The size of offshore wind farms and the distance at which they are located from shore are continuously increasing. Currently, the only way to export the generated energy to shore is by submarine cable. The increase in capacity and distance from shore is pushing theoretical limits of conventional 50 Hz AC technology to transmit the generated energy. In the German sector of the North Sea, this has led the grid operator to opt for an HVDC solution instead.

The constraints on AC cable capacity are inversely correlated to the applied power frequency. The frequency of 16.7 Hz, which has long used in the European railway sector, has thus been suggested in the technical literature [1] for use in offshore wind farms’ export and array systems. Low-frequency transmission extends the range of conventional AC technology, and obviates the need for offshore converter stations. Moreover, generally lower frequencies result in lower losses but larger transformers.

The suggestion of 16.7 Hz is one of convenience, since a standardized supply chain exists around it. A change in frequency affects all electrical and some structural components, and thus the cost, of a wind farm. This work aims to determine which frequency minimizes the lifetime cost of energy of an offshore wind farm.

The development of offshore wind energy started by adapting onshore wind technology to be able to cope with the offshore conditions. By now, manufacturers have designed turbines specifically for this purpose, yet the power system is still designed using the same principles that are used for onshore utility applications.

HVDC maximally utilizes a cable’s real power transmission capacity at the expense of an onshore and an offshore converter stations. The realization of the offshore converter station is challenging and recent setbacks have led to a significant increase in the perceived risk.

DNV GL Energy advocates a paradigm change in design approach by regarding a wind farm as a system rather than as the sum of individually optimized components and aims to understand how technological changes, such as a change in the key system parameter i.e. power frequency, affects the wind farm’s lifetime costs.