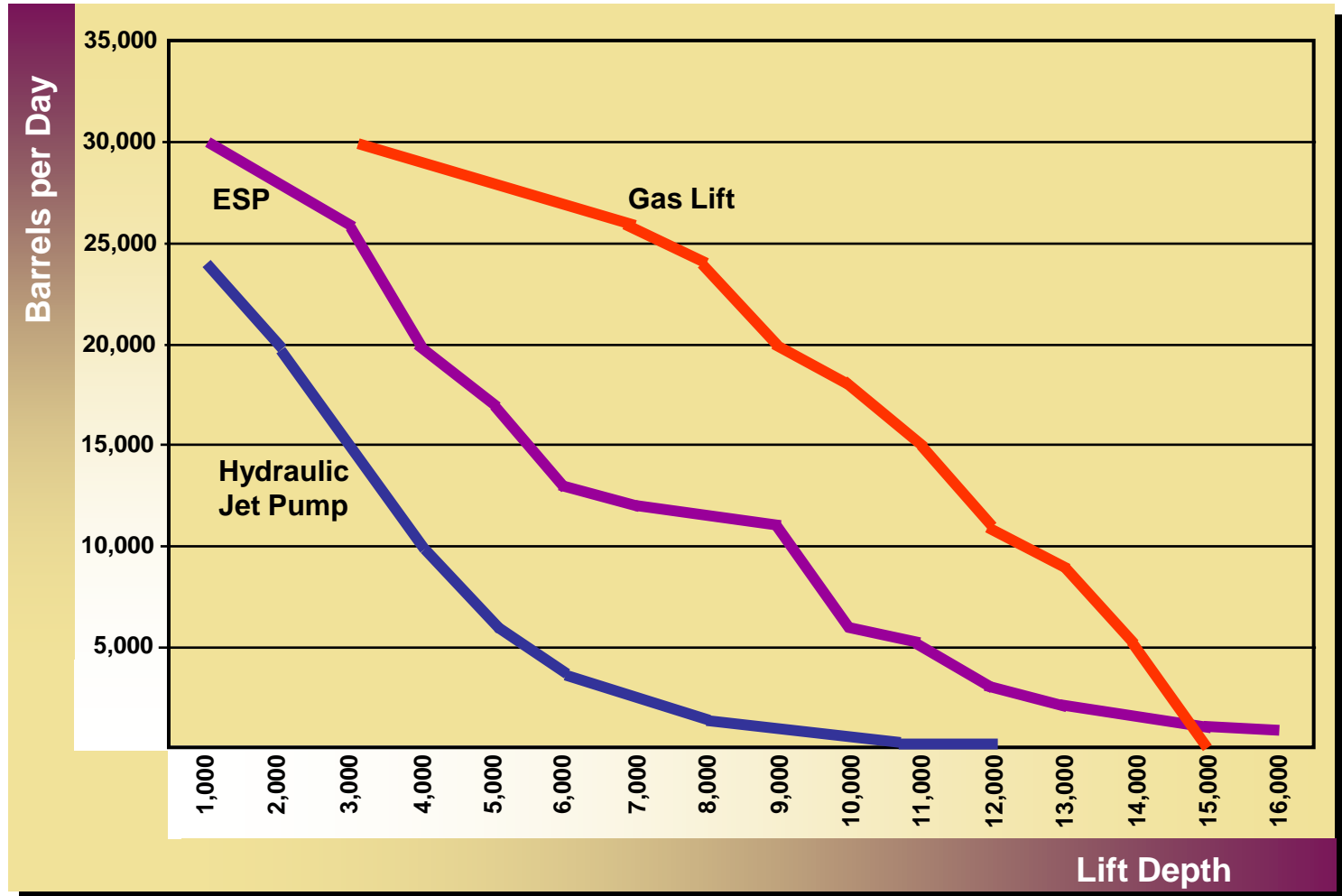


**Final Selection**

# Artificial Lift guide lines

Situation	Recommended Artificial lift
High BHP > 0.4 psi/ft	Flow well, maintain reservoir pressures (water or gas injection)
Medium to High > 0.25 psi/ft with high GLR.	Flow well, size tubing to achieve > 10 fps – Consider gas lift
Medium to High > 0.25 psi/ft with low GLR.	Rod pump for most application E.S.P for high volume lift P.C. pump for high viscous fluid and depth < 5000ft JET pump if casing size restricted
Low BHP < 0.25 psi/ft Or large draw-down required (drain well) Low pump intake pressure	Rod pump for most application P.C. pump for high viscous fluid and depth < 5000ft

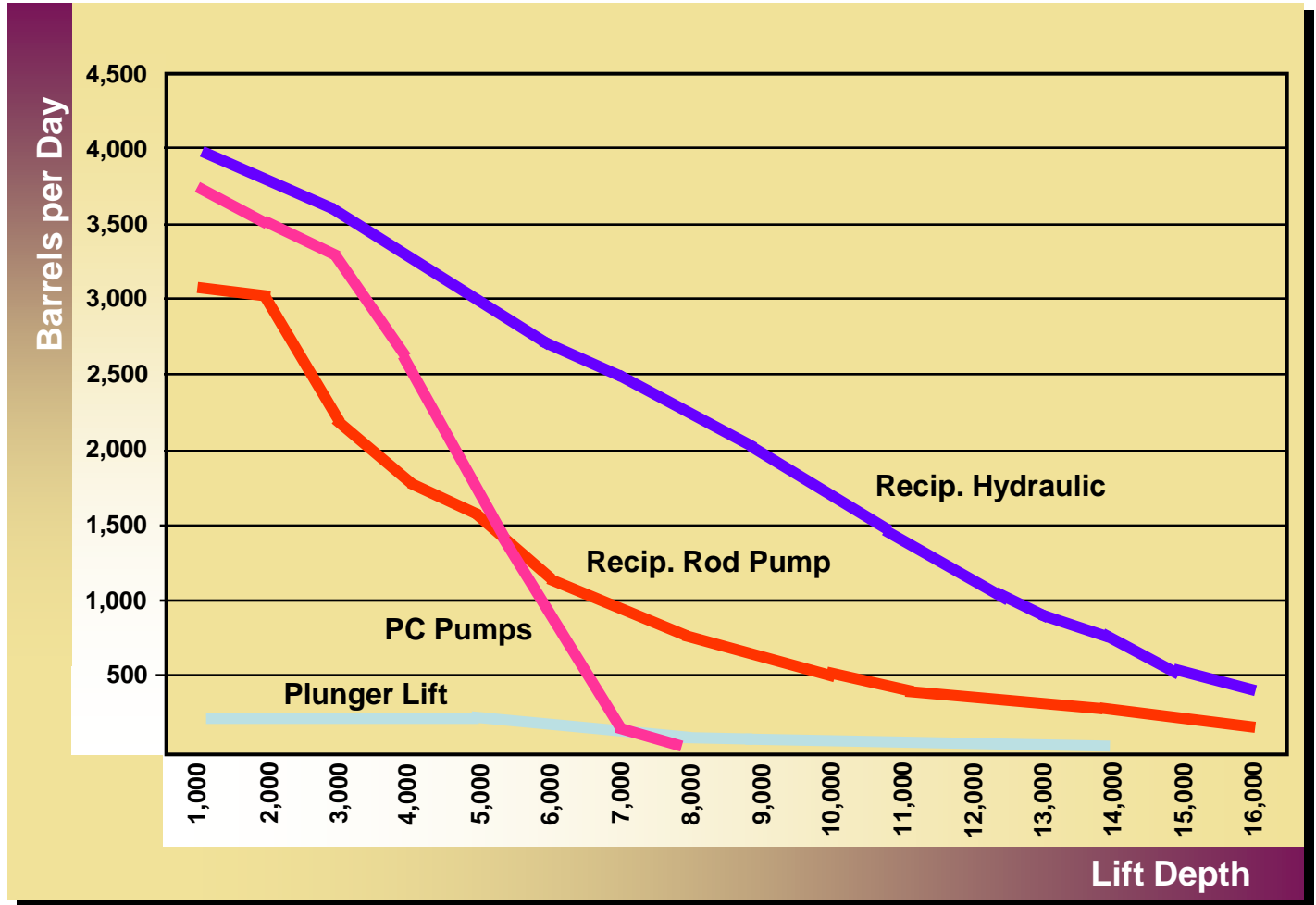
# Elimination Process



**High Volume**

**Hydraulic Jet Pumps, Electric Submersible Pumping and Gas Lift**

# Elimination Process



**Lower Volume**

**Reciprocating Hydraulic Pumps, PC Pumps, and Rod Pumps**

# Selection Process

## Final Selection

- **Proposal for Viable Forms of Lift**
- **Economic Evaluation Model**
  - **Capital Expenditure**
  - **Operating Expenses**
  - **Comprehensive Analysis**
- **What Equipment is Available?**
  - **Customer**
  - **Supplier**

# Hybrid Systems

**Hybrid systems utilize the combined strengths of our various lift forms to**

- **Increase efficiencies**
- **Reduce expenses**
- **Extend the capabilities associated with individual lift methods**
- **Expand application envelopes of opportunity**

# Hybrid System Combinations

- **ESP / Jet Pump**
- **ESP / Gas Lift**
- **HPS / Jet Pump**
- **ESP / Jet Pump**
- **ESP / PCP**
- **Reciprocating Rod Pump / HPS**

# Electric Submersible Pumping/ Gas Lift Combination

- The liquid head reduction capability of gas lift
- The high volume lift capability of ESP's
- Lift gas is injected above the ESP pump to lower the density of the fluid head
- This head reduction can be as significant as 40% of total head vastly improving the performance capabilities of the ESP

# **Electric Submersible Pumping/ Gas Lift Combination**

## **Features**

- **Reduces ESP discharge pressure requirements**
- **Supported by proven system analysis software and technical application experts**

# **Electric Submersible Pumping/ Gas Lift Combination**

## **Benefits**

- **Increased volumetric efficiency-  
higher liquid volumes**
- **Decreased injection gas  
requirements**
- **Superior reservoir draw down-  
increased production**
- **Increase pump installation  
depth**

# **Electric Submersible Pumping/ Gas Lift Combination**

## **Benefits Continued**

- **Reduction in pump and motor requirements**
- **Lower energy consumption**
- **Reduces electrical conduit requirements**
- **Gas lift provides backup to ESP pump failure**

# **Electric Submersible Pumping/ Jet Pump Combination**

**Utilizes an ESP with a downhole separator combined with a unique jet pump design to improve lift capabilities.**

# **Electric Submersible Pumping/ Jet Pump Combination**

**The gas is separated below the ESP and vented into the annulus. The jet pump located above the ESP is driven by the fluid discharged from the ESP.**

**The unique jet pump nozzle pulls the annular gas back into the tubing string mixing it above the ESP lowering the liquid head increasing the overall system efficiency.**

# **Electric Submersible Pumping/ Jet Pump Combination**

## **Features**

- **Utilizes benefits of ESP, Jet Pump and Gas Lift to increase efficiency**
- **Unique Jet Pump Nozzle for gas production**
- **Recombines formation gas above the pump to reduce head**
- **Can be used with annular lift gas injection to further reduce head**

# **Electric Submersible Pumping/ Jet Pump Combination**

## **Benefits**

- **Reduction in motor and pump size**
- **Increase liquid lifting efficiencies**
- **Smaller electrical power requirements**
- **Can be utilized in offshore environments- no annular venting required**
- **Increased pump land depth**

# ESP / PCP Combination

- The downhole drive mechanism of an **ESP**
  - The solids handling and heavy crude lifting ability of **PCP**

**Utilizing a specially designed ESP motor and gear reduction assembly attached to the PCP rotor the well can be lifted with improved power efficiencies.**

# ESP / PCP Combination

## Features

- **Unique motor and gear reduction assembly**
- **Variable Speed drive offered**
- **Eliminates rod string**
- **Applications in deviated wells**

# ESP / PCP Combination

## Benefits

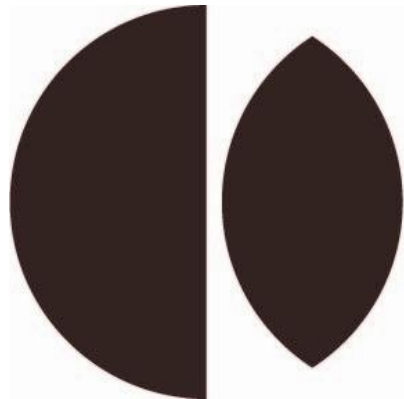
- **Reduced liquid fallback  
increased volumetric efficiency**
- **Increased reservoir drawdown-  
increased production**
- **Extends reserve recovery**
- **Improved lifting efficiency in  
low gravity or emulsified fluid  
applications**

# ESP / PCP Combination

## Benefits (cont.)

- **Eliminates rod wear in deviated wells**
- **Offshore Applications**

**Where is a Well, there is a Way**



الخریفة للبترول  
Alkhorayef Petroleum