The Way Forward With Ultra-High-Speed (UHS) ESP Technology

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AGENDA

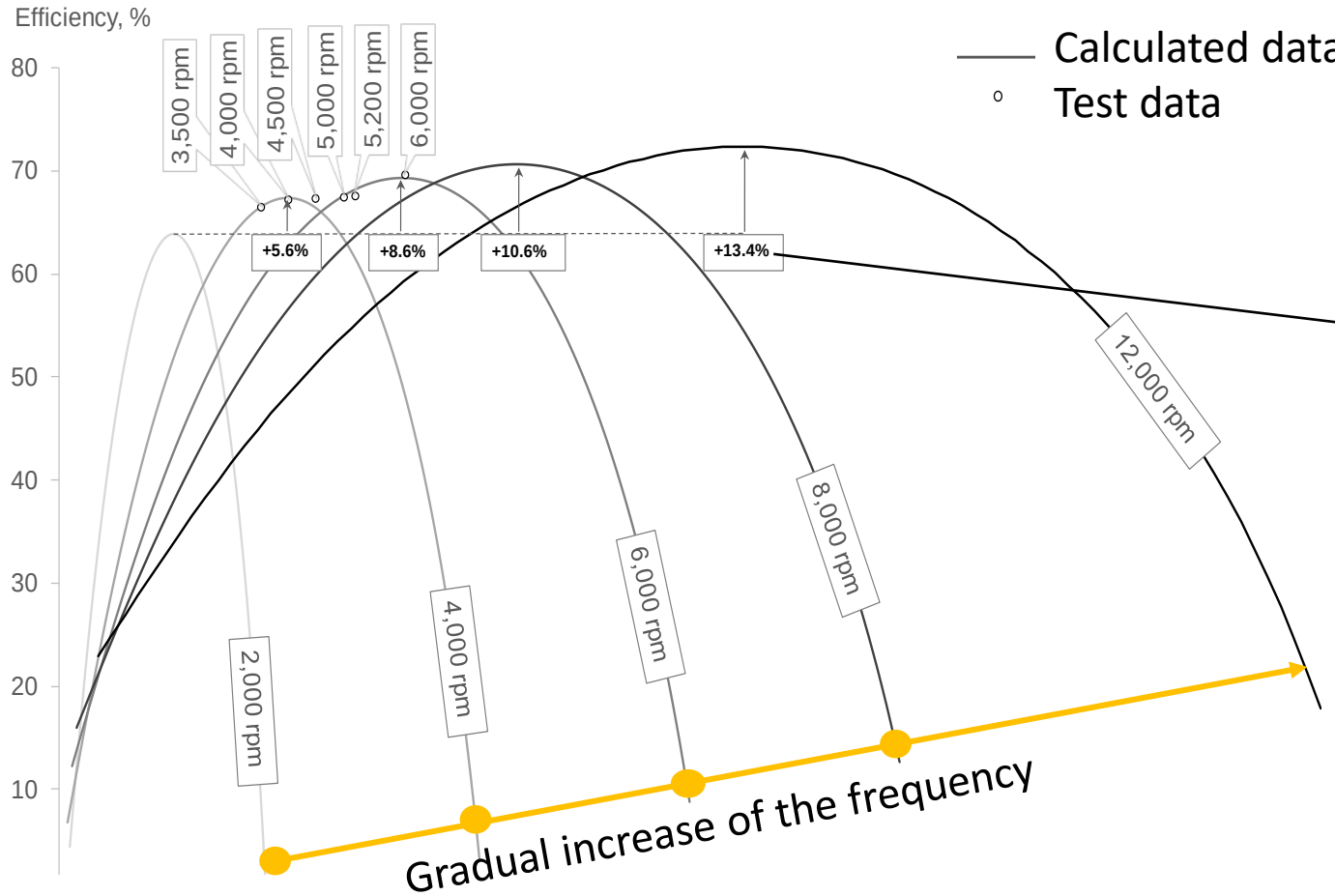
- Ultra-High-Speed ESP (UHS ESP) Technology
- Case Studies
- The way forward
- Conclusions

UHS ESP features

- Wide range & Optimized inventory (fewer pump types)
- Lower power consumption & requirements for cable
- Compact design
- Reducing costs and improving the efficiency of workovers
- Higher runlife

Let’s find out how these became possible….

Efficiency breakthrough



Multiple laboratory test have proved dependence between Operating speed and Efficiency and resulted in following increase:

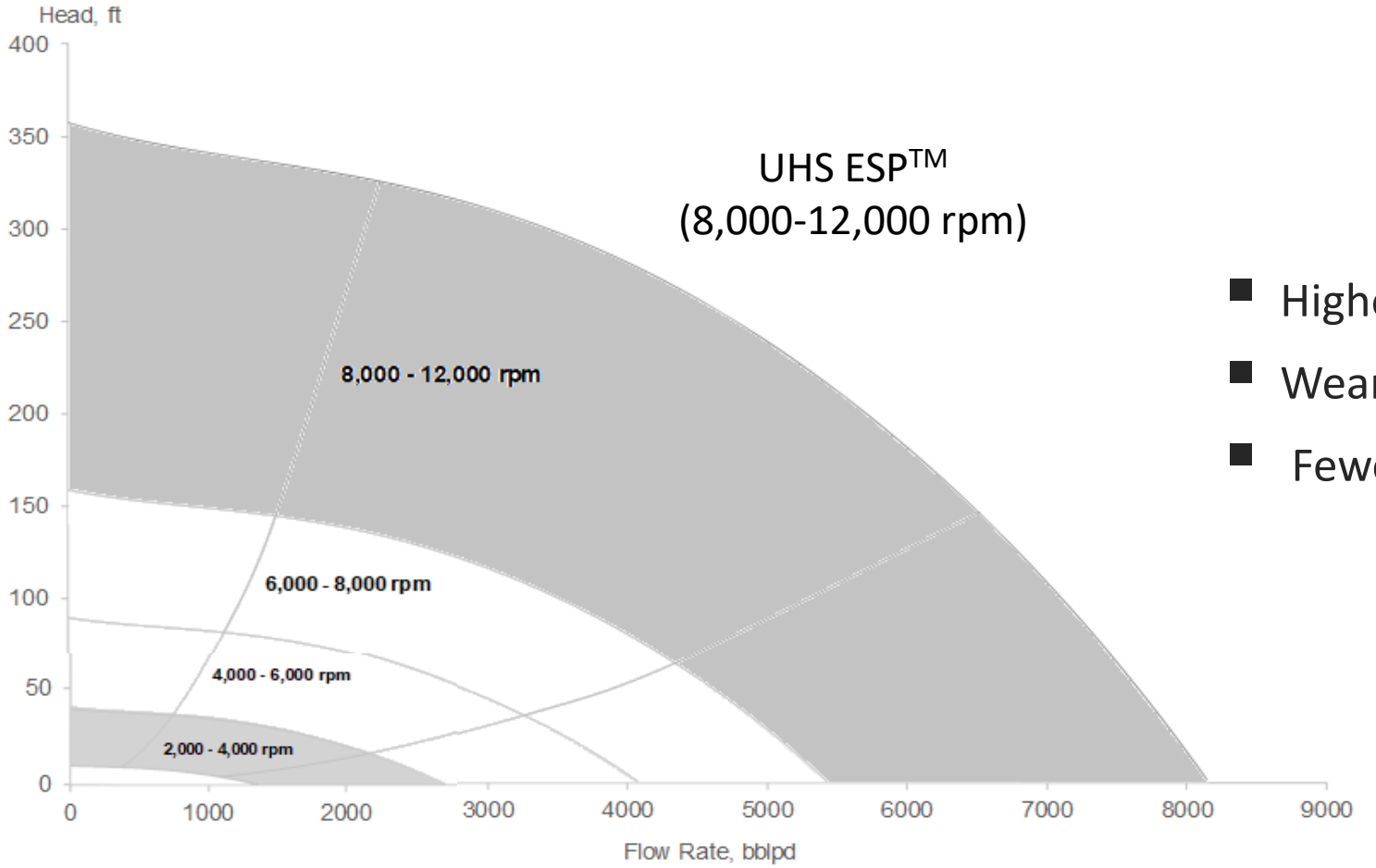
13.4 %

For centrifugal pumps

Pfleiderer / Lyapkov Formula:

$$Eff_2 = 1 - (1 - Eff_1) \cdot \left(\frac{RPM_1}{RPM_2} \right)^{0.15}$$

Pump stage performance



UHS ESP™
(8,000-12,000 rpm)

Conventional ESP
(2,400-4,200 rpm)

Pump stages

- Higher efficiency over a wider range
- Wear and corrosion resistant
- Fewer stages required at TDH

Power savings and CO2 emissions reduction

- Efficient UHS pump
- Efficient PMM
- Less losses in the low profile cable

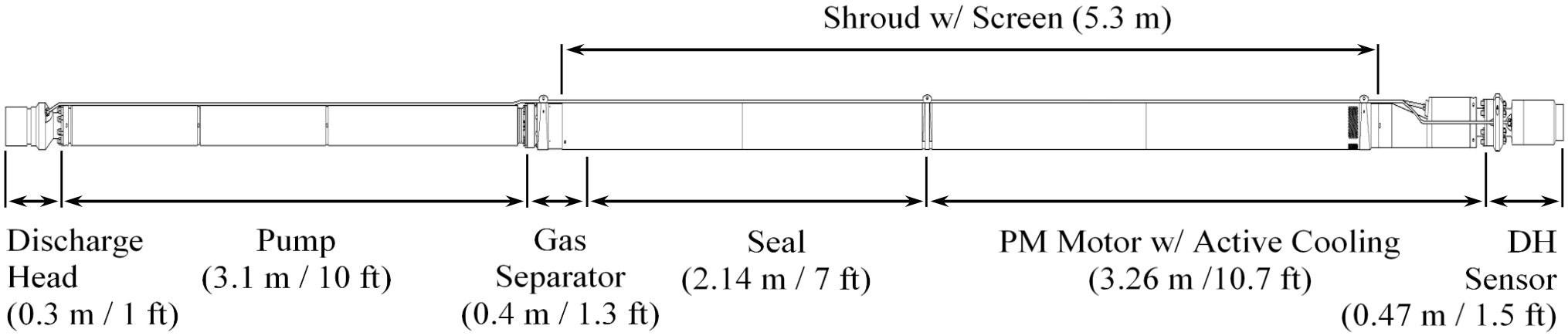
40% of power savings

- Less raw materials required
- Less manufacturing
- Less weight for freight

Implementation of one UHS ESP™ systems reduce **142 tons** of CO2 per year

UHS ESP design

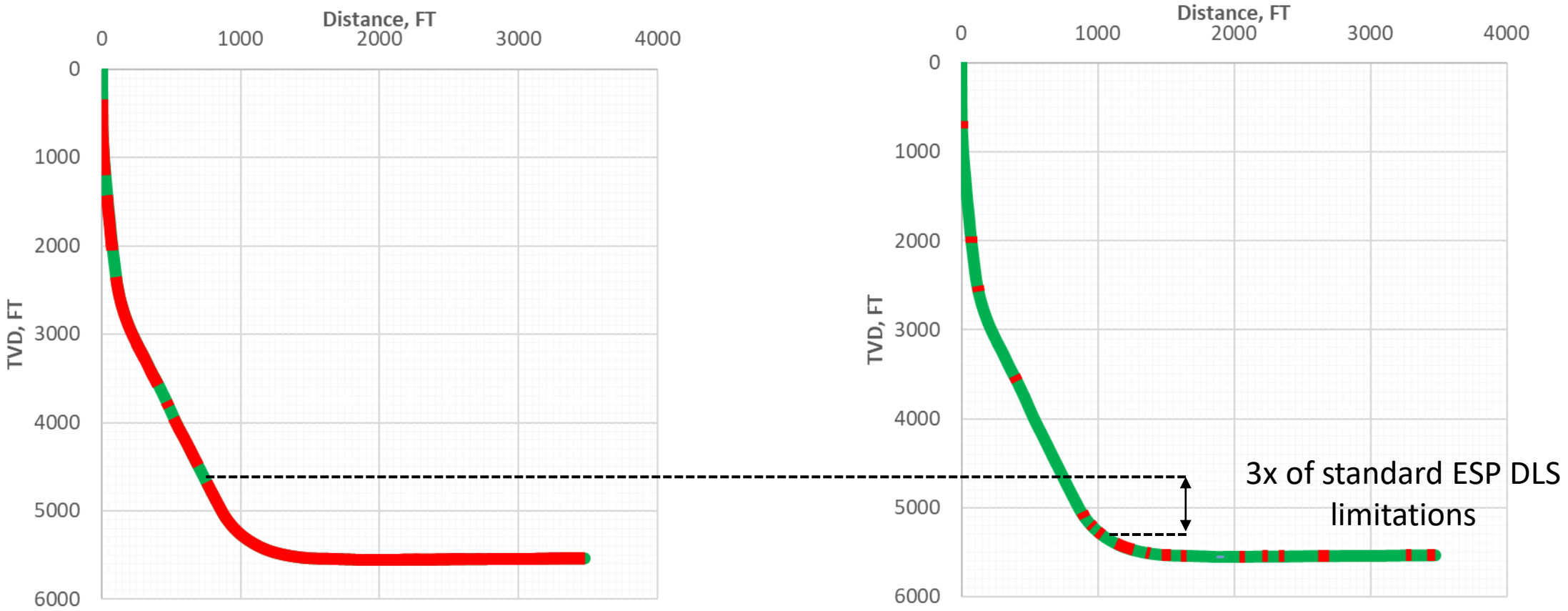
Typical UHS ESP, length 9.7 m / 32 ft



Dogleg severity limitations

Traditional ESP (3,600 RPM)

UHS ESP (10,000 RPM)

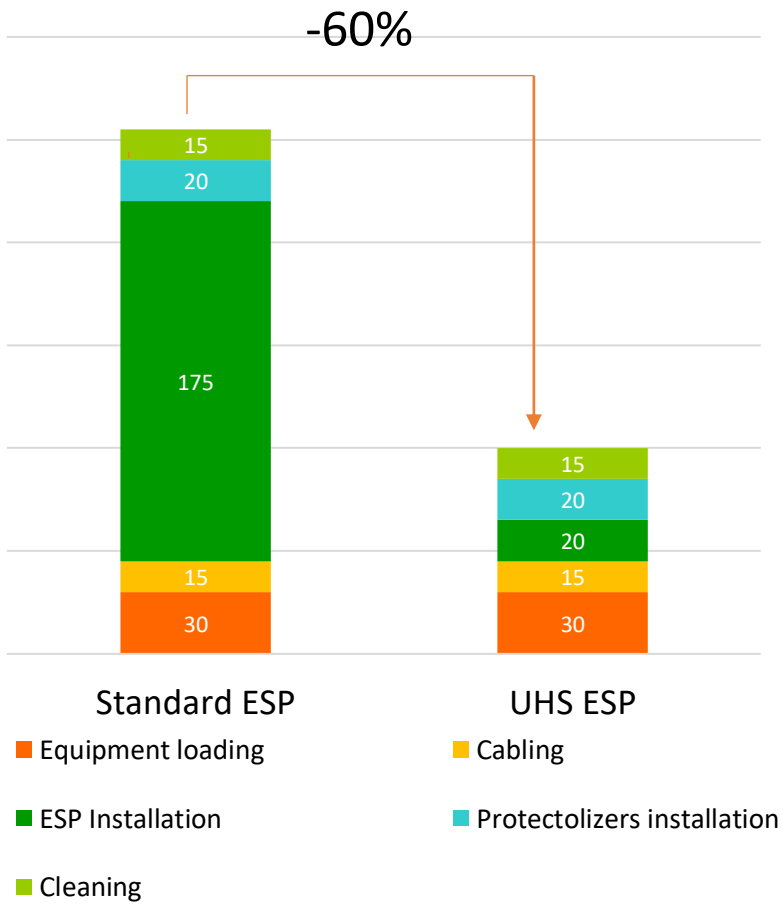


Pump Setting Depth selection: acceptable severe

Installation convenience

60% quicker installation than a standard system

- Total length is 2.5 more compact
- No oil filling on site
- Plug-in type MLE
- Comes on site fully assembled
- Fast and safe ESP unloading and run in hole
- Minimized risk of human error
- Lowered installation cost



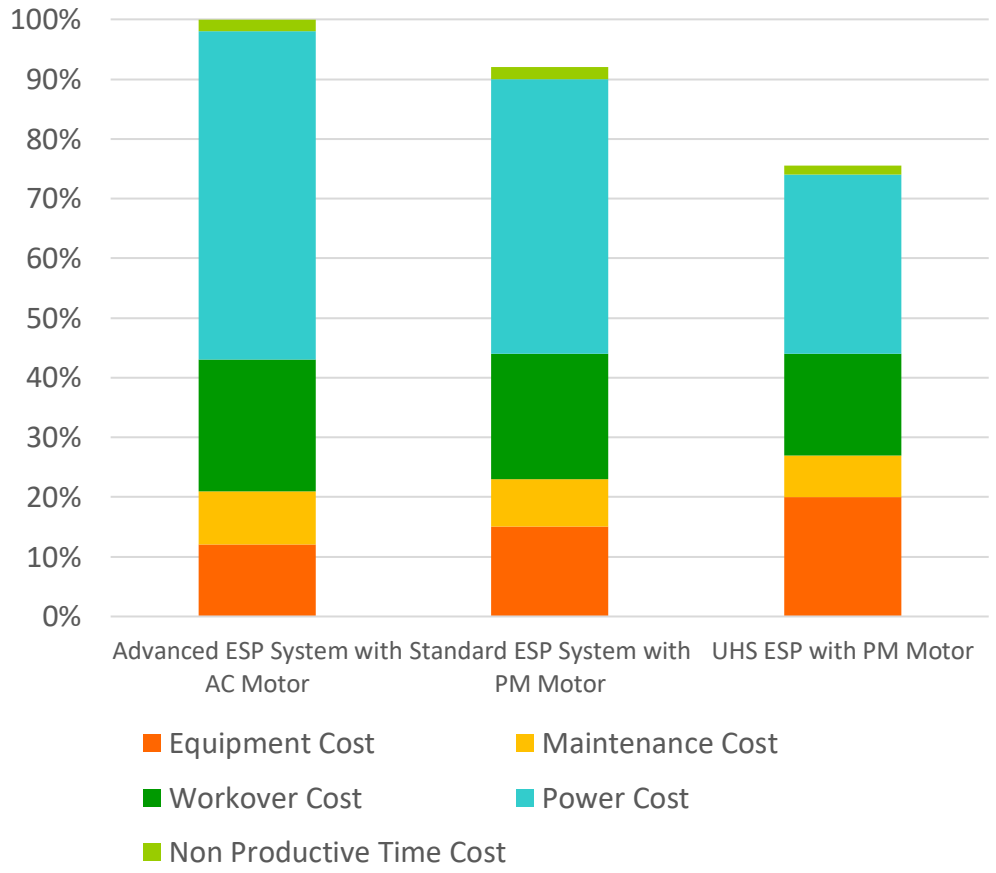
Case study. CIS
improving SPC and gas tolerance

Project goal: conduct mass implementation of the UHS ESP technology

System in use: UHS ESP™ (UHS-200, UHS-500, UHS-600)

Project results:

- Over 270 installations over 5 years
- reduced total cost of ownership by 25%
- power consumption reduced by 31%
- reduced installation time by 40 %
- oil production increased by 12%
- runlife increased by 23%



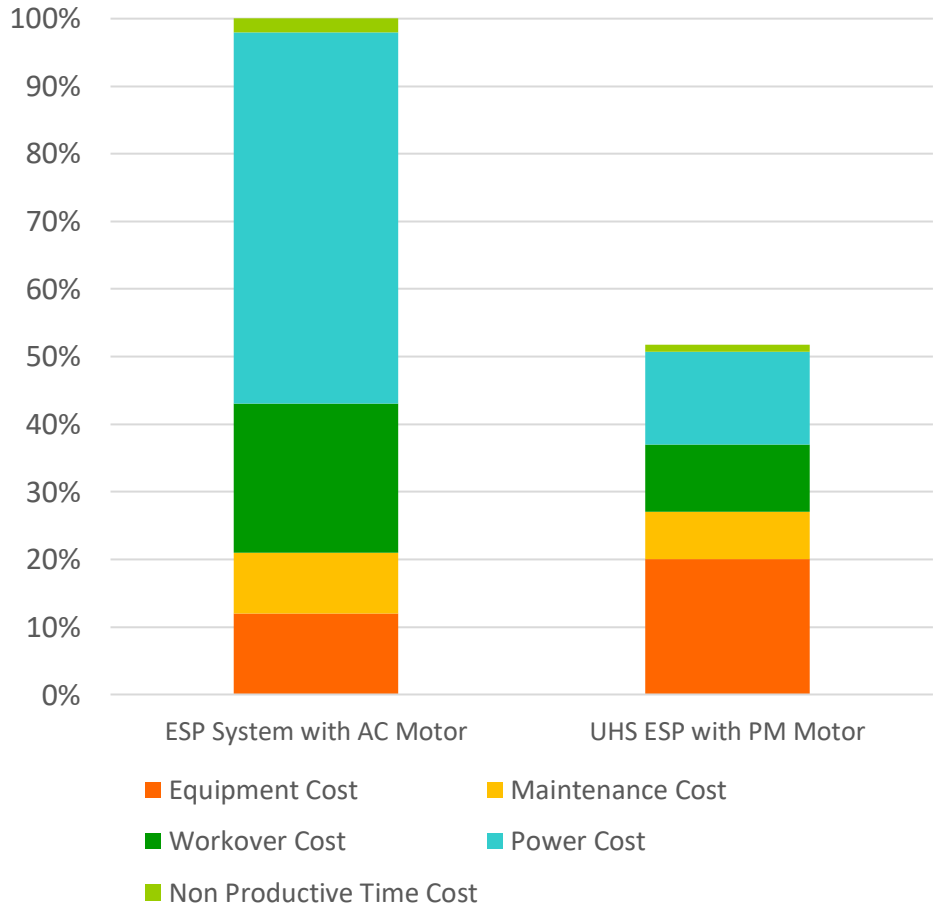
Case Study. Central Africa
improving SPC and gas tolerance

Project goal: reduce Specific Power Consumption in a candidate well and stabilize the operation

System in use: UHS ESP™ (UHS-500)

Project results:

- reduced total cost of ownership by 50%
- power consumption reduced by 75%
- oil production increased by 15%
- runlife increased by 315%
- stable operation with 79% free gas at the PI (applied GH)



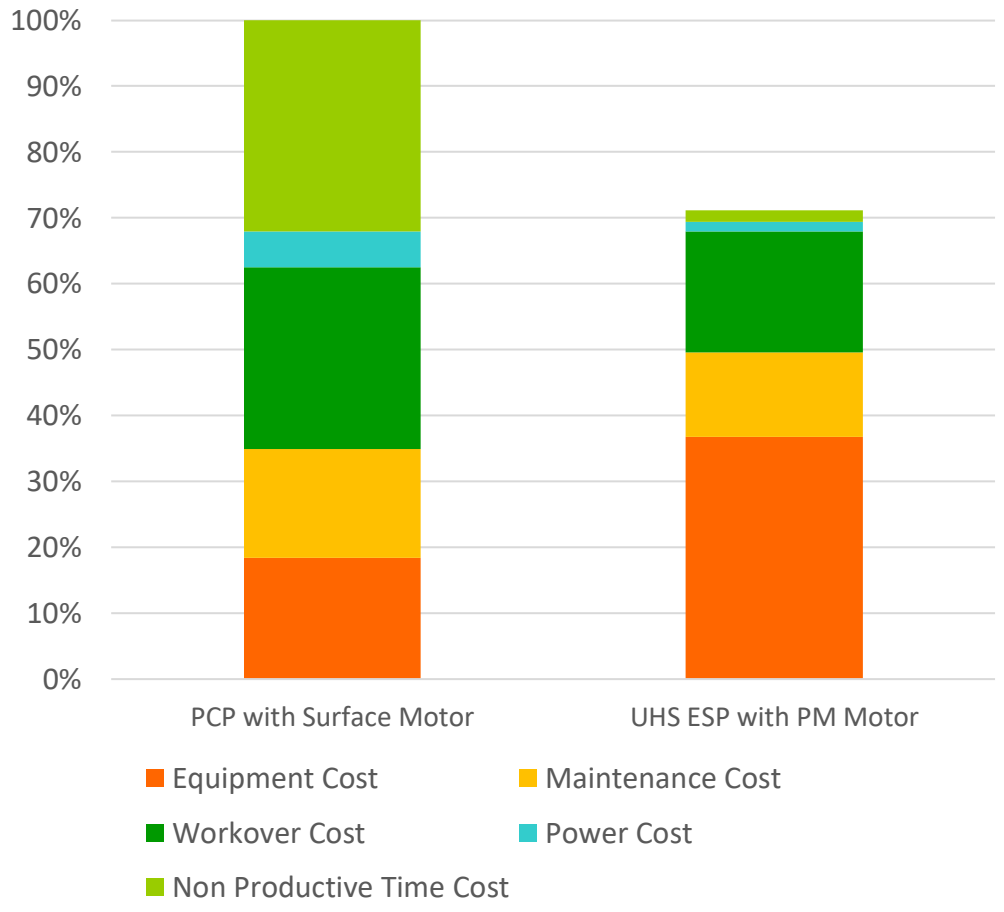
Case study. Central Africa
successful conversion to UHS ESP

Project goal: conversion of PCP (onshore) and Gaslift (offshore) to UHS ESP™

System in use: UHS™ ESP (UHS-500)

Project results:

- reduced total cost of ownership* by 29%
- oil production increased to the maximum available below the perfs
- runlife increased by 400 % vs 18 av. Runlife of 18 previous installations
- stable operation in 215F



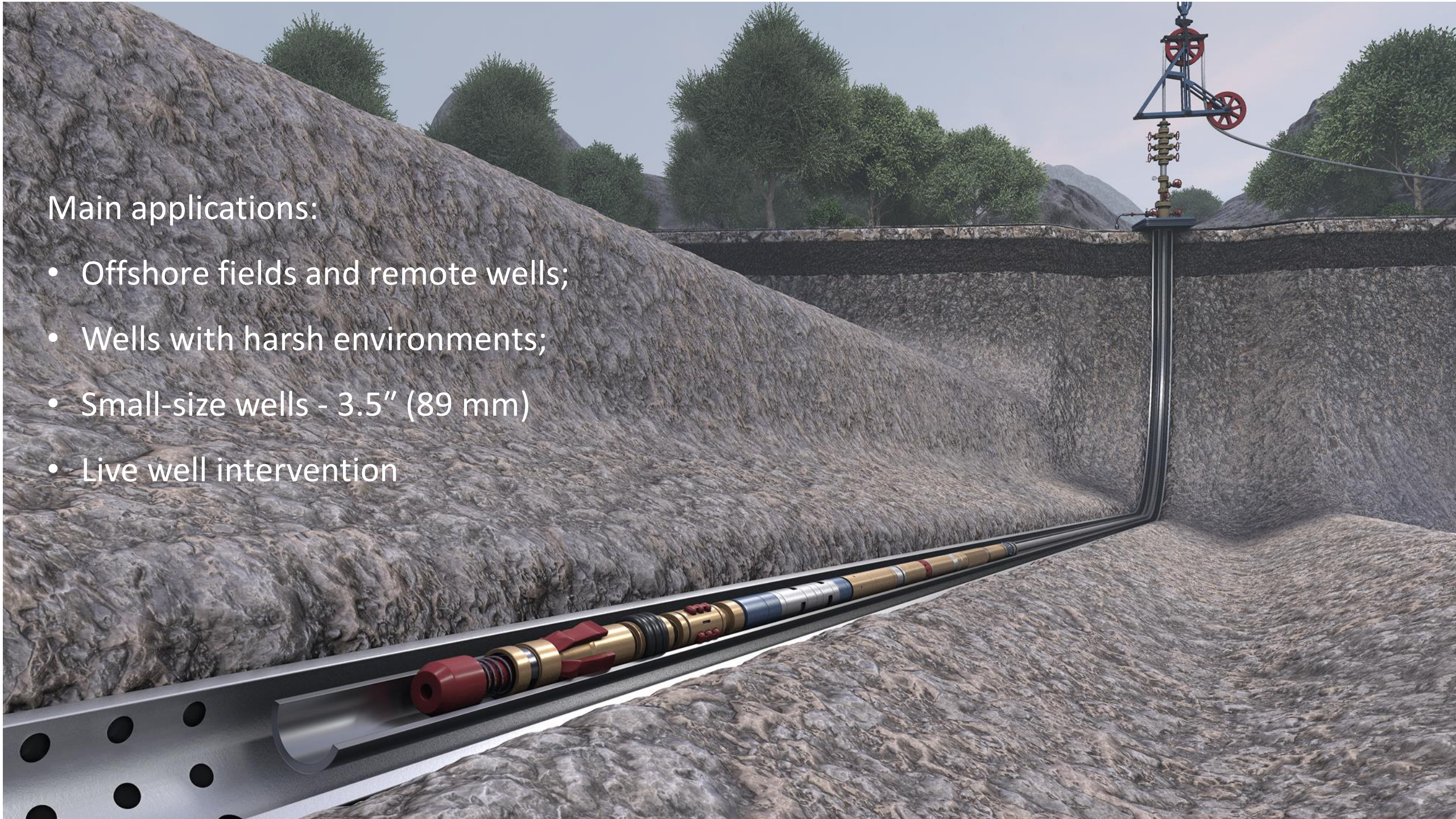
The way forward: Thru-Tubing ESP (TT ESP™)

Rigless Ultra-High-Speed ESP

Thru-tubing ESP is a next step in development of the unique UHS ESP™.

TT ESP is an inverted cable deployed UHS ESP™ for 3.5” tubing.

Up to 12,000 rpm	1300 bblpd	29.5 ft
Operating speed	Max. Rate	Total length



Main applications:

- Offshore fields and remote wells;
- Wells with harsh environments;
- Small-size wells - 3.5” (89 mm)
- Live well intervention

The way forward: Hyper-Speed ESP

15,000 rpm ESP

The Hyper Speed ESP systems represent an innovative technology targeted to provide capital and operational savings. The key elements, identified to evaluate the technology performance, include equipment, services and operating costs, reliability, production and HSE optimization.

HYP Pump

- Rated speed: 15,000 rpm
- Flow up to 4,000 bblpd (640 m3/d)
- Extended operating range

HYP Motor

- Rated speed: 15,000 rpm
- Efficiency >92%
- Modular design
- 120 HP in one module
- Up to 428 F (220 C)

Conclusions

- UHS ESP™ has proved its maturity with over 500 installations worldwide
- UHS ESP™ proved its high tolerance to the harsh environment
- UHS ESP™ proved its economic viability and reduced TCO
- The way forward with TT ESP – the rigless cable deployed UHS ESP™
- The way forward with HYP – the 15,000 rpm Hyper-Speed ESP

Acknowledgements / Thank You / Questions