Electric and hybrid vessels with energy storage in batteries and optimized power control can provide significant reductions in fuel consumption, maintenance and emissions. Such solutions also enable improved ship responsiveness and thereby improved operational regularity and performance, as well as safety in critical situations.

DNV GL’s Maritime Advisory provides decision support to ship owners, designers and yards for making vessels ready for future battery retrofit or ready for battery operation today - pure battery or battery hybrid with diesel or LNG. Based on technical and financial feasibility studies, DNV GL helps you select the best option according to operational and environmental requirements. There are two options for making a vessel Battery Ready: 1. Vessel Ready for future retrofit and 2. Vessel Ready for battery operation today. The DNV GL Guideline for Large Maritime Battery Systems will be used as a reference document in the work.

Option 1: Vessel Ready for future battery retrofit
Build a vessel that will use a diesel or gas based power system that can easily be retrofitted with batteries in the future. This can also be a good option for ships under construction or existing conventional designs.

Benefits
- DNV GL validates that the system is optimized for easy retrofit
- Minimum investment requirement
- Cost-benefit assessment pinpoints when a full conversion is attractive
- Increased confidence for owner, charterer, investor and other stakeholders
- After retrofit, all benefits that are listed below under Option 2

Option 2: Vessel Ready for battery operation today, new building or retrofit
Build or retrofit a vessel with battery system and engines/motors installed and ready to run on battery from first day of operation.

Benefits
- Cost-benefit assessment illustrates the vessel’s performance to ship owners and charterers
- Cost reductions from optimization of engine/motor size vs. battery size
- Independent and credible battery service life assessment
- Avoid engine loads where Tier III-solutions, such as LNG and SCR, have non optimum emission performance
- Optional storage of energy from waste heat recovery, regenerative braking and renewables
- Enlarged negotiation power towards battery vendors.
The path to become ‘Battery Ready’

DNV GL’s Maritime Advisory can assist you all the way from planning, concept design, approval in principle, to a final business risk and safety risk analysis as required by DNV Class requirements. This can be done in four phases as described below.

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<th>THE PATH TO BECOME “BATTERY READY”</th>
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<td>- Battery system safety risk analysis (mandatory if DNV GL Battery Power Class)</td>
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1. **Strategy – Power and energy system decision**
   - Technical feasibility assessment:
     - Battery system location, sizing and range in battery mode based on the ship operational requirements/profile
     - Estimation of operational life of the battery system
     - Engine/motor system location and sizing based on the ship operational profile
     - Outline of key requirements for a Battery Ready design
     - For future retrofit: High level list of technical changes that will be required
   - Financial analysis:
     - A high-level financial comparison of engine/motor options and battery options including both investment cost and operational expenses
     - Sensitivity analysis for impact of fuel price development (and of battery price if future retrofit)
     - High level evaluation of strengths and weaknesses (e.g. SWOT analyses) of alternative solutions with respect to technical issues, environmental aspects and economy

2. **Concept capture**
   - DNV GL can assist you in your development of novel ship designs and perform detailed technical feasibility studies tailored to the specific design and technical challenges of your vessel
   - DNV GL recommends a hazard identification (HAZID) review of the concept to identify hazards which could lead to high risks in operation. DNV GL can also assist with design review of existing drawings at an early stage

3. **Initial design**
   - DNV GL offers verification of the design concept and confirmation of compliance through DNV GL’s Approval in Principle. Ships preparing for Battery retrofit are ready to start the process as soon as the investment climate is right
   - DNV GL helps you to identify and mitigate the risks associated with a given design to ensure the development of a safe and cost effective system right from the beginning

4. **Risk management**
   - DNV GL will perform a risk analysis to identify, rate and manage safety risks and business risks
   - The DNV GL battery guideline state that a risk analysis shall be undertaken for any new or altered concept with the goal to document a safety level which is at least equivalent to a new, comparable diesel-fuelled vessel
   - DNV GL has the tools and competence needed to help in the qualification of battery related systems

DNV GL’s analysis takes into account both investment costs and operational costs in a life cycle perspective. The analysis illustrates payback time and the value of the investment over the lifetime of the ship for relevant options.