Electrification of petroleum installations
Commercial justifiable and necessary for the climate
Electrification, or power from shore, is a powerful tool for the people who manage our oil and gas resources. Given the fact that we will have oil and gas operations for many decades to come, this provides an opportunity to extract natural resources from the sea bed more carefully, while also giving us the maximum possible energy from each cubic metre of gas produced.

For the oil companies, the most important drivers for electrification are:
- Better energy efficiency and reduced greenhouse gas emissions
- Lower operation and maintenance costs, more uptime and more gas for sale
- Greater safety and a better work environment

Whether the emphasis is on the climate or economy, electrification is an investment in the future. If the power comes from renewable sources, electrification will almost always be a positive thing from a climate perspective. Electrification will always be favourable as regards health, the environment and safety. In the longer term, electrification will often be commercially profitable.

The power industry, led by Statnett, confirms that there will be enough electricity based on renewable sources available to cover the increased need on the Norwegian continental shelf as a consequence of the electrification of future developments.

ABB is of the opinion that electrification must be assessed from three perspectives:
1. Climate and energy efficiency
2. Business administration and economics
3. Health, safety and the environment

For the Troll A platform, Statoil has twice selected power from shore with ABB’s direct current system, HVDC Light, to run gas compressors on board. Electrification is eco-friendly and cost-effective, and hence represents a shortcut to a more sustainable and profitable oil and gas industry.

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- Around 18 per cent of Norway’s total emissions of greenhouse gases are due to offshore gas turbines.
- Electrification may eliminate major point sources of greenhouse gases and is a measure which makes a difference, permitting Norway to develop new fields while also meeting its climate obligations.
- At full load, offshore gas-fired power plants typically have an efficiency level of 38 per cent and in the majority of instances will be less energy-efficient than gas-fired power plants on land, which may have an efficiency level of up to 78 per cent. Offshore gas-fired power plants rarely operate at full load, but if they did they would be even less energy-efficient.
- This means that we get more energy out of every unit of gas on land, even taking into account losses in the transfer of gas to the continent and losses in the transfer of power out to the platforms.
- With power from shore, more gas is left over for sale, and more gas available in the market may suppress more polluting power sources.
- Gas power produced at the most efficient gas-fired power plants has around half the emissions of a modern coal-fired power plant.
- For the same reason, gradually replacing coal-fired power with more gas-fired power is a development which the UN’s Panel on Climate Change would like to see as this would significantly reduce greenhouse gas emissions in the short and medium term.
- With a given volume of gas to be extracted, we face a fundamental choice of how much energy we want to get out of each unit of gas. The more energy we get out of each unit of gas, the more coal-fired power – for example – we will have to cover the increased need on the Norwegian continental shelf as a consequence of the electrification of future developments.

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In commercial terms, electrification is often profitable. If electrification is commercially profitable, it will also be successful on older installations too. Just as the offshore industry is concerned with a long-term approach and predictable conditions, a far enough perspective must also form the basis for electrification calculations. With an increasing power surplus on land, short-term cash flow is often the only thing against the electrification of relevant fields.

Electrification is normally more profitable in new fields than in existing ones as power from land is taken into account right from the design and construction phase. Normally a new field will also have a longer payback time, i.e. several years over which to divide the investment costs and several years of lower operating costs. But electrification has been carried out successfully on older installations too.

- In commercial terms, electrification is often profitable. The internal rate of return, and thus the time frame, is decisive.
- Targets for short-term high cash flow and risk assessments may make electrification unprofitable in the short term, but choosing a power supply solution which has higher service life costs goes beyond the total return for the owners in the longer term.
- If electrification is commercially profitable, it will also be economically profitable due to higher income to the State. The economy is influenced positively as power from shore is more reliable than power generated offshore, resulting in lower operating costs and more production days for the platform.
- Greater reliability is linked with fewer mechanical parts on board, resulting in lower costs in respect of production stoppages, maintenance, repairs and the transport of service staff out to the platform. Greater regularity and fewer disruptions mean better earnings.
- Electrified petroleum installations give more gas for sale as they do not consume gas themselves for their own power production or other purposes.
- If area solutions are relevant – i.e. electrifying several fields at the same time – the economy will be further influenced positively as the costs are divided over multiple installations and organisations.

Life cycle costs are often lower in the case of electrification compared with the use of offshore gas-fired power plants. Although electrification results in a higher investment cost, it also results in significantly lower operating costs.

3. Health, safety and the environment

From an HSE perspective, electrification of oil platforms will always be beneficial. Gas turbines cause both noise and vibration which offshore employees avoid by using power from shore. There is also less risk of fire and explosion as the risk of gas igniting is reduced.

Electrical systems consists of fewer moving parts than offshore gas turbines and hence there is less need for maintenance and repairs. This means that fewer people have to travel offshore, hence a reduced risk for individuals and less need for noisy, polluting traffic to the platforms.

- Electrified installations are safer for people and provide better working conditions than gas-driven installations due to less noise and vibration and fewer sources of ignition.
- Reduced maintenance needs reduce the need to transport people from land in order to carry out repairs and servicing.

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Electrification

Projects
ABB is a pioneer in the field of transfer and control systems power. The company is involved in all five of the major electrification projects on the Norwegian continental shelf – Troll A, Gjøa, Valhall, Goliat and Martin Linge – and has supplied to a number of the projects internationally. Over the last ten years, developers on the Norwegian continental shelf have indicated six times that full or partial electrification of their fields is making their operations more profitable and eco-friendly: 2005: Troll A (Statoll)
- 2010: Valhall (BP)
- 2011: Gjøa (GDF Suez)
- 2014: Troll A, phase 2 (Statoll)
- 2015: Goliat (ENI)
- 2016 Martin Linge (Total)

These six projects alone represent a reduction or elimination of CO2 emissions totalling around 1.2 million tonnes per year.

Electrification is not specific to Norway. Electrification projects are taking place in Saudi Arabia, Qatar and the USA and are about to be delivered. Studies have also been carried out which are linked to electrification of offshore installations in Malaysia and Abu Dhabi in the United Arab Emirates.

Area electrification
The power systems used for electrification have been developed over the course of many decades. These are already tried and tested and have documented regularity which surpasses locally produced power on the platforms. Up to now, electrification has solely been used to power individual installations from land. To make electrification even more attractive, we can “think bigger”; for instance, by electrifying entire areas via a single cable from shore to a “hub” which distributes the power on to other installations nearby.

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Cost of action
Estimates for the cost of action, i.e. the cost (present value) per future reduced tonne of CO2 from electrification, vary widely. This is an indicator of how complex the task of devising profitability calculations for electrification is.

Calculations of the cost of action in this connection are used to compare the financial effects of various measures, in this instance in connection with the reduction of CO2 associated with petroleum production. According to EnergyNorge, what is known as the present value method is used as a basis. The following parameters are included as part of the calculation data:
- investment and operating costs for power from shore, power plants, emissions costs, transport costs for gas minus investment and operating cost for gas power on board and sales income for released gas.

Employment
The need for flexible, energy-efficient power systems will increase as the demand for power grows. This means workplaces today, but in the future as well, as greater emphasis on electrification is reinforcing elements of the knowledge we need for sustainable continuation of the Norwegian oil adventure and, not least, what we will have to live on once the age of oil is no more.

We already have the greatest density of electrified offshore installations, and there is major interest on a global level in what Norway has achieved. Norway already has a strong electro-technical environment which will be reinforced and extended if we continue to lead the way in the use of electricity in oil and gas operations. Focusing on electrification is reinforcing and extending expertise which is already an important export commodity and which will become even more important in the future, irrespective of industry.

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The concept
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Power from shore can be supplied via an alternating current (AC) system or a direct current (DC) system. AC is simpler and cheaper to install, but it is not as effective as DC over long distances.

Summary
The electrification of oil and gas installations at sea is a positive aspect for the global climate and often favourable on a commercial level, and will definitely improve working conditions offshore.

- Electrification has a beneficial effect on climate due to lower global emissions overall and because more power is produced for every unit of gas produced.
- Electrification has a positive effect on commercial considerations for the fields in the long term due to lower operating costs and increased recovery.
- Electrification has an immediate positive effect on health, the environment and safety for everyone working offshore.

Electrification is eco-friendly and cost-effective, and hence represents a shortcut to a more sustainable and profitable oil and gas industry.