OneSubsea
A Schlumberger Company

Subsea Boosting Systems

Increase well flow and recoverable reserves

Aligned with United Nations Sustainable Development Goals:
7—Affordable and clean energy, 12—Responsible consumption and production, 13—Climate action

Energy Consumption and Emissions Reduction:
Reduce energy consumption by 62% and CO_2 emissions by 131,000 metric tons compared with gas lift, for a typical 4–8 well tieback[†]

Reliability:
Mean time to failure (MTTF) >35 years, based on >4 million operating hours

Pressure:
Up to 16,500 psi [1,138 bar]

Water depth:
Up to 10,000 ft [3,000 m]

Step-out from host to subsea pump station:
Up to 74.6 mi [120 km]

Applications

- Enable or boost subsea—including deepwater—oil production
- Improve estimated ultimate recovery
- Increase tieback distance

How they improve wells

Subsea pumps boost production and recovery by increasing the pressure drawdown, creating a significant impact along the entire fluid journey from reservoir to processing facilities.

How they work

OneSubsea® boosting pumps are inherently robust and wear-resistant, suitable for use with fluids containing sand particles—a common occurrence in most subsea production systems.

All boosting pumps have an electric motor mounted above the pump section, both within a vertical cartridge that is fully encapsulated in a pressure housing. The optimized compact design enables subsea installation and retrieval by light vessels. The pump portfolio includes the following:

- Multiphase pumps use helicoaxial technology and are based on a rotodynamic pumping principle—energy is continuously imparted to the unprocessed well stream by a rotating impeller. The pumps can handle gas volume fractions (GVFs) up to 95% operationally and generate differential pressures up to 2,900 psi [200 bar], depending on the GVF. They are also suitable for high-viscosity fluids.
- Single-phase pumps use the rotodynamic pumping principle and a centrifugal design.
- Hybrid pumps combine helicoaxial and centrifugal technologies and are ideal for use downstream from a separator when there is a risk of gas carryover.

Depending on how a field develops, any pump type can be fitted into the standardized subsea interface, giving operators the option to replace one pump with a different type to meet their specific needs during the life of the field.

OneSubsea pump systems can be operated topside via the VSDs and pump control systems located in dedicated power and control modules or in local equipment rooms.

Increase oil recovery

Subsea boosting systems eliminate sole reliance on reservoir drive. By lowering wellhead pressures, they deliver 5%–50% improvement in reservoir drainage or recovery, reducing the cost per barrel of oil.

Accelerate production

These subsea systems increase flow rates by 20%–200%, boosting early revenue, decreasing the cost of incremental oil production to just USD 1–10/bbl, improving NPV, shortening the time to recoup investment, and more. Accelerated production also decreases the time needed to recover the producible volume of hydrocarbons, reducing the required life of the field and the associated expense and environmental impact.

Multiphase boosting pump.

Improve flow assurance

Subsea boosting systems are effective filters against pressure transients and slugging. Compression as well as heat transfer from the pump and motor increase the temperature of the produced fluid. Higher temperature along the flowline may bring several advantages in terms of hydrate and wax management.

Facilitate heavy oil production

Subsea multiphase pumps have been qualified for viscosities up to 30,000 cP. They have been installed in several heavy oil fields worldwide and reduce the viscosity of the fluid by increasing its temperature and the shear forces. The effect of this viscosity change can be as significant as the impact of the differential pressure across the pump.

[†] These results are for a typical 4–8 well tieback using an average-sized single-pump station and having differential pressures up to 2,900 psi [200 bar], assuming 95% uptime over 10 y. The longer the step-out, the greater the energy savings. The reduction in CO_2 emissions is based on an energy saving of 3.2 MW (2 MW vs. 5.2 MW) and an emission factor of 0.493312 kg of CO_2/kW.h—a number typically used for offshore gas turbines. For subsea boosting, the main source of energy consumption is the electric motor, while the power transmission system is the main source of energy loss. In the case of gas lift, energy consumption is driven by gas compression and cooling of the heated gas. Friction in the well and pipeline is responsible for energy wasted. Additional benefits ensue from improved operational efficiencies, including accelerated production, reduction in unplanned interventions due to reliable performance, less pigging, slugging mitigation, quicker field or well startup, and fewer shutdowns.

Subsea Boosting Systems

Lower capex and opex

Subsea boosting reduces insulation and hydrate management requirements, and it needs significantly less topside modification and space compared with gas lift. Moreover, it can enable smaller flowlines, further reducing capex. Continuous technology development and improved manufacturing methods have enabled a cost-optimized standardized subsea boosting system for pressures up to 15,000 psi [1,034 bar].

OneSubsea's high-reliability systems increase overall uptime, reduce pigging, mitigate slugging, shorten startup time, and reduce well intervention frequency, minimizing opex.

Enhance production management

As production progresses, different wells connected to the same manifold and pipeline experience different backpressures. Producing from weaker but economically viable wells may require restricting flow from the stronger and more profitable ones. Subsea boosting lowers pressures downstream of the chokes, maintaining production from weaker wells without adjustments to the stronger ones. It can even reduce the number of wells required, more than compensating for the cost of the entire boosting system.

Enable production from otherwise unviable fields

Subsea boosting is generally used to increase recovery, but in some cases—such as very long tiebacks—it may be the enabling factor; it would be impossible to flow the required distance without adding energy. Gas lift may help lift fluids out of the well, but it may not be able to efficiently transport them across longer distances to the host facility, or it may simply not be available.

Reduce environmental impact

For a typical tieback with four wells and a 20-km pipeline, subsea multiphase boosting uses about 60%–80% less energy than gas lift to achieve the same production rate. This is a significant saving because generally, compressing gas for export, injection, or lift consumes about a third of the energy required to operate an offshore production system.

Moreover, in the absence of a boosting system, offshore facilities often reduce separator pressure as much as possible in the late stages of the field's life to increase production. The lower the pressure, the more the energy consumed by the compression system to bring the gas pressure back up for export, injection, or lift.

Simpler interfaces to electrical infrastructure, less topside space requirements due to a more compact electrical power supply system, and smaller flowlines all reduce the footprint and further lower the environmental impact compared with gas lift.

Maximize advantages in greenfields

Subsea boosting can have a significant impact when incorporated into the early stages of planning. Considerable savings and environmental benefits can be realized by optimizing the system layout, chemical injection strategy, number of wells, and drainage plan.

Improve economics of brownfields

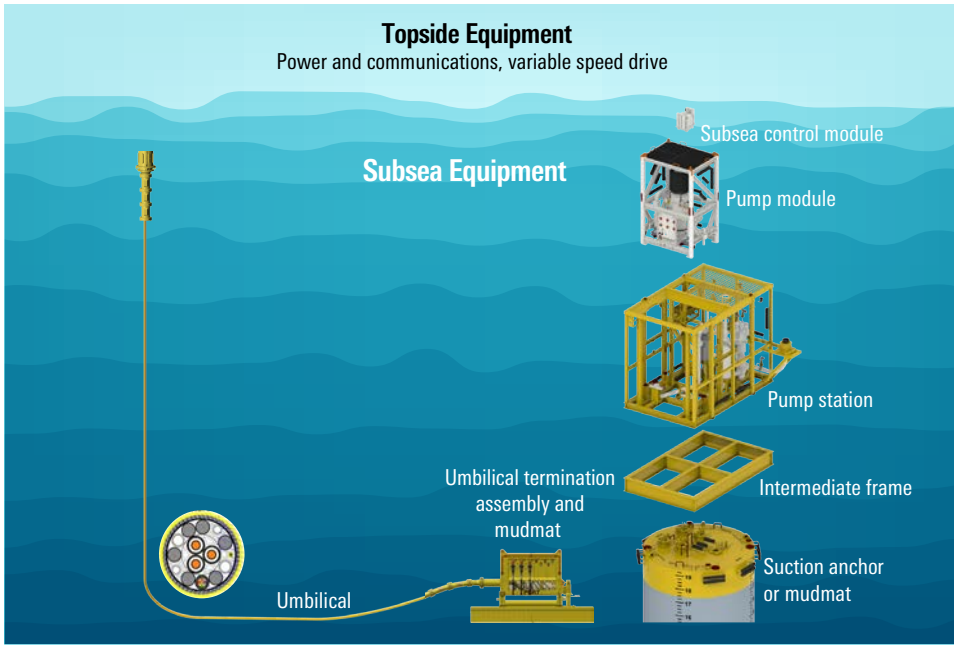
In an existing oil field, IOR is typically the main driver for subsea boosting. There is less to gain from optimizing hardware, but there may be a great deal to gain from revitalizing weak or dead wells, in addition to operational savings and environmental benefits.

Benefit from a system solution

To simplify installation and optimize pump performance, OneSubsea supplies single- and dual-pump subsea stations, comprising

- structural framework
- piping arrangement with valves and vessels (inlet flow mixer and outlet flow splitter tanks)
- retrievable items, including pump(s), choke insert, control modules, and electrical and hydraulic jumpers.

A dedicated umbilical connects directly to the station and, at a minimum, includes not only power, barrier fluid supply, and pump control lines but also methanol lines, fiber-optic cables, and chemical inhibitor lines, as required.



Subsea and topside equipment for OneSubsea boosting systems.

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