

1 Introduction

The U.S. Department of Energy’s (DOE’s) National Renewable Energy Laboratory (NREL), through the National Wind Technology Center (NWTC), has sponsored conceptual studies aimed at assessing offshore wind technology suitable in the shallow and deep waters off the U.S. offshore continental shelf (OCS) and other offshore sites worldwide. To obtain useful information from such studies, use of realistic and standardized input data is required. This report documents the turbine specifications of what is now called the “NREL offshore 5-MW baseline wind turbine” and the rationale behind its development. Our objective was to establish the detailed specifications of a large wind turbine that is representative of typical utility-scale land- and sea-based multimegawatt turbines, and suitable for deployment in deep waters.

Before establishing the detailed specifications, however, we had to choose the basic size and power rating of the machine. Because of the large portion of system costs in the support structure of an offshore wind system, we understood from the outset that if a deepwater wind system is to be cost-effective, each individual wind turbine must be rated at 5 MW or higher [23].¹ Ratings considered for the baseline ranged from 5 MW to 20 MW. We decided that the baseline should be 5 MW because it has precedence:

- Feasible floater configurations for offshore wind turbines scoped out by Musial, Butterfield, and Boone [23] were based on the assumption of a 5-MW unit.
- Unpublished DOE offshore cost studies were based on a rotor diameter of 128 m, which is a size representative of a 5- to 6-MW wind turbine.
- The land-based Wind Partnerships for Advanced Component Technology (WindPACT) series of studies, considered wind turbine systems rated up to 5 MW [19,24,29].
- The Recommendations for Design of Offshore Wind Turbines project (known as RECOFF) based its conceptual design calculations on a wind turbine with a 5-MW rating [32].
- The Dutch Offshore Wind Energy Converter (DOWEC) project based its conceptual design calculations on a wind turbine with a 6-MW rating [8,14,17].
- At the time of this writing, the largest wind turbine prototypes in the world—the Multibrid M5000 [5,21,22] and the REpower 5M [18,26,27]—each had a 5-MW rating.

We gathered the publicly available information on the Multibrid M5000 and REpower 5M prototype wind turbines. And because detailed information on these machines was unavailable, we also used the publicly available properties from the conceptual models used in the WindPACT, RECOFF, and DOWEC projects. These models contained much greater detail than was available about the prototypes. We then created a composite from these models, extracting the best available and most representative specifications.

¹ A single 5-MW wind turbine can supply enough energy annually to power 1,250 average American homes.