Chapter 1

The current status of wind power

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At the beginning of 2020, wind power capacity worldwide exceeded approximately 650 GW, covering less than 5% of the global electricity demand. This current global wind power capacity is enough to power more than 400 million average houses. The International Renewable Energy Agency projects that wind will generate approximately 35% of the total required electricity by 2050. Technological developments in towers, foundations, rotors, and drivetrains will enable this accelerated expansion of the wind industry. After presenting a brief on the current state of these significant wind energy technology pillars, the chapter lays out the various topics that the present book covers.

1.1 Introduction

Wind power is expected to address one-third of the global electricity demand by 2050. The industry is far away from such a high production capacity. The research community, including research universities, national laboratories, and industrial R&D teams, is leading the way into more efficient turbines and farms that can deliver this promise. Hence, smarter blades [1], rotors [2], towers [3], foundations [4], drivetrains, farm layouts [5, 6], and control strategies [7, 8] are introduced rapidly. In this opening chapter, we present a high-level view of the current status of these major aspects of the wind power industry. The following chapters will take a deep dive into many of them.

1.2 History of wind power harvesting

From very early on, civilizations have experienced wind power and asked themselves how they could use this limitless resource to make their lives easier. From

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to mitigating this issue without wasting the generated power due to roundtrip losses associated with storage plants. Researchers have proposed multiple hybridization concepts and strategies. Such advances will be covered in Chapter 13.

1.8.5 Offshore wind

Chapter 14 will deal with the site selection problem. There has been a significant surge in wind power investment in recent years. The push for developing more utility-scale wind farms demands much more accurate and reliable methods to identify optimal sites for both inland and offshore wind farms. Site selection is complicated by several factors, including available wind resources, the feasibility of installation, safety, and interaction with the surrounding infrastructures. This chapter will report on the most recent progress made in developing more efficient site-selection strategies.

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