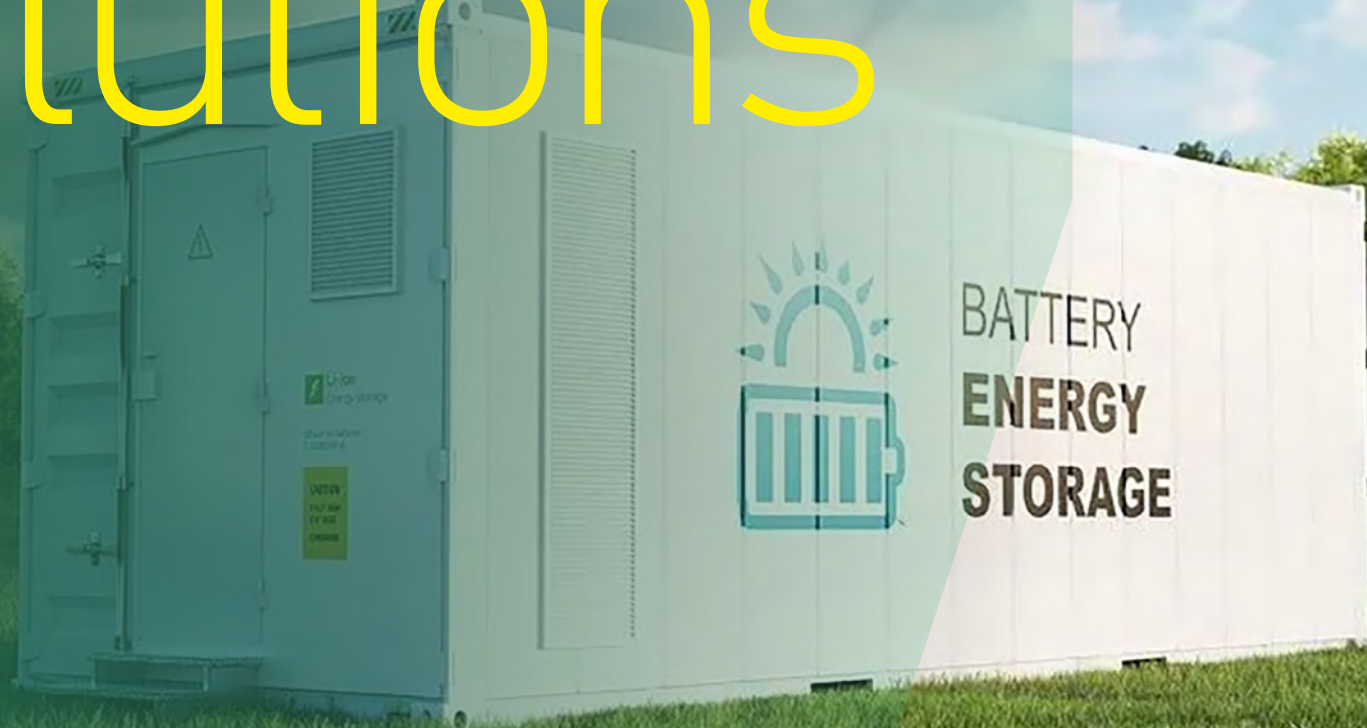


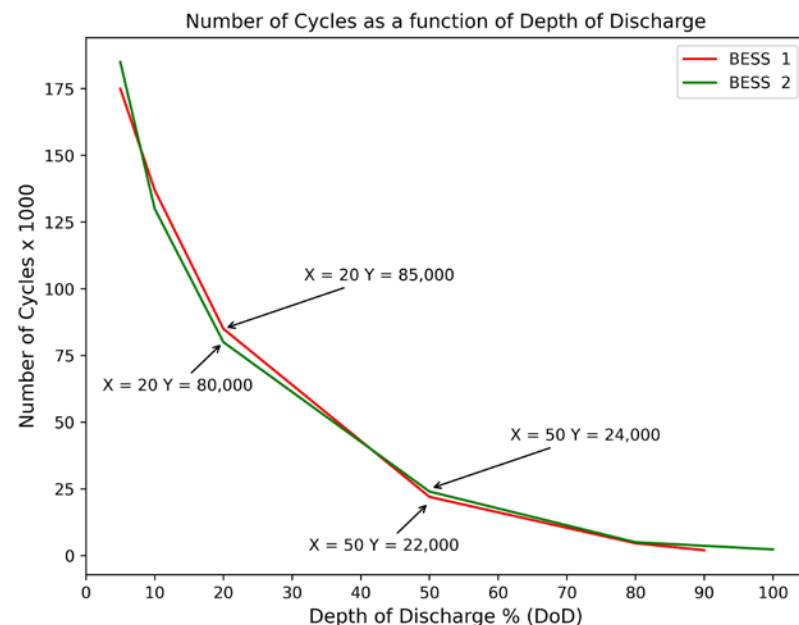
BATTERY solutions



The use of batteries enables numerous functionalities on board a vessel, from optimising generator operations and fuel consumption, to supporting methanol engines and fuel cells during rapid power changes. On the other hand, batteries are expensive, heavy and dead within two years if not operated properly. Understanding batteries and properly defining their role in an electrical network is essential in ensuring their lifetime and return on investment (ROI) potential.

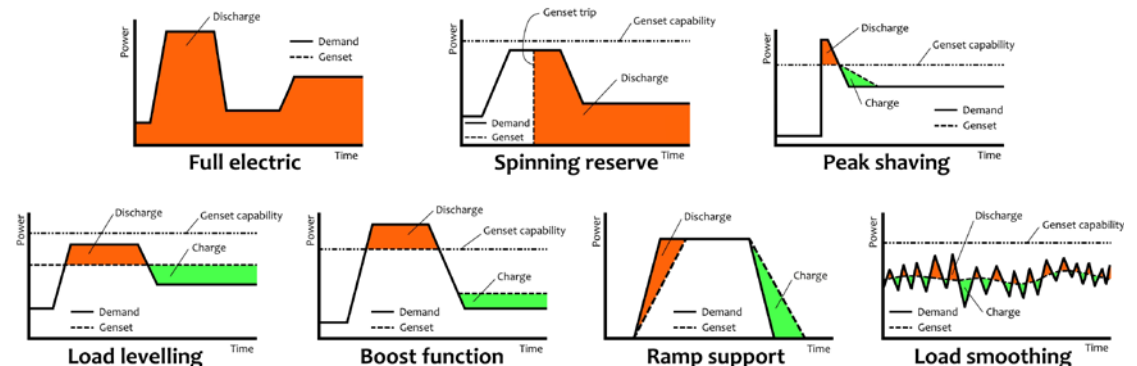
Battery specifications

A important characteristic of a battery is its Depth of Discharge (DoD). The DoD defines how much of the total battery capacity is actually being used. There is a direct relationship between the DoD and the number of cycles of a battery, which indicates its lifetime. A DoD of eighty per cent typically means that a battery is used between ten and ninety per cent of its state of charge. Depending on the battery chemistry, at eighty per cent DoD, the battery can do a number of charge and discharge cycles, until it is considered to be at its end of life. The lower the DoD, the higher the number of cycles a battery is able to provide.



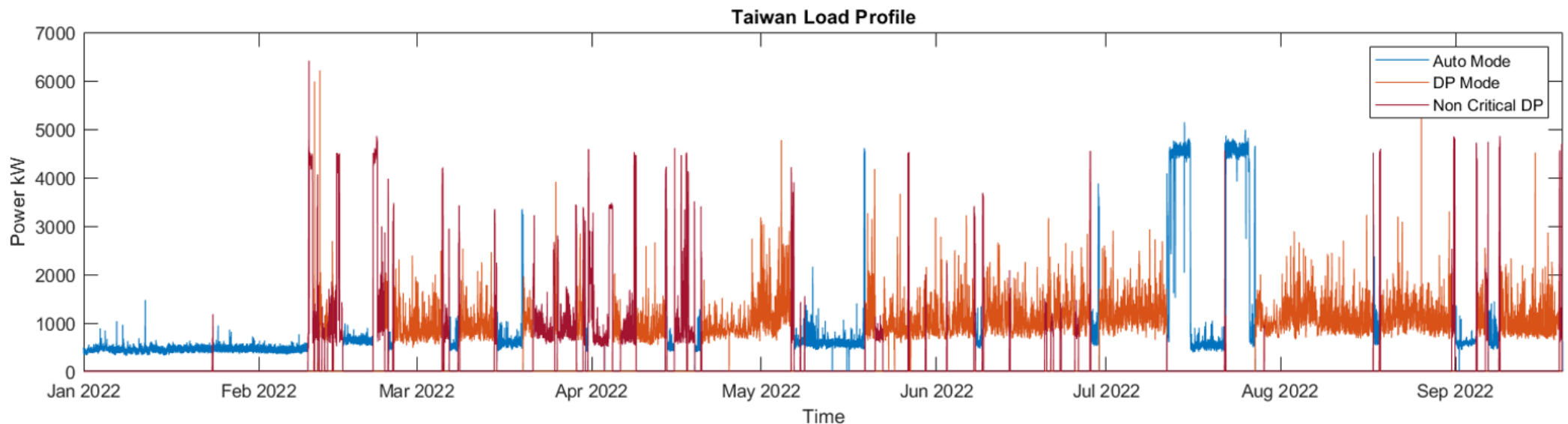
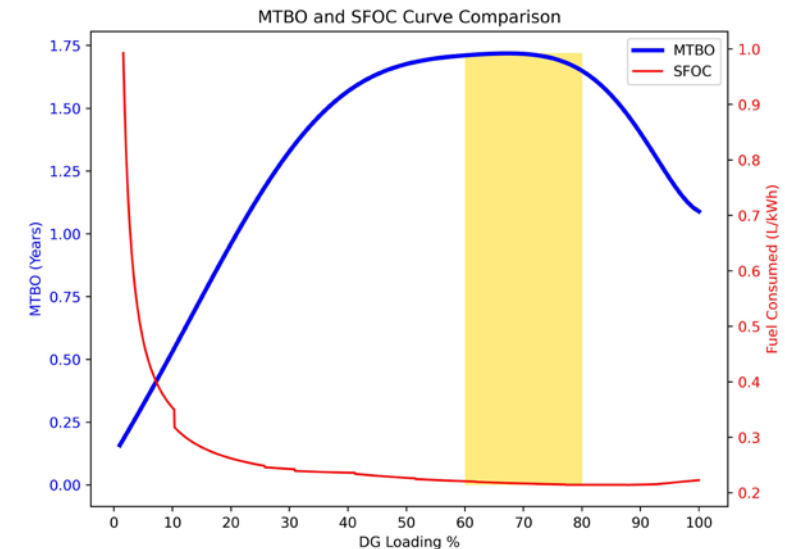
The benefits of a BESS on a vessel

A battery can be employed to perform a variety of tasks on a vessel depending upon its needs. Nowadays, there are governments across the world mulling over the introduction of zero emission zones and silent operation zones, especially inside and in the vicinity of ports. A vessel can be operated with a battery in the fully electric mode to meet the vessel's load demand and keep the generators switched off to meet these regulations. To increase the vessel's redundancy, for example in the event of a fault, the battery can operate as a spinning reserve and meet most parts of the load demand until the fault has been corrected. This capability ensures that all critical and operational equipment on board can continue to perform their tasks uninterrupted. Batteries can also assist in the function of peak shaving to, for example, prevent the startup of another generator in case the increase in load demand is only for a short period of time.



Design considerations

A goal of installing a battery onboard can be to reduce generator operational costs. Consistent operation of diesel generators at low load factors makes them susceptible to wet-stacking. This can drive up maintenance costs as several components will need to be replaced more frequently. The minimum time before overhaul (MTBO) curve provides an idea as to how many operational hours can be achieved by the generator when operated at a certain load factor on average, before heading into long term maintenance. The MTBO curve estimates that consistent operations with an average load factor from sixty to eighty per cent can minimise generator maintenance costs and increase the availability of the generator for operations. At the same time, the specific fuel oil consumption curve of a diesel generator indicates that at low load factors in the range of ten to thirty per cent, fuel consumption is quite high for the minimal energy it delivers. Whereas at high load factors in the range of sixty to eighty per cent, the fuel consumed is relatively lower for the much higher energy it delivers. With this knowledge, maintaining a high load factor can be seen as beneficial for both fuel and maintenance cost savings.



Operational profile analysis

The (optimal) battery size is highly dependent on the operational profile of the vessel it is installed on. Whether the battery is designed for a newbuilt vessel or designed for a (midlife) upgrade of the vessel, the operations and load demand of the vessel must be known in order to determine how the BESS can be used. The operational profile will lead to the required battery functions, which will then lead

to a power and energy capacity requirement for which the battery and converter can be sized. It is important to understand batteries and the role they play in the electrical power system, as choosing a battery system is not a simple task. But with the early involvement in the design process of electrical system integrators such as Alewijnse, this task can be made substantially easier.



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Our goal is to co-create value with and for our customers and partners. We aim to develop and improve electrification and automation solutions which are innovative, sustainable and of the highest quality. We focus on making a valuable contribution to successful projects in the maritime and industrial sectors.

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