

D7.6 Framework for LCOE, uncertainty and risk considerations during design

This report provides information regarding how risk, uncertainty and technology parameters choices taken during design phase can influence the levelized cost of energy (LCOE) of floating offshore wind turbines (FOWT). The first chapter introduces with a brief explanation of the LCOE calculation methodology followed by a short description of the three offshore sites and the four floating wind turbine concepts considered in the LIFES50+ project. The second chapter of this report provides a breakdown of the life cycle costs (LCC) for each of the floating wind turbine concepts and the different offshore sites. The calculations were made considering a 500MW floating offshore wind farm consisting of 50 floating wind turbine units. The results show the contributions from different life cycle stages to the total LCC and the variations between the concepts and sites. This is the basis for a comprehensive sensitivity analysis and detailed analysis of parameters that contribute the most to the final cost as a result of technical decisions at the design phase.

Chapter 3 focuses on the sensitivity analysis of the input parameters used for the LCOE calculation performed in WP2 during the Phase I Evaluation. In this study, over 325 parameters are included and their impact studied. The objective is to identify the parameters that influence the LCOE the most and thus represent parameters with the highest cost reduction potentials for floating wind farms. The results can be useful for floating wind turbine developers and researchers to improve the cost competitiveness of this technology and, last but not least, to accelerate the transition of floating wind to a mature technology. Chapter 4 is complementary to Chapter 3. It presents the results of applying specific variation ranges to the parameters that most influence the LCOE and that were obtained in Chapter 3. The specific variation ranges are based on uncertainty ranges defined by the designers and ranges for the common components. This analysis serves to identify how much the LCOE could actually vary based on the specific uncertainty ranges.

Chapter 5 focuses on disclosing about risk consideration during design that can also lead to a LCOE reduction. For example, a structured, detailed and well-recorded risk management can increase the confidence of insurers and financiers leading to reduced insurance and cost of financing. Similarly, it can also reduce the risk contingency budget. In this report, whilst no risks to a specific FOWT are provided, a list of hazards that can affect any FOWT design is provided.

It can be summarized that the parameters that most influence the LCOE are related to capital expenses, which is also demonstrated in the high contribution of the manufacturing phase in the LCC. This includes the cost of the substructure, turbine and offshore substation due to their capital intensive investment. For the three sites, the results show further that the discount rate has the largest influence on the LCOE value for all four floating wind turbine concepts. Besides that, it has been demonstrated that the environmental conditions have a significant impact on the cost. Severe conditions require the design of a more robust structure but, in particular influence the choice of anchor and mooring system as well as the need for a more specialized installation spread, which impacts the costs. Besides costs, energy losses in the system are also significant for the LCOE and should be minimized. Finally, operation and maintenance cost have also been identified as important parameters to consider especially for West of Barra, where a larger distance to shore is present with severe met-ocean conditions. The common parameters studied show mostly a similar effect on the LCOE among the different floating wind turbine concepts. However, a differentiation is found among the offshore sites. Finally, the parameters that are dependent on the design such as substructure, anchor and mooring cost as well as installation vessel cost show a different influence among the concepts and offshore sites.

